FOUNDATION INVESTIGATION REPORT
REPLACEMENT OF CPR OVERHEAD AT SELIM HILL
HIGHWAY 17
DISTRICT OF THUNDER BAY (UNORGANIZED), ONTARIO

G.W.P 6108-10-01, Site No. 48C-25

Geocres Number: 42D-35

Report to

MMM Group Limited

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

February 19, 2015
File: 19-1351-197

H:\19\1351\197 NWR 32 Rehabs\Reports & Memos\CP Overhead at Selim Hill (48C-25)\03 FIR - Final\CP Overhead At Selim Hill-FIR-FINAL.docx

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
REPLACEMENT OF CPR OVERHEAD AT SELIM HILL
HIGHWAY 17
DISTRICT OF THUNDER BAY (UNORGANIZED), ONTARIO
G.W.P 6108-10-01, Site No. 48C-25

Geocres Number: 42D-35

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed replacement of the existing overhead structure which carries Highway 17 over Canadian Pacific (CP) rail line, M10.34 of the Nipigon Subdivision. The site is located approximately 6.5 km east of Rossport and approximately 13.7 km west of Schreiber, in the District of Thunder Bay (unorganized), Ontario.

The purpose of this investigation was to explore the subsurface conditions at the site and based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, 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 MMM Group Limited (MMM), under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The CPR Overhead structure is located approximately 6.5 km east of Rossport and approximately 13.7 km west of Schreiber, in the District of Thunder Bay (unorganized), Ontario. At this location, Highway 17 travels in a predominantly northwest to southeast direction along the north edge of Lake Superior. For the purpose of this report, reference will be made to the existing west and east abutments.

At present, Highway 17 crosses the CP rail line on a three-span structure supported on two piers and two abutments. The total length of the bridge is 30.4 m and width of 14.3 m. The bridge is oriented at a skew of approximately 39.5° to the rail line.

The railway at this location was constructed in an approximate 1.5 to 4.0 m deep rock cut. Fractured bedrock is exposed along the alignment of the existing east pier and partially exposed behind the alignment of the west pier.

Each pier is supported on three rectangular columns and the tops of the pier foundations are exposed. The columns at the east pier are supported on individual spread footings constructed either above the rock cut face (north and centre columns) or along the alignment of the rock cut (south column). The west pier columns are supported on one continuous strip footing constructed in front of the rock cut face.

The existing approach embankments behind the abutments are up to about 6.4 m in height. No evidence of instability was observed on the embankment side slopes.

Overhead hydro wires run along the west side of the railway and pass under the west span of the overhead structure. A wooden hydro pole is situated under the bridge near the centre of the west span.

The area surrounding the bridge is gently rolling and is generally covered with a mix of deciduous and coniferous trees. Outcropping bedrock was noted at and in the general vicinity of the CPR Overhead structure.

Photographs in Appendix C show the existing CPR Overhead structure at Selim Hill and the general nature of the site.

The site lies within the physiographic region known as the Wawa Subprovince of the Superior Province of the Canadian Shield. Based on Ontario Geological Survey (OGS) Map 2518, titled "Surficial Geology of Northern Ontario", dated 1987, the site is located in an area of "bare bedrock with thin glacial sediment cover". Based on OGS Map 2545, titled "Bedrock Geology of Ontario", dated 1991, the bedrock is of the Archean age and consists of intrusive rocks, mainly massive to foliated granodiorite and granite.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out in two stages. Between November 12 and 14, 2011, a total of four boreholes numbered SEL-01 to SEL-04 were advanced from the top of Highway 17. On each side of the existing overhead structure, one borehole was located in proximity to the abutment and one borehole within the approach embankment areas. Between April 23 and 27, 2014, an additional five boreholes numbered SEL-05 to SEL-09 were drilled beneath the deck structure on both sides of the CPR tracks.

The approximate borehole locations are shown on the enclosed Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

During the first stage of the investigation, Boreholes SEL-01 to SEL-04 were drilled using a truck mounted drill rig with hollow stem augers, NW casing and wash boring techniques. Boreholes SEL-01

and 04 were drilled within the existing west and east approaches to the structure, respectively, and were terminated at depths of 3.4 and 5.9 m (elevations 214.4 and 215.9 m), where refusal to auger penetration was encountered. Boreholes SEL-02 and 03 were drilled near the existing abutments to depths of 9.8 m and 7.8 m (elevations 209.1 to 213.3 m). Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Bedrock was proved in boreholes SEL-02 and SEL-03 by diamond coring in NQ size. The boreholes were advanced 3.4 and 2.9 m into bedrock.

Dynamic Cone Penetration Tests (DCPT) were conducted adjacent to borehole SEL-02 and 03 to supplement the subsurface information. The DCPT's were terminated at 5.7 and 6.0 m depths (elevation 213.2 to 215.1 m), upon refusal on probable bedrock.

During the second stage of the investigation, Boreholes SEL-05 to SEL-09 were advanced to depths ranging from 4.6 m to 7.9 m (between Elev. 208.3 m and 207.0 m) using portable equipment to core bedrock in BTQ size.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's field staff. The boreholes were logged in the field and recovered soil and rock samples were processed and transported to Thurber's geotechnical testing laboratory in Oakville, Ontario for further examination and testing.

All rock cores were logged and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions were observed in the open boreholes during and upon completion of drilling operations. Standpipe piezometers were installed in two boreholes to measure groundwater levels. The piezometers consisted of 19 mm PVC pipes with slotted screen and were enclosed in filter sand. The piezometers were subsequently decommissioned in general accordance with MOE Regulation 903 following completion of the final water level reading. The piezometer installation and borehole completion details are summarized in Table 3.1.

Borehole locations were selected and established in the field by Thurber Engineering Ltd. The borehole co-ordinates and the ground surface elevations were obtained from the drawings provided by MMM Group Limited.

Table 3.1 - Borehole Completion Data and Piezometer installation Details

Borehole Number	Borehole Termination Depth/Elevation (m)	Piezometer Tip Depth/ Elevation (m)	Backfill Details
SEL-01	3.4 / 214.4	None installed	Concrete to 0.6 m, cuttings to 0.3 m, then asphalt to surface.
SEL-02	9.8 / 209.1	7.7 / 211.2	Sand to 4.1 m, bentonite holeplug to 1.9 m, concrete to 0.8 m, sand to 0.2 m, then asphalt to surface
SEL-03	7.8 / 213.3	4.9 / 216.2	Sand to 2.7 m, bentonite holeplug to 0.9 m, concrete to 0.2 m, then asphalt to surface.
SEL-04	5.9 / 215.9	None installed	Bentonite holeplug to 1.8 m, cuttings to 1.0 m, concrete to 0.15 m, then asphalt to surface.
SEL-05	4.7 / 208.3	None installed	Bentonite holeplug to 0.1 m then sand to surface.
SEL-06	4.6 / 207.9	None installed	Bentonite holeplug to 0.1 m then sand to surface.
SEL-07	4.6 / 207.4	None installed	Bentonite holeplug to 0.3 m then sand to surface.
SEL-08	7.9 / 207.2	None installed	Bentonite holeplug to 1.0 m then sand to surface.
SEL-09	7.7 / 207.0	None installed	Bentonite holeplug to 0.6 m then sand to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Grain size distribution tests (hydrometer and sieve) were carried out on selected samples. The results of these tests are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the unconfined compressive strength of the bedrock. Results of point load tests on the rock core samples are enclosed in Appendix B, and are also presented on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented in these sheets and on the Borehole Locations and Soil Strata drawing in Appendix D. 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. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general, the stratigraphy encountered at the overhead site consists of pavement structure overlying granular embankment fill, which in turn overlies the granite bedrock. In the boreholes drilled from the top of the highway embankment, bedrock and possible bedrock (interpreted as refusal to auger penetration) were encountered below the embankment fill at depths ranging from 3.4 to 6.4 m (Elev. 216.2 to 212.5 m). In the boreholes drilled under the structure on both sides of the CPR tracks, bedrock was either outcropping or encountered beneath shallow fill between Elev. 212 m and 214.7 m.

More detailed descriptions of the individual strata are presented below.

5.1 Pavement Structure

A pavement structure, consisting of 125 mm of asphalt, was encountered in all of the boreholes drilled from the top of the highway embankment, i.e., in Boreholes SEL-01 to SEL-04.

5.2 Gravelly Sand to Sand and Gravel Fill

Cohesionless embankment fill consisting of gravelly sand to sand and gravel with trace fines (silt and clay) was encountered directly below the pavement structure in Boreholes SEL-01 to SEL-04. Where fully penetrated in Boreholes SEL-02 and SEL-03, the underside of this layer was at 6.4 and 4.9 m depth below the ground surface, or at Elev.212.5 and 216.2, respectively. Boreholes SEL-01 and SEL-04 were terminated in the fill upon refusal to auger penetration at 3.4 m and 5.9 m depth (Elev. 214.4 and 215.9).

SPT N-values recorded in the granular fill ranged from 5 to 40 blows for 0.3 m penetration, indicating a loose to dense relative consistency. SPT N-values of 50 blows per 0.075 and 0.125 m of penetration were recorded in proximity to the bedrock surface in Borehole SEL-01, and near the ground surface in Borehole SEL-04, where cobbles may be present in the fill.

A fill consisting of sand with some gravel was encountered at the ground surface in Boreholes SEL-05 and SEL-08, drilled underneath of the structure. The fill was 0.2 m and 0.5 m thick and extended to Elev. 212.8 m and 214.6 m in Boreholes SEL-05 and SEL-08, respectively.

The moisture content of samples of the fill ranged from 1% to 5%, except for a single moisture content of 13% measured near the base of the fill in Borehole SEL-03.

Three samples of fill were selected for laboratory grain size analysis testing. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets included in Appendix A. The grain size distribution curves for the samples are plotted on Figures B1 and B2 in Appendix B.

Soil Particles	Percentage %
Gravel	30 to 37
Sand	58 to 65
Silt and Clay	3 to 7

5.3 Bedrock

Granite and granodiorite bedrock was encountered and proved by coring in Boreholes SEL-02, SEL-03 and SEL-05 to SEL-09. Boreholes SEL-01 and 04 were terminated upon auger refusal on probable bedrock or on boulders. Details of rock coring are presented on the Record of Borehole sheets in Appendix A.

The bedrock is generally described as foliated, moderately weathered to fresh, grey to reddish brown granite and granodiorite with occasional light grey quartz inclusions.

Table 5.1, below, summarizes the depth to bedrock and bedrock surface elevations determined at the borehole locations.

Table 5.1 - Depths and Elevations of Bedrock Surface or Auger Refusal

Borehole Location/ Nearest Existing Foundation Units	Borehole Number	Top of Bedrock or Auger Refusal	
		Depth (m)	Elevation (m)
East Approach	SEL-04[2, 3]	5.9	215.9
East Abutment	SEL-03[1, 3] DCPT	4.9 6.0	216.2 215.1
East side of tracks	SEL-08[1] SEL-09[1]	0.5 0.0	214.6 214.7
West side of tracks	SEL-05[1] SEL-06[1] SEL-07[1]	0.2 0.0 0.0	212.8 212.5 212.0
West Abutment	SEL-02[1, 3] DCPT	6.4 5.7	212.5 213.2
West Approach	SEL-01[2,3]	3.4	214.4

[1]Bedrock proved by coring
[2]Auger refusal
[3]Borehole drilled from the top of the approach embankment

Dynamic cone penetration tests (DCPT) were conducted at a distance of 1 m and 0.5 m from Boreholes SEL-02 and SEL-03. The refusal to cone penetration were encountered at depth of 5.7 m (Elev.213.2) near Borehole SEL-02, and at 6.0 m (Elev.215.1) near Borehole SEL-03. These depths are approximately 0.7 m above and 1.1 m below the bedrock surface proved in the nearby Boreholes SEL-02 and SEL-03, respectively. The variations in the bedrock surface even within the short distance from the borehole locations should be anticipated.

Total Core Recovery (TCR) in the bedrock ranged from 94% to 100%. The Rock Quality Designation (RQD) determined from the recovered cores ranged from 0 to 100%, indicating a very poor to excellent rock quality. The upper 0.7 m to 3.5 m of bedrock was of a very poor to poor quality with frequent fractured zones and foliations. A fair to excellent quality bedrock was typically encountered below Elev. 209.5 on the west side of the tracks and below

Elev. 211.5 on the east side of the tracks. In Borehole SEL-03, drilled approximately 3 m east of the east abutment, a fair quality bedrock was encountered as high as at Elev. 215.5, approximately 0.7 m below the bedrock surface. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 17.

The unconfined compressive strength (UCS) of the rock, estimated from the results of point load tests conducted on the rock core samples, ranges from 35.9 MPa to in excess of 250 MPa, indicating a medium strong to extremely strong intact rock. One value of UCS of 20.3 MPa was obtained for a rock sample retrieved from 2.7 m depth in Borehole SEL-08; this value indicates a weaker zone in the rock mass.

The point load test results (average values) carried out for rock samples are included on the Record of Borehole sheets in Appendix A, and the Point Load Test results are enclosed in Appendix B.

5.4 Water Levels

The water levels in the boreholes were observed during drilling and upon completion of drilling in overburden. Water was used during the coring operations and therefore the measured water levels may not reflect prevailing groundwater levels at the site. Two standpipe piezometers were installed in Boreholes SEL-02 and SEL-03 to monitor water levels after completion of drilling. The water levels measured in the piezometer and observed in open boreholes advanced in overburden are summarized in Table 5.2.

Table 5.2 - Water Level Measurements

Foundation Unit	Borehole	Date	Water Level (m)		Comments
			Depth	Elevation	
West Abutment	SEL-01	Nov. 14, 2011	Dry	-	Open borehole
	SEL-02	Nov. 14, 2011 Nov. 30, 2011 May 29, 2012	Dry* 7.7 7.2	 211.2 211.7	In piezometer
East Abutment	SEL-03	Nov. 14, 2011 Nov. 30, 2011	Dry* -	 -	Piezometer Damaged
	SEL-04	Nov. 12, 2011	Dry	-	Open borehole

*Borehole dry during drilling in overburden.

Piezometric readings indicate that the water level is below the bedrock surface.

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 intensive or prolonged periods of precipitation.

6 MISCELLANEOUS

Eastern Ontario Diamond Drilling Ltd. from Ottawa supplied the truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations. To advance boreholes below the existing overhead structure, portable coring equipment (Hilti System) was used.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber Engineering Ltd. Routine laboratory testing was carried out by Thurber Engineering Ltd.

Mr. Mark Farrant, P.Eng. directed the field operations.

The report was prepared by Ms. Anna Piascik, P.Eng., and reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects.

THURBER ENGINEERING LTD.

Anna Piascik, P.Eng.
Senior Geotechnical Engineer

Murray R. Anderson, P.Eng
Associate, Senior Foundation Engineer

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

THURBER

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

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

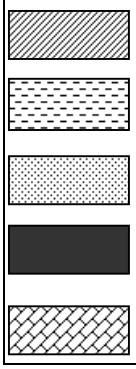
ROCK WEATHERING CLASSIFICATION

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.

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

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

BEDROCK

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

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 % 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.

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-01 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 352.3 E 273 175.7 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.11.14 - 2011.11.14 CHECKED BY RPR

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	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
217.8	GROUND SURFACE										
0.0	**ASPHALT:**(125mm)										
0.1	**SAND and GRAVEL**trace silt, occasional cobbles Loose to Compact Brown Moist (FILL)		1	GS			217				
			1	SS	29						
			2	SS	12		216				37 58 5 (SI+CL)
			3	SS	9		215				
214.4			4	SS	50/0.075						
3.4	END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL. BOREHOLE OPEN TO 1.5m AND DRY. BOREHOLE BACKFILLED WITH CONCRETE TO 0.6m, CUTTINGS TO 0.3m THEN ASPHALT TO SURFACE.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-02 1 OF 2 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 351.7 E 273 193.9 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.11.12 - 2011.11.12 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
218.9	GROUND SURFACE							20 40 60 80 100	20 40 60		
0.0	**ASPHALT:**(125mm)										
0.1	**SAND**, gravelly, trace silt, occasional cobbles Loose to Compact Brown Moist (FILL)		1	SS	18		218				DCPT located 1.0m N & 1.0m E of borehole
			2	SS	9		217				
			3	SS	10		216				32 65 3 (SI+CL)
			4	SS	15		215				
			5	SS	8		214				
			6	SS	9		213				
212.5	Auger refusal at 6.4m and start coring										
6.4	**GRANITE** and **GRANODIORITE**, with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown		1	RUN			212			FI 3 8	RUN #1 TCR=100% SCR=45% RQD=45% UCS=115.7MPa (Average)
	Sub-vertical fracture (125mm) at 6.4m Vertical fracture (250mm) at 6.7m		2	RUN						5 4	RUN #2 TCR=100% SCR=0% RQD=0%
	Vertical joint from 7.6m to 8.4m		3	RUN			211			4 4	RUN #3 TCR=100% SCR=5% RQD=0%
			4	RUN			210			3 2 4 2	RUN #4 TCR=100% SCR=72% RQD=69% UCS=112.8MPa (Average)
209.1	Vertical joint (350mm) at 9.4m										
9.8	END OF BOREHOLE AT 9.8m.										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-02 2 OF 2 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 351.7 E 273 193.9 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.11.12 - 2011.11.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			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	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Piezometer installation consists of 31mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.										
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov 14/11 Dry Nov 30/11 7.7 211.2 May 29/12 7.2 211.7										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-03 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 373.2 E 273 220.4 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN

DATUM Geodetic DATE 2011.11.13 - 2011.11.13 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.1	GROUND SURFACE										
0.0	**ASPHALT:**(125mm)						221				
0.1	**SAND**, gravelly, trace silt, occasional cobbles Compact to Dense Brown Moist (FILL)		1	SS	17						DCPT located 1.0m S & 0.5m W of borehole
			2	SS	12		220				
			3	SS	40		219				
			4	SS	10		218				
			5	SS	10		217				
216.2	Start coring at 4.9m									FI	
4.9	**GRANITE** and **GRANODIORITE** with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown		1	RUN			216			6 6	RUN #1 TCR=100% SCR=27% RQD=17% UCS=90.2MPa (Average)
	Vertical joint at: 200mm at 5.0m 150mm at 5.3m Rubble zone (50mm) at 5.2m		2	RUN			215			3 3 3 3 5	RUN #2 TCR=100% SCR=96% RQD=78% UCS=168.0MPa (Average)
	Sub-vertical joint at: 300mm at 5.6m 75mm at 6.9m		3	RUN			214			4 3	RUN #3 TCR=100% SCR=97% RQD=60% UCS=57.4MPa (Average)
213.3											
7.8	END OF BOREHOLE AT 7.8m. Piezometer installation consists of 31mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov 14/11 Dry May 29/12 Blocked (Unable to read)										

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

(%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-04 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 373.1 E 273 236.8 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2011.11.12 - 2011.11.12 CHECKED BY RPR

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)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
221.9	GROUND SURFACE										
0.0	**ASPHALT:**(125mm)										
0.1	**SAND**, gravelly, trace silt, occasional cobbles. Loose to Very Dense Brown Moist (FILL)		1	SS	50/0.125		221				
			2	SS	16						
			3	SS	9		220				
			4	SS	19						
			5	SS	5		219				30 63 7 (SI+CL)
							218				
			6	SS	13		217				
215.9							216				
5.9	END OF BOREHOLE AT 5.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE BACKFILLED WTH BENTONITE HOLEPLUG TO 1.8m, CUTTINGS TO 1.0m, CONCRETE TO 0.15m THEN ASPHALT TO SURFACE.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-05 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 361.6 E 273 189.8 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE BTQ Coring COMPILED BY AN

DATUM Geodetic DATE 2014.04.26 - 2014.04.26 CHECKED BY MEF

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	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
213.0	GROUND SURFACE										
0.0	**SAND**, trace gravel									FI	
0.2	Frozen (FILL)									10	RUN #1 TCR=100% SCR=31% RQD=0%
	GRANITE and **GRANODIORITE**, with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown		1	RUN						17	
	Rubble zone from 0.4m to 1.0m						212			12	RUN #2 TCR=100% SCR=73% RQD=27% UCS=126.9MPa (Average)
	Sub-vertical joint (25mm thick) at 1.0m, 1.3m, 1.6m		2	RUN						5	
	200mm at 1.8m									7	
	Rubble zone (125mm thick) at 1.7m									7	
	Fractured zone (125mm) at 2.1m						211			10	RUN #3 TCR=100% SCR=17% RQD=0%
	Sub-vertical joint (25mm thick) at 2.3m		3	RUN						10	
	Vertical joint (250mm thick) at 2.3m									2	RUN #4 TCR=100% SCR=95% RQD=0% UCS=74.4MPa (Average)
	Sub-vertical joint (50mm thick) at 3.1m, 3.4m and (100mm) at 3.0m		4	RUN			210			4	
										5	
	Sub-vertical joint (25mm to 50mm thick) at 3.6m, 4.3m and (250mm) at 3.8m									2	
			5	RUN			209			2	RUN #5 TCR=100% SCR=100% RQD=92% UCS=177.2MPa (Average)
208.3										3	
										2	
4.7	END OF BOREHOLE AT 4.7m. BOREHOLE GROUTED WITH BENTONITE HOLEPLUG TO 0.1m, THEN SAND TO SURFACE.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-06 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 358.2 E 273 197.6 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE BTQ Coring COMPILED BY AN

DATUM Geodetic DATE 2014.04.24 - 2014.04.26 CHECKED BY MEF

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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
212.5	GROUND SURFACE										
0.0	**GRANITE** and **GRANODIORITE** with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown Vertical joint (100mm thick) at surface Sub-vertical joint (25mm to 75mm thick) at 0.2m, 0.6m, 1.1m 225mm at 0.8m 300mm at 1.6m Rubble zone (75mm to 100mm thick) at 1.1m, 1.8m Sub-vertical joint (175mm thick) at 1.9m Rubble zone (75mm thick) at 2.1m Sub-vertical joint (25mm thick) at 3.3m		1	RUN			212		FI 4 5	RUN #1 TCR=100% SCR=100% RQD=37% UCS=212.9MPa (Average)
			2	RUN					4 7 5	RUN #2 TCR=100% SCR=60% RQD=8% UCS=187.9MPa (Average)
			3	RUN			211		4 10 4	RUN #3 TCR=100% SCR=88% RQD=60% UCS=173.6MPa (Average)
			4	RUN			210		1 2 2	RUN #4 TCR=100% SCR=100% RQD=99% UCS=201.1MPa (Average)
			5	RUN			209		1 2 0	RUN #5 TCR=100% SCR=100% RQD=86% UCS=240.8MPa (Average)
207.9							208		1	
4.6	END OF BOREHOLE AT 4.6m. BOREHOLE GROUTED WITH BENTONITE HOLEPLUG TO 0.1m, THEN SAND TO SURFACE.									

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

(%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-07 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 355.0 E 273 204.9 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE BTQ Coring COMPILED BY AN

DATUM Geodetic DATE 2014.04.23 - 2014.04.23 CHECKED BY MEF

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	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
212.0	GROUND SURFACE										
0.0	**GRANITE** and **GRANODIORITE** with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown Sub-vertical joint at surface at: 100mm at 0.5m 150mm at 0.6m 125mm at 1.0m		1	RUN						FI 8	RUN #1 TCR=100% SCR=54% RQD=0% UCS=287.9MPa (Average)
			2	RUN			211			8 5	RUN #2 TCR=94% SCR=94% RQD=33% UCS=243.8MPa (Average)
	Quartz seam (200mm thick) at 1.5m Sub-vertical joint (75mm thick) at 1.7m, 2.1m		3	RUN			210			6 4 2 3	RUN #3 TCR=100% SCR=100% RQD=85% UCS=74.7MPa (Average)
	Mechanical break at 2.5m Sub-horizontal joint (25mm thick) at 2.9m		4	RUN			209			3 3 0	RUN #4 TCR=100% SCR=100% RQD=90% UCS=148.6MPa (Average)
	Mechanical break at 3.6m, 3.7m		5	RUN			208			1 2 2	RUN #5 TCR=100% SCR=100% RQD=100% UCS=200.3MPa (Average)
207.4			6	RUN						0 2	RUN #6 TCR=100% SCR=100% RQD=91%
4.6	END OF BOREHOLE AT 4.6m. BOREHOLE GROUTED WITH BENTONITE HOLEPLUG TO 0.3m, THEN SAND TO SURFACE.										UCS=241.5MPa (Average)

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-08 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 369.9 E 273 212.1 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE BTQ Coring COMPILED BY AN

DATUM Geodetic DATE 2014.04.27 - 2014.04.27 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.1	GROUND SURFACE						215	20 40 60 80 100	20 40 60		
0.0 214.6	**SAND**, some gravel (FILL)									FI	RUN #1 TCR=100% SCR=33% RQD=0% UCS=145.8MPa (Average)
0.5	**GRANITE** and **GRANODIORITE**, with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown Vertical joint (50mm thick) at 0.4m 300mm at 0.6m Rubble zone (75mm thick) at 0.8m		1	RUN						6 10	
	Sub-vertical joint (200mm thick) at 1.3m, (75mm thick) at 1.7m Vertical joint (25mm thick) at 1.8m and (250mm) at 2.0m		2	RUN			214			6 6 5	RUN #2 TCR=100% SCR=60% RQD=13% UCS=157.8MPa (Average)
	Horizontal joint at 2.6m and 2.8m		3	RUN			213			8 3 7	RUN #3 TCR=100% SCR=65% RQD=0% UCS=20.3MPa (Average)
	Sub-vertical joint (75mm thick) at 2.9m 200mm at 2.3m and 2.5m Sub-vertical joint 125mm at 3.2m and 3.6m		4	RUN			212			6 4	RUN #4 TCR=100% SCR=100% RQD=0% UCS=171.5MPa (Average)
	Sub-vertical joint (50mm to 100mm thick) at 3.7m, 4.1m, 4.2m, 4.3m, 4.5m and 4.7m		5	RUN			211			13 8 3	RUN #5 TCR=100% SCR=65% RQD=24% UCS=35.9MPa (Average)
	Rubble zone from 3.8m to 4.1m		6	RUN			210			6 4 2	RUN #6 TCR=100% SCR=100% RQD=49% UCS=196.5MPa (Average)
	Sub-vertical joint (25mm thick) at 5.5m, 5.6m		7	RUN						3 1	RUN #7 TCR=100% SCR=100% RQD=91% UCS=70.2MPa (Average)
	Sub-vertical joint (75mm thick) at 6.1m and 6.4m		8	RUN			209			2 2 7	RUN #8 TCR=100% SCR=54% RQD=54% UCS=260.6MPa (Average)
	Sub-vertical joint (125mm thick) at 7.1m		9	RUN			208			3 4	RUN #9 TCR=100% SCR=84% RQD=41% UCS=210.2MPa (Average)
	Rubble zone (50mm thick) at 7.8m									9	
207.2 7.9	END OF BOREHOLE AT 7.9m. BOREHOLE GROUTED TO 1.0m, THEN SAND TO SURFACE.										

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

20
15 10 5 (%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SEL-09 1 OF 1 METRIC

WP# 6108-10-01 LOCATION Selim Hill/CPR N 5 411 365.7 E 273 220.9 ORIGINATED BY SLL

HWY 17 BOREHOLE TYPE BTQ Coring COMPILED BY AN

DATUM Geodetic DATE 2014.04.26 - 2014.04.26 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	FRACTURE INDEX /0.3m	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
214.7	GROUND SURFACE							20 40 60 80 100	20 40 60	FI	
0.0	**GRANITE** and **GRANODIORITE** with occasional light grey quartz inclusions, foliated, moderately weathered to fresh, grey to reddish brown		1	RUN						4	RUN #1 TCR=100% SCR=99% RQD=34% UCS=141.4MPa (Average)
							214			7	
	Sub-vertical joint contain trace sandy material at: 75mm at 0.05m 150mm at 0.3m 225mm at 0.5m		2	RUN						3	
										15	RUN #2 TCR=100% SCR=20% RQD=11%
	Highly fractured zone from 0.9m to 1.3m									8	
	Sub-vertical joint through out the run		3	RUN			213			8	RUN #3 TCR=100% SCR=88% RQD=11% UCS=146.3MPa (Average)
										9	
	Sub-vertical joint: 250mm at 1.9m 375mm at 2.3m									6	
	Highly fractured zone from 2.8m to 3.4m		4	RUN						5	RUN #4 TCR=96% SCR=35% RQD=23% UCS=174.1MPa (Average)
							212			15	
	Sub-vertical joint from 3.2m to 3.4m									12	
	Horizontal joint at 3.6m, 3.8m		5	RUN						7	RUN #5 TCR=100% SCR=83% RQD=53% UCS=265.3MPa (Average)
							211			8	
	Sub-vertical joint: 150mm at 3.8m 175mm at 4.1m									4	
	Sub-vertical joint (50mm thick) at 4.4m, 4.9m 250mm at 4.6m		6	RUN						3	RUN #6 TCR=100% SCR=97% RQD=87% UCS=202.9MPa (Average)
							210			3	
	Sub-vertical joint (25mm to 50mm thick) at 5.3m, 5.4m 150mm at 5.0m		7	RUN						3	
	Horizontal joint at 5.2m									2	RUN #7 TCR=100% SCR=88% RQD=42% UCS=175.3MPa (Average)
	Fractured zone 75mm at 5.5m						209			7	
	Sub-horizontal joint (25mm to 50mm thick) at 5.6m, 5.8m, 5.9m 150mm at 6.3m Horizontal joint at 6.8m, 6.9m		8	RUN						3	
										1	RUN #8 TCR=100% SCR=100% RQD=80% UCS=220.0MPa (Average)
							208			1	
	Subvertical joint (25mm to 75mm thick) at 7.1m, 7.3m, 7.5m		9	RUN						2	
207.0										2	RUN #9 TCR=100% SCR=100% RQD=74% UCS=228.8MPa (Average)
							207			3	
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE BAKCFILLED WITH BENTONITE HOLEPLUG TO 0.6m, THEN SAND TO SURFACE.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/19/15

Appendix B

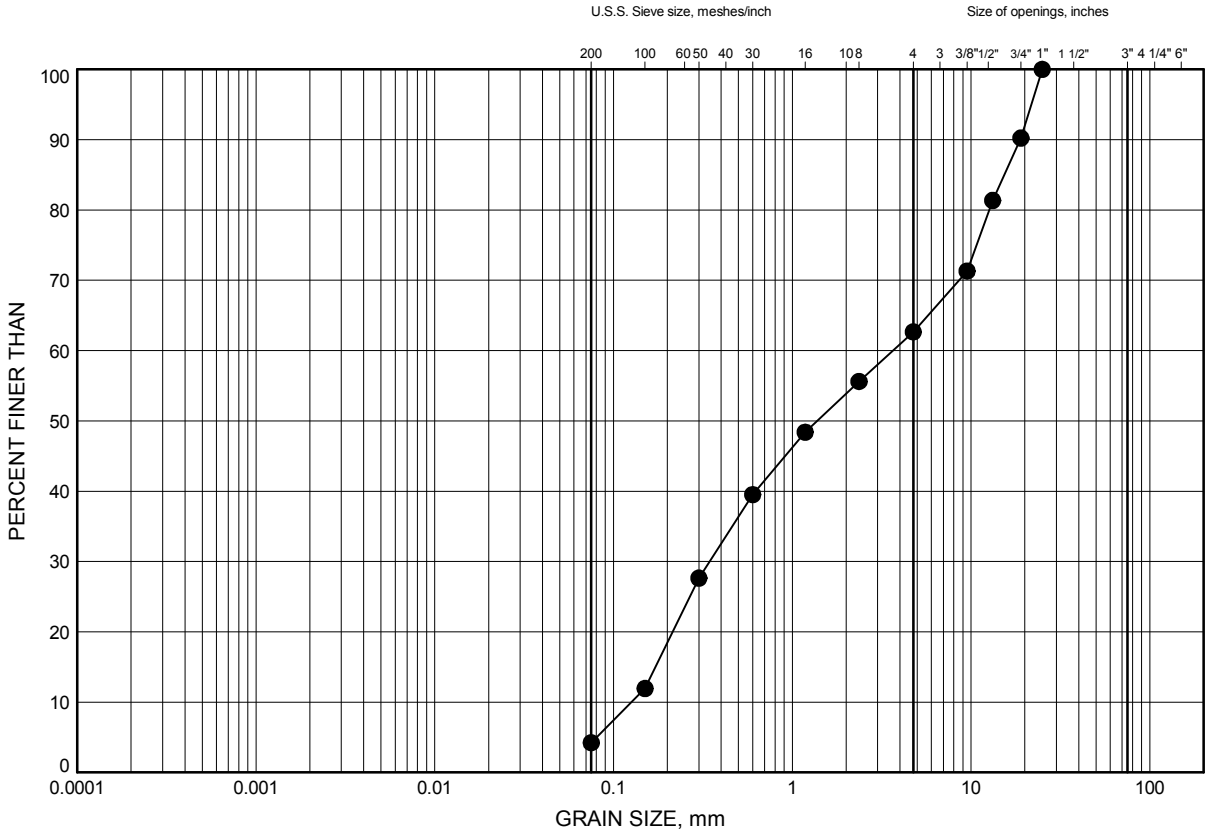
Laboratory Test Results

Selim Hill/CPR

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SEL-01	1.83	215.99

Date December 2014

WP# 6108-10-01

THURBER

Prep'd AN

Chkd. AP

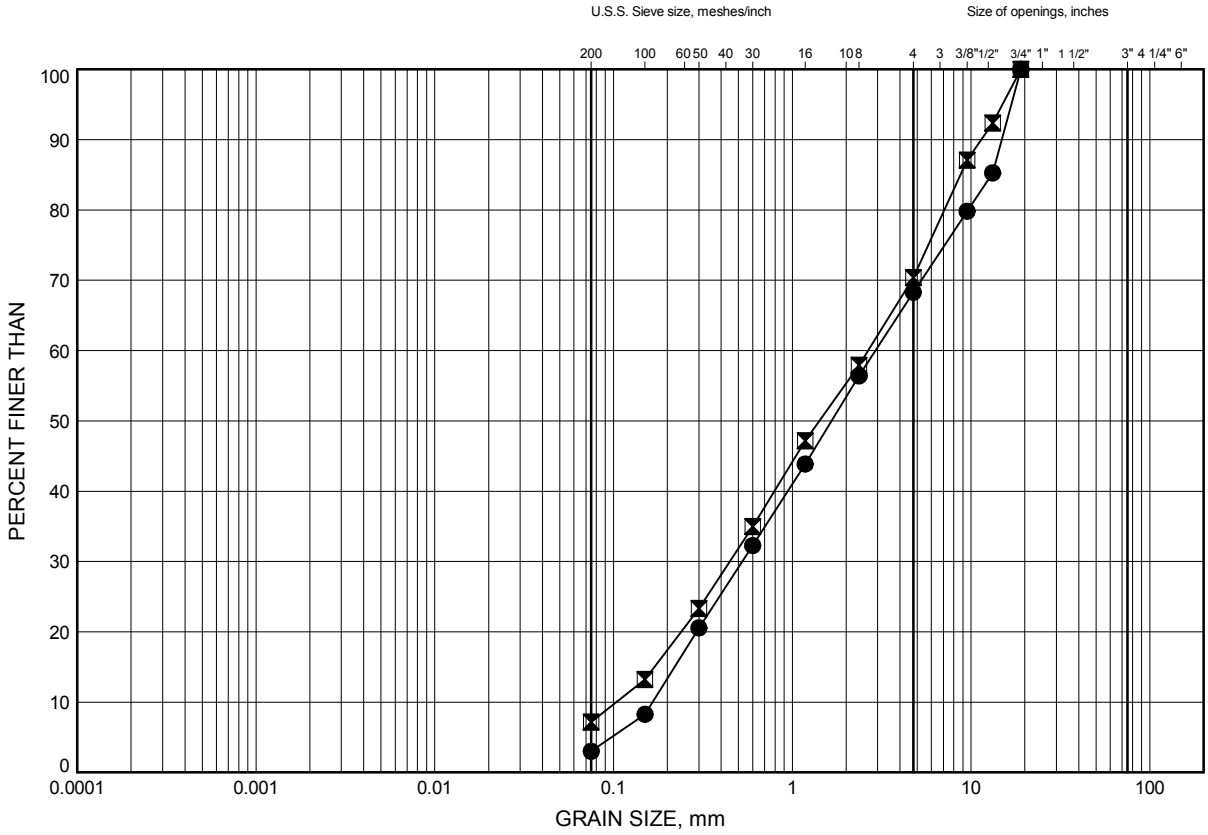
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 12/4/14

Selim Hill/CPR

GRAIN SIZE DISTRIBUTION

FIGURE B2

GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SEL-02	2.59	216.28
⧓	SEL-04	3.05	218.81

Date December 2014

WP# 6108-10-01

THURBER

Prep'd AN

Chkd. AP

GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 12/4/14

Appendix C

Site Photographs

Photograph 1 – Looking north at south side of overhead structure

Photograph 2 – Looking southwest on Highway 17 at overhead structure location

Photograph 3 – Existing east pier and abutment

Photograph 4 – North column of east pier

Photograph 5 – Centre column of east pier

Photograph 6 – South column of east pier

Photograph 7 – West pier and abutment

Photograph 8 – South column of west pier

Photograph 9 – Behind centre column of west pier

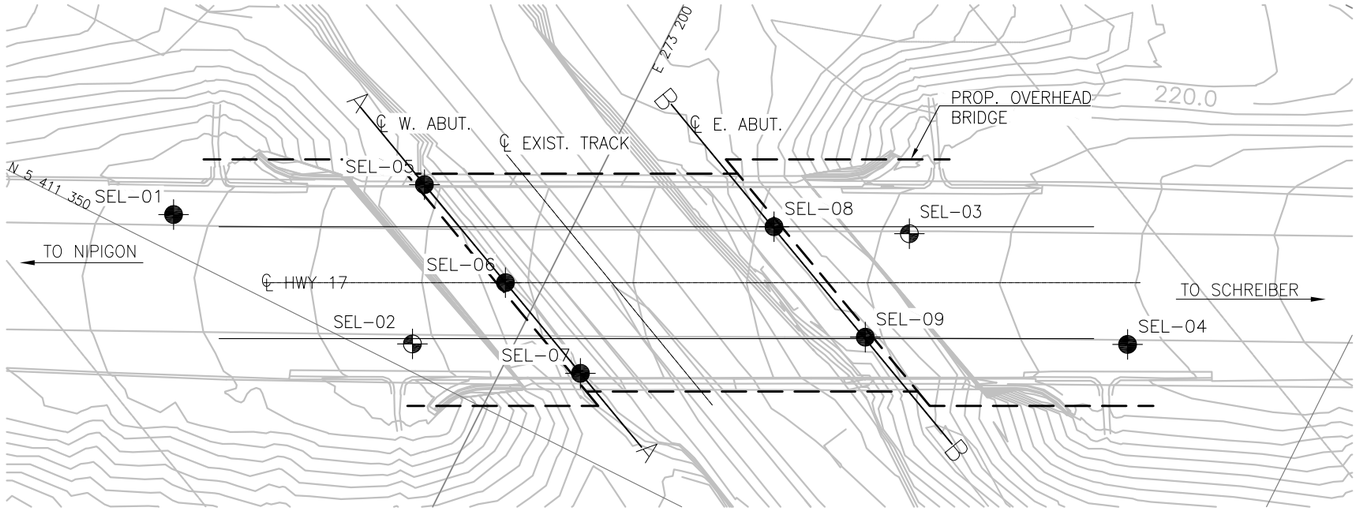
Photograph 10 – Behind north column of west pier

Photograph 11 – Hydro wires passing under west span of structure

Appendix D

Borehole Locations and Soil Profile Drawing

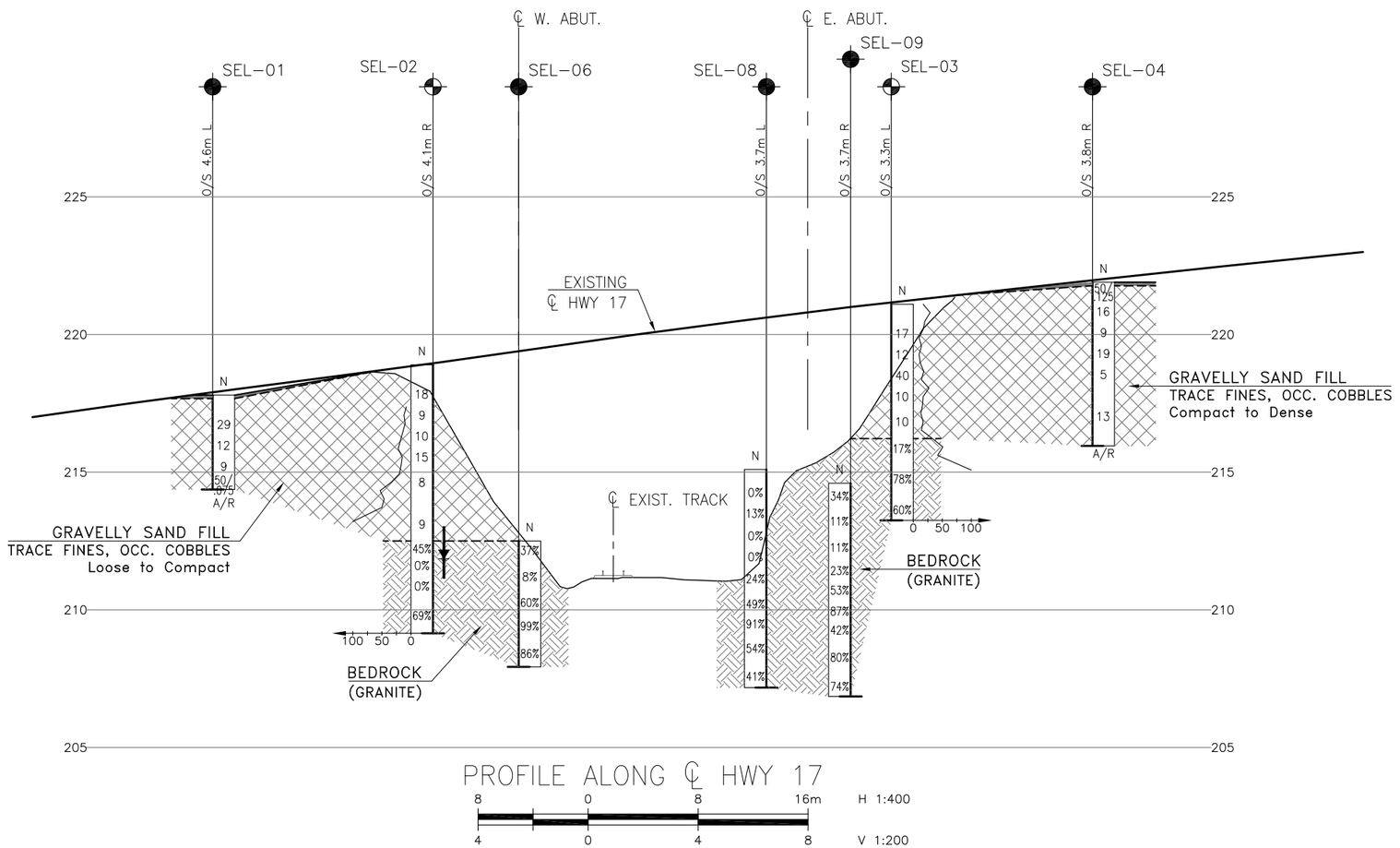
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

8 0 8 16m

SCALE 1:400



PROFILE ALONG ℄ HWY 17

8 0 8 16m H 1:400

4 0 4 8 V 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
Feb 17/15
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Feb 17/2015
PROVINCE OF ONTARIO

CONT No 2015-6004
WP No 6108-10-01

HIGHWAY 17
SELIM HILL
CPR OVERHEAD
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 12

MMM GROUP

THURBER ENGINEERING LTD.

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 During Drilling
▼	Water Level In Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SEL-01	217.8	5 411 352.3	273 175.7
SEL-02	218.9	5 411 351.7	273 193.9
SEL-03	221.1	5 411 373.2	273 220.4
SEL-04	221.9	5 411 373.1	273 236.8
SEL-05	213.0	5 411 361.6	273 189.8
SEL-06	212.5	5 411 358.2	273 197.6
SEL-07	212.0	5 411 355.0	273 204.9
SEL-08	215.1	5 411 369.6	273 212.1
SEL-09	214.7	5 411 365.7	273 220.9

-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. 42D-35

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN AP	CHK MA	CODE		LOAD	DATE FEB 2015
DRAWN AN	CHK AP	SITE 48C-25	STRUCT	DWG 2	

FILENAME: H:\Drafting\19\351\197\Selim Hill\ted1197-Plan&Profile-SelimHill.dwg
PLOTDATE: 2/17/2015 9:44 AM

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No 2015-6004
WP No 6108-10-01

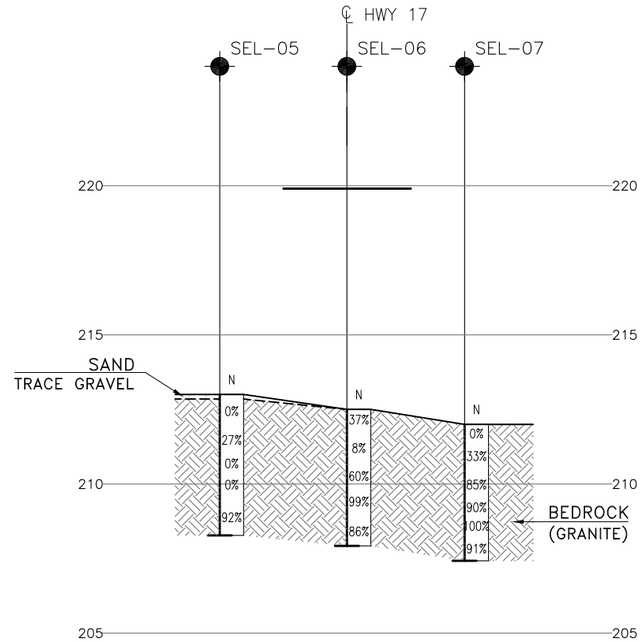
HIGHWAY 17
SELIM HILL
CPR OVERHEAD
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET 13

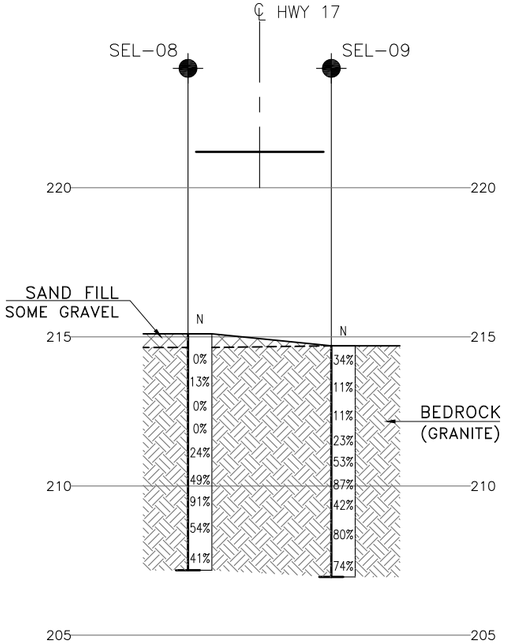
MMM GROUP

THURBER ENGINEERING LTD.

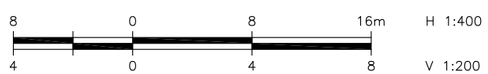
KEYPLAN



SECTION ALONG A-A



SECTION ALONG B-B



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 During Drilling
▼	Water Level In Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SEL-01	217.8	5 411 352.3	273 175.7
SEL-02	218.9	5 411 351.7	273 193.9
SEL-03	221.1	5 411 373.2	273 220.4
SEL-04	221.9	5 411 373.1	273 236.8
SEL-05	213.0	5 411 361.6	273 189.8
SEL-06	212.5	5 411 358.2	273 197.6
SEL-07	212.0	5 411 355.0	273 204.9
SEL-08	215.1	5 411 369.6	273 212.1
SEL-09	214.7	5 411 365.7	273 220.9

-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. 42D-35

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN AP	CHK MA	CODE	LOAD / DATE FEB 2015
DRAWN AN	CHK AP	SITE 48C-25	STRUCT / DWG 3

FILENAME: H:\Drafting\19\351\197\Selim Hill\ted1197-Plan&Profile-SelimHill.dwg
PLOTDATE: 2/17/2015 9:46 AM