FOUNDATION INVESTIGATION REPORT
RETAINING WALL AT ISLINGTON AVENUE
HIGHWAY 401 WESTBOUND COLLECTORS
JANE STREET TO KIPLING AVENUE
G.W.P. 2147-01-00

Geocres Number: 30M11-230

Report to

McCormick Rankin Corporation

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TABLE OF CONTENTS

PART A: FOUNDATION INVESTIGATION REPORT

Appendices

FOUNDATION INVESTIGATION REPORT
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PART A: FOUNDATION INVESTIGATION REPORT

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for a proposed retaining wall to be constructed along the north side of the Highway 401 Westbound Collector Lanes at Islington Avenue in Toronto.

The retaining wall is required as part of the proposed widening of the Westbound Collector Lanes between Jane Street and Kipling Avenue. The wall will be approximately 130 m long.

The purpose of this investigation was to explore the subsurface conditions along the retaining wall alignment and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 2005-E-0023.

2 SITE DESCRIPTION

The site is located along the existing Highway 401 Westbound Collector Lanes at the Islington Avenue underpass in Toronto, Ontario. At this location, the Westbound Collector Lanes are situated between the Highway 401 Express Lanes to the south and Highway 409 to the north.

The distance between the Collector Lanes and Highway 409 presently increases from about 3 m at the east limit of the proposed wall to near 13 m at the west limit. The grade difference between the roadways increases from approximately 0.8 to 2.5 m towards the west, with Highway 409 being below the level of the Collector Lanes. The area between the roadways is grassed to the west of Islington Avenue and asphalt surfaced to the east.

The existing grade along the proposed wall alignment, located adjacent to the north shoulder of the existing Westbound Collector Lanes, falls from approximate elevation 152.9 m at the west limit to elevation 150.2 m at the east limit.

The general site area is located within the physiographic region referred to as the Peel Plain, a level to undulating region of massive to laminated, glaciolacustrine clay and silt. The clay and silt are underlain by glacial till deposits of silty clay to clayey silt.

Grey shale bedrock of the Georgian Bay Formation underlies the site. The bedrock surface is expected to be near elevation 120 m at the site.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for the study were carried out on November 10, 2008 and consisted of drilling and sampling four boreholes (Nos. BW-01 to BW-04) to 5.2 m depth.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing in Appendix C. The coordinates and elevations of the boreholes are given on this drawing and on the individual Record of Borehole Sheets in Appendix A.

Thurber positioned the boreholes in the field relative to local site features. The coordinates and ground surface elevations at the boreholes were subsequently established by J.D. Barnes Limited. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Solid stem augers were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the boreholes, visually examined the recovered samples, and transported them to Thurber's laboratory for further examination and testing.

Standpipe piezometers were installed in two boreholes to monitor groundwater levels. The completion details of the piezometers are presented in Table 3.1. The piezometers were subsequently decommissioned in accordance with the abandonment requirements of MOE Reg. 903. The boreholes without piezometers were grouted upon completion in accordance with the Regulation.

Table 3.1 – Piezometer Details

Borehole	Tip Position (m)		Completion Details
	Depth	Elevation	
BW-01	5.0	149.5	Sand filter and screen from 5.2 to 3.5 m, bentonite to 0.3 m, protective cap set in concrete to surface.
BW-04	5.0	145.2	Sand filter and screen from 5.2 to 3.5 m, bentonite to 0.3 m, protective cap set in concrete to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Approximately 25% of the recovered samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A and on the Borehole Locations and Soil Strata Drawings in Appendix C. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the site was found to be underlain by a shoulder pavement structure overlying native silty clay till. In one borehole, about 3.7 m of clay fill and sand fill were encountered between the pavement structure and native clay till. More detailed descriptions of the individual strata are presented below.

5.1 Pavement Structure

A pavement structure comprising 125 to 150 mm of asphalt overlying 0.8 to 1.2 m of sand and gravel was encountered at the shoulder surface in all boreholes. The granular material was described as brown and moist.

Standard Penetration Test N-values of 25 to 29 blows/0.3 m were obtained in the granular material, indicating a compact condition. Moistures contents varied from 5 to 8%.

5.2 Silty Clay Fill and Silty Sand Fill

Locally in borehole BW-03 located adjacent to the east side of the Islington Avenue structure, a layer of silty clay fill underlain by silty sand fill was encountered below the pavement structure. This fill possibly comprises utility trench backfill.

The clay fill layer was 1.1 m thick with a lower boundary at 2.0 m depth (elevation 149.1 m). SPT N-values of 34 and 36 blows/0.3 m were obtained in the clay fill, indicating a hard consistency. Moisture contents of 8 and 10% were measured.

The underlying silty sand fill was 2.6 m thick with a lower boundary at 4.6 m depth (elevation 146.5 m). This layer was described as brown and moist, becoming wet below 3.5 m depth. The sand fill is very loose with recorded SPT N-values of 3 blows/0.3 m. The moisture content ranged from 8 to 15%, with one value of about 2% measured near the upper boundary of this unit.

The results of a grain size analysis carried out on a sample of the sand fill are presented on Figure B1, Appendix B.

5.3 Silty Clay Till

In general, the pavement structure was underlain by native silty clay till at depths of 1.2 to 1.3 m (elevation 148.9 to 153.3 m). Locally in borehole BW-03 located adjacent to the east side of the Islington Avenue structure, the native clay till was encountered below possible utility trench backfill at 4.6 m depth (elevation 146.5 m).

The clay till was described as grey, sandy and containing trace gravel. Although not encountered in the boreholes, till soils often contain cobbles and boulders.

SPT N-values obtained in the clay till ranged from 11 to 36 blows/0.3 m. The consistency of the till was typically very stiff to hard, with N-values of 18 to 36 blows/0.3 m recorded in boreholes BW-01 to BW-03. In borehole BW-04 located east of Islington Avenue, the consistency was stiff to very stiff (N-values of 11 to 19 blows/0.3 m) above 4.5 m depth (elevation 145.7 m).

The natural moisture content of recovered samples ranged from 10 to 18%.

The results of laboratory tests carried out on seven samples were as follows:

Gravel %	0 to 2
Sand %	23 to 33
Silt %	44 to 52
Clay %	18 to 25
Liquid Limit	21 to 26
Plastic Limit	12 to 14

The grain size distribution curves for the samples tested are shown in Figures B2 and B3, Appendix B. The Atterberg Limits are plotted on Figure B4. The results of these tests indicate that the silty clay till is a CL soil (low plasticity).

The boreholes were terminated in the clay till at 5.2 m depth (elevation 145.0 to 149.3 m). This unit was at least 3.9 to 4.0 m thick in boreholes BW-01, BW-02 and BW-04.

5.4 Groundwater Conditions

Upon completion of drilling, water was observed in borehole BW-03 at 2.9 m depth (elevation 148.2 m). This water appears to be perched in the very loose sand backfill. Water was not observed in the other boreholes during drilling.

Standpipe piezometers were installed in two boreholes to monitor water levels after drilling. The water levels measured in the piezometers are summarized in Table 5.1.

Table 5.1 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
BW-01	11-Dec-2008	1.8	152.7
BW-04	11-Dec-2008	3.4	146.8

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in more permeable fill above the clay till.

6 MISCELLANEOUS

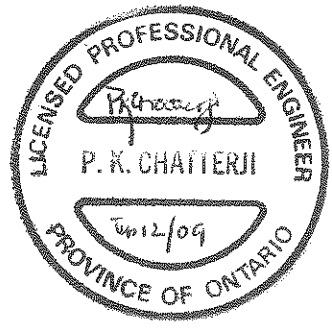
J.D. Barnes Limited determined the co-ordinates and ground elevations at the boreholes following completion of the site investigation. Walker Drilling Ltd. supplied and operated the drilling and sampling equipment.

Full time supervision of the field activities was carried out by Mr. Jason Mei of Thurber. Utility clearances were obtained by Mr. David Elwood.

Supervision of the field program, interpretation of the field data, and preparation of the report was performed by Mr. Murray Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.
Murray R. Anderson, P.Eng., M.Eng.
Senior Geotechnical Engineer

P.K. Chatterji, P.Eng., Ph.D.
Review Principal



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

SS Split Spoon Sample WS Wash Sample AS Auger (Grab) Sample
TW Thin Wall Shelby Tube Sample TP Thin Wall Piston Sample
PH Sampler Advanced by Hydraulic Pressure PM Sampler Advanced by Manual Pressure
WH Sampler Advanced by Self Static Weight RC Rock Core SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

$\overline{\blacktriangledown}$ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

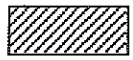
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

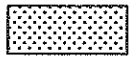
ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

SYMBOLS


CLAYSTONE


SILTSTONE


SANDSTONE


COAL


Bedrock (general)

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

THURBER

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Ontario

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RECORD OF BOREHOLE No BW-01 1 OF 1 METRIC

G.W.P. 2147-01-00 LOCATION Islington Avenue, N 4 841 025.8 E 300 478.6 ORIGINATED BY JM

HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2008.11.10 - 2008.11.10 CHECKED BY MRA

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, FIELD VANE, QUICK TRIAXIAL, 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
154.5											
0.0	**ASPHALT** (150mm)										
0.2	**SAND** and **GRAVEL** Compact Brown Moist (FILL)										
153.3			1	SS	29		154				
1.2	Sandy Silty **CLAY**, trace gravel Very Stiff to Hard Grey (TILL)		2	SS	26		153				
			3	SS	29		152				1 28 48 23
			4	SS	35		151				
			5	55	36						1 29 52 18
149.3			6	SS	24		150				
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE DRY UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.12.11 1.8 152.7										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 1122.GPJ 12/24/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BW-02 1 OF 1 METRIC

G.W.P. 2147-01-00 LOCATION Islington Avenue, N 4 841 063.4 E 300 540.9 ORIGINATED BY JM

HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2008.11.10 - 2008.11.10 CHECKED BY MRA

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 (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
152.5											
0.0	**ASPHALT** (150mm)										
0.2	**SAND** and **GRAVEL** Compact Brown Moist (FILL)		1	SS	25		152		○		
151.3											
1.2	Sandy Silty **CLAY**, trace gravel Very Stiff Grey (TILL)		2	SS	20		151		○		
			3	SS	26		150		⊢●		1 27 50 22
			4	SS	21		149		○		
			5	SS	18				⊢●		1 23 52 24
			6	SS	24		148		○		
147.3											
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN TO 4.5m AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.15m, THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
$\frac{}{10}$

ONTMT4S 1122.GPJ 12/24/08

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Ontario

THURBER

RECORD OF BOREHOLE No BW-03 1 OF 1 METRIC

G.W.P. 2147-01-00 LOCATION Islington Avenue, N 4 841 096.8 E 300 609.8 ORIGINATED BY JM

HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2008.11.10 - 2008.11.10 CHECKED BY MRA

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 + FIELD VANE ● QUICK TRIAXIAL × 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
151.1											
0.0	**ASPHALT** (125mm)						151				
0.1	**SAND** and **GRAVEL** Compact Brown Moist								○		
150.1	(FILL)										
0.9	Silty **CLAY**, some sand, trace gravel Hard Grey		1	SS	34		150		○		
	(FILL)								○		
149.1			2	SS	36				○		
2.0	Silty **SAND**, trace gravel Very Loose Brown Moist						149				
	(FILL)		3	SS	3	▽			○		2 72 26 (SI+CL)
							148				
	Wet		4	SS	3				○		
			5	SS	3		147		○		
146.5											
4.6	Sandy Silty **CLAY**, trace gravel Very Stiff Grey		6	SS	26				⊢○		2 33 45 20
145.9	(TILL)						146				
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AT 5.2m AND WATER LEVEL AT 2.9m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.13m, THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 1122.GPJ 1/5/09

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BW-04 1 OF 1 METRIC

G.W.P. 2147-01-00 LOCATION Islington Avenue, N 4 841 116.9 E 300 663.8 ORIGINATED BY JM

HWY 401 Westbound Collectors BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2008.11.10 - 2008.11.10 CHECKED BY MRA

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 (o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) 40 80 120 160 200	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
150.2											
0.0	**ASPHALT** (125mm)										
0.1	**SAND** and **GRAVEL**, trace silt Compact Brown Moist (FILL)		1	SS	27		150		o		
148.9							149				
1.3	Sandy Silty **CLAY**, trace gravel Stiff to Very Stiff Grey (TILL)		2	SS	11				o		
			3	SS	17		148		⊢o⊣		2 27 46 25
			4	SS	14	▼	147		o		
			5	SS	19		146		⊢o⊣		0 33 44 23
145.0			6	SS	31				o		
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY TO 4.5m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.12.11 3.4 146.8										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\overset{20}{15\oplus 5}$ $\overset{}{10}$ (%) STRAIN AT FAILURE

ONTMTAS 1122.GPJ 2/11/09

Appendix B

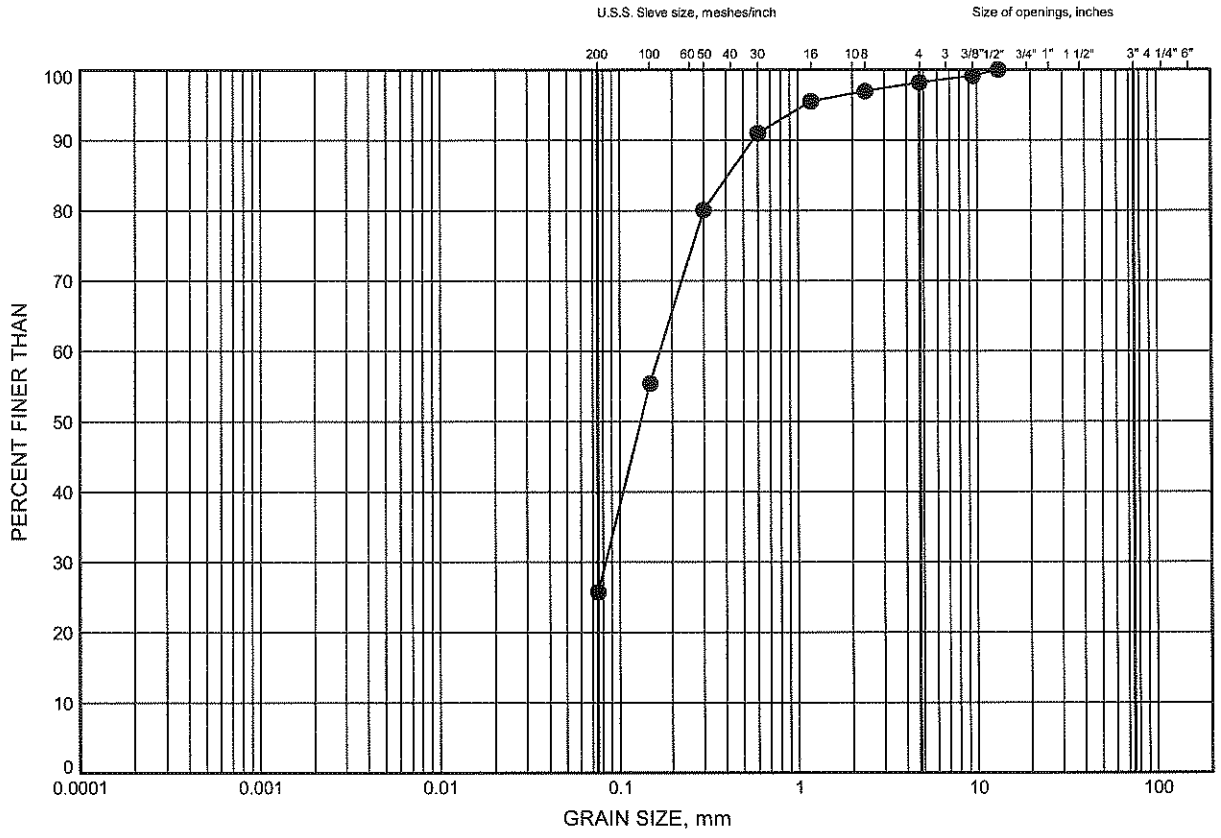
Laboratory Test Results

Hwy 401 Westbound Collectors, Jane to Kipling

GRAIN SIZE DISTRIBUTION

FIGURE B1

SILTY SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-03	2.59	148.46

W.P.# 2147-01-00

Prepared By AN

Checked By MRA

THURBER

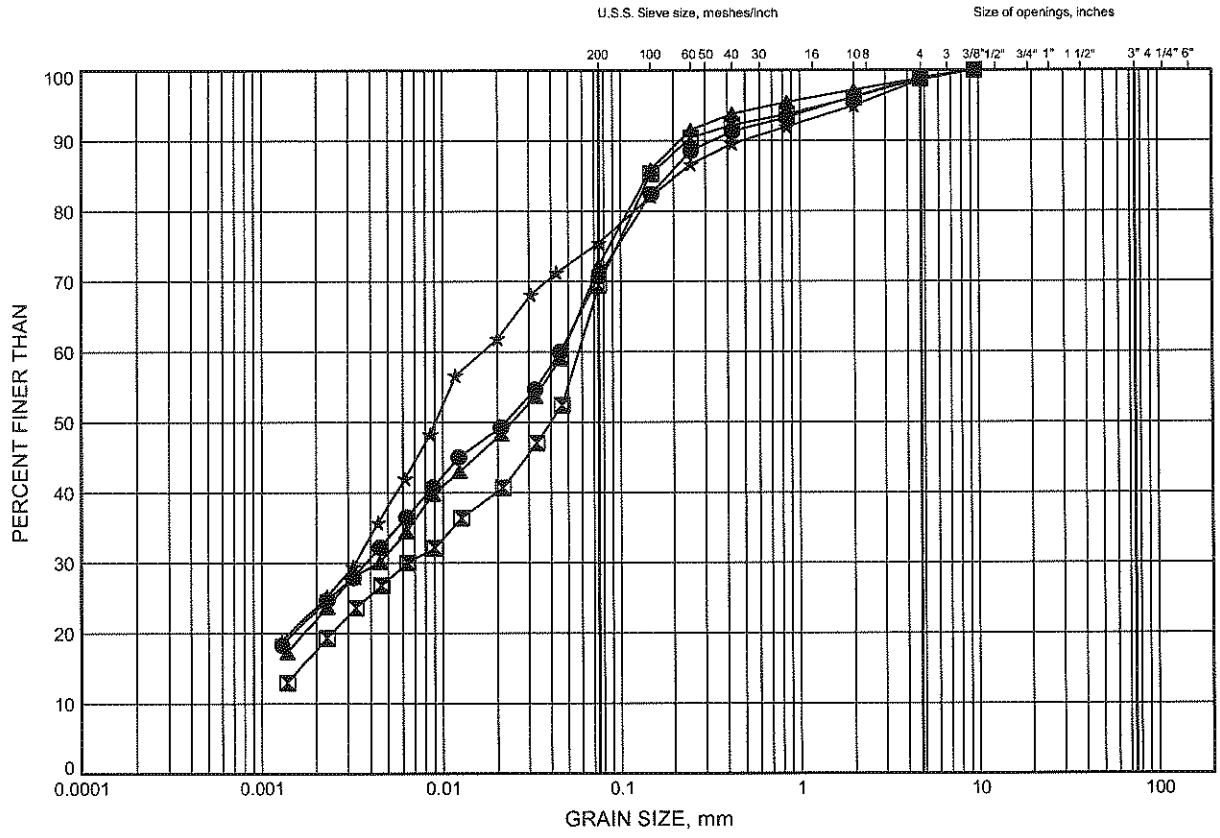
GRAIN SIZE DISTRIBUTION - THURBER 1122.GPJ 12/24/08

Hwy 401 Westbound Collectors, Jane to Kipling

GRAIN SIZE DISTRIBUTION

FIGURE B2

SANDY SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-01	2.59	151.92
⊠	BW-01	4.11	150.40
▲	BW-02	2.59	149.89
★	BW-02	4.11	148.37

W.P.# 2147-01-00
Prepared By AN
Checked By MRA

THURBER

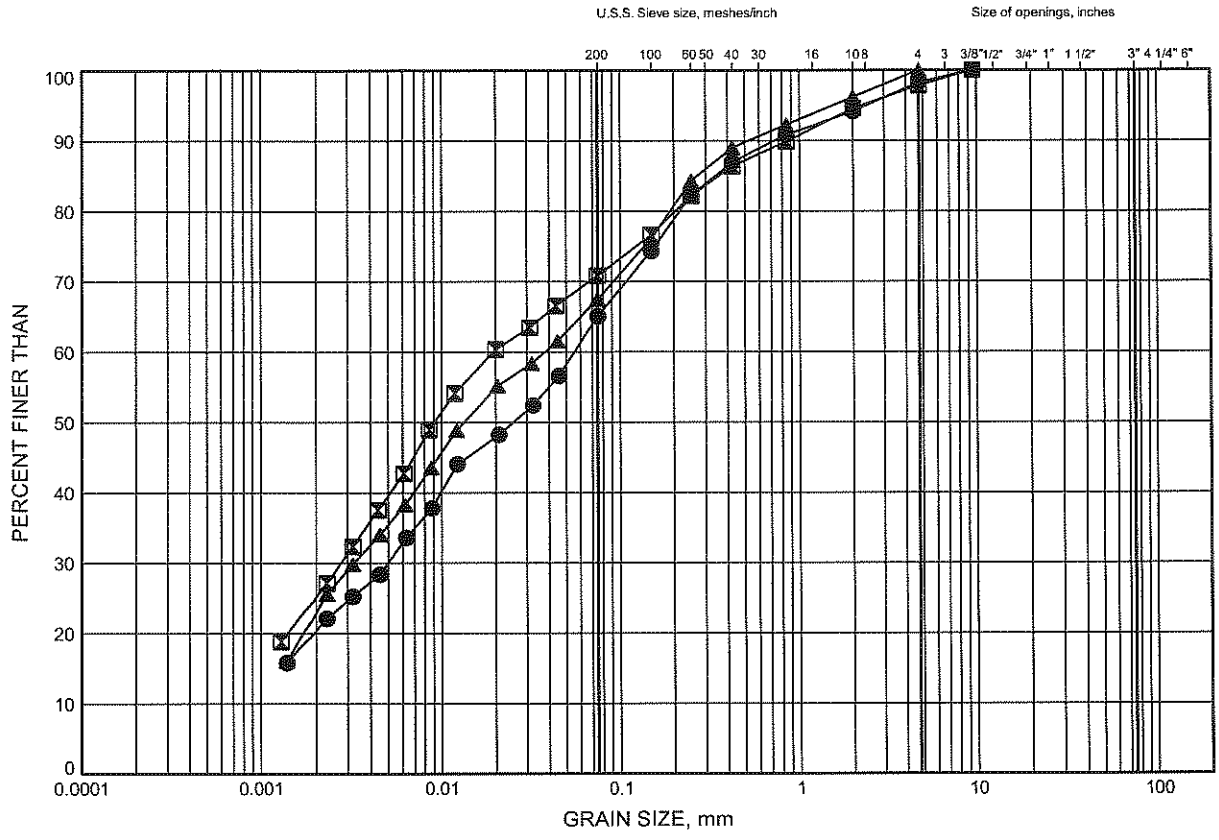
GRAIN SIZE DISTRIBUTION - THURBER 1122.GPJ 12/24/08

Hwy 401 Westbound Collectors, Jane to Kipling

GRAIN SIZE DISTRIBUTION

FIGURE B3

SANDY SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-03	4.88	146.17
⊠	BW-04	2.59	147.57
▲	BW-04	4.11	146.05

W.P.# 2147-01-00
Prepared By AN
Checked By MRA

THURBER

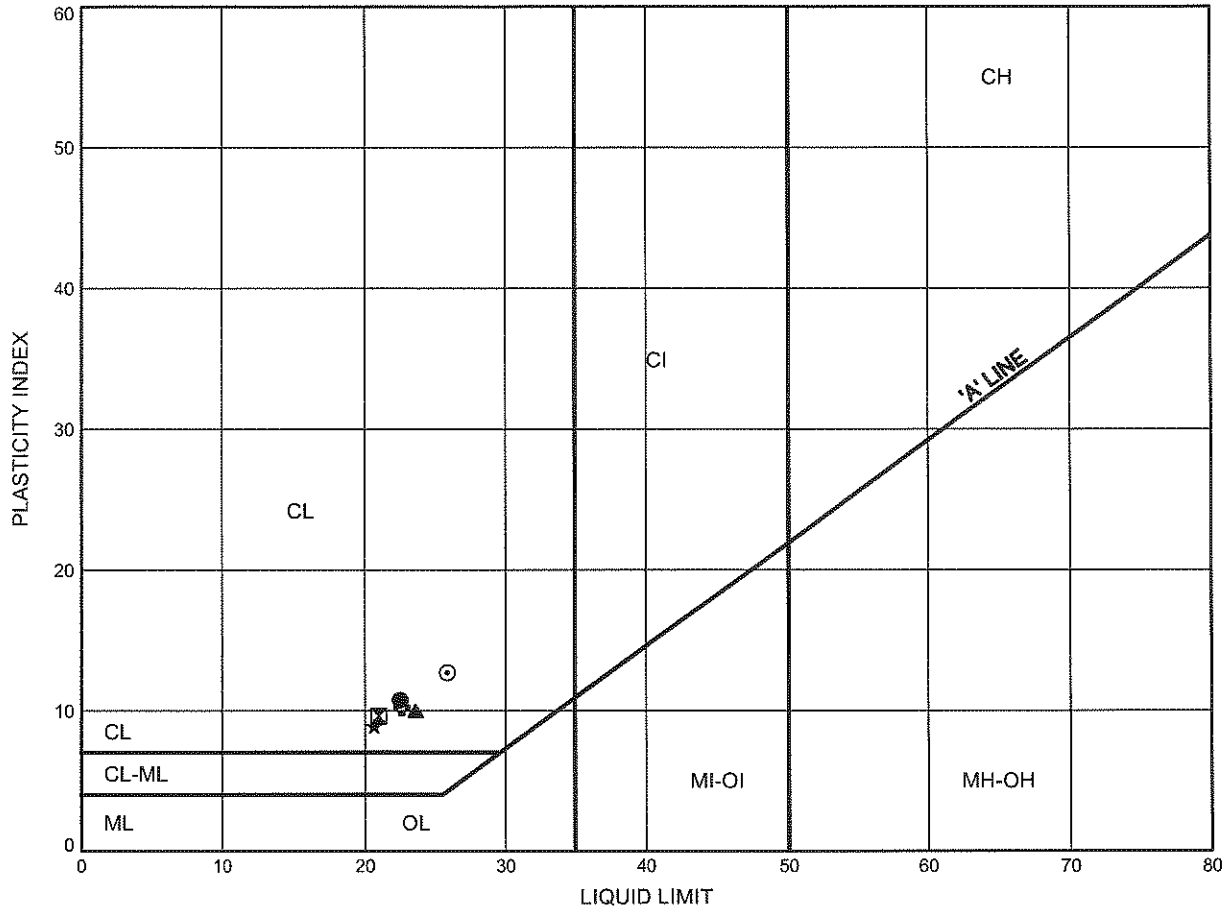
GRAIN SIZE DISTRIBUTION - THURBER 1122.GPJ 12/24/08

Hwy 401 Westbound Collectors, Jane to Kipling

ATTERBERG LIMITS TEST RESULTS

FIGURE B4

SANDY SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW-01	2.59	151.92
⊠	BW-02	2.59	149.89
▲	BW-02	4.11	148.37
★	BW-03	4.88	146.17
⊙	BW-04	2.59	147.57
✿	BW-04	4.11	146.05

Date December 2008

Project 2147-01-00

THURBER

Prep'd AN

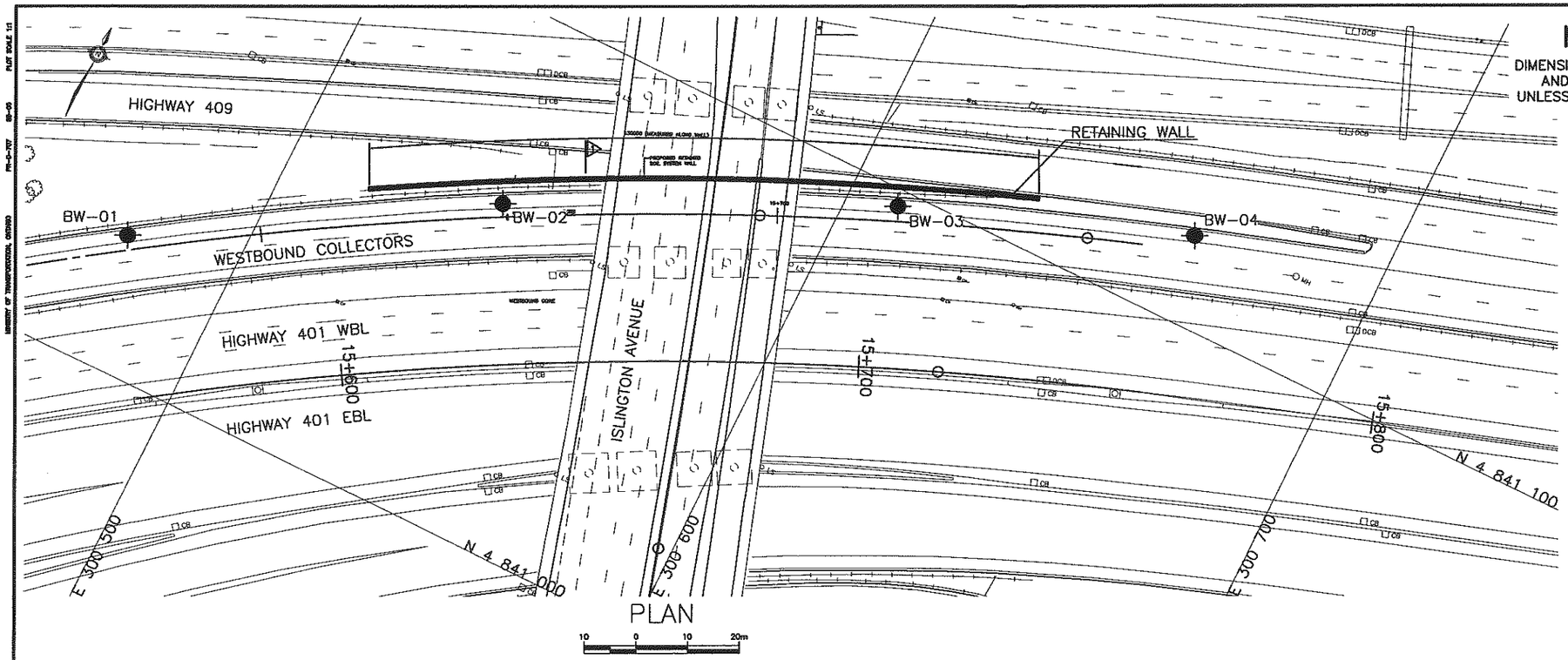
Chkd. MRA

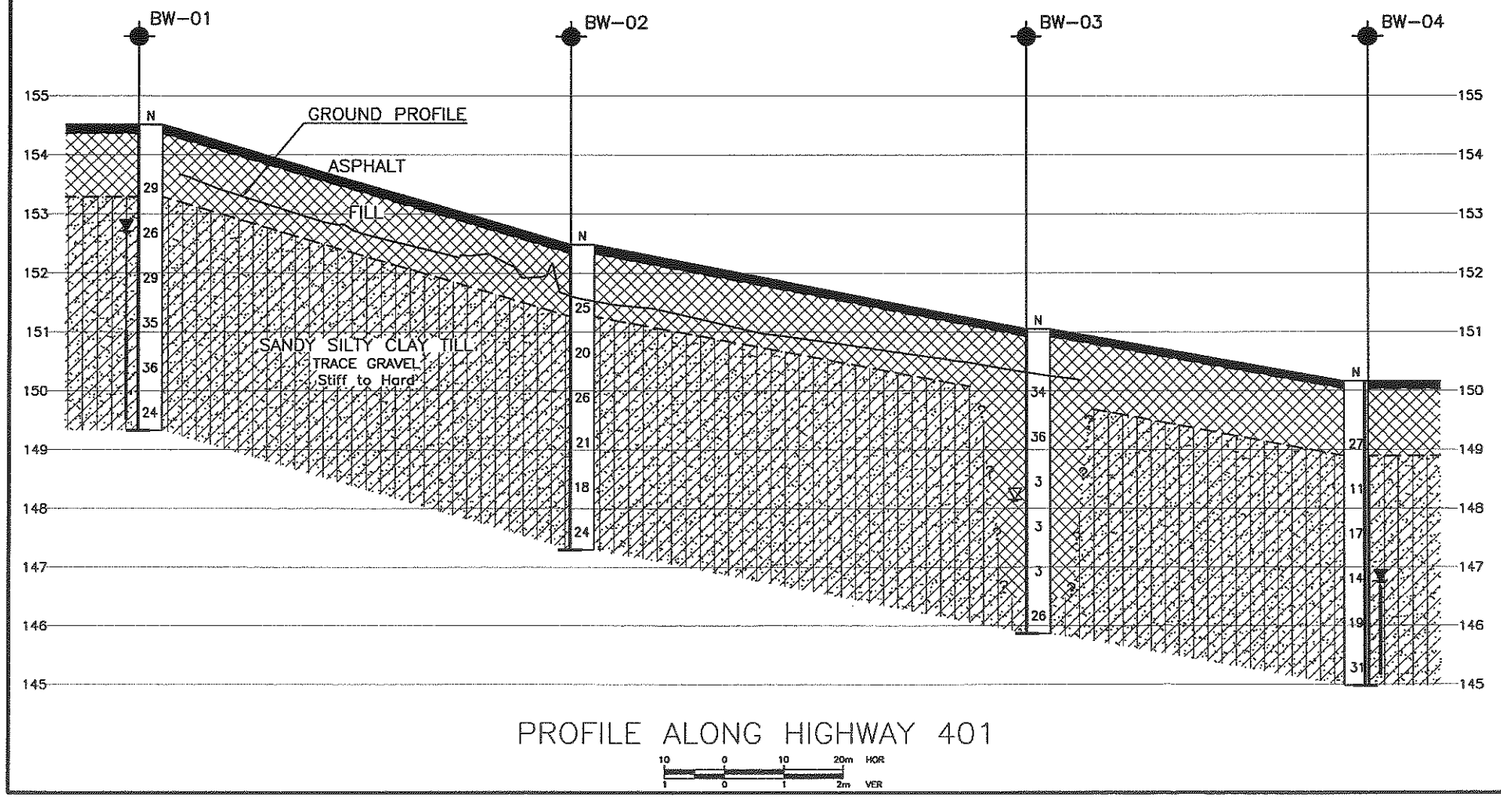
THURBALT 1122.GPJ 12/24/08

Appendix C

Drawing

Borehole Locations and Soil Strata





PROFILE ALONG HIGHWAY 401

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

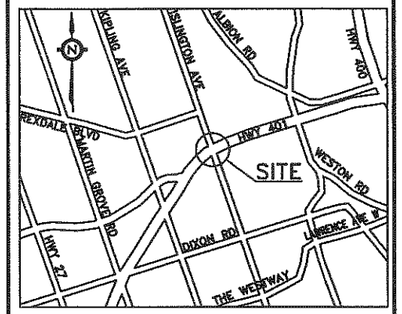
CONT No
GWP No 2147-01-00

SHEET

HIGHWAY 401 W.B. COLLECTORS RETAINING WALL AT ISLINGTON
BOREHOLE LOCATIONS AND SOIL STRATA

McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BW-01	154.5	4 841 025.8	300 478.6
BW-02	152.5	4 841 063.4	300 540.9
BW-03	151.1	4 841 096.8	300 609.8
BW-04	150.2	4 841 116.9	300 663.8

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Feb 12/09
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Feb 12/09
PROVINCE OF ONTARIO

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M11-230

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	MRA	CHK	PKC	CODE		LOAD	DATE JAN. 2009
DRAWN	MFA	CHK	MRA	SITE		STRUCT	DWG 1

FILENAME: H:\Drafting\191\1351\122\sd1122-RetainingWallIslington.dwg
PLOTDATE: Feb 11, 2009 - 3:59pm

PLOT SCALE 1:1
09-05
PR-D-707
MINISTRY OF TRANSPORTATION, ONTARIO