



THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

GEOCRES No:
31G-246

November 24, 2010
GENIVAR
100-15 Fitzgerald Road
Ottawa, Ontario
K2H 9G1

Project: 19-5308-27

Attn: Mr. Steve Taylor, P.Eng.

**Preliminary Foundation Investigation and Design Report
Bridge Replacement
Highway 401 and Cornwall Centre Road
Cornwall, Ontario
GWP 4029-08-00**

Dear Mr. Taylor

Thurber Engineering Ltd. is pleased to present the background review and preliminary geotechnical design recommendations for the removal, replacement or rehabilitation of the twin structures carrying Highway 401 over Cornwall Centre Road at Cornwall, Ontario.

1 GEOTECHNICAL CONDITIONS

In 2009, Thurber Engineering Ltd. was engaged by the Ministry to carry out a site investigation and field testing program at this site to provide information on which to base geotechnical design recommendations for the emergency remediation of the west median retaining wall.

The results of that investigation were presented in:

“Foundation Investigation and Design Report, Retaining Wall Distress, Highway 401 / Cornwall, Centre Road, Cornwall, Ontario, Site No. 31-209, Geocres Number: 31G – 232, June 15, 2009”

This geotechnical information is considered to be valid for the assessment of the preliminary design alternatives being considered. Accordingly, the factual part of the report is attached to this letter.



2 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on our understanding of the project based on the GENIVAR Structural Memorandum dated July 27, 2010, and on the teleconference held on July 9, 2010.

The boreholes drilled at this site were initially intended to provide information on which to base recommendations relating to the design of emergency repair measures for the west median retaining wall. Only three of the boreholes were drilled with the objective of also providing information for the preliminary design of foundations. Accordingly, the available information on which to base recommendations is limited.

2.1 Option 1 – Concrete Rigid Frame

Construction of a concrete rigid frame with open footings is considered to be feasible at this site.

For the purposes of feasibility assessment and preliminary design, it can be assumed that the rigid frame can be supported on spread footings, as follows:

- The spread footings must bear on the dense or very dense sand and silt glacial till soil or on hard clay
- Footings may be assumed to be founded at Elevation 61.0
- Bearing resistance of 400 kPa at SLS and 600 kPa at factored ULS may be assumed
- A coefficient of sliding friction of 0.6 may be assumed

Some of the available boreholes indicate firm clay or compact cohesionless soils below Elevation 61.0. For preliminary design, and in the absence of detail-level foundation investigation, it may be assumed that local pockets of poorer soil can be replaced during construction using either granular fill or unshrinkable fill.

If support on spread footings does not prove feasible, the structure could be supported on short steel piles driven to bedrock, at Elevations 55.7 to 57.3. Recommendations for pile design are given in Section 2.4.

Dewatering measures would be required to control the seepage of groundwater into the excavation, particularly from the existing embankment fill.



2.2 Options 2 and 3 – Semi-Integral Abutments

The subsurface conditions at this site are considered to be suitable for the construction of semi-integral abutments.

The geotechnical design recommendations for semi-integral abutments are the same as for the rigid frame option.

2.3 Option 4 – Precast Concrete Box

In this option the structure will consist of a closed-bottom concrete box on granular bedding.

In order to provide adequate bearing support and to manage differential settlements, we recommend the following:

- The existing fill, clay and any other unsuitable soils that may be encountered must be stripped to expose the underlying dense or very dense glacial till soil at approximately Elevation 61.0 to 62.0. The width and length of the base of the excavation must accommodate the engineered fill pad described below.
- The box must be supported on a pad of engineered fill that extends a nominal 500 mm beyond the edge of the culvert and is sloped at 1H:1V to the base of the excavation.
- The engineered fill must consist of OPSS Granular A compacted to 100% of the standard Proctor maximum dry density (SPMDD) at $\pm 2\%$ of the optimum moisture content.

Dewatering measures would be required to control the seepage of groundwater into the excavation, particularly from the existing embankment fill.

2.4 Additional Foundation Option

From a geotechnical perspective, the ground conditions at the site are considered to be suitable for the design of integral or false integral abutments, if the structure is redesigned to reduce the skew angle sufficiently.

For this option, steel H-piles would be driven to bedrock and for preliminary design purposes the axial geotechnical resistance can be assumed to be 2,000 kN at ULS_f . The SLS condition will not govern for steel piles driven to bedrock.



Based on the geotechnical information obtained in the course of the 2009 investigation, the average elevation of the bedrock surface across the site is 56.5.

2.4.1 Lateral Resistance

The lateral resistance on the length of pile above the grade of Cornwall Centre Road will depend on the type of construction selected, e.g. concentric CSPs, and on the material used as backfill behind the new abutments. This must be determined in the course of detailed design but values assuming a pile embedded in Granular B backfill and in glacial till are provided below.

The lateral resistance of the piles may be calculated using a value for the coefficient of horizontal subgrade reaction (k_s) and ultimate lateral resistance (p_{ult}) as follows:

Non-cohesive

$$k_s = n_h \cdot z / D \quad (\text{kN/m}^3)$$

$$p_{ult} = 3 \cdot \gamma \cdot z \cdot K_p \quad (\text{kPa})$$

where z = depth of embedment of pile in metres

D = pile width in metres

n_h = value from Table 1

γ = unit weight from Table 1

K_p = passive earth pressure coefficient from Table 1

The above equations and recommended parameters may be used to analyze the interaction between a pile and the surrounding soil. The lateral pressures obtained from the analysis should not exceed the ultimate lateral resistance.

The spring constant, K , for analysis may be obtained by the expression, $K = k_s \cdot L \cdot D$ (kN/m), where k_s is the coefficient of horizontal subgrade reaction (kN/m³), D is the pile width (m) and L is the length (m) of the pile segment or element used in the analysis. The ultimate lateral resistance on any one segment of pile, P_{ult} , may be obtained from the expression, $P_{ult} = p_{ult} \cdot L \cdot D$. This represents the ultimate load at which that particular element of the pile fails and will not support any additional load at greater displacements. It is recommended, however, that the total lateral resistance assumed in one pile be limited to no more than 120 kN at ULS and 50 kN as SLS.



Table 1 – Average Parameters for Lateral Pile Resistance for Preliminary Design

Elevation (m)	n_h (kN/m³)	K_p	Unit Weight* (kN/m³)	Soil Conditions
Hwy 401 Grade to 63.0	15,000	3.3	21	Compacted Granular B
63.0 to 60.0	5,000	3.0	11*	Sandy silt till
60.0 to 56.5 (BDR)	10,000	3.3	11*	Sandy silt till

* Submerged unit weight.

2.5 Backfill to Structure

The backfill to the structure, semi-integral abutment or box-structure, must be in accordance with OPSD 3101.150.

Based on the findings from the boreholes drilled at this site, the existing fill behind the abutments is not suitable for re-use behind the abutments and must be removed at least to the extent shown for granular backfill in OPSD 3101.150.

2.6 Roadway Protection

The soils at the site are considered to be suitable for the construction of roadway protection based on either driven steel sheet piles or soldier piles and lagging. The roadway protect must be designed in accordance with OPSS 539, November, 2009 and must meet Performance Level 2.

Roadway protection is temporary work that must be designed by the contractor. However, in assessing the feasibility of designing roadway protection for this site, the earth pressure parameters given in Table 2 may be used.

**Table 2 – Earth Pressure Design Coefficients**

Depth (m)	Material	Bulk Unit Wt. (kN/m ³)	Friction Angle (°)	Active Coefficient (K _a)	Passive Coefficient (K _p)	Coefficient At Rest (K _o)
0 - 1.4	Clayey Silt Fill	20	28	0.36	2.8	0.53
1.4 - 5.3	Silty Sand Fill	22	29	0.35	2.85	0.52
5.3 - 6.8	Sand & Gravel Fill	23	32	0.31	3.3	0.47
6.8 - 8.1	Silty Clay	19	28	0.36	2.8	0.53
8.1 - 12.1	Sand & Silt Till	23	32	0.31	3.3	0.47

2.7 Embankments

The existing embankments appear to be performing satisfactorily from the point of view of global stability and stability of the side slopes. Examination of the median immediately behind the abutments suggested that settlement has occurred due to either one, or a combination of consolidation of the foundation soils or self-consolidation within the mass of the embankment fill. At the west median retaining wall, the impression of settlement is probably exacerbated by the effect of the forward movement of the wall and relaxation of the fill behind it.

For the purposes of preliminary design, it can be assumed that embankments reconstructed to the original geometry and profile will be stable and will not experience significant settlement, provided there is not a grade raise.

If embankment widening or a detour embankment is required, there is a risk of time-dependent settlement that will produce differential settlements with respect to the existing embankment. These settlements are not expected to exceed 100 mm and this is an issue that must be addressed during the detail design phase.

3 SCOPE OF WORK FOR DETAIL DESIGN

During the detail design phase, additional foundation engineering investigation and analysis will be required. The main activities required in the detail design phase include, but are not necessarily limited to:

- Drilling additional boreholes to fully develop a model of the geotechnical conditions under the foundations of the proposed new structures and a possible detour structure



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- Preparation of foundation design alternatives for a range of permanent structure types and for a possible detour structure
- Analysis of potential settlement issues if widened/new embankments are required and recommendations for management of these settlements.

4 CLOSURE

We trust that the recommendations contained in this report address the requirements for preliminary design. If we can be of further service, do not hesitate to contact our office.

Thurber Engineering Ltd.



Alastair E. Gorman, P.Eng.
Associate



P.K. Chatterji, P.Eng.
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

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

 Water Level

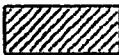




 Shear Strength Determination by Pocket Penetrometer

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION		
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	Field Estimation of Hardness*
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m			
Medium bedded	0.2 to 0.6m	Very Strong	100-250	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m			
Very thinly bedded	20 to 60mm	Strong	50-100	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm			
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	Indented by thumbnail

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.

RECORD OF BOREHOLE No 09-01

1 OF 2

METRIC

G.W.P. 15-04-19 LOCATION 4 991 153.6 N 203 325.3 E ORIGINATED BY SLL
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Rods COMPILED BY SLL
 DATUM Geodetic DATE 2009-12-05 - 2009-12-05 CHECKED BY DEE

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
69.0							SHEAR STRENGTH kPa						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)						
							PLASTIC NATURAL LIQUID						
							LIMIT MOISTURE LIMIT						
							W P W W L						
69.0	SOD: (50mm)		1	SS	9								
68.3	Clayey SILT, some sand, trace gravel												
0.7	Firm to Stiff												
	Dark Brown		2	SS	12								8 55 28 8
	Moist (FILL)												
	Silty SAND, some clay, trace gravel,		3	SS	10								
	trace asphalt fragments,												
	Compact		4	SS	22								2 52 36 10
	Brown												
	Moist		5	SS	21								
			6	SS	18								
			7	SS	8								4 50 36 10
	Loose		8	SS	29								
63.0													
6.0	SAND & GRAVEL, trace to some silt		9	SS	19								42 39 19
62.3	Compact												(SI+CL)
	Brown		10	SS	100/								
	Moist (FILL)				.100								
6.7	Silty SAND, some clay, trace gravel		11	SS	100/								
	Very Dense				.025								
	Brown												
	Moist to Wet (TILL)												
60.5													
8.5	SAND, some gravel, trace silt		12	SS	32								
	Dense												
	Grey												
	Wet												

Continued Next Page

+ 3 x 3

Numbers refer to
Sensitivity

20
15 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-01

2 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 153.6 N 203 386.3 E ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Hollow Stem Augers/NW Casing/HQ Rods COMPILED BY SLL
DATUM Geodetic DATE 2009-12-05 - 2009-12-05 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
58.8 10.2	Continued From Previous Page SAND, some gravel, trace silt Dense Grey Wet SAND & SILT, some clay, trace gravel Compact to Very Dense Grey Moist (TILL)		13	SS	25												
			1.5	SS	100/ .125											2 43 48 7	
55.7 13.3	LIMESTONE BEDROCK, fresh, grey, with some rubble zones from 13.7 to 13.8m. Vertical joints from 13.5 to 13.7m and 14.0 to 14.2m. Cohesive till layer at 15.2m for 25mm.		1	RUN												RUN # TCR=100%, SCR=73%, ROD=89%, UCS=27-133MPa	
			2	RUN												RUN # TCR=100%, SCR=100%, ROD=100%, UCS=33-114MPa	
52.2 16.7	END OF BOREHOLE AT 16.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 13, 09 6.7 62.3 May 15, 09 6.4 62.6 May 19, 09 6.6 62.4 May 20, 09 6.7 62.3																

METRIC

CHECKED BY DEE

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-02

2 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 153.46 N 203 341.9 E ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SLL
DATUM Geodetic DATE 2009-11-05 - 2009-11-05 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page																
	SAND & SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		14	SS	100/ .125												
57.2																	
57.2	LIMESTONE BEDROCK, weathered		15	SS	100/ .025												
12.2	END OF BOREHOLE AT 12.2m. PROBABLE BEDROCK SURFACE. BOREHOLE OPEN AND WATER LEVEL AT 10.5m ON 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) May 13, 09 5.3 64.1 May 15, 09 5.7 63.7 May 19, 09 5.8 63.6 May 20, 09 5.9 63.5																

RECORD OF BOREHOLE No 09-03

2 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 153.0 N 203 353.3 E ORIGINATED BY SL
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SL
DATUM Geodetic DATE 2009-11-05 - 2009-11-05 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page																
	SAND & SILT, some clay, trace gravel Compact Grey Moist (TILL) Very Dense		13	SS	18											3 50 38 10	
			14	SS	100												
57.3																	
12.1	END OF BOREHOLE AT 12.1m. PROBABLE BEDROCK SURFACE. BOREHOLE OPEN AND WATER LEVEL AT 9.9m ON 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) May 13, 09 6.0 63.4 May 15, 09 6.3 63.1 May 19, 09 6.4 63.0 May 20, 09 6.4 63.0 May 26, 09 6.3 63.1																

RECORD OF BOREHOLE No 09-04

1 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 151.7 N 203 362.6 E ORIGINATED BY SLL
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Rods COMPILED BY SLL
 DATUM Geodetic DATE 2008-05-15 - 2009-05-15 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
63.4								20 40 60 80 100						
0.0	ASPHALT: (100mm)		1	AS				○ UNCONFINED + FIELD VANE						45 39 16 (SI+CL)
0.1	Gravelly SAND, some silt							● QUICK TRIAXIAL × LAB VANE						
62.7	Moist (FILL)		2	SS	12									2 46 38 14
0.7	Silty SAND, some clay to clayey, trace gravel, trace rootlets													
	Compact Brown Moist (FILL)		3	SS	12									
60.8			4	SS	18									
2.6	Silty SAND, some clay, trace gravel		5	SS	15									9 51 31 10
	Compact Brown to Grey Moist (TILL)		6	SS	18									
			7	SS	22									
	Very Dense		8	SS	100/ 275									
			9	SS	87									7 46 36 10
56.5														
6.9	LIMESTONE BEDROCK, fresh, grey, sub-vertical joints from 9.0 to 9.1m.		1	RUN										RUN # TCR=100%, SCR=15%, RQD=100%, UCS=4MPa
			2	RUN										RUN # TCR=7%, SCR=3%, RQD=7%, UCS=4MPa
			3	RUN										RUN # TCR=100%, SCR=100%, RQD=100%

Continued Next Page

+ 3 x 3 Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-05

1 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 142.6 N 203 323.9 E ORIGINATED BY SLL
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/NW Casing/HQ Rods COMPILED BY SLL
 DATUM Geodetic DATE 2009-05-13 - 2009-05-14 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT T kNm ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
70.2														
0.0	ASPHALT: (175mm)													
0.2	CONCRETE: (325 mm)													
69.7														
0.5	SAND & GRAVEL, trace to some silt Very Dense to Compact Brown Moist (FILL)		1	SS	70									37 45 18 (SI+CL)
			2	SS	24									
			3	SS	25									
	Dense		4	SS	31									44 42 13 (SI+CL)
			5	SS	26									38 42 19 (SI+CL)
			6	SS	16									
	Loose		7	SS	6									37 48 15 (SI+CL)
			8	SS	14									
63.4														
6.8	Silty CLAY, some sand, trace gravel, Loose Brown Moist		9	SS	6									2 36 42 20
62.5														
7.7	SAND & SILT, some clay, trace to some gravel Compact to Very Dense Grey Moist (FILL)		10	SS	16									7 45 39 9
			11	SS	100/ 275									
			12	SS	100/ 200									15 42 42 (SI+CL)

Continued Next Page

+ 3 x 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-05

2 OF 2

METRIC

G.W.P. 15-64-19 LOCATION 4 991 142.6 N 203 323.9 E ORIGINATED BY SL
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NO Rods COMPILED BY SL
 DATUM Geodetic DATE 2009-05-13 - 2009-05-14 CHECKED BY DEE

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20 40 60 80 100	40 80 120 160 200					
	Continued From Previous Page												
	SAND & SILT, some clay, trace to some gravel Very Dense Grey Moist (TILL)		13	SS	100/ .125								
			14	SS	100/ .050								
56.8													
13.3	LIMESTONE BEDROCK, fresh, grey, sub-vertical joints from 13.9 to 14.2m.		1	RUN									RUN 1# TCR=84%, SCR=39%, RQD=84%, UCS=24-85MPa RUN 2# TCR=100%, SCR=0%, RQD=100%, UCS=40-74MPa RUN 3# TCR=100%, SCR=78%, RQD=100%, UCS=39-125MPa
			2	RUN									
			3	RUN									
			4	RUN									
53.2													RUN 4# TCR=100%, SCR=100%, RQD=100%, UCS=10-104MPa
16.9	END OF BOREHOLE AT 16.9m. BOREHOLE OPEN TO 16.9m.												

ONTMT-45 6419.GPJ 28/5/09

+ 3 x 3 Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-06

1 OF 1

METRIC

G.W.P. 15-64-19 LOCATION 4 991 157.8 N 203 361.9 E ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2009-05-19 - 2009-05-19 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT T kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
69.2								SHEAR STRENGTH kPa						
0.0	SOD: 100 mm							O UNCONFINED + FIELD VANE						
0.2	Silty SAND, some gravel, trace clay, occasional limestone fragments Brown Loose Moist to Wet (FILL)		1	SS	4		69	● QUICK TRIAXIAL X LAB VANE						
			2	SS	3		68	WATER CONTENT (%)						6 47 37 9
			3	SS	23		67							10 52 31 7
	Compact		4	SS	20		66							16 51 26 7
65.4			5	SS	26		65							
3.7	SAND & GRAVEL, trace silt Dense to Compact Brown Moist (FILL)		6	SS	30		64							43 41 16 (SI+CL)
			7	SS	34		63							41 43 16 (SI+CL)
	Organic Staining		8	SS	28		62							
			9	SS	6									
62.3			10	SS	50/ .150									2 37 34 28
6.9	Silty CLAY, some sand, trace gravel Hard Grey Moist		11	SS	50/ .150									
61.2														
7.9	END OF BOREHOLE AT 7.9m Open borehole groundwater level at 6.4m depth upon completion. Borehole backfilled with holeplug to ground surface.													

ONTMT4S 6419.GPJ 28/5/09

RECORD OF BOREHOLE No 09-07

1 OF 1

METRIC

G.W.P. 15-64-19 LOCATION 4 991 149.0 N 203 380.0 E ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2009-05-20 - 2009-05-20 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT T kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
69.1								SHEAR STRENGTH kPa						
0.0	SOD: 100 mm							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
0.2	Silty SAND, trace to some clay, trace gravel Loose Brown Moist (FILL)		1	SS	7									
			2	SS	6									3 49 36 11
			3	SS	50									Split Spoon Boulding
					.075									
	Compact		4	SS	26									6 50 36 8
	Dense		5	SS	45									3 49 38 10
	Compact		6	SS	24									
			7	SS	21									8 48 34 9
	Loose		8	SS	5									
63.0														
6.1	SAND & GRAVEL Compact Brown Wet (FILL)		9	SS	25									40 44 16 (SI+CL)
62.4														
6.7	Silty CLAY, some sand Firm Grey Moist		10	SS	6									
			11	SS	6									0 15 31 51
60.8														
8.2	END OF BOREHOLE AT 6.3m Open borehole groundwater level at 6.7m depth upon completion. Borehole backfilled with holeplug to ground surface.													

ONTM245 6419.GPJ 28/5/09

RECORD OF BOREHOLE No 09-08

1 OF 1

METRIC

G.W.P. 15-64-19 LOCATION 4 991 147.2 N 203 386.5 E ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2009-05-20 - 2009-05-20 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
68.9								SHEAR STRENGTH kPa						
0.0	SOD: 75 mm							○ UNCONFINED + FIELD VANE						
0.1	Silty SAND, some clay, trace gravel		1	SS	19			● QUICK TRIAXIAL × LAB VANE						
	Brown							WATER CONTENT (%)						
	Compact		2	SS	25			W P W L						
	Moist							PLASTIC NATURAL LIQUID						
	(FILL)							LIMIT MOISTURE CONTENT LIMIT						
			3	SS	33									
	Dense													
			4	SS	27									
66.0														
3.0	SAND & GRAVEL, some silt													
	Very Dense		5	SS	80									
	Brown													
	Moist													
65.2	(FILL)													
3.7	Silty SAND, some clay, trace gravel													
	Dense to Compact		6	SS	48									
	Brown													
	Moist													
	(FILL)		7	SS	28									
			8	SS	31									
62.6														
6.1	Silty CLAY, some sand, trace gravel,													
	trace organics		9	SS	8									
	Firm													
62.2	Mottled Brown/Grey													
	Moist													
6.7	END OF BOREHOLE AT 6.7m													
	Borehole open and dry upon													
	completion.													
	Piezometer installation consists of													
	19mm diameter Schedule 40 PVC-pipe													
	with a 1.52m slotted screen.													
	WATER LEVEL READINGS:													
	DATE DEPTH (m) ELEV. (m)													

+ 2 x 3 Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-09

1 OF 1

METRIC

G.W.P. 15-64-19 LOCATION 4 991 148.6 N 203 347.7 E ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2009-05-19 - 2009-05-19 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
69.5														
0.0	SOD: 75 mm													
0.2	SAND & GRAVEL, trace to some silt Compact Brown Moist (FILL)		1	SS	12		69							23 63 14 (SI+CL)
			2	SS	14		68							
	Loose		3	SS	7		67							26 43 32 (SI+CL)
	Dense		4	SS	32		66							58 31 11 (SI+CL)
			5	SS	22		65							
	Compact		6	SS	31		64							23 47 30 (SI+CL)
			7	SS	22		63							
	Dense		8	SS	40		62							43 45 12 (SI+CL)
	Loose		9	SS	10									
	Compact		10	SS	16									53 38 10 (SI+CL)
62.0														
7.5	Silty CLAY, some sand, trace gravel Hard Grey Moist		11	SS	50/ 125									5 37 37 21
61.4														
8.1	END OF BOREHOLE AT 8.1m Open borehole groundwater level at 6.5m depth upon completion. Borehole backfilled with holeplug to ground surface.													

ONTMTAS 6419.GPJ 28/5/09

+ 3 x 3. Numbers refer to
Sensitivity

20
15 5
16 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-10

1 OF 1

METRIC


G.W.P. 15-64-19 LOCATION 4 991 145.1 N 203 372.7 E ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2009-05-20 - 2009-05-20 CHECKED BY DEE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
69.4							20	40	60	80	100						
0.0	SOD: 75 mm						40	80	120	160	200						
0.1	Silty SAND, trace to some clay, trace gravel Brown Loose Moist (FILL) Compact		1	SS	7		69										
			2	SS	10		68									2 50 37 10	
			3	SS	17		67										
			4	SS	13		66									3 50 33 15	
	Loose		5	SS	4		65										
			6	SS	4		64										
	Very Loose		7	SS	3		63									6 52 33 10	
	Loose		8	SS	4		62										
63.3																	
6.1	SAND & GRAVEL, trace silt Compact Brown Moist (FILL)		9	SS	16		63									47 38 15 (SI+CL)	
			10	SS	50/ 150		62									72 22 6 (SI+CL)	
61.7			11	SS	50/ 150												
7.7	END OF BOREHOLE AT 7.7m Open borehole groundwater level at 7.3m depth upon completion. Borehole backfilled with holoplug to ground surface.				.075												

ONTM145 6419.GPJ 28/5/03

APPENDIX C

RECORD OF TEST PITS

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	Open (kPa)	Water Content (%)	Photo
- 0	63.33					
ORGANICS, trace roots and rootlets: (75mm)						
CLAY, silty, with sand layer from pipe backfill, firm, brown to grey, moist (FILL)						
- 0.4						
- 0.6						
- 0.8						
- 1.0	62.33					
- 1.2						
- 1.4						
TOP OF CONCRETE FOOTING - 1.0m in width						
- 1.6						
END OF TEST PIT AT 1.63m (Elev. 61.7 m)						
- 1.8						
No obvious cracks observed at footing/wall interface.						
2.0	61.33					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 6, 2009

Excavation Co: Bob Bulging Co. Ltd

Client: MTO

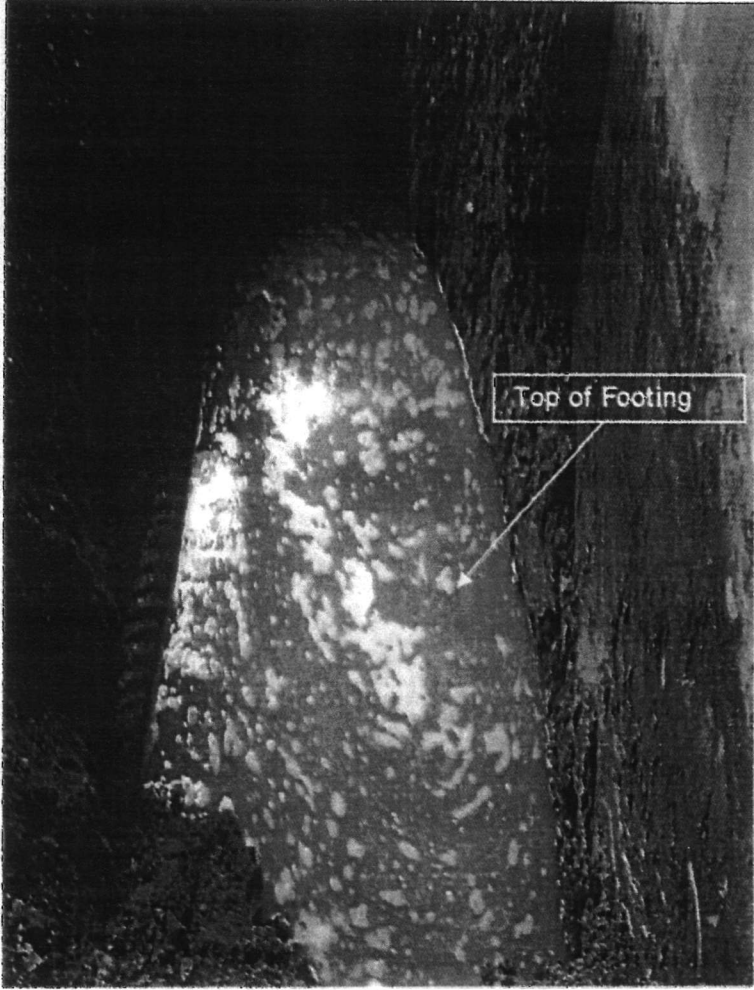
Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-1
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0	ASPHALT: (50mm) 63.43					
-	SAND, some gravel, grey, moist, (200mm): (FILL)					
-	CLAY, silty, topsoil stained, dark brown, moist: (FILL)					
- 0.4						
-	SAND, some gravel with occasional cobbles, brown, wet (FILL)					
- 0.6						
- 0.8						
- 1.0	CLAY, silty, with occasional cobbles, brown to grey, moist to wet (FILL) 62.43					
- 1.2						
- 1.4						
- 1.6	TOP OF CONCRETE FOOTING - 1.5 m in width					
-	END OF TEST PIT AT 1.57m (Elev. 61.86 m).					
- 1.8	A 150mm dia. CSP was located approx. 1.3m from retaining wall and 0.7m below top of concrete curb.					
- 2.0	Water seepage was noted from the 150mm dia. CSP backfill. 61.43					
	No obvious cracks observed at footing/wall interface.					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Bulging Co. Ltd

Client: MTO

Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-2
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
-0	ASPHALT: (50mm) 63.48					
-	SAND, some gravel, grey, moist, (125mm): (FILL)					
-	CLAY, silty, topsoil stained, dark brown, moist (FILL)					
-0.4						
-	SAND, some gravel with occasional cobbles, brown, moist					
-0.6	(FILL)					
-						
-0.8						
-	CLAY, silty, with occasional cobbles, brown to grey, moist					
-1.0	(FILL) 62.48					
-						
-1.2						
-						
-1.4						
-1.6	TOP OF CONCRETE FOOTING – 1.5 m wide					
-	END OF TEST PIT AT 1.63m (Elev. 61.85 m).					
-1.8	A 150mm dia. CSP was located approx. 1.5m from retaining wall and 1.2m below top of concrete curb.					
-	Some minor water seepage coming from SAND/CLAY interface at 0.9m below ground surface.					
-2.0	61.48					
The retaining wall rotated into excavation approx. 12mm as measured with a 1.2m long level.						
Footing toe approx. 35mm higher than at wall interface as measured with a 1.2m long level.						
No obvious cracks observed at footing/wall interface.						

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Bulging Co. Ltd

Client: MTO

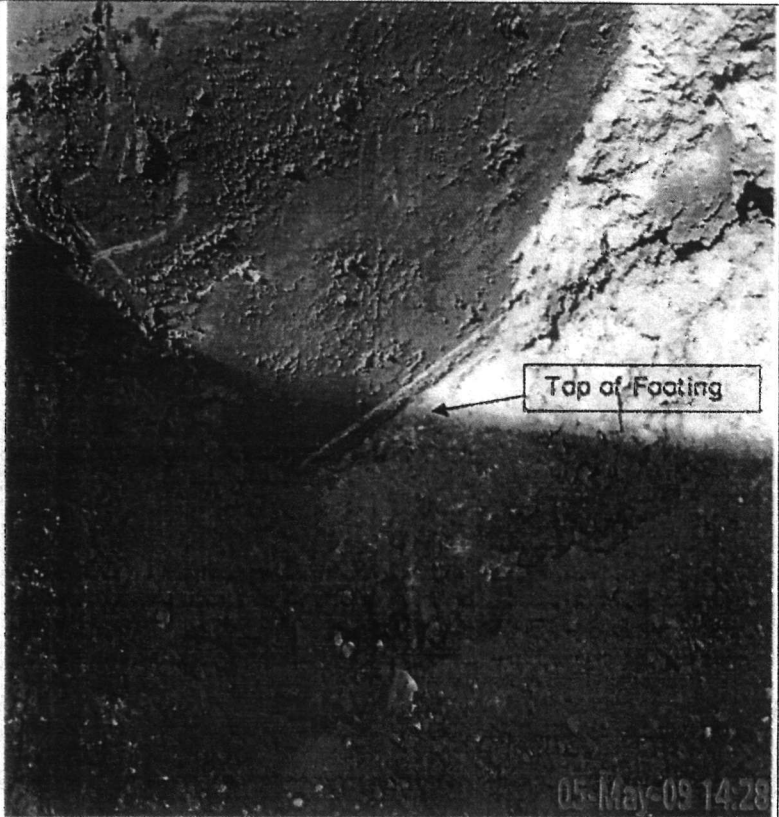
Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-3
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0 ASPHALT: (50mm)	63.52					
- SAND, some gravel, grey, moist, (125mm): (FILL)						
- CLAY, silty, organic stained, dark brown, moist (FILL)						
- 0.4						
- SAND, some gravel with occasional cobbles, brown, moist						
- 0.6 (FILL)						
- 0.8						
- CLAY, silty, with occasional cobbles and construction debris, brown to grey, wet	62.52					
- 1.0 (FILL)						
- 1.2						
- 1.4						
- 1.6 TOP OF CONCRETE FOOTING						
- END OF TEST PIT AT 1.68m (Elev. 61.84 m).						
- 1.8 A 150mm dia. CSP was located approx. 1m from retaining wall and 0.8m below top of concrete curb and gutter.						
- No obvious cracks observed at footing/wall interface.						
- 2.0	61.52					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Buiting Co. Ltd

Client: MTO

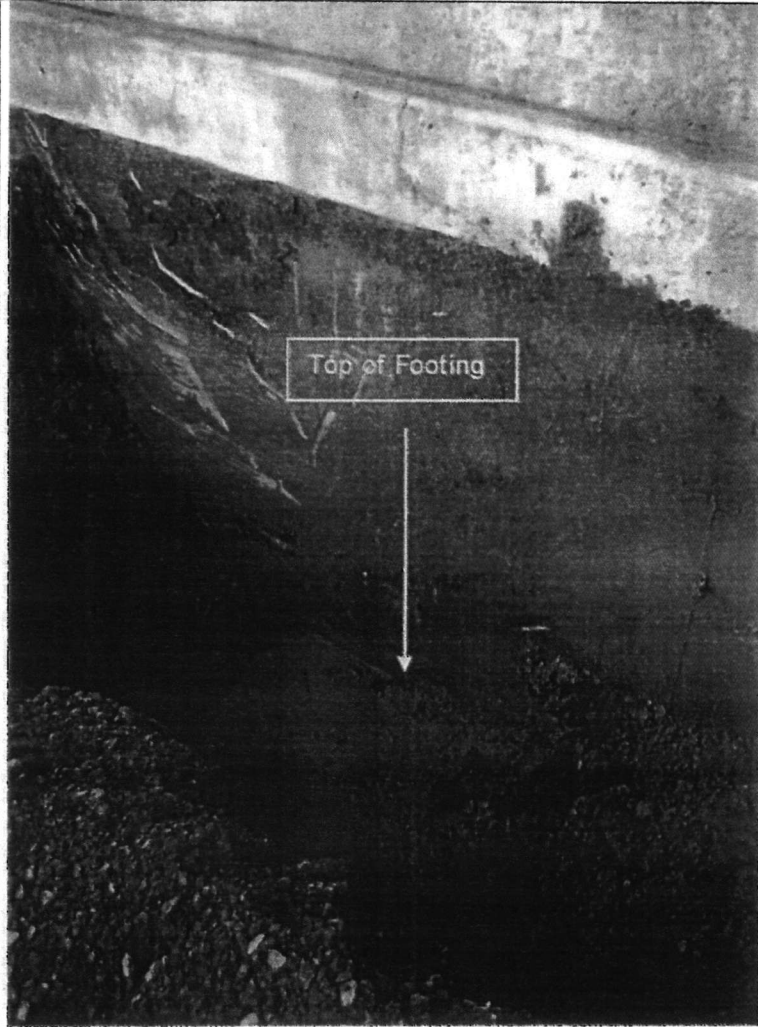
Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-4
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0 ASPHALT: (50mm)	63.53					
- SAND, some gravel, grey, moist, (19mm CRL): (FILL)						
- CLAY, silty, topsoil stained, dark brown, moist (FILL)						
- 0.4						
- 0.6 SAND, some gravel with occasional cobbles, brown, wet (FILL)						
- 0.8						
- 1.0	62.53					
- 1.2 CLAY, silty, with occasional cobbles, brown to grey, moist to wet (FILL)						
- 1.4						
- TOP OF CONCRETE FOOTING						
- 1.6 END OF TEST PIT AT 1.68m (Elev. 61.85 m).						
- 1.8 There was no inclination noted on the 1.2m level along the retaining wall.						
- Asphalt debris encountered at footing level.						
- 2.0 No obvious cracks observed at footing/wall interface.	61.53					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Buiting Co. Ltd

Client: MTO

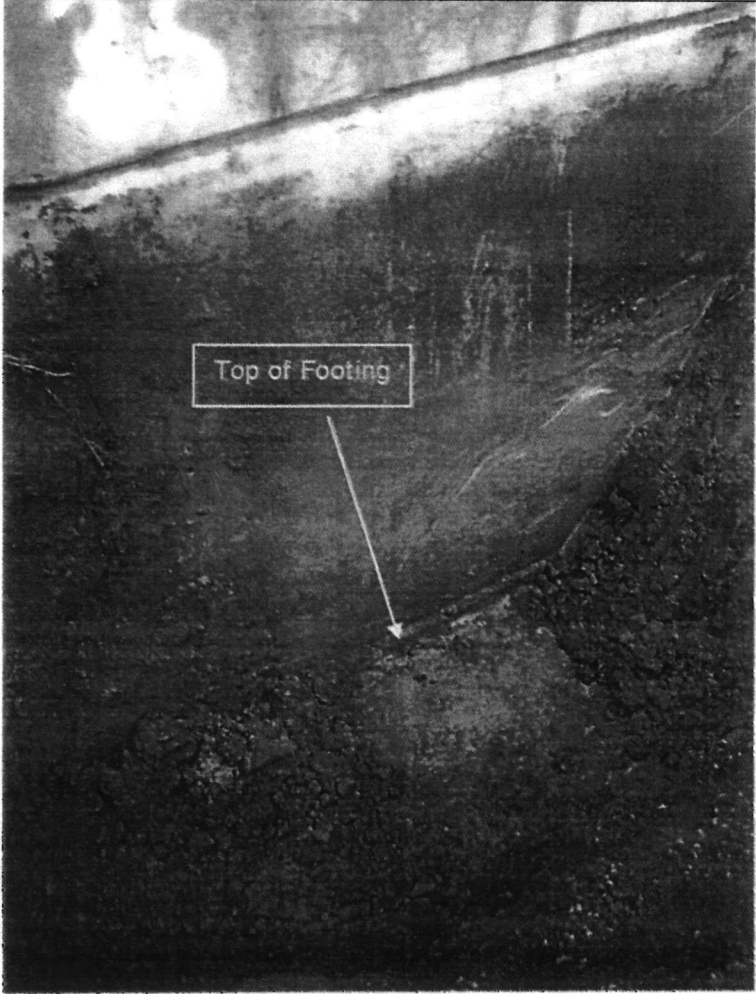
Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-5
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	Open (kPa)	Water Content (%)	Photo
- 0 ASPHALT: (50mm)	63.58					
- SAND, some gravel, grey, moist, (19mm CRL): (FILL)						
- CLAY, silty, topsoil stained, dark brown, moist (FILL)						
- 0.4				150 kPa		
- 0.6 SAND, some gravel with occasional cobbles, brown, wet (FILL)						
- 0.8						
- 1.0	62.58					
- 1.2 CLAY, silty, with occasional cobbles, brown to grey, moist to wet (FILL)				50 - 75 kPa		
- 1.4						
- 1.6 TOP OF CONCRETE FOOTING						
- 1.8 END OF TEST PIT AT 1.75m (Elev. 61.83 m).						
- 2.0 No obvious cracks observed at footing/wall interface.	61.58					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Bunting Co. Ltd

Client: MTO


Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-6
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0 ORGANICS, trace roots and rootlets: (150mm)	63.59					
- CLAY, silty, with occasional cobbles and construction debris (re-bar), dark brown to brown, moist (FILL)				50 kPa		
- 0.4						
- 0.6						
- 0.8						
- 1.0	62.59					
- 1.2				75 kPa		
- 1.4						
- 1.6						
- 1.8 TOP OF CONCRETE FOOTING - 1.0 m width						
- 2.0 END OF TEST PIT AT 1.93m (Elev. 61.66 m).	61.59					
No obvious cracks observed at footing/wall interface.						

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 5, 2009

Excavation Co: Bob Buiting Co. Ltd

Client: MTO

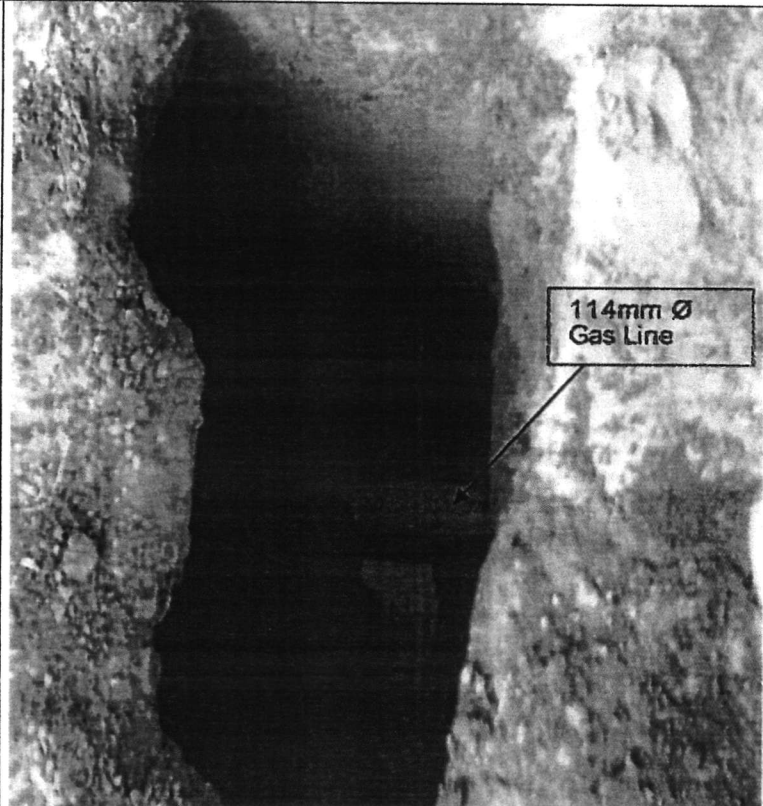
Weather: Cloudy

Inspector: SLL

Project: 15-64-19

Method: Backhoe

LOG OF TEST PIT: NO. TP 09-7
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0	ASPHALT: (50mm) 63.55					
-	SAND, some gravel, grey, moist: (FILL)					
-	CLAY, silty, topsoil stained, dark brown, moist: (FILL)					
- 0.4						
-						
- 0.6						
-						
- 0.8						
-	SAND, some gravel with occasional cobbles, brown, wet: (FILL)					
- 1.0	62.55					
-	END OF TEST PIT AT 1.1m (Elev. 62.45 m)					
-	A 114mm dia. Gas Pipe was located approx. 0.3m from retaining wall and 0.8m below top of concrete curb.					
-	A 150mm CSP was found approx. 0.9m from the retaining wall and 1.0m below top of concrete curb.					
-	No obvious cracks observed at footing/wall interface					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 14, 2009

Excavation Co: DBC Environmental

Client: MTO

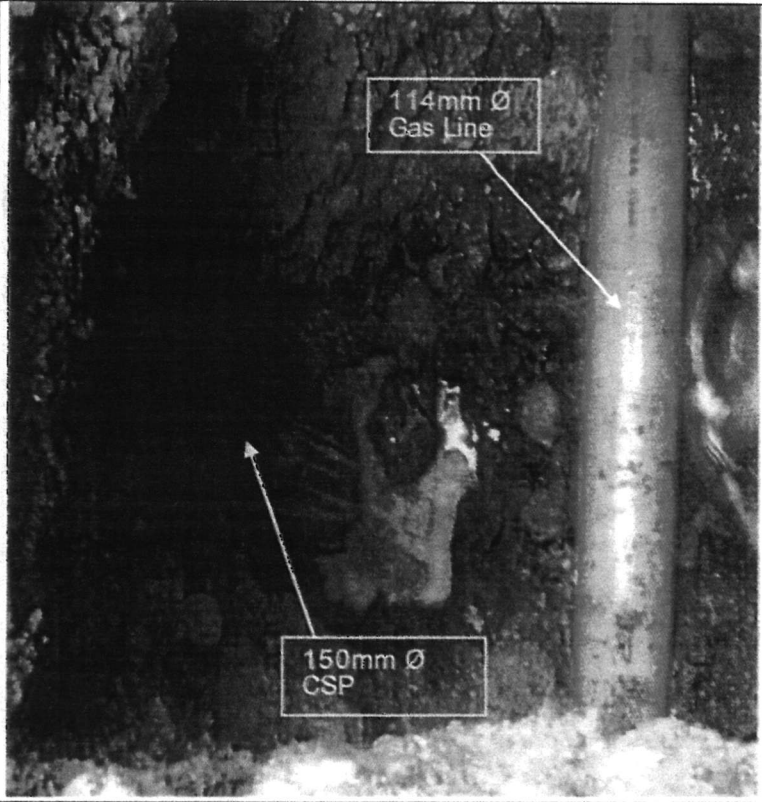
Weather: Cloudy, Rain

Inspector: SLL

Project: 15-64-19

Method: Daylighting

LOG OF TEST PIT: NO. TP 09-8
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0	ASPHALT: (50mm) 63.45					
-	SAND, some gravel, grey, moist: (FILL)					
-	SAND, trace gravel and silt, brown, moist to wet (FILL)					
- 0.4						
-						
- 0.6						
-						
- 0.8						
-						
- 1.0	62.45					
-	END OF TEST PIT AT 1.1m (Elev. 62.35 m)					
- 1.2						
-	A 114mm dia. Gas Line located approx. 0.3m from retaining wall and 0.8m below top of concrete curb.					
-	A 150mm CSP was encountered approx. 0.9m from the retaining wall and 1.0m below top of concrete curb.					
-	No obvious cracks observed at footing/wall interface					

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 14, 2009

Excavation Co: DBC Environmental

Client: MTO

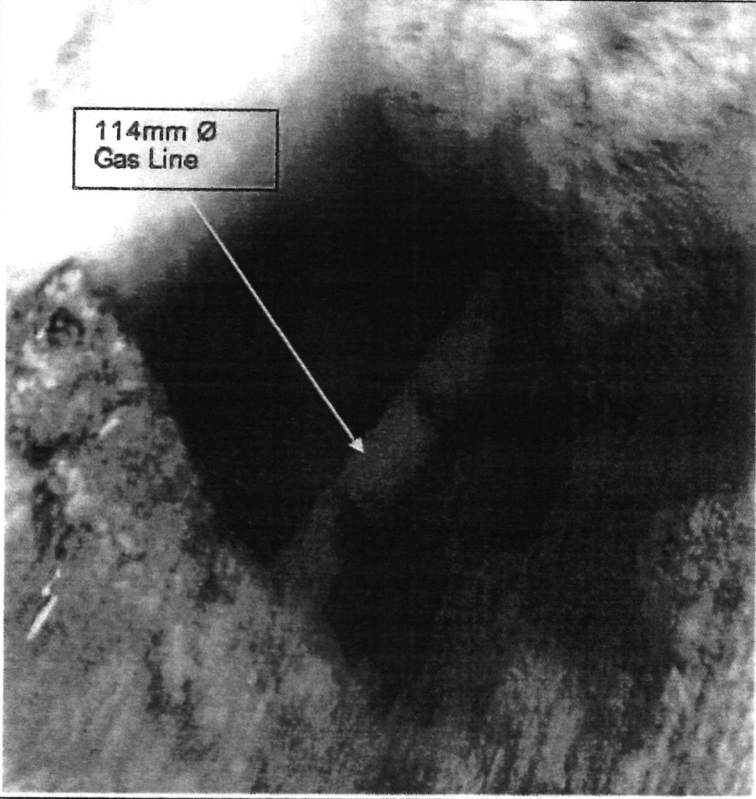
Weather: Cloudy, Rain

Inspector: SLL

Project: 15-64-19

Method: Daylighting

**LOG OF TEST PIT: NO. TP 09-9
JOB NO.: 15-64-19**

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0 ASPHALT: (50mm)	62.22					
- SAND, some gravel, grey, moist: (FILL)						
- SAND, trace gravel and silt, brown, moist to wet (FILL)						
- 0.4						
- 0.6						
- 0.8						
- 1.0 END OF TEST PIT AT 1.0m (Elev. 61.22 m)	61.22					
A 114mm dia. Gas Line was located approx. 0.3m from retaining wall and 0.8m below top of concrete curb. Tracer wire for the gas line was sheared in two by vacuum. Contacted Union Gas, they came and stated that the wire is not a tracer wire. No obvious cracks observed at footing/wall interface						

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 14, 2009

Excavation Co: DBC Environmental

Client: MTO

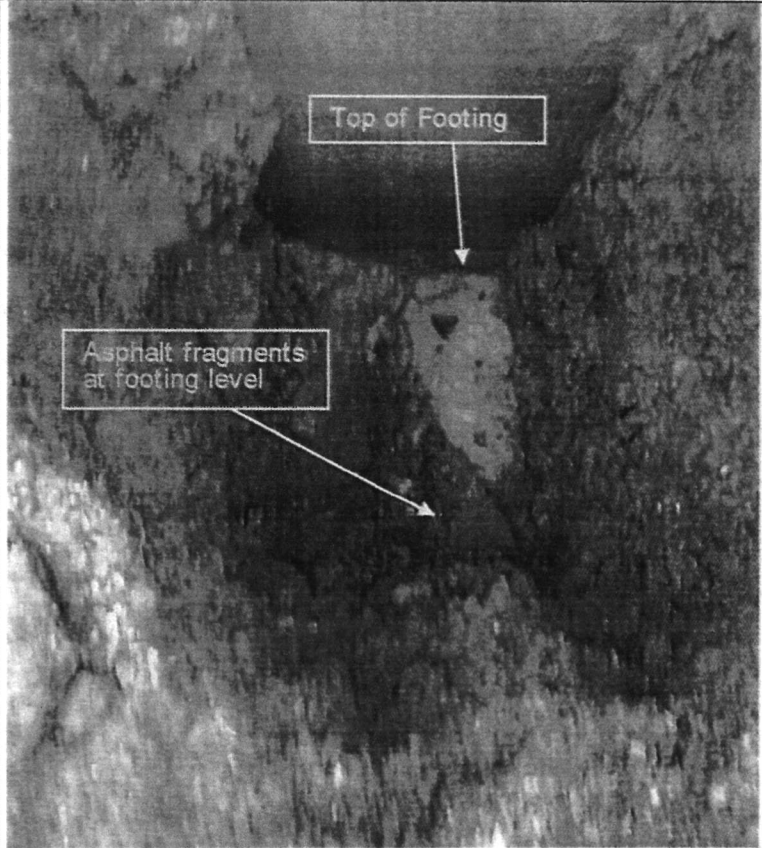
Weather: Cloudy, Rain

Inspector: SLL

Project: 15-64-19

Method: Daylighting

LOG OF TEST PIT: NO. TP 09-11
JOB NO.: 15-64-19

STRATIGRAPHY						
DEPTH	ELEV.	Sample Depth (m)	Soils Class.	C _{pen} (kPa)	Water Content (%)	Photo
- 0 ASPHALT: (50mm)	63.57					
- SAND, some gravel, grey, moist, (19mm CRL): (FILL)						
- CLAY, silty, topsoil stained, dark brown, moist (FILL)						
- 0.4						
- SAND, some gravel with occasional cobbles, brown, wet (FILL)						
- 0.6						
- 0.8						
- 1.0 CLAY, silty, with occasional cobbles and construction debris, brown to grey, wet (FILL)	62.57					
- 1.2						
- 1.4						
- 1.6 TOP OF CONCRETE FOOTING						
- END OF TEST PIT AT 1.68m (Elev. 61.89 m)						
No obvious cracks observed at footing/wall interface.						
No inclination was noted along ret. wall face.						

THURBER ENGINEERING LTD.

Location: Cornwall Centre Road, Cornwall, Ontario

Date: May 14, 2009

Excavation Co: DBC Environmental Services

Client: MTO

Weather: Cloudy

Inspector: SLL

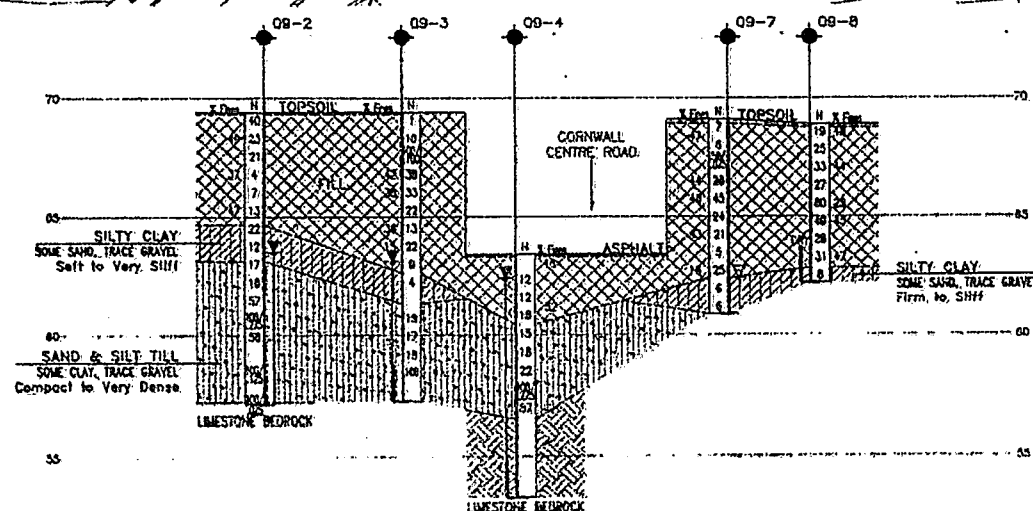
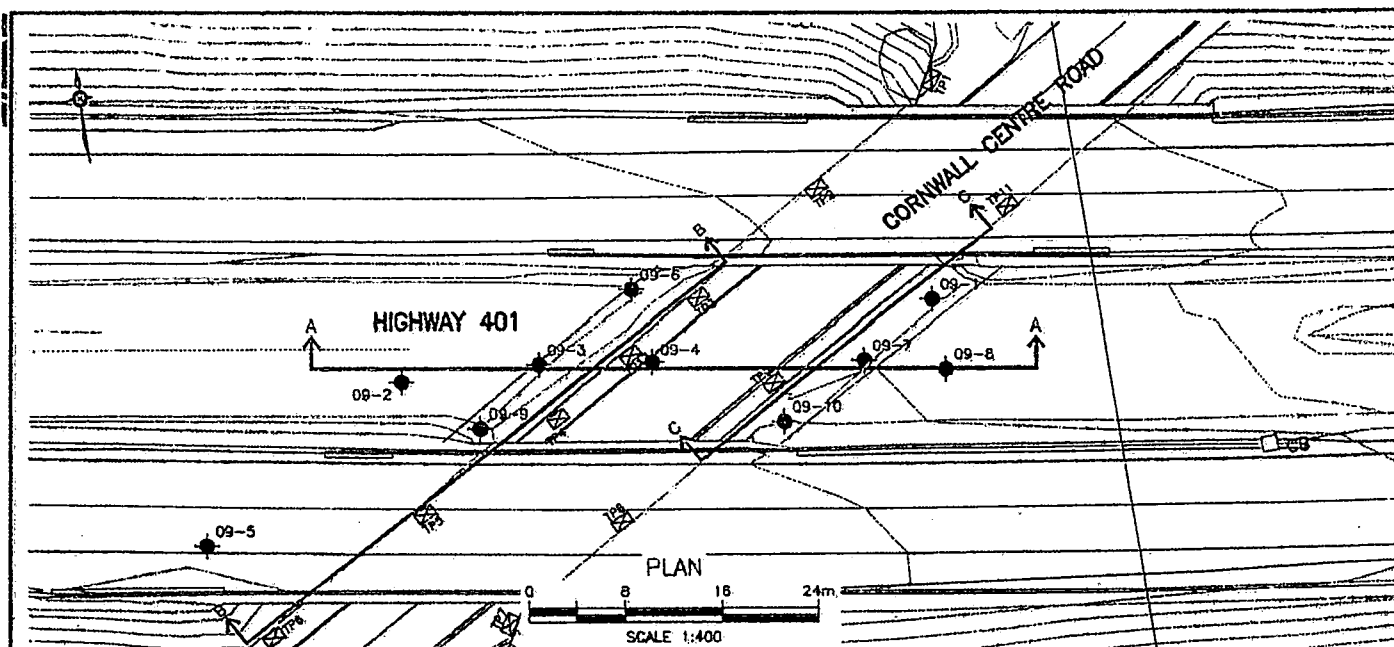
Project: 15-64-19

Method: Daylighting

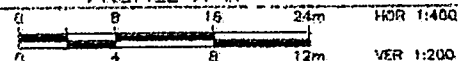
**LOG OF TEST PIT: NO. TP 09-13
JOB NO.: 15-64-19**

APPENDIX D

**BOREHOLE LOCATIONS
AND SOIL STRATA DRAWING**



PROFILE A-A



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

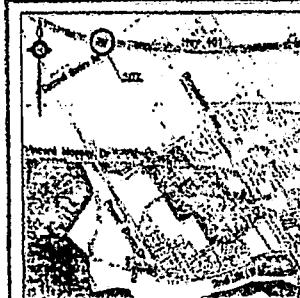
CONT No
GWP No

HIGHWAY 401
CORNWALL CENTRE ROAD OVERPASS
RETAINING WALL
ROADSIDE LIGHTING AND POL SIGNALS



SHEET

THUNDERBOLT ENGINEERING LTD.
GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS



KEYPLAN
LEGEND

- ◆ Borehole
- ◆ Borehole and Cone
- N Bore / 0.3m (Std Pen Test, 475/Blow)
- CONE Bore / 0.3m (Std Pen Test, 475/Blow)
- PH Pressure, Hydraulic
- W Water Level
- W Head Artesian water
- W Flattometer
- W Rock Quality Designation (RQD)
- W Auger Refusal
- N/A

NO	ELEVATION	NORTHING	EASTING
09-1	68.0	4 981 153.0	203 348.1
09-2	69.4	4 981 153.4	203 341.8
09-3	68.4	4 981 153.7	203 353.1
09-4	63.4	4 981 151.7	203 342.8
09-5	70.7	4 981 143.8	203 323.9
09-6	69.2	4 981 157.5	203 361.9
09-7	69.1	4 981 148.0	203 350.0
09-8	65.8	4 981 147.2	203 356.5
09-9	64.5	4 981 148.8	203 347.7
09-10	68.4	4 981 143.1	203 372.7

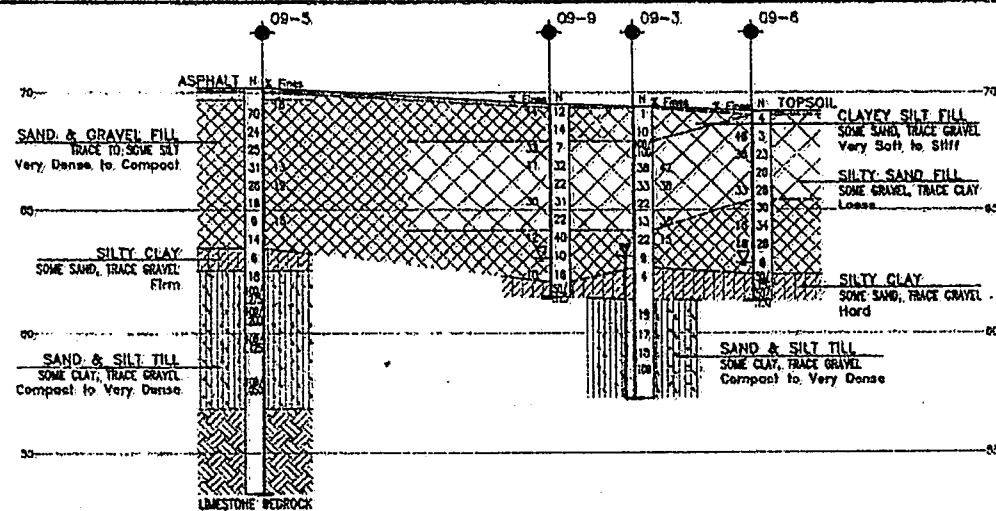
NOTES

- 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 synoptical reference.

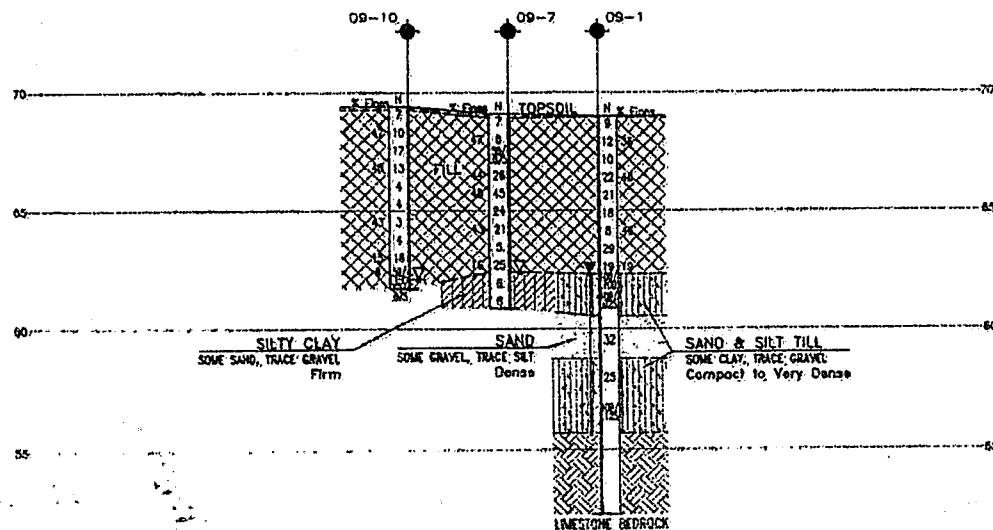
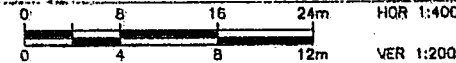
GEOCRES No. 31G-232



DATE	BY	REVISION	DATE	BY	REVISION



SECTION B-B



SECTION C-C



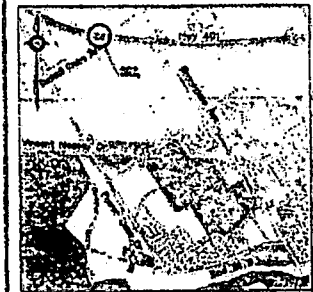
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No

HIGHWAY 401
CORNWALL CENTRE ROAD OVERPASS
RETAINING WALL
CONCRETE LOCATED AT 250.00 ELEV.

SHEET

THOMPSON ENGINEERING LTD.
GEOTECHNICAL & ENVIRONMENTAL & MATERIALS



KEYPLAN
LEGEND

- ◆ Borehole
- ◆ Borehole and Cone
- N North / 0.3m (514 West Tark, 4754/100m)
- CONE Bore / 0.3m (517 Cone, 4754/100m)
- PH Pressure, Hydraulic
- W Water Level
- W Hard Artesian Water
- PH Piezometer
- RQR Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
09-1	60.0	4 991 153.0	203 394.3
09-2	60.2	4 991 153.4	203 391.8
09-3	60.4	4 991 153.0	203 393.3
09-4	61.4	4 991 151.7	203 391.8
09-5	60.2	4 991 147.8	203 393.8
09-6	60.1	4 991 157.5	203 391.3
09-7	60.1	4 991 149.0	203 393.0
09-8	60.8	4 991 147.2	203 396.5
09-9	60.3	4 991 145.8	203 397.7
09-10	60.4	4 991 145.1	203 372.7

NOTES

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

GEOCRES No. 31G-232



