Peto MacCallum Ltd.
CONSULTING ENGINEERS

DETAIL FOUNDATION INVESTIGATION AND DESIGN REPORT

for

STORMWATER MANAGEMENT POND
HOWARD AVENUE / CPR GRADE SEPARATION
GWP 3030-06-00
CITY OF WINDSOR, ONTARIO

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PML Ref.: 07TF022A-5
Index No.: 179FIR and 180FDR
GEOCRES No.: 40J6-23
May 5, 2009

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DETAIL FOUNDATION INVESTIGATION REPORT

for
Stormwater Management Pond
Howard Avenue / CPR Grade Separation
GWP 3030-06-00
City of Windsor, Ontario

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1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed stormwater management pond for the Howard Avenue/Canadian Pacific Railway (CPR) grade separation project in the City of Windsor, Ontario. Peto MacCallum Ltd. (PML) conducted the foundation investigation for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The proposed project involves construction of a stormwater management pond west of Howard Avenue, between the Essex Terminal Railway and Canadian Pacific Railway corridors.

This report pertains to the stormwater management pond for the project. Other foundation facets of this project were reported separately to efficiently incorporate changes in the design. The following separate reports were prepared:

PML Ref. No.	Report Title
07TF022A-1	Canadian Pacific Railway Overhead
07TF022A-2	Retaining Walls
07TF022A-3	Road Cuts and Deep Sewers
07TF022A-4	Pumping Station
07TF022A-5	SWM Ponds
07TF022A-6	Watermain Tunnels

The Final Detail Foundation Investigation Report should be listed in SP 109F10.

All elevations in this report are expressed in metres.

2. SITE DESCRIPTION AND GEOLOGY

The project site is located about 5 km north of the Highway 401/Howard Avenue Interchange in the City of Windsor.

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BARRIE, HAMILTON, KITCHENER, TORONTO

The proposed site is partly occupied by commercial buildings and parking lots such as those of the Ferguson Glass Ltd. and Dayus Roofing. Land use in the vicinity of the site includes the existing transportation corridors of Howard Avenue to the east, the Essex Terminal Railway to the northwest and Canadian Pacific Railway to the south.

The local topography of the site is generally flat and level. The ground cover beyond the parking lots include grassed areas and scattered stands of trees.

The project is situated within the deep clay till glacial deposits of the Essex Clay Plain, a sub region of the St. Clair Clay Plain. Bedrock comprises middle Devonian limestone of Paleozoic Era. The soil/bedrock interface is generally over 30 to 35 m deep.

3. INVESTIGATION PROCEDURES

The subsurface investigation was carried out on October 15 and 16, 2008. A total of eight boreholes were put down at the site and identified as boreholes SWM-1 to SWM-8. The boreholes were drilled to depths of 5.0 to 6.6 m at the locations shown on Drawing SW-1.

PML laid out and cleared the locations of the boreholes for the presence of underground services and utilities. Callon Dietz Ltd. (CD) surveyed the boreholes locations. All elevations in this report are expressed in metres and are referred to the geodetic datum.

The boreholes were advanced using continuous solid stem augers and equipment powered by a truck-mounted CME-55 drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a Field Supervisor from PML engineering staff.

Representative samples of the soils were recovered in the boreholes at depth intervals of 0.75 and 1.5 m. The soil samples were obtained using a split spoon sampler in conjunction with standard penetration tests. Penetrometer tests were also performed to assess the shear strength of the cohesive soils. It is noted that the results of penetrometer tests may be lower than the actual values due to sample disturbance.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open boreholes. It is noted that piezometers were installed upon completion of drilling in three of the boreholes to permit long-term monitoring of the groundwater table. The water level observations and piezometer readings taken are noted on the attached record of boreholes.

The boreholes were backfilled in accordance with the MTO guidelines and MOE Reg. 903 for borehole abandonment procedures using a bentonite/cement mixture grout.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The recovered soil samples were returned to our laboratory for detailed visual examination, soil classification and laboratory testing. The laboratory test program comprised the following tests:

- Natural moisture content determinations (49)
- Grain Size analyses (11)
- Atterberg Limits (11)

The results of the laboratory natural moisture content determinations, grain size analyses and Atterberg limits are shown on the Record of Borehole sheets. The grain size distribution charts are presented on Figures GS-SW-1 and GS-SW-2. The Atterberg limits results are presented on Figures PC-SW-1 and PC-SW-2 and are listed in the attached Table A. The chart for a moisture-density relationship test carried out for the pavement and design report is shown in Figure MD-SW-1 for reference.

4. SUMMARIZED SUBSURFACE CONDITIONS

4.1 General

Refer to the Record of Borehole sheets for the details of the subsurface conditions including soil classifications, inferred stratigraphy, soil and groundwater observations and piezometer readings.

The borehole locations and the layout of the storm water management ponds are presented in the attached Foundation Drawing SW-1.

The soil stratigraphy revealed in the boreholes generally comprised of fill (0.2 to 1.0 m thick) locally underlying paved parking lots and driveways overlying 0.2 and 0.3 m thick topsoil underlain by cohesive glacial deposits of silty clay till and/or clayey silt till. The cohesive glacial till deposits typically are stiff to hard. It is noted that glacial till deposits contain fissures. All of the boreholes were terminated on the glacial till deposits at depths of 5.0 and 6.6 m (elevations 181.6 to 183.7).

4.2 Fill

A 0.2 to 1.0 m thick fill unit was present in all of the boreholes. The unit is generally composed of asphalt or gravel pavements made of asphaltic concrete, sand and gravel or sand in most of the boreholes. Coal and cinder or brick fragments over cohesive deposits were present in boreholes SWM-4 and SWM-7. The unit extended to elevations 187.6 to 188.2. The fill unit was found to be stiff or compact to dense. N values ranged from 26 to 40. One N value of 78 was obtained for 20 cm sample penetration in borehole SWM-1. The water content of the fill ranged from 7 to 18%.

4.3 Topsoil

In all boreholes except in borehole SWM-4 a buried 200 to 300 mm thick topsoil layer was encountered below the fill at depths of 0.4 to 1.0 m (elevations 187.6 to 188.2). The unit extended to the native soils at depths of 0.6 to 1.2 m (elevations 187.4 to 188.0). The moisture content of one topsoil sample was 27%.

4.4 Silty Clay Till

A discontinuous deposit of cohesive silty clay till containing oxidized stains and fissures was encountered below the topsoil in all of the boreholes except boreholes SWM-4 and SWM-7 at depths of 0.6 to 1.2 m (elevations 187.4 to 188.0). The stratum was 0.6 to 1.5 m thick extending to underlying clayey silt till at depths of 1.5 to 2.3 m (elevations 186.0 to 187.2).

The deposit typically exhibits a stiff consistency, with local firm and very stiff areas. N values varied from 4 to 12 with typical values in the 7 to 12 range. Penetrometer test results on the silty clay till samples ranged from 62 to 87 kPa.

The grain size distribution charts of two representative samples of the silty clay till are shown on Figure GS-SW-1. The results of a moisture-density relationship test shown in the attached Figure MD-SW-1 on a representative silty clay till indicated an ASTM D 698 maximum dry density of 1.825 t/m^3 and an optimum water content of 15.0%. The Atterberg plasticity limits are presented on the Plasticity Chart Figure PC-SW-1 and are listed in Table A. The liquid limits of the silty clay till were 36 and 41 the plastic limits 19 and 20, giving the plasticity index values of 17 and 21. The water content of representative samples of the silty clay till ranged from 11 to 22%.

4.5 Clayey Silt Till

A continuous deposit of cohesive clayey silt till was found below the silty clay till in boreholes SWM-1 to SWM-3, SWM-5, SWM-6 and SWM-8 at depths of 1.5 to 2.3 m (elevations 186.0 to 187.2) and beneath the topsoil in boreholes SWM-4 and SWM-7 at 0.2 and 1.0 m depths, respectively (elevation 188.2 and 187.5). The deposit extended to the 5.0 to 6.6 m termination depths of the boreholes (elevations 181.6 to 183.7).

The consistency of the clayey silt till was typically very stiff to hard becoming stiff to very stiff with depth. N values varied from 9 to 40. Penetrometer test results on this deposit ranged from 37 to 160 kPa.

The envelope of the grain size distribution charts of representative samples of the clayey silt till is shown on Figure GS-SW-2. The Atterberg plasticity limits on the Plasticity Chart is presented on Figure PC-SW-2 and are listed in Table A. The liquid limits of the clayey silt ranged from 23 to 31 and the plastic limits 13 to 18, giving the plasticity index values 10 to 14. The water content of the clayey silt till varied from 10 to 16%.

4.6 Groundwater

Groundwater was observed during and upon completion of drilling in borehole SWM-1 at a depth of 1.7 m (elevation 186.5).

Piezometers were installed in boreholes SWM-3, SWM-5 and SWM-8 upon completion of drilling. Water levels in piezometer boreholes SWM-3 and SWM-5 were at depths of 3.5 and 5.0 m (elevations 184.9 and 183.4). The piezometer in borehole SWM-8 was found to be dry. The following table summarizes piezometer readings taken.

Borehole No.	SWM-3		SWM-5		SWM-8	
Ground Surface Elevation	188.4		188.4		188.6	
Installation Date	October 16, 2008		October 15, 2008		October 15, 2008	
Date	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation
October 15, 2008	-	-	Dry	<181.8	-	-
October 16, 2008	Dry	<183.4	5.0	183.4	Dry	<182.0
October 17, 2008	3.5	184.9	-	-	Dry	<182.0
May 5, 2009	0.8	187.6	0.5	187.9	0.6	188.0

Based on the water level observations and water content profile in the borehole samples, the observed water indicated a locally perched condition within the fissures of the upper desiccated cohesive soils. The level of the perched water changed from about 1.7 m depth, elevation 186.5 in October 2008 to about 0.5 to 0.8 m depths (elevation 187.6 to 188.0) on May 5, 2009. The regional groundwater table is judged to be at a level deeper than those investigated.

It is noted that the groundwater levels are subjected to fluctuations due to seasonal and rainfall patterns.

5. MISCELLANEOUS

The field work was carried out under the supervision of Mr. M. Rapsey, Senior Technician and the direction of Mr. C.M.P. Nascimento, P.Eng., Senior Foundation Engineer. Aardvark Drilling Inc. supplied the drilling equipment. The laboratory work was carried out in the PML laboratory in Toronto.

This Foundation Investigation Report was prepared by Mr. C.M.P. Nascimento, P.Eng., with the assistance of Ms. N.S. Balakumaran, E.I.T., and was independently reviewed by Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact.

Yours very truly,

Peto MacCallum Ltd.

C. M. P. Nascimento, P.Eng.
Senior Project Engineer

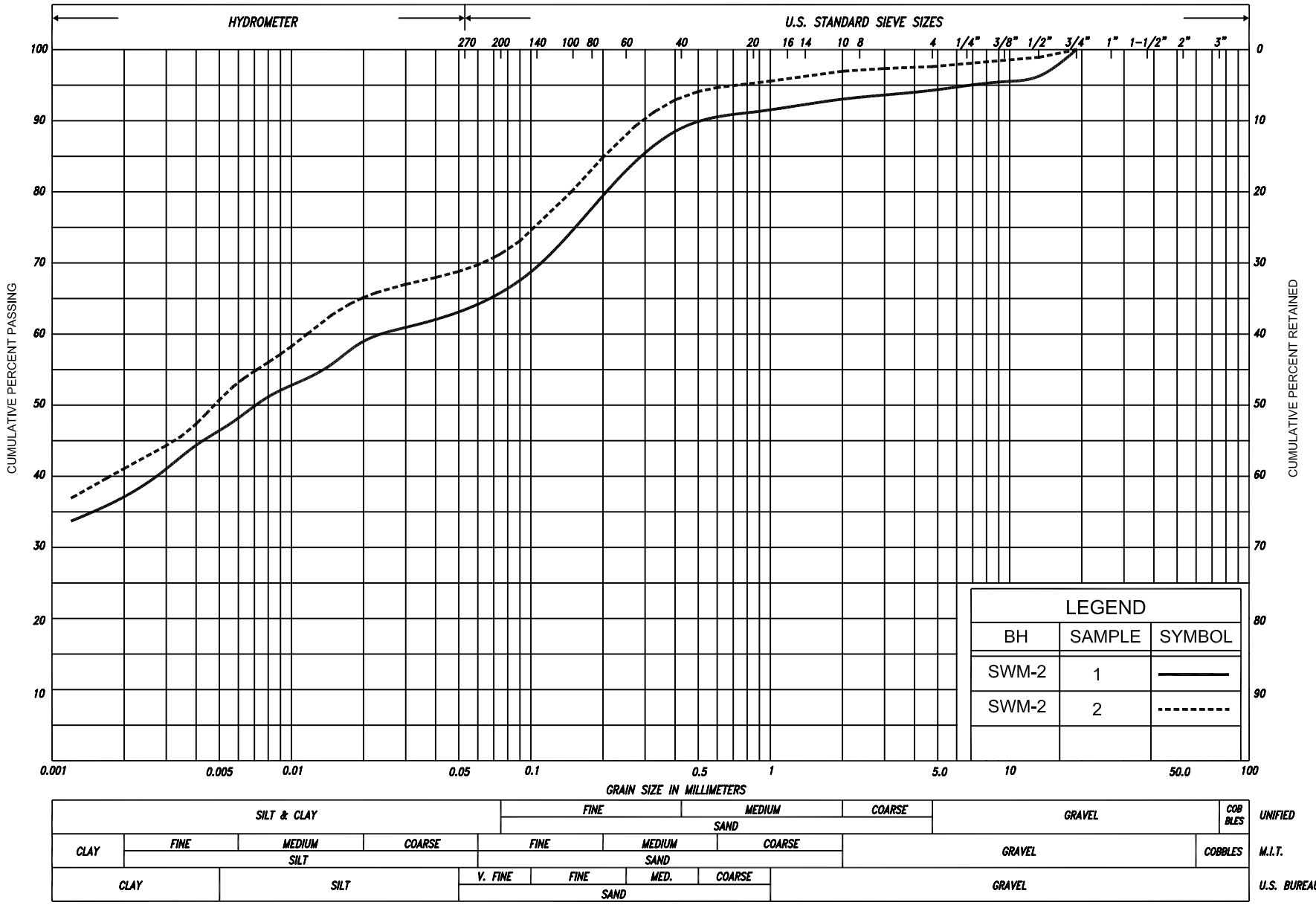
Brian R. Gray, MEng, P.Eng.
MTO Designated Principal Contact

CN/BRG/nb-nk

TABLE A

LIST OF ATTERBERG LIMITS AND MOISTURE CONTENT RESULTS

SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	SAMPLE DEPTH (m)	ELEVATION (m)	LIQUID LIMIT (W_L)	PLASTIC LIMIT (W_P)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (W)
Silty Clay Till	SWM-2	1	0.8 – 1.3	187.8	36	19	17	20
	SWM-2	2	1.5 – 2.1	187.1	41	20	21	15
Clayey Silt Till	SWM-2	3	2.3 – 2.8	186.3	26	16	10	12
	SWM-2	6	6.1 – 6.6	182.5	23	13	10	14
	SWM-3	4	3.1 – 3.6	185.3	26	15	11	13
	SWM-4	2	0.8 – 1.4	187.6	31	17	14	16
	SWM-5	5	3.1 – 3.6	185.4	27	15	12	13
	SWM-6	3	2.3 – 2.8	186.4	27	16	11	12
	SWM-7	3	1.5 – 2.1	187.0	31	18	13	15
	SWM-7	5	3.1 – 3.6	185.4	26	15	11	10
	SWM-7	6	4.6 – 5.1	183.9	25	15	10	14



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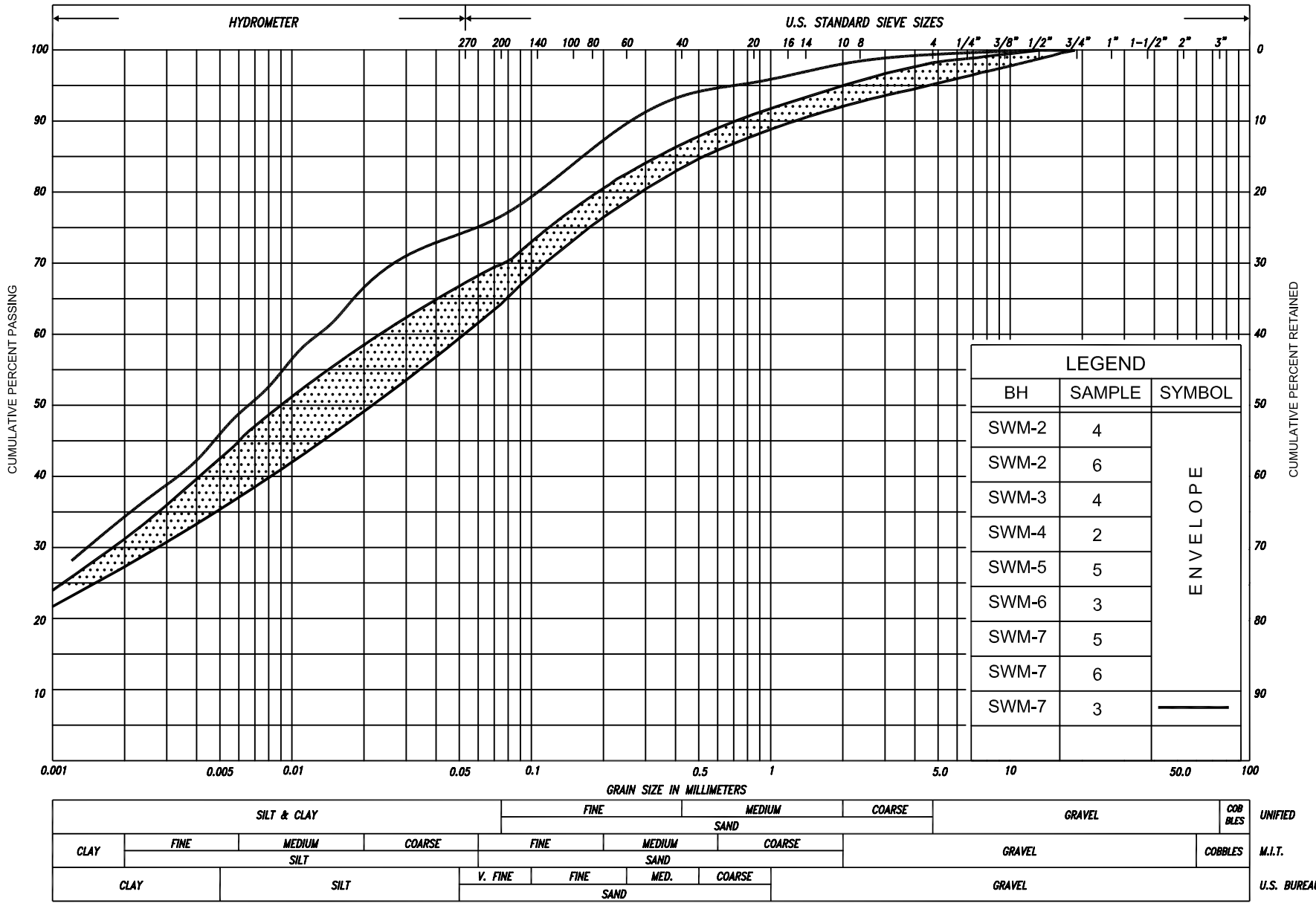
GRAIN SIZE DISTRIBUTION

SILTY CLAY, with sand, trace gravel
(TILL)

FIG No.	GS-SW-1
HWY:	HOWARD AVENUE
G.W.P. No.	3030-06-00



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Ontario

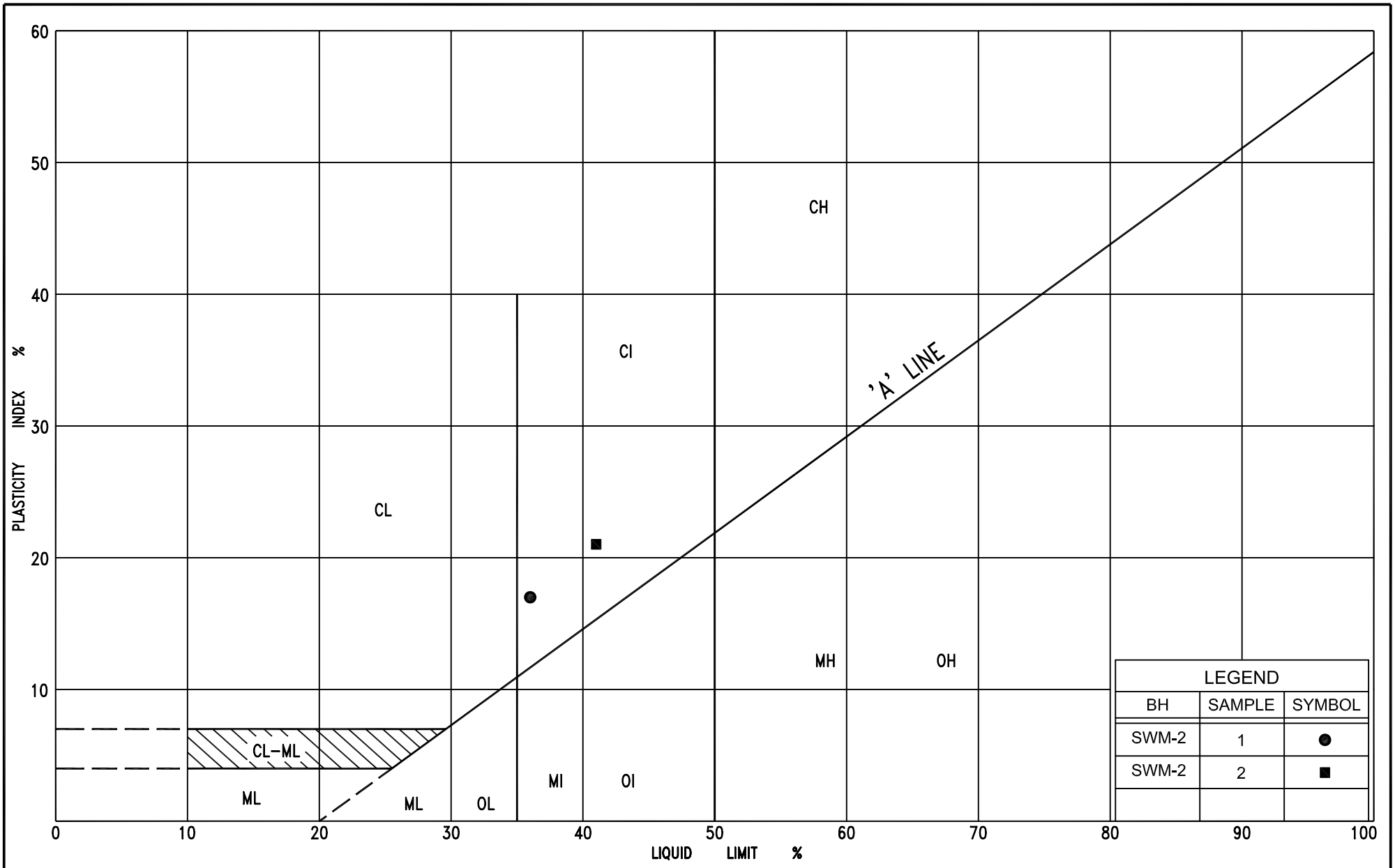
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, with sand to sandy, trace gravel
(TILL)

FIG No. GS-SW-2

HWY: HOWARD AVENUE

G.W.P. No. 3030-06-00



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Ontario

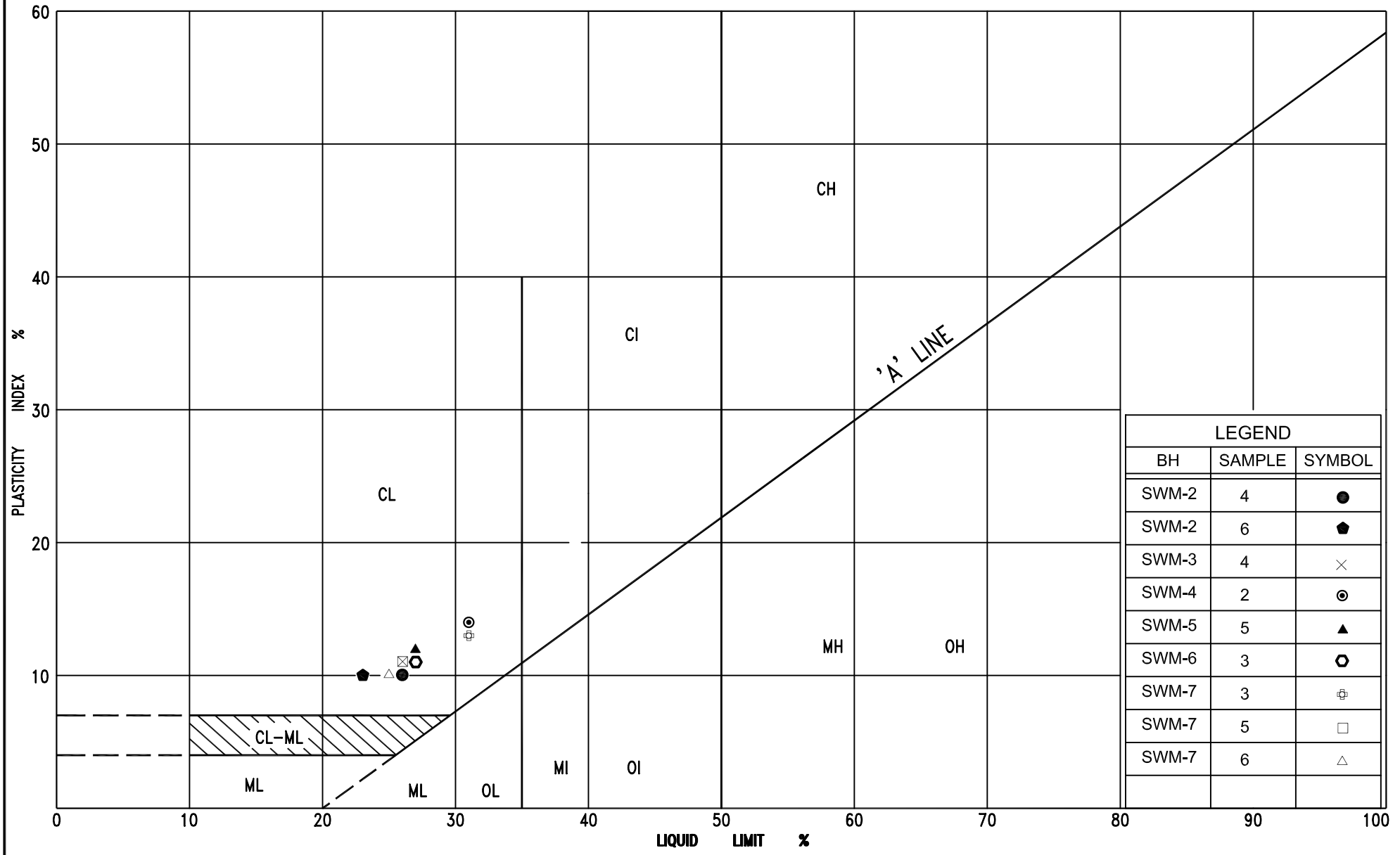
PLASTICITY CHART

SILTY CLAY, with sand, trace gravel
(TILL)

FIG No. PC-SW-1

HWY: HOWARD AVENUE

G.W.P. No. 3030-06-00



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PLASTICITY CHART

CLAYEY SILT, with sand to sandy, trace gravel
(TILL)

FIG No. PC-SW-2

HWY: HOWARD AVENUE

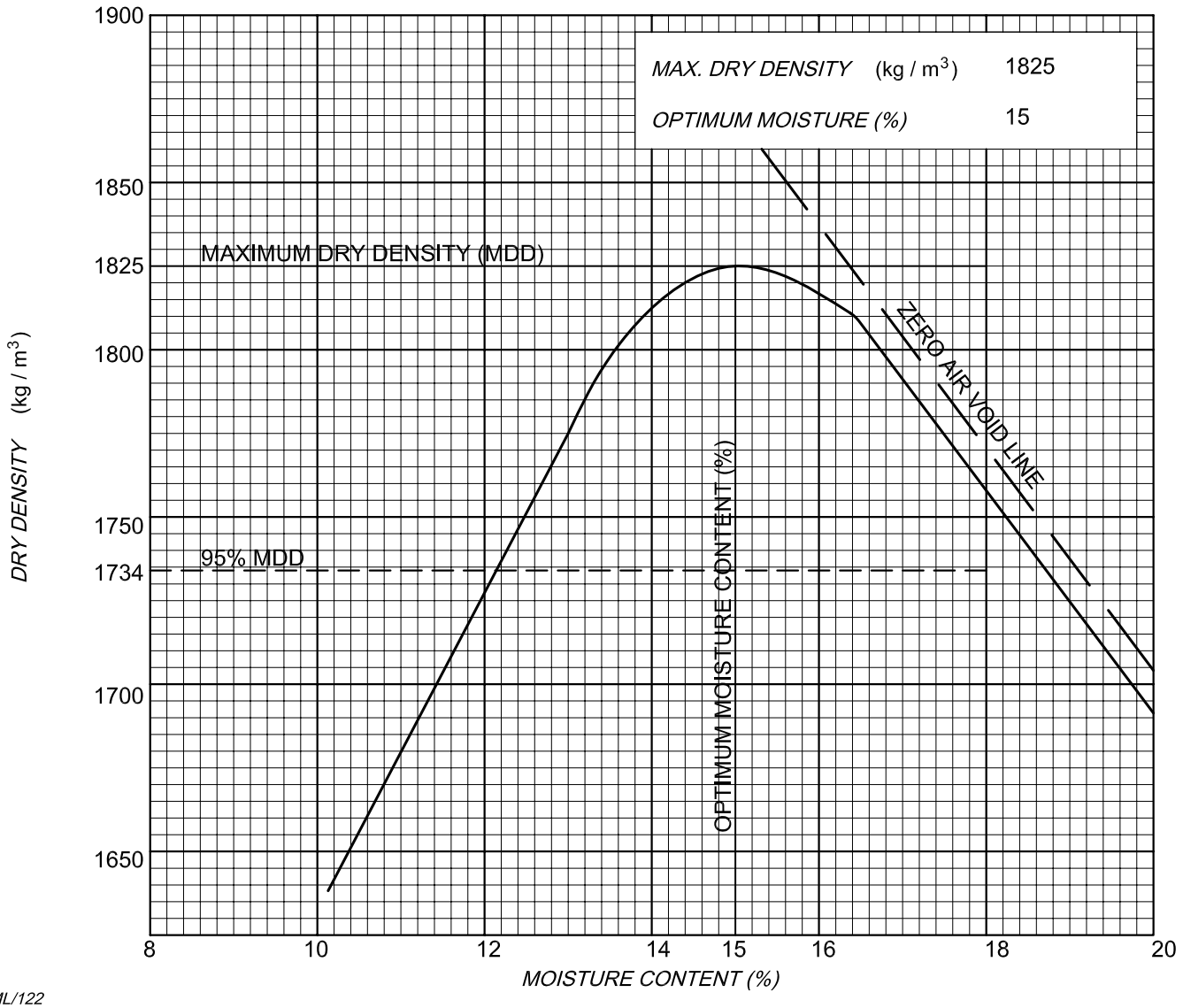
G.W.P. No. 3030-06-00

Peto MacCallum Ltd.
CONSULTING ENGINEERS

MOISTURE DENSITY RELATIONSHIP TEST REPORT

CLIENT	McCORMICK RANKIN CORPORATION	*OUR PROJECT NO.*	07TF022B
PROJECT	HOWARD AVENUE / CPR GRADE SEPARATION WINDSOR, ONTARIO	*FIGURE NO.*	MD-SW-1

SAMPLE TYPE	SILTY CLAY TILL	*SAMPLE NO.*	24582
		DATE SAMPLED	
SAMPLED FROM	HOWARD AVENUE Sta. 10+410, o/s 4.7m Lt. SOUTH BOUND LANE (H-11) DEPTH: 0.5 to 1.5m	*SAMPLED BY*	G.I. *OF* PML
		DATE TESTED	DECEMBER 05, 2008
MOISTURE CONTENT AS RECEIVED	19%	*STANDARD PROCTOR - ASTM D698-70*	
REMARKS	W_L = 36 W_P = 20	*METHOD -*	*A* ☒ *B* ☐ *C* ☐ *D* ☐
		MODIFIED PROCTOR - ASTM D1557-70	
		METHOD -	*A* ☐ *B* ☐ *C* ☐ *D* ☐



PML/122

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 63.5kg, 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 $\tilde{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J 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 COMPOSITION AND STRUCTURAL 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 (R Q D), FOR MODIFIED RECOVERY, IS:

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

JOINTING 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

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

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
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	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'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

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Foundation Design

RECORD OF BOREHOLE No SWM-1 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 058 N; 333 959 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 15, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.2	Ground Surface										
0.0 / 187.7	Sand and gravel, with silt Dense Brown Moist (FILL)		1	SS	78/20cm		188		○		
0.5 / 187.4	Topsoil										
0.8	Silty clay with sand, trace gravel fissured Stiff Brown Moist (TILL)		2	SS	5			■	○		
			3	SS	7	▼ ▽	187	■	○		
186.0 / 2.2	Clayey silt with sand, trace gravel oxidized stains Hard to very stiff Brown Moist (TILL)		4	SS	37		186		○		
			5	SS	37		185		○		
			6	SS	24		184		○		
	Grey Moist						183				
181.6			7	SS	15		182		○		
6.6	End of borehole										

* 2008 10 15

▽ Water level observed during drilling

▼ Water Level measured after drilling

■ Penetrometer test

ON_MOT VER3 07TF022A.GPJ ON_MOT.GDT 4/29/2009 10:49:06 AM

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-2 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 104 N; 333 949 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 16, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.6	Ground Surface										
0.0 / 188.2 / 0.4	100mm asphalt over 125mm coal and cinders over 150mm sand with silt										
188.0 / 0.6	Brown Moist grey (FILL)		1	SS	7		188	■	○—●		6 28 29 37
	Topsoil										
	Silty clay with sand, trace gravel fissured, oxidized stains		2	SS	6		187		○—●		2 27 30 41
186.5 / 2.1	Stiff Brown Moist (TILL)										
	Clayey silt, sandy trace gravel		3	SS	39		186		○		
	Hard Brown Moist (TILL)		4	SS	39				○—●		2 31 37 30
							185				
	Very stiff Mottled grey						184		○		
			5	SS	21						
	Stiff Grey						183				
182.0			6	SS	10		182	■	○—●		4 31 36 29
6.6	End of borehole										

Note: Fissures filled with water in sample 2.

* Borehole dry

■ Penetrometer test

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+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE (20 / 15 / 5 / 10)

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-3 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 179 N; 333 948 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 16, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.4	Ground Surface						
0.0 / 188.1	100mm asphaltic concrete over 200mm sand some silt						
0.3 / 187.8	Brown Moist (PAVEMENT FILL)						
0.6 / 187.6	Silty clay, some sand	1	SS	12			
0.8	Brown Moist (FILL)						
	Topsoil						
	Silty clay some sand, trace gravel fissured, oxidized stains	2	SS	10			
186.3 / 2.1	Stiff Brown Moist (TILL)	3	SS	34			
	Clayey silt, sandy trace gravel						
	Hard Brown Moist (TILL)	4	SS	39			2 32 37 29
183.4		5	SS	30			
5.0	End of borehole						

* Borehole dry

Piezometer Legends:

- Native cuttings
- Bentonite seal
- Filter sand
- Screen

Water Level Readings

Date	Depth (m)	Elev.
10/16/2008	Dry	----
10/17/2008	3.5	184.9
05/05/2009	0.8	187.6

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

GROUND WATER CONDITIONS: * (Borehole dry)

ELEVATION SCALE: 188 187 186 185 184

+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE: 20 / 15 — 5 / 10

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Ontario

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Foundation Design

RECORD OF BOREHOLE No SWM-4 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 057 N; 333 903 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 16, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.4	Ground Surface										
0.0	Coal and brick fragments										
188.2 / 0.2	(FILL)		1	SS	16		188		○		
	Clayey silt with sand, trace gravel fissured, oxidized stains										
	Very stiff Brown Moist to stiff		2	SS	9				○		5 25 41 29
	(TILL)						187				
			3	SS	10				○		
	Hard						186				
			4	SS	30				○		
			5	SS	40		185		○		
	Very stiff Grey										
			6	SS	13		184	160 ■	○		
							183				
181.8			7	SS	11		182	■	○		
6.6	End of borehole										

* Borehole dry

■ Penetrometer test

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+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE (20 / 15 5 / 10)

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-5 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 095 N; 333 908 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 15, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.4	Ground Surface										
0.0	Sand and gravel with silt coal and cinders inclusions		1	SS	40		188	○	○		
187.7	Dense Brown Moist										
0.7	(FILL)										
187.5	Topsoil		2	SS	4			○	○		
0.9	Silty clay with sand, trace gravel fissured						187				
186.6			3	SS	9			○	○		
1.8	Firm Brown Moist										
	(TILL)										
	Clayey silt, sandy trace gravel		4	SS	29		186	○	○		
	Stiff to very stiff Brown Moist										
	(TILL)		5	SS	28		185	○	○		2 32 36 30
							184				
	Stiff Grey		6	SS	12	*		○	○		
							183				
181.8			7	SS	12		182				
6.6	End of borehole										

* Borehole dry

Piezometer Legends:

- Bentonite seal
- Native cuttings
- Filter sand
- Screen

Water Level Readings

Date	Depth (m)	Elev.
10/15/2008	Dry	----
10/16/2008	5.0	183.4
05/05/2009	0.5	187.9

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-6 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 163 N; 333 918 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 15, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.7	Ground Surface					*					
0.0	100mm asphaltic over sand some silt granular "A"										
188.1	Brown Moist										
0.6	(PAVEMENT FILL)						188				
187.8			1	SS	7				○		
0.9	Topsoil										
	Silty clay some sand, trace gravel fissured, oxidized stains										
187.2											
1.5	Firm Brown Moist		2	SS	16		187		○		
	(TILL)										
	Clayey silt with sand, trace gravel fissured, oxidized seams		3	SS	28				○		2 29 38 31
	Very stiff Brown Moist to hard						186				
	(TILL)		4	SS	36				○		
							185				
			5	SS	39		184		○		
183.7											
5.0	End of borehole										

* Borehole dry

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+7, ×5 : Numbers refer to Sensitivity

(%) STRAIN AT FAILURE (20 / 15 5 / 10)

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-7 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 074 N; 333 876 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 16, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.5	Ground Surface										
0.0	Coal and cinders fragments										
188.3 / 0.2	(FILL)		1	SS	26		188		○		
187.8	Silty clay, some sand										
0.7 / 187.5	Very stiff Brown Moist		2	SS	9				○ ○		
1.0	(FILL)										
	Topsoil						187				
	Clayey silt with sand, trace gravel fissured, oxidized stains		3	SS	15				○		1 23 42 34
	Stiff to very stiff Brown Moist										
	(TILL) sandy		4	SS	25		186		○		
	Hard		5	SS	37		185		○		3 33 37 27
	Mottled grey						184				
			6	SS	30				○		3 30 37 30
	Stiff Grey						183				
181.9			7	SS	15		182	■	○		
6.6	End of borehole										

* Borehole dry

■ Penetrometer test

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+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No SWM-8 1 of 1 METRIC

G.W.P. 3030-06-00 LOCATION Co-ords: 4 684 109 N; 333 881 E ORIGINATED BY M.R.

DIST 32 HWY Howard Avenue BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B

DATUM Geodetic DATE October 15, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.6	Ground Surface										
0.0 / 188.3 / 0.3	Sand and gravel										
	Compact Dark brown Moist		1	SS	26	*	188		○		
	Silty clay some sand, trace gravel										
187.6 / 1.0	oxidized stains		2	SS	12				○		
187.4 / 1.2	Stiff Brown Moist (FILL)						187				
	Topsoil		3	SS	15				○		
	Silty clay with sand, trace gravel										
186.3 / 2.3	oxidized stains		4	SS	37		186		○		
	Very stiff Brown Moist (TILL)										
	Clayey silt with sand, trace gravel oxidized stains		5	SS	30				○		
	Hard Brown Moist (TILL)						185				
	Very stiff Mottled grey										
			6	SS	25		184		○		
	Stiff Grey						183				
182.0			7	SS	9		182				
6.6	End of borehole										

* Borehole dry

Piezometer Legends:

- Bentonite seal
- Native cuttings
- Filter sand
- Screen

Water Level Readings

Date	Depth (m)	Elev.
10/16/2008	Dry	-
10/17/2008	Dry	-
05/05/2009	0.6	188.0

+7, ×5 : Numbers refer to Sensitivity

20 / 15 — 5 / 10 (%) STRAIN AT FAILURE

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No
GWP No 3030-06-00

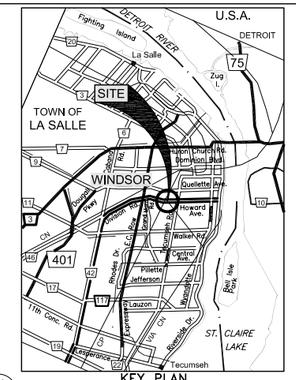
STORMWATER MANAGEMENT POND

HOWARD AVENUE/CPR GRADE SEPARATION

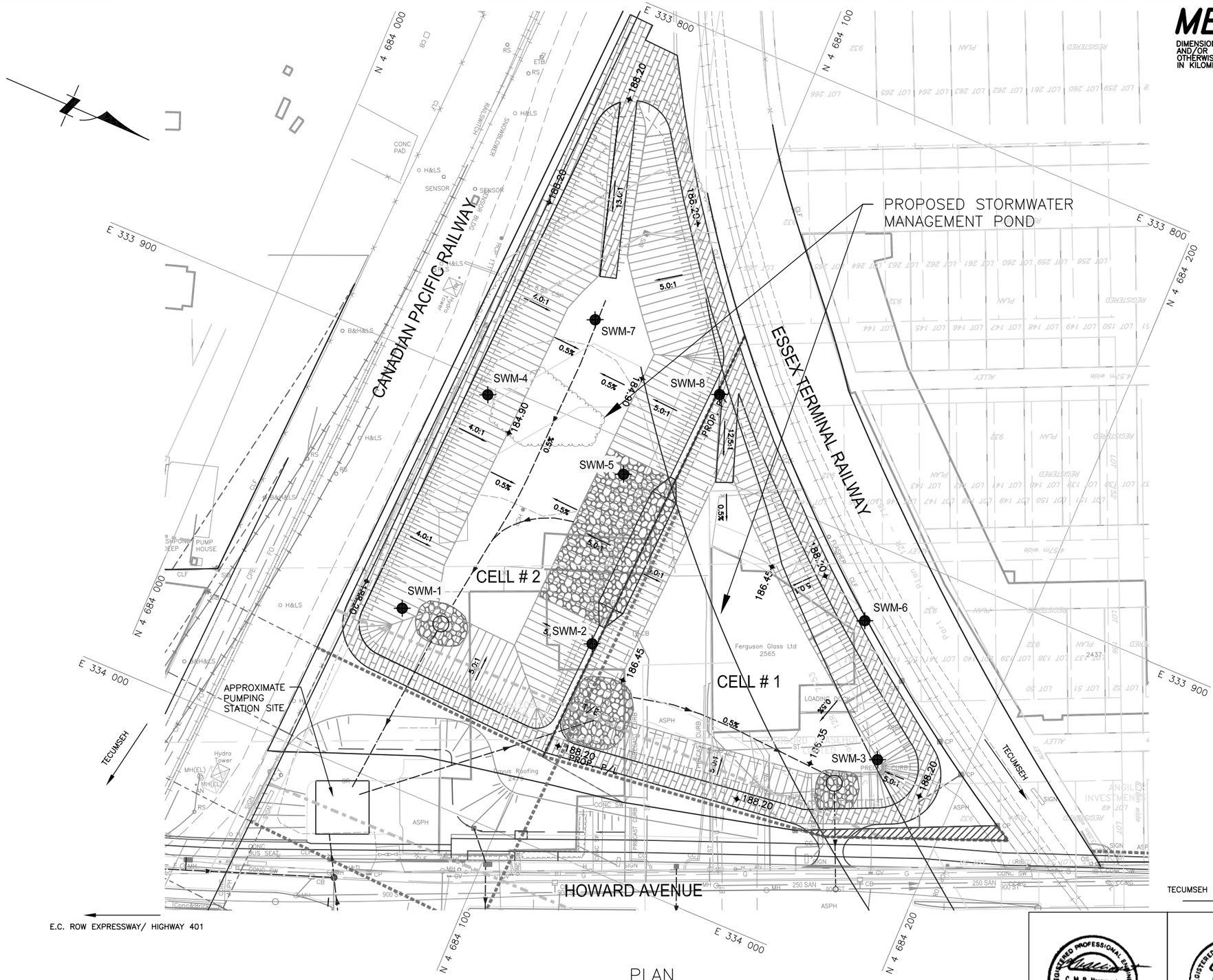
BOREHOLE LOCATIONS

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE
2 0 2 4 6km



PLAN
SCALE
10 0 10 20m

NOTE:

THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N — Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60°Cone, 475 J/blow)
- W L at time of investigation Oct 2008
- Head ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	COORDINATES NORTHINGS	COORDINATES EASTINGS
SWM-1	188.2	4 684 058	333 959
SWM-2	188.6	4 684 104	333 949
SWM-3	188.4	4 684 179	333 948
SWM-4	188.4	4 684 057	333 903
SWM-5	188.4	4 684 095	333 908
SWM-6	188.7	4 684 163	333 918
SWM-7	188.5	4 684 074	333 876
SWM-8	188.6	4 684 109	333 881

C M P Nascimento
REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
April 30, 2009

B. R. GRAY
REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
April 30, 2009

REF No MRC DRAWINGS: H6933XA01.dwg; H6933XB01.dwg; H6933XN01.dwg; H6933xu01.dwg; H6933XY2.dwg and H6933Xd2-prop-req.dwg; dated May 13, 2008

– NOTE –

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 40J6-23

HWY No	HOWARD AVENUE			DIST	32
SUBM'D	NSB	CHECKED	NSB	DATE APR. 30, 2009	SITE — —
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG SW-1

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DETAIL FOUNDATION DESIGN REPORT

for

STORMWATER MANAGEMENT POND
HOWARD AVENUE / CPR GRADE SEPARATION
CITY OF WINDSOR
GWP 3030-06-00
CITY OF WINDSOR, ONTARIO

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PML Ref.: 07TF022A-5
Index No.: 180FDR
GEOCRES No.: 40J6-23
May 5, 2009

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

DETAIL FOUNDATION DESIGN REPORT
for
Stormwater Management Pond
Howard Avenue / CPR Grade Separation
GWP 3030-06-00
City of Windsor, Ontario

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1. ENGINEERING RECOMMENDATIONS

1.1 General

This report provides the foundation engineering design recommendations and comments for construction of the proposed stormwater management pond (SWM) included in the Howard Avenue / CPR grade separation project in the City of Windsor, Ontario. Peto MacCallum Ltd. (PML) conducted the foundation investigation for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

According to the MRC drawing dated May 13, 2008, the proposed SWM pond will include two cells. Cell No. 1 has an approximately 100 m side triangle shape and is to be located on the southwest corner of Essex Terminal Railway and the Howard Avenue intersection. Cell No. 2 will occupy an approximately rectangular area about 55 by 130 m (average) adjacent to cell No. 1 with the longest dimension oriented roughly east to west. The bottoms of the cells No. 1 and No. 2 are at about elevations 186.5 and 184.9 respectively. The top of the bank around the both cells is planned at about elevation 188.2.

In summary, the soil stratigraphy revealed in the boreholes generally comprised of fill (0.2 to 1.0 m thick) overlying 0.2 and 0.3 m thick topsoil underlain by cohesive deposits of silty clay till and/or clayey silt till. Within the depth investigated for the stormwater pond, the cohesive glacial till deposits were typically found to be desiccated and have a very stiff consistency. It is noted that the upper layers of the glacial till deposits were found to be fissured. The water content of the upper native soils typically were within 4% of the optimum water content on the wet side of the standard Proctor test.

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BARRIE, HAMILTON, KITCHENER, TORONTO

The groundwater observations indicated the presence of perched water within the upper zones of the fill and clayey soils at about 1.7 m depth, elevation 186.5. It should be noted that groundwater levels and the perched water levels in particular are subjected to fluctuations due to seasonal and rainfall patterns.

It is considered that the construction of proposed stormwater management pond is feasible, however some precautions should be taken due to fissured native subgrade soils and groundwater conditions, as described on the following sections.

In addition, the proposed SWM pond location is partly occupied by commercial buildings foundations and their services and utility trenches. Consequently, the subgrade preparation during construction should be carefully planned and monitored with geotechnical personal to ensure that all of the existing features which may affect the water tightness of the pond are removed and remediated as indicated in this report.

The "red flag" issues outlined in the preceding paragraphs and the recommended methods of overcoming these issues noted in the following sections of the report are intended to alert and aid the designer and the contractor. These comments and recommendations are based on the conditions revealed during the investigations and no responsibility is assumed by the consultants or the MTO for alerting the contractor to all critical issues. The requirements to deliver acceptable construction quality remain the responsibility of the contractor.

1.2 Design Considerations

1.2.1 General

Based on the subsurface investigation data, the bottom of both SWM pond cells No.1 and 2 placed at elevations 186.5 and 184.9, respectively will be established at or below the boundary of the typically very stiff to hard deposits of silty clay till and clayey silt till. It is envisaged that construction of the SWM pond in these soils is feasible.

Infiltration from perched water may occur due to fissured native soils and demolition of commercial building foundation and removal of sewers and utilities may cause disturbance to the native soils. To minimize perched water infiltration through fissures in the soil and eliminate the effect of potential subgrade disturbance from the removals, it is recommended that the upper 0.5 m thick layer of the soils at the bottom of the SWM pond cells and 1.0 m deep below the proposed side slopes be excavated below the proposed final grades and replaced with the remolded excavated clayey silt / silty clay till compacted to about 95% of the ASTM D 698 (standard Proctor) maximum dry density. The soil should be replaced in accordance with OPSS 501 using maximum 200 mm thick loose lifts.

It is considered to be feasible to re-use the existing silty clay till and clayey silt till soils to reinstate the bottom and side slopes of the pond cells. It is estimated that the materials typically are within 4% of the optimum water content on the wet side of the standard Proctor curve which is an adequate condition for the purposes intended considering that the soils would lose 1 to 2% of moisture during excavation and handling. Excessively dry or wet materials should be discarded.

The soils should be carefully handled to avoid excessive loss of moisture which would make it difficult to achieve the recommended degree of compaction. To this end the excavated materials should not be stockpiled or allowed to dry out during the dry summer months. To facilitate uniformity of compaction, the soils should be scarified using disks before removal and replacement. It is recommended that the target highest hydraulic conductivity (k) of compacted native soil for the pond base be 1×10^{-6} cm/s.

1.2.2 Side Slope Stability

The current plans call for side slopes of 4H:1V and 5H:1V. It is considered that the SWM pond side slope will be adequately stable at slopes cut at (3H:1V) or flatter, therefore the proposed side slopes are also considered to be stable. For the analysis, the least favourable hydraulic condition was implemented with the water level 0.5 m below the top of the bank lowering to the base of the pond cell. Rapid draw-down conditions were also considered to be adequately safe. The fissured condition of the silty clay till zone was also considered in the cohesion value. The results of a slope stability analysis carried out for the SWM pond side slopes at the 3H:1V configuration indicated a Factor of safety was of 2.6 which is well in excess of a minimum 1.5 generally acceptable value. The results are presented in the attached Figure 1.

Where the exposed subsoil comprises of fill or topsoil having more pervious characteristics than the native silty clay till / clayey silt till soils, these exposed materials on the slopes or bottom of the pond should be cut back about 1.0 m from the final configuration and replaced with native silty clay till on clayey silt till soils and compacted to about 95% of the ASTM D 698 maximum dry density using maximum 200 mm thick loose lifts (OPSS 501).

All backfilling and compaction operations should be supervised on a full-time basis by geotechnical personnel to examine and approve backfill materials, evaluate placement operations and verify that the specified degree of compaction is achieved uniformly throughout the fill.

All side slopes should be protected against erosion and slope degradation. For this purposes, sodding, hydro seeding and mulching placement should be considered according to OPSS 571 and OPSS 572. Rip-rap protection should be according to OPSS 511.

1.3 Construction Considerations

1.3.1 Excavation

It is anticipated that the excavation of the native soils will be straightforward using conventional equipment. The excavation should generally follow the OPSS 902 specification.

All excavation at the stormwater management pond site should be carried out in accordance with the Occupational Health and Safety Act (OHSA), local and MTO regulations. For this purpose, the topsoil, fill and locally firm to stiff native soils encountered in the boreholes are considered Type 3 soils. The very stiff to hard clayey silt till and silty clay till are considered Type 2 soils.

1.3.2 Groundwater Control

It is considered that perched groundwater is approximately at 1.7 m depth (elevation 186.5). This level is about 0.1 m above the bottom of cell No. 1 and about 1.6 m below the cell No. 2 proposed bottom subgrade elevation.

It is considered that this perched water and seepage from soil fissures or surface water run-off that enters from the excavation should be readily handled by conventional sump pumping techniques in view of the relatively impervious nature of the native soils. It is noted that groundwater levels are subjected to fluctuations due to seasonal and rainfall patterns and these may influence the volume of water to be removed.

2. CLOSURE

This Detail Foundation Design Report was prepared by Mr. C.M.P. Nascimento, P.Eng., with the assistance of Ms. N.S. Balakumaran, E.I.T., and independently reviewed by Mr. B.R. Gray, MEng, P.Eng., MTO Designated Principal Contact.

Yours very truly,
Peto MacCallum Ltd.

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CN/BRG:nb-nk

TABLE 1

LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

DOCUMENT	TITLE
OPSS 501	Construction Specification for Compaction
OPSS 511	Construction Specification for Rip-Rap, Rock Protection, and Granular Sheeting
OPSS 571	Construction Specification for Sodding
OPSS 572	Construction Specification for Seed and Cover
OPSS 902	Excavation and Backfilling of Structures
SP 109F10	Structural Reference Plans and Reports

SLOPE STABILITY ANALYSIS RESULTS

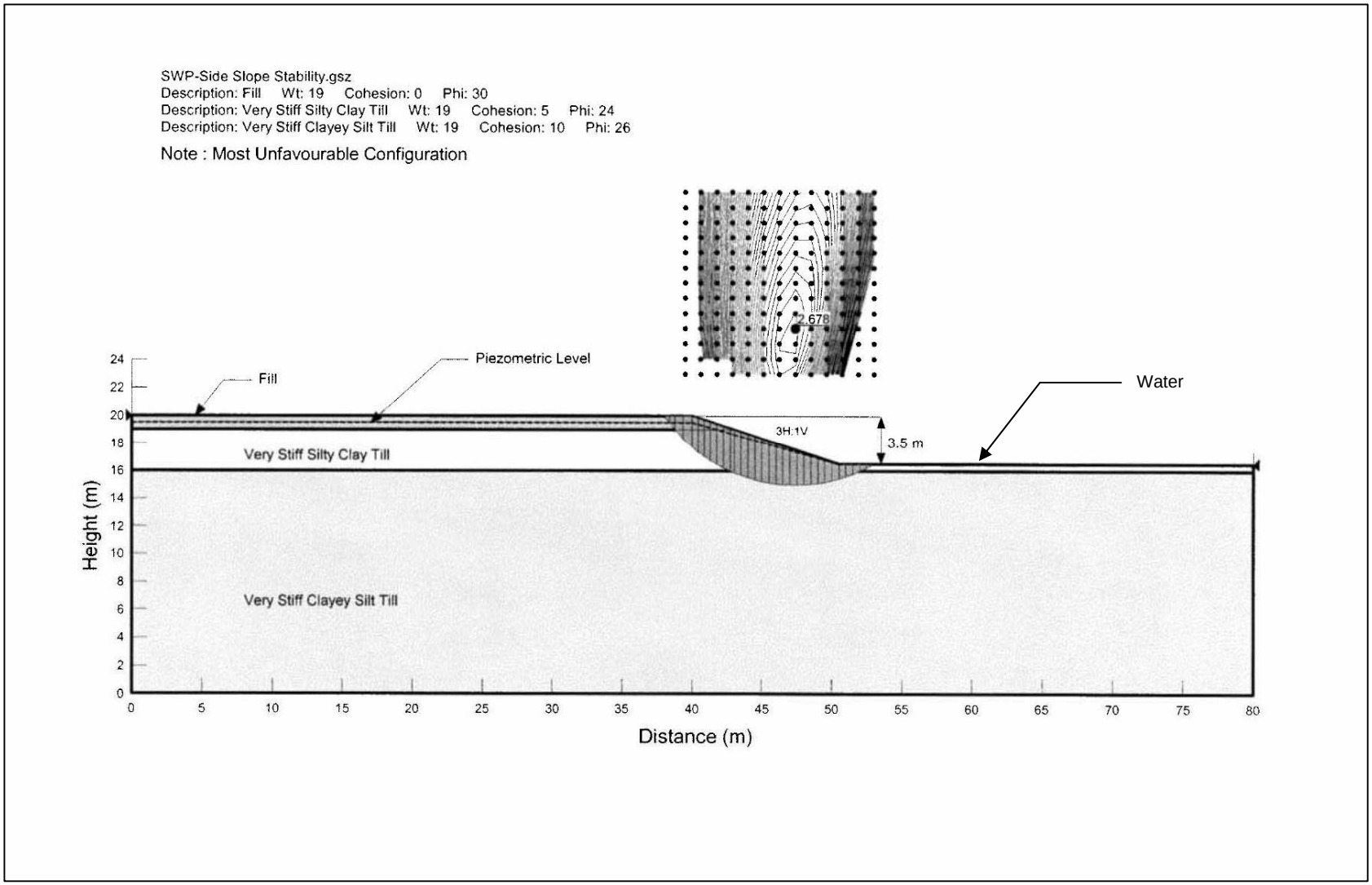

Figure 1