

**FOUNDATION INVESTIGATION REPORT  
PROPOSED HIGHWAY 11 NORTHBOUND LANE CUT  
STATION - 18+860 to 18+960  
HIGHWAY 11 FOUR-LANING  
FROM 0.5 km NORTH OF HIGHWAY 520 NORTHERLY 5.7 km  
G.W.P. No. 473-93-00**

**GEOCRES Number: 31E-298**

**Report to**

**MMM Group Limited**

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted in conjunction with the four-laning of Highway 11 in the vicinity of Burk's Falls, Ontario.

Highway 11 will be four-laned from 0.5 km north of Highway 520, northerly 5.7 km. The investigation was conducted on a section of the highway approximately 100 m in length extending from Station 18+860 to Station 18+960.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile, laboratory test results, and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained during the course of the investigation.

Thurber Engineering Ltd. (Thurber) was retained by MMM Group Limited (MMM) to carry out the geotechnical investigation at this site under the Ministry of Transportation Ontario (MTO) Agreement Number 5006-E-0063.

**2 SITE DESCRIPTION**

The site is located along the eastern limit of the proposed Highway 11 northbound lanes, west of the Village of Burk's Falls, within the District of Parry Sound, Ontario.

The site is situated on the side of a southeast to northwest trending slope that falls towards the Magnetawan River, which flows east to west a short distance north of the site before swinging southward along the west of the highway.

The areas to the south, west and north of the site are predominantly undeveloped or used for agricultural purposes. To the east of the site is the Village of Burk's Falls which consists of a mixture of residential dwellings and commercial buildings.

The site is located in the Physiographic Region known as the Highway 11 Strip, which is characterized by a narrow strip that was positioned just below the shoreline of Glacial Lake Algonquin. The region is characterized by overburden materials composed of sand, silt and clay deposited by watercourses entering the lake. Sands were deposited as deltas while the finer particles were deposited as deep water sediments further offshore. The bedrock is composed of black to grey gneissic granite that has undergone extensive tectonization and distinct changes in lithology which delineates the various geologic regions and sub-regions in the Muskoka, Algonquin and Parry Sound Districts.

### **3 SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing for this project was carried out from December 12 to 21, 2008, January 12 to 20, 2009 and from February 11 to 17, 2009 and consisted of drilling and sampling fourteen boreholes (numbered 08-01 to 08-14). The boreholes were advanced to depths ranging from 5.3 to 16.0 m below the ground surface.

Prior to the start of drilling, the borehole locations were marked in the field and utility clearances were obtained by Thurber.

Track mounted drill rigs were used to drill and sample the boreholes. Hollow stem augers were used to advance the boreholes through the overburden soils and NQ2 diamond coring equipment was used to sample the bedrock when encountered. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT).

Standpipe piezometers consisting of a 19 mm diameter PVC pipe with a 1.52 m long slotted screen were installed and enclosed in sand in six of the fourteen boreholes. The piezometers were installed to monitor the longer-term groundwater levels throughout the site. The location and completion details of the piezometers are shown below in Table 3.1.

**Table 3.1**  
**Borehole Completion and Piezometer Installation Details**

Borehole ID	Total Depth (m)	Piezometer Tip Details			Backfill
		Depth (m)	El. (m)	Stratum	
08-01	5.3	3.0	301.4	Bedrock	Compacted borehole cuttings from 5.3 to 3.0 m, sand filter from 3.0 to 1.5 m, bentonite holeplug from 1.5 m to surface
08-02	7.0	None Installed			Bentonite grout to 0.2 m, bentonite holeplug to ground surface
08-03	6.8	4.6	306.2	Sandy Silt to Sand & Gravel	Compacted borehole cuttings from 6.8 to 4.6 m, sand filter from 4.6 to 2.7 m, bentonite holeplug from 2.7 m to surface
08-04	7.3	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-05	10.6	10.6	297.5	Sand	Sand filter from 10.6 to 8.8 m, bentonite holeplug from 8.8 m to surface
08-06	6.9	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-07	11.7	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-08	13.7	9.1	298.8	Silt	Compacted borehole cuttings from 13.7 to 9.1 m, sand filter from 9.1 to 7.3 m, bentonite holeplug from 7.3 m to surface
08-09	12.3	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-10	16.0	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-11	12.2	9.8	298.4	Silt	Compacted borehole cuttings from 12.2 to 9.8 m, sand filter from 9.8 to 7.9 m, bentonite holeplug from 7.9 m to surface
08-12	13.0	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-13	12.0	None Installed			Bentonite holeplug mixed with cuttings to ground surface
08-14	15.8	11.0	292.9	Sand	Compacted borehole cuttings from 15.8 to 11.0 m, sand filter from 11.0 to 9.2 m, bentonite holeplug from 9.2 m to surface

Results of field drilling and sampling are presented on the Record of Borehole Sheets in Appendix A.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the boreholes, secured the recovered soil and rock samples in labelled containers, and transported the samples to Thurber's laboratory.

#### **4 LABORATORY TESTING**

All recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole Sheets in Appendix A.

A total of 36% of the recovered samples were subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing when appropriate. The results of this testing program are shown on the Record of Borehole Sheets in Appendix A and on the charts in Appendix B.

All rock core samples were and total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were measured. Point load tests were carried out on selected rock cores.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

##### **5.1 General**

Reference is made to the Record of Borehole Sheets in Appendix A for details of the encountered soil stratigraphy. Stratigraphic profiles are presented on the Borehole Locations and Soil Strata Drawings, Appendix D, for illustrative purposes. 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.

The soil stratigraphy encountered at the borehole locations typically consists of cohesive soils composed of clayey silt to silty clay overlying interbedded layers of cohesionless sand and silt over gneissic granite bedrock. More detailed descriptions of the individual strata are presented below.

##### **5.2 Silty Clay**

In every borehole except Boreholes 08-06 and 08-10 a layer of cohesive silty clay with trace sand was encountered from the ground surface. In general, the silty clay was observed to be horizontally bedded (varved) with alternating layers of silt and clay. The varves were observed to range in thickness from 3 to 5 mm. The varves were identified by the change in colour ranging from grey in the clay layers to light brown to brown in the siltier layers. The surface of the cohesive deposit was generally desiccated with frequent vertical and sub-vertical fissures observed in the recovered samples.

Where encountered, the silty clay extended from the ground surface to a lower extent ranging from 0.8 to 4.6 m below the ground surface, or to Elevation 301.3 to 309.2. A second layer of silty clay was encountered in Borehole 08-9 at a depth of 6.1 m (El. 299.6 m) and extended to

a depth of 7.6 m (El. 298.1 m). The lower cohesive deposit did not show any obvious indications of the rhythmical depositional patterns or desiccation observed in the surficial deposit.

Grain size analyses conducted on thirteen (13) samples retrieved from the surficial silty clay layer are presented on the Record of Borehole Sheets and Figures B1 to B3 of Appendix B. The results of laboratory grain size analyses carried out on the silty clay deposit were as follows:

Gravel %	0 to 1
Sand %	0 to 9
Silt %	40 to 56
Clay %	35 to 59
Liquid Limit %	41 to 50
Plastic Limit %	22 to 25

Atterberg limits testing on eleven (11) samples indicated that the silty clay is an intermediate plasticity clay (CI). The results of the Atterberg limits testing may be found on the Record of Borehole Sheets and Figures B10 and B11 in Appendix B.

SPT N-values recorded in the surficial silty clay layer ranged widely from 3 to 48 blows for 0.3 m of penetration indicating a soft to hard consistency. In general the SPT N-values were typically between 5 to 20 blows for 0.3 m of penetration, corresponding to a firm to very stiff consistency.

The moisture content in the silty clay deposits varied widely from 8 to 67%, though were typically from 25 to 45%.

### 5.3 Clayey Silt

A layer clayey silt of variable thickness was encountered below the surficial silty clay in Boreholes 08-04, 08-11 and 08-12, and from the ground surface in Borehole 08-06. The clayey silt is similar in appearance to the overlying silty clay with an increasing number and thickness of silt layers. The clayey silt was found to extend to depths ranging from 0.8 to 3.8 m below the ground surface. The underside of the clayey silt lay at Elevation 300.8 to 305.8.

Grain size analysis conducted on one (1) sample is presented on the Record of Borehole Sheets and Figure B4 of Appendix B. The result of the laboratory grain size analysis carried out on the clayey silt deposit is as follows:

Gravel %	0
Sand %	1
Silt %	62
Clay %	36

Atterberg limits testing on one (1) sample indicated that the clay silt is a low plasticity soil (CL). The results of the Atterberg limits testing may be found on the Record of Borehole Sheet and Figure B12 in Appendix B

SPT N-values obtained in the clayey silt layer ranged from 8 to 13 blows per 0.3 m of penetration, indicating a firm to stiff consistency.

The moisture content of the recovered clayey silt samples ranged from 30 to 39%.

#### 5.4 Silt

A layer of silt was encountered in all boreholes except Borehole 08-1, at the southeast corner of the cut. The silt lay below the clayey silt and silty clay strata, except in Borehole 08-10, where it was encountered at the surface. This soil is described as silt, trace to some clay, trace to some sand. Occasional outlier results indicate sandy or clayey conditions but these are within the expected variability of the deposit. The material was highly dilatant, rapidly yielding pore water and sloughing upon disturbance.

The silt was contacted at the ground surface in Borehole 08-10 and otherwise at depths ranging from 0.8 to 4.6 m below the ground surface (Elevation 300.8 to 309.2). The base of the silt layer was contacted at depths ranging from 3.8 to 10.1 m below the ground surface (Elevation 307.0 to 296.3).

Grain size analyses conducted on eighteen (18) samples are presented on the Record of Borehole Sheets and Figures B5 to B7 of Appendix B. The result of the grain size analyses carried out on the silt deposit is as follows:

Gravel %	0
Sand %	2 to 17 (2 outliers at 32 and 41%)
Silt %	52 to 86
Clay %	7 to 20 (1 outlier at 30%)

Atterberg Limits testing was attempted on several samples, however were not possible to complete since no plastic limit could be measured.

SPT N-values obtained in the clayey silt layer ranged from 6 to 34 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The moisture content of the recovered silt samples ranged from 14 to 37%.

### 5.5 Sand and Gravel

Below the silt layer, Boreholes 08-02, 08-03 and 08-07 at the south end of the cut, encountered a layer of gravelly sand to sand and gravel.

The upper boundary of the sand and gravel was encountered at depths ranging from 3.8 to 9.1 m (Elevation 300.6 to 307.0) and the lower boundary of the layer was at depths ranging from 5.0 to 9.8 m (Elevation 300.0 to 305.9). In all cases the sand and gravel was located immediately above the surface of the bedrock.

SPT test results conducted in the sand and gravel deposit varied from 64 to greater than 94 for 0.3 m of penetration indicating a very dense condition.

Moisture contents from this deposit ranged from 2 to 8%.

The results of grain size distribution analyses conducted on three (3) samples are presented on the Record of Borehole Sheets and Figure B8. The results of the geotechnical laboratory testing are summarized below.

Gravel %	22 to 45
Sand %	38 to 53
Silt and Clay%	17 to 27

### 5.6 Sand

Below the silt, Boreholes 08-05, 08-06, 08-08, 08-09, 08-10 and 08-12 to 08-14 encountered a layer of sand, trace gravel, occasional cobbles, trace silt to silty and trace clay. The upper boundary of this deposit was contacted at depths ranging from 3.8 to 9.1 m below the ground surface (Elevation 296.3 to 302.0). The lower boundary was contacted at depths ranging from 5.0 to 12.5 m below the ground surface (Elevation 291.9 to 300.1).

Grain size analyses conducted on six (6) samples are presented on the Record of Borehole Sheets and Figure B9 of Appendix B. The result of the grain size analysis carried out on the sand deposit is as follows:

Gravel %	0 to 4
Sand %	50 to 92
Silt and Clay %	8 to 26 (2 outliers at 44 and 46%)

SPT N-values obtained in this cohesionless layer ranged from 10 blows per 0.3 m of penetration to 50 blows for 0.025 m of penetration, indicating a compact to very dense relative density. SPT N-value of greater than 50 blows for 0.25 m of penetration were recorded in Boreholes 08-6 and 08-13 on the surface of the underlying bedrock. The high N-value may not be representative of the overburden material and may reflect the location of the surface of the bedrock.

The moisture content of the recovered samples ranged widely from 4 to 34%.

## 5.7 Bedrock

Bedrock was encountered in all boreholes at the depths and elevations shown in Table 5.1

Borehole	Approximate Station	Approximate Offset	Depth (m)	Elevation
08-01	18+860	20m Rt	3.1	301.3
08-02	18+880	20m Rt	5.2	304.6
08-03	18+900	20m Rt	5.0	305.9
08-04	18+920	20m Rt	4.3	305.3
08-05	18-940	20m Rt	7.9	300.1
08-06	18+960	20m Rt	5.0	296.6
08-07	18+900	C.L.	9.8	300.0
08-08	18+920	C.L.	11.3*	298.1
08-09	18+940	C.L.	9.8	295.9
08-10	18+960	C.L.	12.2	292.2
08-11	18+900	15m Lt	10.1	298.1
08-12	18+920	15m Lt	10.8	296.2
08-13	18+940	15m Lt	9.7	294.1
08-14	18+960	15m Lt	14.3	289.6

\* Initial soil sampling borehole approximately 1m north encountered bedrock or boulder at 9.8 m depth.

The bedrock is gneissic granite and is described as fresh to slightly weathered, with a highly weathered zone at Borehole 08-09. The rock is assessed to be very strong but rubble zones were detected in some boreholes.

The total core recovery, solid core recovery and RQD values all ranged from 0 to 100%, indicating variable quality of rock from poor to excellent. The inferred rock strength, from point load tests, is generally in the range of 126 to 266 MPa, indicating very strong to extremely strong rock. Two lower values of 85 and 92 MPa were recorded, indicating zones of strong rock.

## 5.8 Groundwater Conditions

All boreholes were observed to be open and dry following completion of drilling. 19 mm diameter standpipe type piezometers were installed into six of the fourteen boreholes drilled along the length of the proposed cut section. Details of the standpipe piezometer construction are indicated above in Table 3.1.

The water levels measured in the piezometers are summarized in Table 5.2.

**Table 5.2 – Measured Groundwater Levels**

Borehole	Date	Water Level (m)	
		Depth	El.
08-01	22-Dec-08	Dry	N/A
	12-Jan-09	Damaged	N/A
08-03	22-Dec-08	Dry	N/A
	12-Jan-09	Dry	N/A
	13-Feb-09	Dry	N/A
	14-Apr-09	Dry	N/A
08-05	13-Feb-09	8.8	299.3
	14-Apr-09	8.2	299.9
08-08	14-Apr-09	0.9	307.0
08-11	12-Jan-09	Dry	N/A
	13-Feb-09	Dry	N/A
	14-Apr-09	Dry	N/A
08-14	13-Feb-09	Dry	N/A
	14-Apr-09	11.0	292.9

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

The water level measured in the piezometer in Borehole 08-08 is higher relative to the levels measured in the other piezometers. However, the lower groundwater levels measured in the other piezometers may be due to under-drainage of the slope by coarser sand and gravel layers overlying the bedrock. Wet zones were noted within the silts and clays at various levels, particularly near the middle of the area investigated (Boreholes 08-08 and 08-12). These strata may be saturated at certain times, especially after the spring snow melt.

## 6 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Following completion of the drilling program, MMM surveyed the as-drilled locations, and provided northing and easting coordinates and ground surface elevations at each borehole location.

Walker Drilling Inc. of Utopia, Ontario supplied and operated a track-mounted Morooka MST-1500 drill rig to conduct the drilling, sampling and in-situ testing operations at some of the borehole locations. Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied and operated a

track-mounted CME 55HT drill rig to conduct the drilling, sampling and in-situ testing operations at the remaining borehole locations.

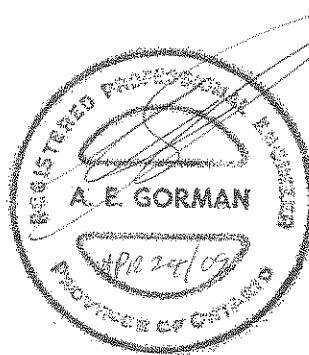
The drilling and sampling operations in the field were supervised on a full time basis by Mr. Luke Gilarski and Ms. Eckie Sui of Thurber.

Laboratory testing was carried out by Thurber Engineering Ltd. in its MTO-approved Oakville laboratory.

Interpretation of the field data and preparation of the investigation report was completed by Mr. David E.Y. Elwood, P.Eng and Mr. Alastair E. Gorman, P. Eng. Overall supervision of the field program was performed by Mr. David E.Y. Elwood, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Review Principal, Designated MTO Contact

## **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 <sup>(1)</sup> '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<sub>pen</sub>





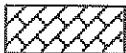
Shear Strength Determination by Pocket Penetrometer

- (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
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	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	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	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	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 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 08-01

1 OF 1

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 526.7 E 311 565.6 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.17 - 2008.12.17 CHECKED BY DE


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
304.4								20 40 60 80 100									
0.0	Silty CLAY, trace sand, occasional rootlets Firm to Hard Brown to Grey		1	SS	5		304										
			2	SS	10		303										0 1 47 52
	Hard		3	SS	48		302										
			4	SS	39		301										
301.3																	
3.1	BEDROCK, Gneissic Granite Black Very Strong Fresh  Medium Grained  Fracture at 4.3m. Weathered		1	RUN			301									RUN 1# TCR=100%, SCR=100%, RQD=94%, UCS=92.2MPa	
			2	RUN			300										RUN 2# TCR=100%, SCR=80%, RQD=80%, UCS=159.5MPa
			3	RUN													RUN 3# TCR=100%, SCR=83%, RQD=83%, UCS=125.8MPa
299.1																	
5.3	END OF BOREHOLE AT 5.3m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52m LONG SLOTTED SCREEN.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec. 22, 2008 Dry Jan. 12, 2009 Damaged																

# RECORD OF BOREHOLE No 08-02

1 OF 1

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 552.3 E 311 552.2 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.12 - 2008.12.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
309.8	Silty CLAY, some sand, occasional rootlets Stiff to Very Stiff Brown to Grey Moist		1	SS	15																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-03

1 OF 1

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 564.1 E 311 551.2 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.16 - 2008.12.19 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
310.9								20 40 60 80 100						
0.0	Silty CLAY, trace sand Firm to Very Stiff Brown Grey Mottled		1	SS	7			○ UNCONFINED + FIELD VANE						
			2	SS	13			● QUICK TRIAXIAL × LAB VANE						
309.2								40 80 120 160 200						
1.7	Sandy SILT, trace clay Compact Brown Moist		3	SS	21									
			4	SS	14									
			5	SS	17									
307.0														
3.8	Gravelly, silty SAND Very Dense Grey Moist		6	SS	75									
			7	SS	94									
305.9			1	RUN										
5.0	BEDROCK, Gneissic Granite, fresh Very Strong Grey to Black  Fractured Zone from 5.5 to 5.6m.		2	RUN										
			3	RUN										
304.1														
6.8	END OF BOREHOLE AT 6.8m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1 52m LONG SLOTTED SCREEN.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec 22, 08 Dry Jan 12, 09 Dry Feb 13, 09 Dry Apr 14, 09 Dry													

ONTMT14S 6116.GPJ 8/20/09

## METRIC

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-05

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 803.0 E 311 530.9 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.17 - 2009.02.11 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								20 40 60 80 100	w <sub>p</sub> w      w <sub>L</sub>							
						○ UNCONFINED      + FIELD VANE										
						● QUICK TRIAXIAL      x LAB VANE										
308.1							40 80 120 160 200	20 40 60						GR SA SI CL		
0.0	Silty CLAY, trace sand Firm Brown to Grey Mottled Frequent Silt Partings		1	SS	7											
	Very Stiff		2	SS	22									0 9 40 51		
	Stiff		3	SS	12											
			4	SS	12									0 0 45 55		
	Moist to Wet		5	SS	12											
304.3																
3.8	SILT, some clay, trace sand Compact Brown Moist		6	SS	24									0 5 75 20		
	Wet		7	SS	15											
302.0																
6.1	Silty SAND Dense Light Brown Moist		8	SS	31									0 76 24 (SI+CL)		
300.1																
7.9	BEDROCK Gneissic Granite Highly Weathered with Frequent Clay Infilling		1	RUN										RUN 1# TCR=44%, SCR=27%, RQD=0%, UCS=MPa		
	Grey Slightly Weathered Very Strong Rubble Zone at 6.5m. Clay Infilling		2	RUN										RUN 2# TCR=100%, SCR=100%, RQD=92%, UCS=189.4MPa		

Continued Next Page

+<sup>3</sup> X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-05

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 603.0 E 311 530.9 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.17 - 2009.02.11 CHECKED BY DE




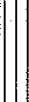







SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
	Continued From Previous Page												
297.5							298						
10.6	END OF BOREHOLE AT 10.6m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52m LONG SLOTTED SCREEN. WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Feb 13, 09      8.8      299.3 Apr 14, 09      8.2      299.9												

RECORD OF BOREHOLE No 08-06

1 OF 1

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 623.0 E 311 521.3 ORIGINATED BY LG  
HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
DATUM Geodetic DATE 2009.01.20 - 2009.01.20 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
301.6								20 40 60 80 100						
0.0	Clayey SILT, some sand Stiff Brown		1	SS	11		301							
300.8														
0.8	SILT, trace to some clay, trace sand Dense Brown Moist		2	SS	34		300							0 10 77 13
	Compact		3	SS	20									
	Occasional Clay Inclusions		4	SS	19		299							
														
	Wet		5	SS	11		298							0 7 84 9
297.8														
3.8	SAND, some silt, some gravel Compact Brown Wet		6	SS	17									
	Occasional Rhythmites													
296.6	Very Dense Moist		7	SS	53/ 0.275		297							13 69 18 RUN 1# (SI+CL) TCR=95%, SCR=62%, RQD=60%, UCS=230.7MPa
5.0	BEDROCK Gneissic Granite Fresh Rubble Zone at Bedrock Surface to 5.2m Depth Grey Very Strong		1	RUN			296							RUN 2# TCR=96%, SCR=78%, RQD=78%, UCS=194.6MPa
	Rubble Zone at 6.4 m Depth		2	RUN			295							
294.7														
6.9	END OF BOREHOLE AT 6.8m. BOREHOLE BACKFILLED WITH MIXTURE OF HOLEPLUG AND DRILL CUTTINGS TO GROUND SURFACE.													

# RECORD OF BOREHOLE No 08-07

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 558.9 E 311 531.9 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.21 - 2009.01.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED							+ FIELD VANE			
								● QUICK TRIAXIAL							x LAB VANE			
309.8						20	40	60	80	100								
0.0	Silty CLAY, trace sand Very Stiff to Stiff Brown Grey Layered Laminated Clay and Silt Desiccated Near the Ground Surface		1	SS	11													
			2	SS	8													
			3	SS	16													
			4	SS	8													
	Trace gravel Firm		5	SS	5													
	Soft		6	SS	3													
305.2																		
4.6	SILT, some clay, trace sand Compact Brown		7	SS	18									0 0 41 59				
303.7																		
6.1	Sandy SILT Compact Brown		8	SS	20													
			9	SS	24													
300.6																		
9.1	Silty SAND and GRAVEL Very Dense Brown to Black		10	SS	64									22 51 27 (SI+CL)				
300.0																		
9.8	BEDROCK Gneissic Granite																	

Continued Next Page

+ 3 x 3 : Numbers refer to  
Sensitivity 20  
15-5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-07

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 558.9 E 311 531.9 ORIGINATED BY LG  
HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
DATUM Geodetic DATE 2008.12.21 - 2009.01.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL x LAB VANE						
								40 80 120 160 200						

# RECORD OF BOREHOLE No 08-08

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 579.8 E 311 521.3 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.17 - 2009.01.17 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	x LAB VANE						
307.9						20	40	60	80	100					
0.0	Silty CLAY Very Stiff Brown and Grey layered Moist Frequent Silt and Clay Partings		1	SS	18										
			2	SS	14										
	with Organics Dark Brown Wet		3	SS	12										
			4	SS	5										
			5	SS	5										
304.1															
3.8	SILT, some sand, some clay Loose to Compact Brown Moist		6	SS	10										
			7	SS	6										
	Moist to Wet		8	SS	12										
	Loose		9	SS	6										
298.8															
9.1	Silty SAND, some clay Compact Brown Moist		10	SS	10										
298.1															
9.8															

Continued Next Page

+<sup>3</sup> ×<sup>3</sup> : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-08

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 579.8 E 311 521.3 ORIGINATED BY LG  
HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
DATUM Geodetic DATE 2009.01.17 - 2009.01.17 CHECKED BY DE






SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
	Continued From Previous Page					20 40 60 80 100 40 80 120 160 200 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w <sub>p</sub> w w <sub>L</sub> WATER CONTENT (%)				
	BEDROCK, Gneissic Granite Grey Slightly Weathered Very Strong  Begin Rock Core at 11.3m Depth														
			1	RUN											
			2	RUN											
294.2															
13.7	END OF BOREHOLE AT 13.7m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52m LONG SLOTTED SCREEN. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Apr 14, 09 0.9 307.0														

# RECORD OF BOREHOLE No 08-09

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 594.3 E 311 512.9 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LG  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED    + FIELD VANE								
305.7 0.0	Frost 0.8m						20 40 60 80 100	40 80 120 160 200	20 40 60							
304.9 0.8	Silty CLAY Stiff Brown Grey Mottled Moist Frequent Silt Partings Firm		1	SS	13						○					
			2	SS	6						○					
303.4 2.3	SILT, some clay, trace sand Stiff Brown Grey Mottled Moist		3	SS	9						○			0 2 86 12		
			4	SS	9						○					
			5	SS	11						○					
			6	SS	12						○					
299.6 6.1	Silty CLAY, some sand, coarse sand interbeds Firm to Stiff Grey Moist		7	SS	8						○					
298.1 7.6	SAND, fine to medium grained Compact Light Brown Moist		8	SS	17						○					
	Cobble															
	Trace Gravel		9	SS	14						○			4 80 16 (SI+CL)		
295.9 9.8	Begin Rock Coring at 10.1m Depth		10	SS	56											
					.25											

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W <sub>P</sub> W W <sub>L</sub>					
295.6 10.1	Continued From Previous Page  BEDROCK, Gneissic Granite Grey Highly Weathered Very Strong Rubble Zone at 10.4m Depth		1	RUN		295								RUN 1# TCR=27%, SCR=0%, RQD=0%
			2	RUN		294								RUN 2# TCR=40%, SCR=20%, RQD=20%, UCS=206.7MPa
293.3 12.3	END OF BOREHOLE AT 12.3m. BOREHOLE BACKFILLED WITH MIXTURE OF HOLEPLUG AND DRILL CUTTINGS TO GROUND SURFACE.													

# RECORD OF BOREHOLE No 08-10

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 615.0 E 311 503.8 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LG  
 DATUM Geodetic DATE 2009.02.13 - 2009.02.17 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
304.4							20 40 60 80 100											
0.0	Frost for 0.6m							○ UNCONFINED + FIELD VANE										
303.7								● QUICK TRIAXIAL × LAB VANE										
0.6	SILT, some clay, trace sand Compact Brown Grey Mottled Moist		1	SS	10		304											
	Occasional Clay Partings		2	SS	11		303							0 2 68 30				
			3	SS	10		302											
			4	SS	12		301											
			5	SS	10		300							0 17 68 15				
			6	SS	16		299											
298.3																		
6.1	SAND, some silt, trace clay Compact Grey Moist		7	SS	11		298											
							297											
			8	SS	18		296							0 92 8 (SI+CL)				
	Cobbles for 0.1m						295											
			9	SS	17													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-10

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 615.0 E 311 503.8 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LG  
 DATUM Geodetic DATE 2009.02.13 - 2009.02.17 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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								
Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE				WATER CONTENT (%)					
							40 80 120 160 200				20 40 60					
292.2																
12.2																
291.7	Began Rock Coring at 12.6m Depth		10	SS	22										0 74 26 (SI+CL)	
12.6	<b>BEDROCK</b> Gneissic Granite Grey Highly Weathered Very Strong															

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-11

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 554.1 E 311 519.7 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2008.12.21 - 2008.12.21 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      x LAB VANE		WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>					
308.2	Silty CLAY, trace sand Stiff to Very Stiff Brown Moist		1	SS	15		20	40	60	80	100	20	40	60	GR   SA   SI   CL
0.0															
305.2	Clayey SILT, trace sand Firm to Stiff Brown Moist to Wet		5	SS	8										
3.0															
304.4	SILT, some clay, trace sand Compact Brown Moist to Wet        Moist		6	SS	18										
3.8															

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-11

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 554.1 E 311 519.7 ORIGINATED BY LG  
HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
DATUM Geodetic DATE 2008.12.21 - 2008.12.21 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)		
								20 40 60 80 100 40 80 120 160 200						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub>		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE									
298.2	Continued From Previous Page															
10.1	Begin Rock Coring at 10.1m Depth															
	BEDROCK Gneissic Granite		1	RUN			298							RUN 1# TCR=0.08%, SCR=0%, RQD=0%, UCS=MPa		
	Grey Slightly Weathered Very Strong Coarse Grained		1.5	RUN			297							RUN 1.5# TCR=92%, SCR=42%, RQD=38%, UCS=233.9MPa		
296.0																
12.2	END OF BOREHOLE AT 12.2m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52m LONG SLOTTED SCREEN. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec 22, 08 Dry Jan 12, 09 Dry Feb 13, 09 Dry Apr 14, 09 Dry															

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-12

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 572.0 E 311 510.1 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.13 - 2009.01.13 CHECKED BY DE




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE					PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)
	Continued From Previous Page						20 40 60 80 100 40 80 120 160 200						
296.2	Some gravel		11	SS	51/ 0.025								
10.8	<b>BEDROCK</b> Gneissic Granite Very Strong Grey Slightly Weathered Rubble Zones at 11.1m, 11.3m, 11.8m and 12m Depth		1	RUN									
294.1			2	RUN									
13.0	END OF BOREHOLE AT 13.0m. BOREHOLE BACKFILLED WITH MIXTURE OF HOLEPLUG AND DRILL CUTTINGS TO GROUND SURFACE.												

# RECORD OF BOREHOLE No 08-13

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 587.0 E 311 498.2 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LG  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.11 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								20	40	60	80						
						○ UNCONFINED      + FIELD VANE											
						● QUICK TRIAXIAL    × LAB VANE											
303.8	Silty CLAY, trace organics Soft Brown-Grey Moist		1	SS	3											GR SA SI CL	
303.1																	
0.8	SILT, trace to some clay, trace sand Loose to Compact Brown Moist  Wet  Sandy seam at 3.8m Moist to Wet		2	SS	7											0 3 79 18	
			3	SS	12												
			4	SS	12												
			5	SS	12												
															0 41 52 7		
	6	SS	17														
	7	SS	12														
297.7																	
6.1	SAND, trace silt Compact Grey Moist		8	SS	12											0 85 15 (SI+CL)	
			9	SS	19												

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-13

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 587.0 E 311 498.2 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY LG  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.11 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						
	Continued From Previous Page						20 40 60 80 100							GR SA SI CL
291.8	BEDROCK Gneissic Granite Black and Light Brown Mottled to Grey Fresh Very Strong Rubble Zones at 25mm from 10.4m to 11.0m Depth		1	RUN										SCR=42%, RQD=42%, UCS=130.8MPa RUN 2# TCR=100%, SCR=100%, RQD=43%, UCS=137.3MPa
			2	RUN			293							
			3	RUN			292							RUN 3# TCR=100%, SCR=100%, RQD=50%, UCS=164.8MPa
12.0	END OF BOREHOLE AT 12.0m. BOREHOLE BACKFILLED WITH MIXTURE OF HOLEPLUG AND DRILL CUTTINGS TO GROUND SURFACE.													

+ 3, X 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-14

1 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 607.7 E 311 493.3 ORIGINATED BY LG  
 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.12 - 2009.02.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL X LAB VANE									
							WATER CONTENT (%)										
							20 40 60 80 100										
303.9																	
0.0	Silty CLAY, trace organics Firm Mottled Brown-Grey Moist		1	SS	5												
			2	SS	7												
302.4							303							0 0 49 51			
1.5	SILT, some clay, trace sand Compact Brown with Occasional Grey Partings Moist		3	SS	10												
	Grey		4	SS	13									0 6 80 14			
			5	SS	12												
			6	SS	13									0 17 76 7			
			7	SS	14												
			8	SS	10												
296.3							299										
							298										
							297										
7.6	SAND, some silt Compact Light Brown Moist		9	SS	18												
			10	SS	20									0 79 21 (SI+CL)			
							296										
							295										
							294										

Continued Next Page

+ 3, X 3. Numbers refer to  
Sensitivity 20  
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-14

2 OF 2

METRIC

G.W.P. 473-93-00 LOCATION N 5 052 607.7 E 311 493.3 ORIGINATED BY LG  
HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AN  
DATUM Geodetic DATE 2009.02.12 - 2009.02.12 CHECKED BY DE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page							20 40 60 80 100							
292.9			11	SS	50/ .125		293								
10.9	SAND and GRAVEL, some silt Wet Boulder Encountered from 11.3m to 11.9m Depth		1	RUN			292								
							291								
			12	SS	50/ .125		290								
289.6															
14.3	BEDROCK Gneissic Granite Grey Fresh Very Strong		2	RUN			289								RUN 2# TCR=93%, SCR=83%, RQD=83%, UCS=131.8MPa
288.0															
15.8	END OF BOREHOLE AT 15.8m. PIEZOMETER INSTALLATION CONSISTS OF 19mm DIAMETER SCHEDULE 40 PVC PIPE WITH A 1.52m LONG SLOTTED SCREEN. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Feb 13, 09 Dry Apr 14, 09 11.0 292.9														

ONTMT4S 6116.GPJ 8/20/09

## **Appendix B**

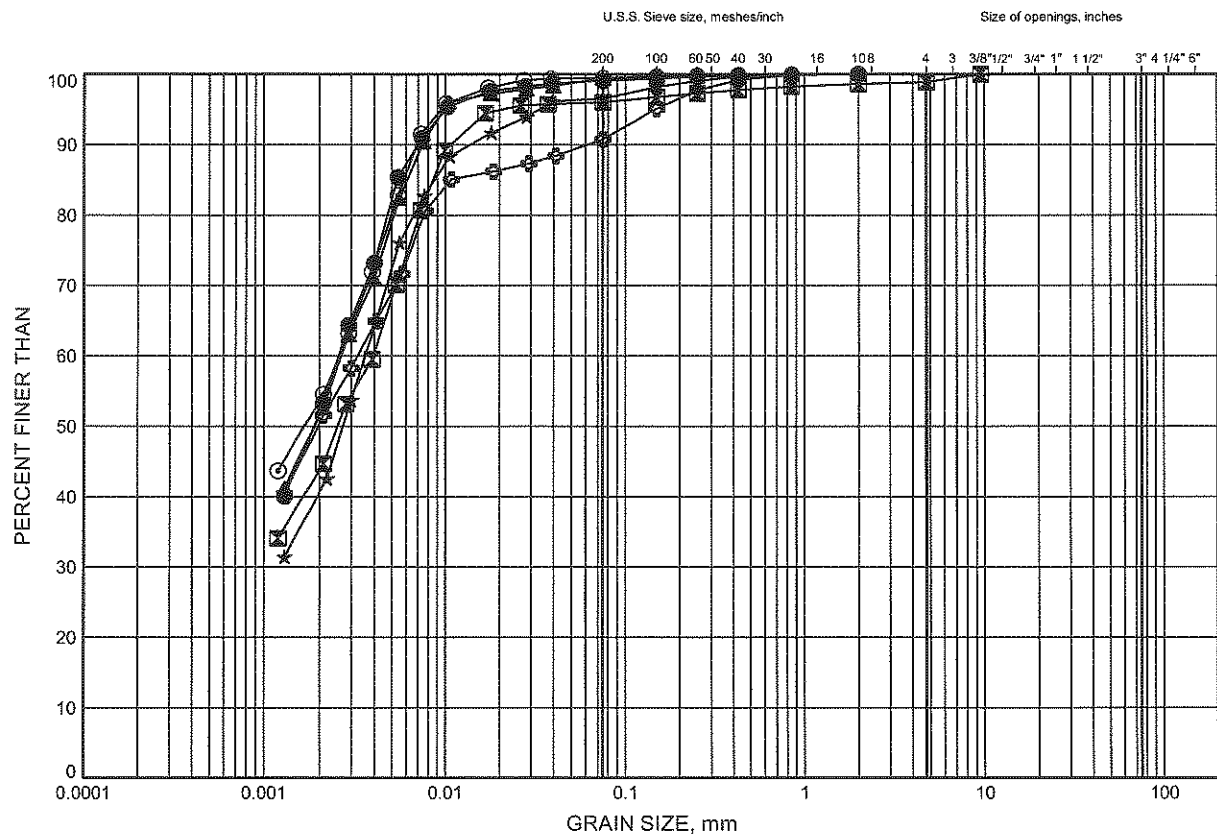
### **Geotechnical Laboratory Test Results**

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B1

# GRAIN SIZE DISTRIBUTION

## SILTY CLAY



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-01	1.07	303.34
⊠	08-01	2.51	301.89
▲	08-03	1.07	309.79
★	08-04	0.30	309.33
⊙	08-04	2.59	307.04
⊕	08-05	1.07	307.00



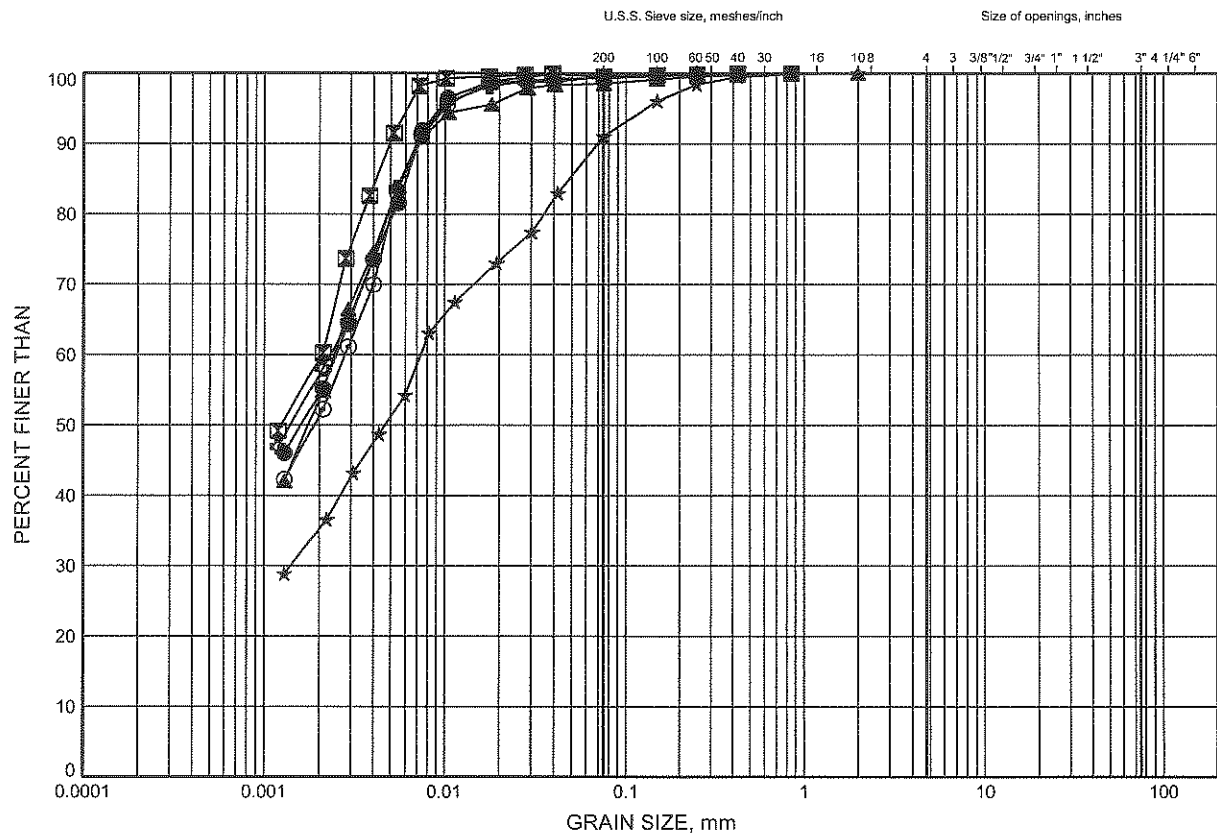
W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B2

# GRAIN SIZE DISTRIBUTION

## SILTY CLAY



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-05	2.59	305.48
⊠	08-07	2.59	307.18
▲	08-08	1.07	306.83
★	08-08	3.51	304.40
⊙	08-11	2.59	305.65
⊕	08-12	1.83	305.21



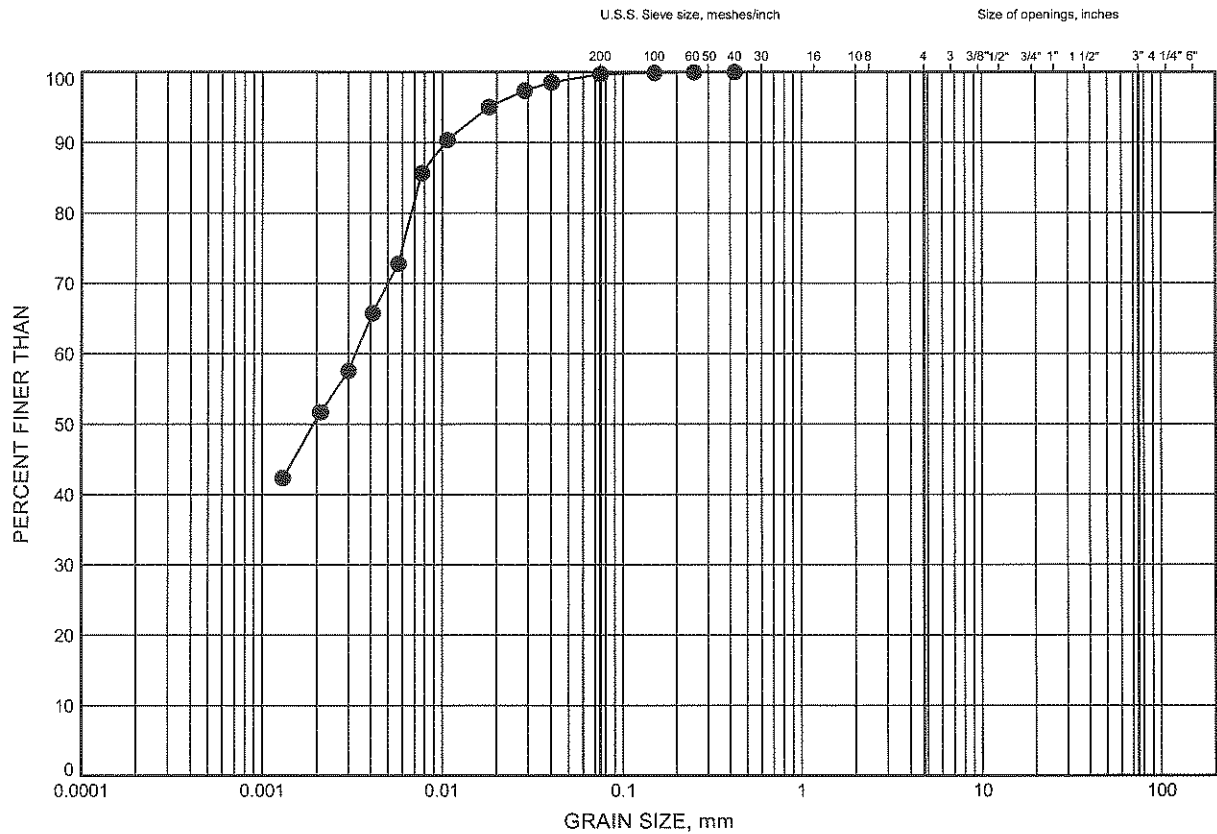
W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B3

# GRAIN SIZE DISTRIBUTION

SILTY CLAY



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-14	1.07	302.82



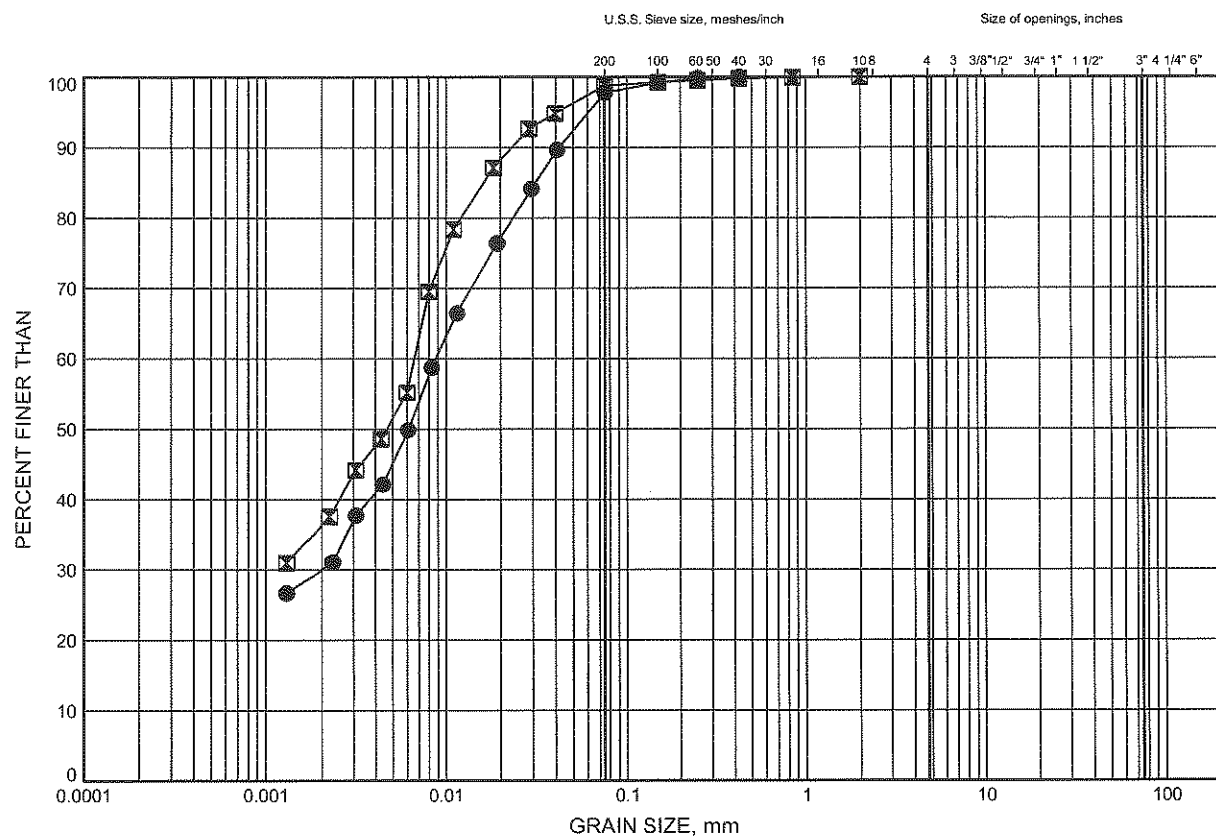
W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B4

# GRAIN SIZE DISTRIBUTION

## CLAYEY SILT



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-10	1.83	302.53
⊠	08-12	3.35	303.68



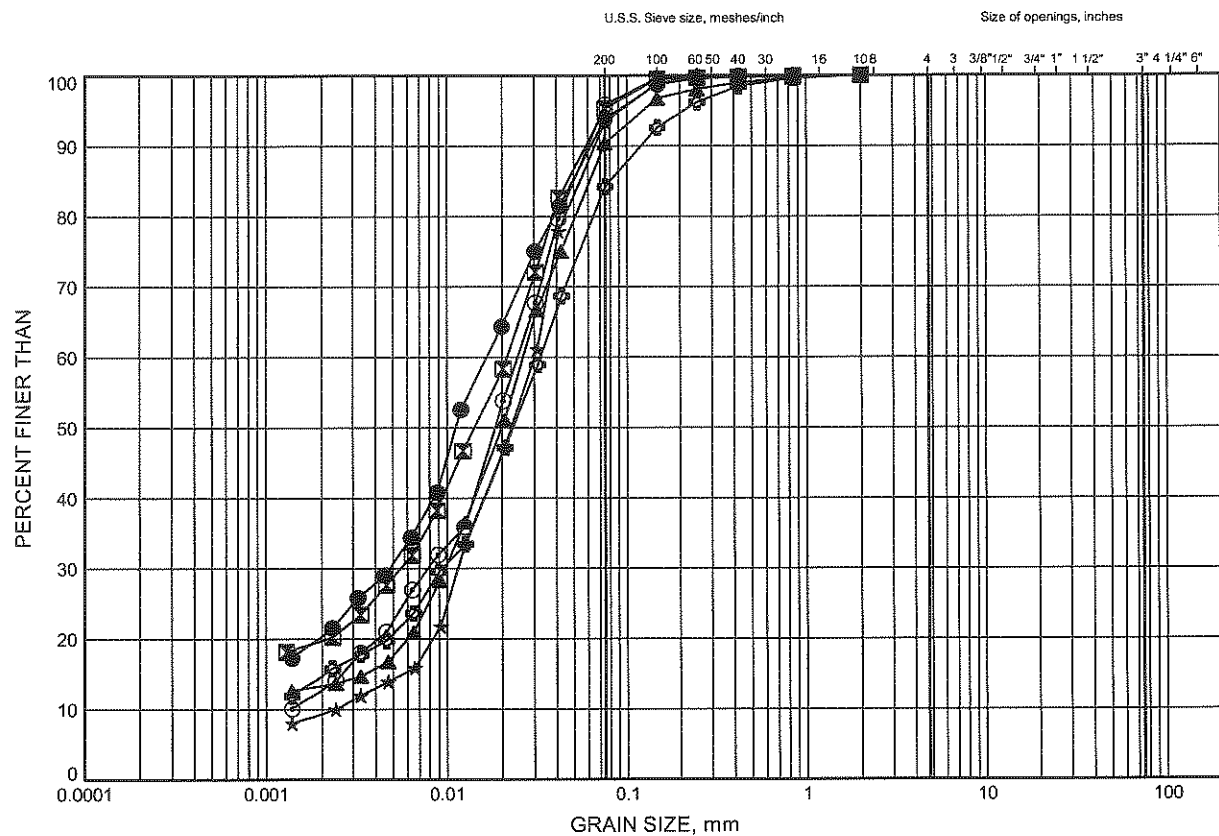
W.P.# 473-93:00  
 Prepared By MFA  
 Checked By DEE

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B5

# GRAIN SIZE DISTRIBUTION

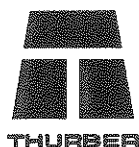
## SILT



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

## LEGEND

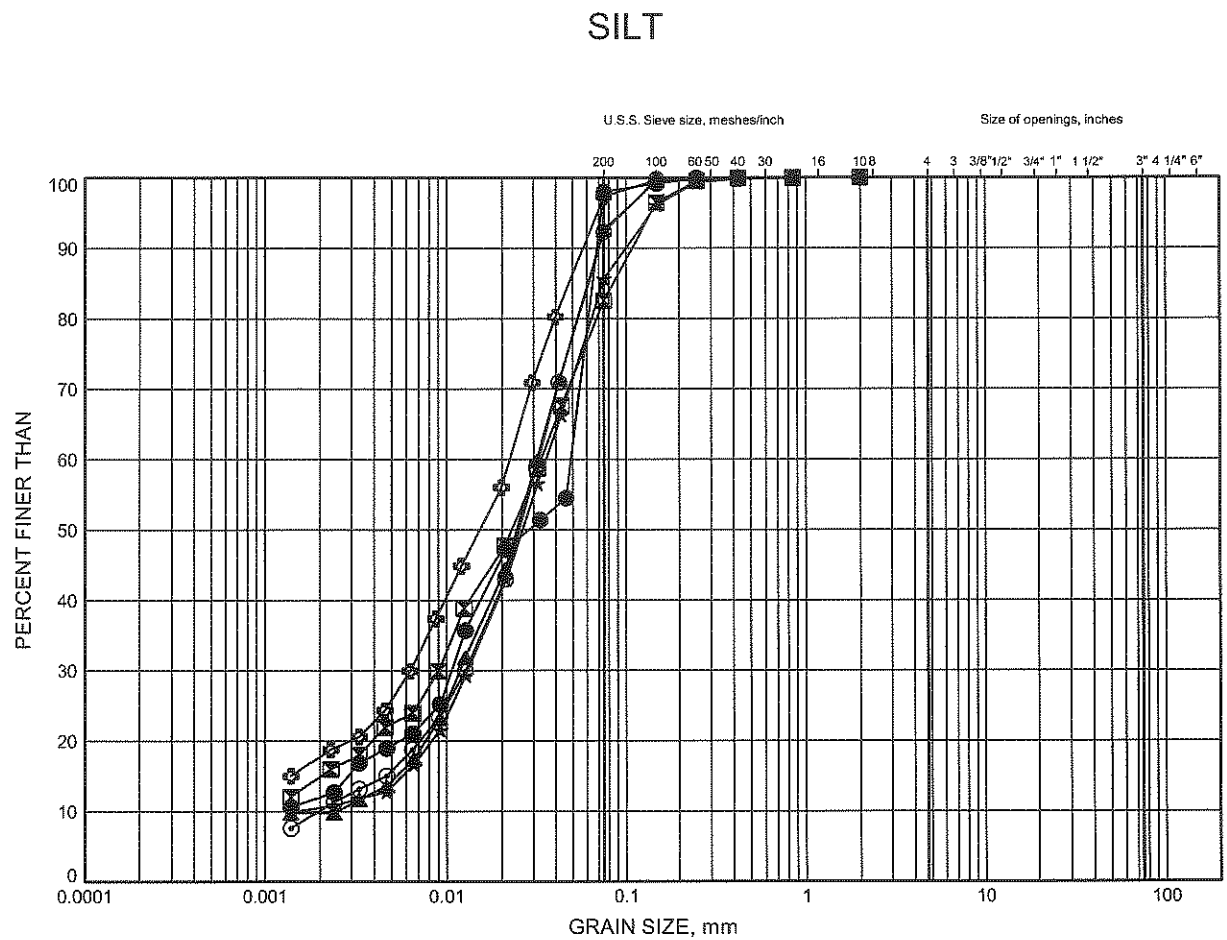
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-02	2.59	307.23
⊠	08-05	4.11	303.95
▲	08-06	1.07	300.54
★	08-06	3.35	298.25
⊙	08-07	4.88	304.89
⊕	08-08	4.11	303.79



W.P.# 473-93-00  
 Prepared By MFA  
 Checked By DEE

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km  
**GRAIN SIZE DISTRIBUTION**

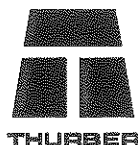
FIGURE B6



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

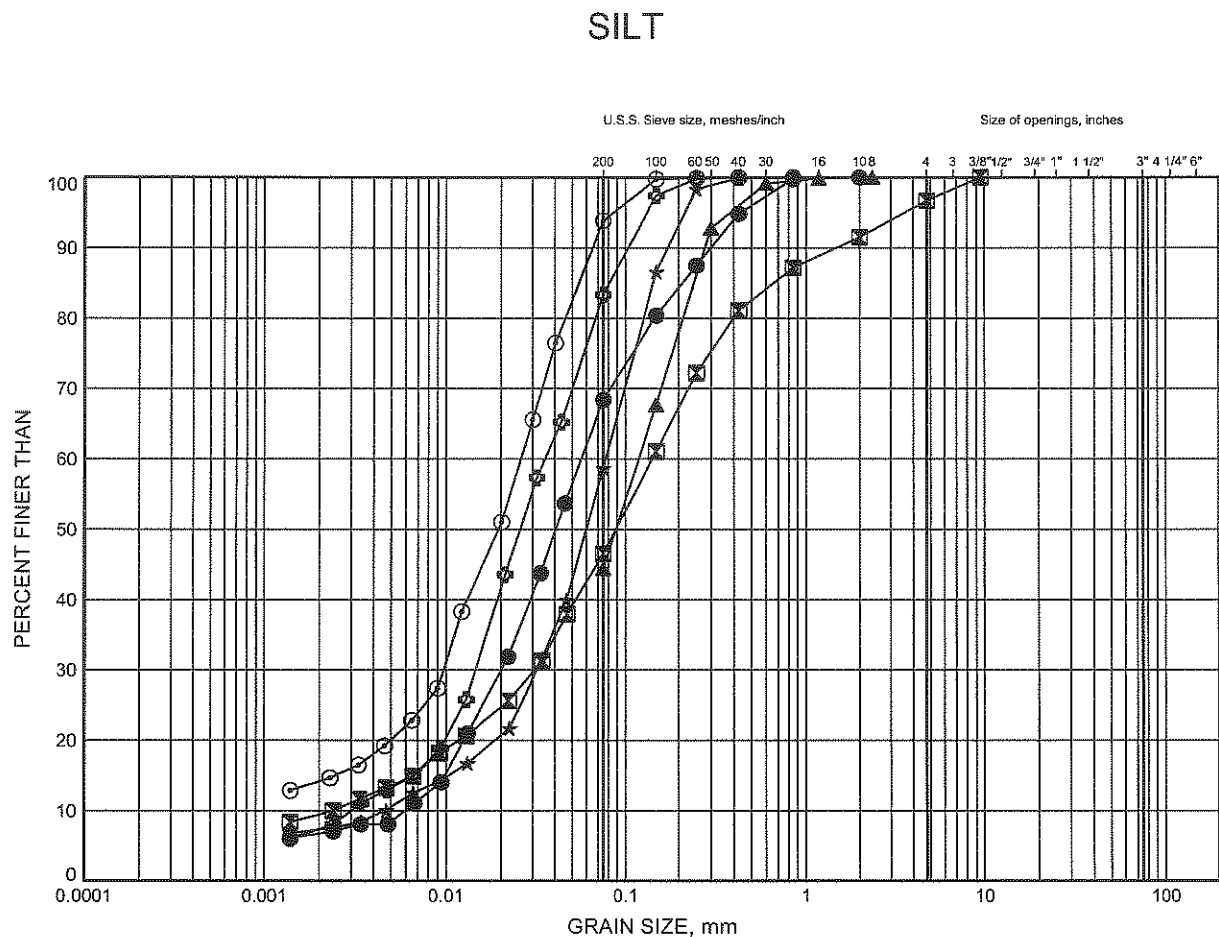
**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-09	2.59	303.09
⊠	08-10	4.11	300.24
▲	08-11	4.11	304.12
★	08-11	7.92	300.31
⊙	08-12	4.88	302.16
⊗	08-13	1.83	301.99



W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

## GRAIN SIZE DISTRIBUTION



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-03	3.35	307.50
⊠	08-08	9.45	298.45
▲	08-12	7.92	299.11
★	08-13	4.11	299.70
⊙	08-14	2.59	301.29
⊕	08-14	4.11	299.77



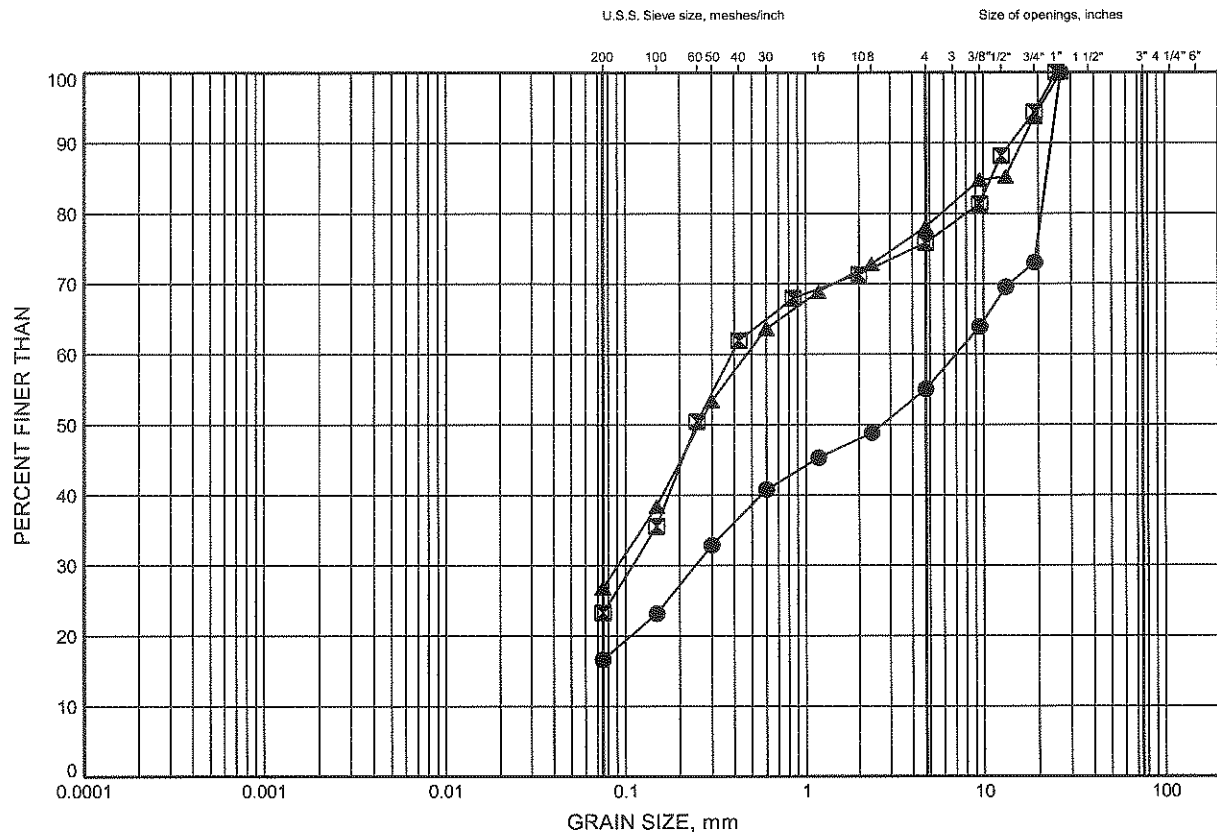
W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B8

# GRAIN SIZE DISTRIBUTION

## SAND AND GRAVEL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-02	4.88	304.94
■	08-03	4.11	306.74
▲	08-07	9.45	300.32



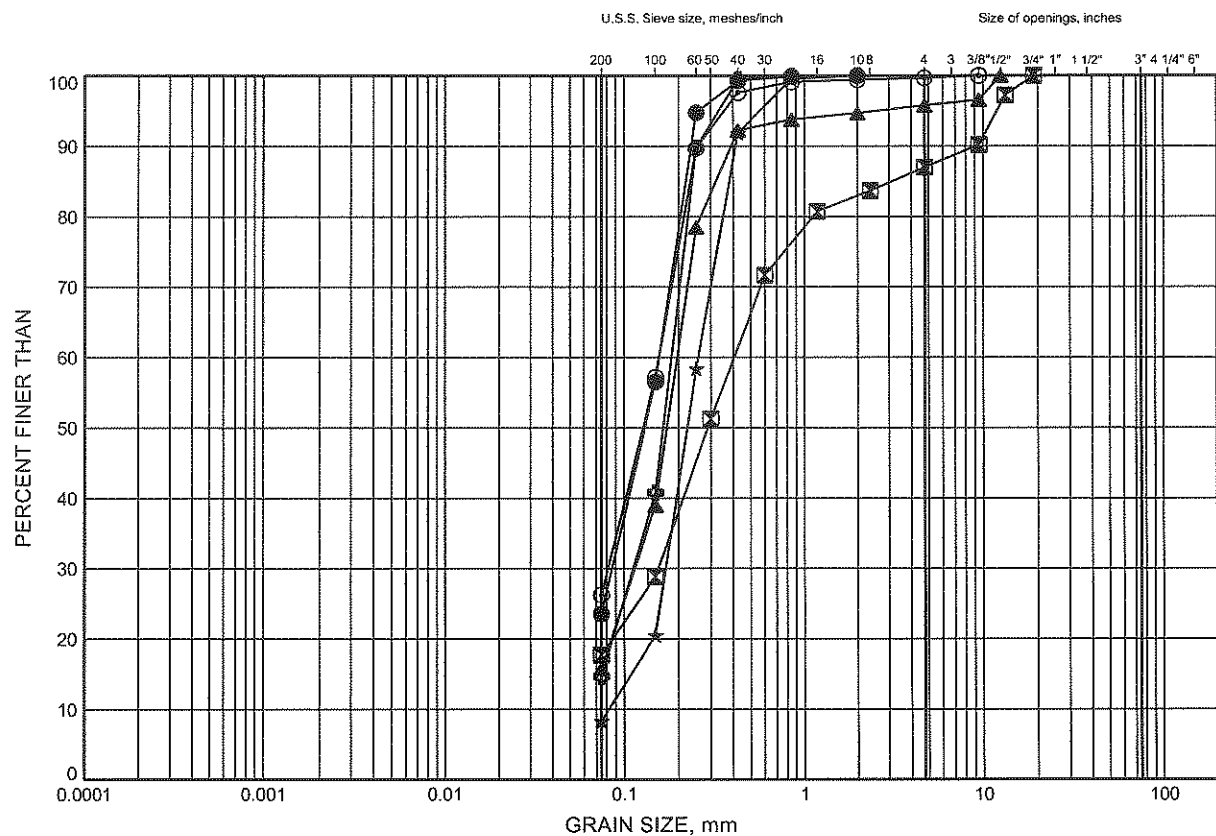
W.P.# 473-93-00.....  
 Prepared By MFA.....  
 Checked By DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km

FIGURE B9

# GRAIN SIZE DISTRIBUTION

## SAND



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-05	6.40	301.67
⊠	08-06	4.88	296.73
▲	08-09	8.99	296.69
★	08-10	7.92	296.43
⊙	08-10	10.97	293.38
⊕	08-13	7.92	295.89

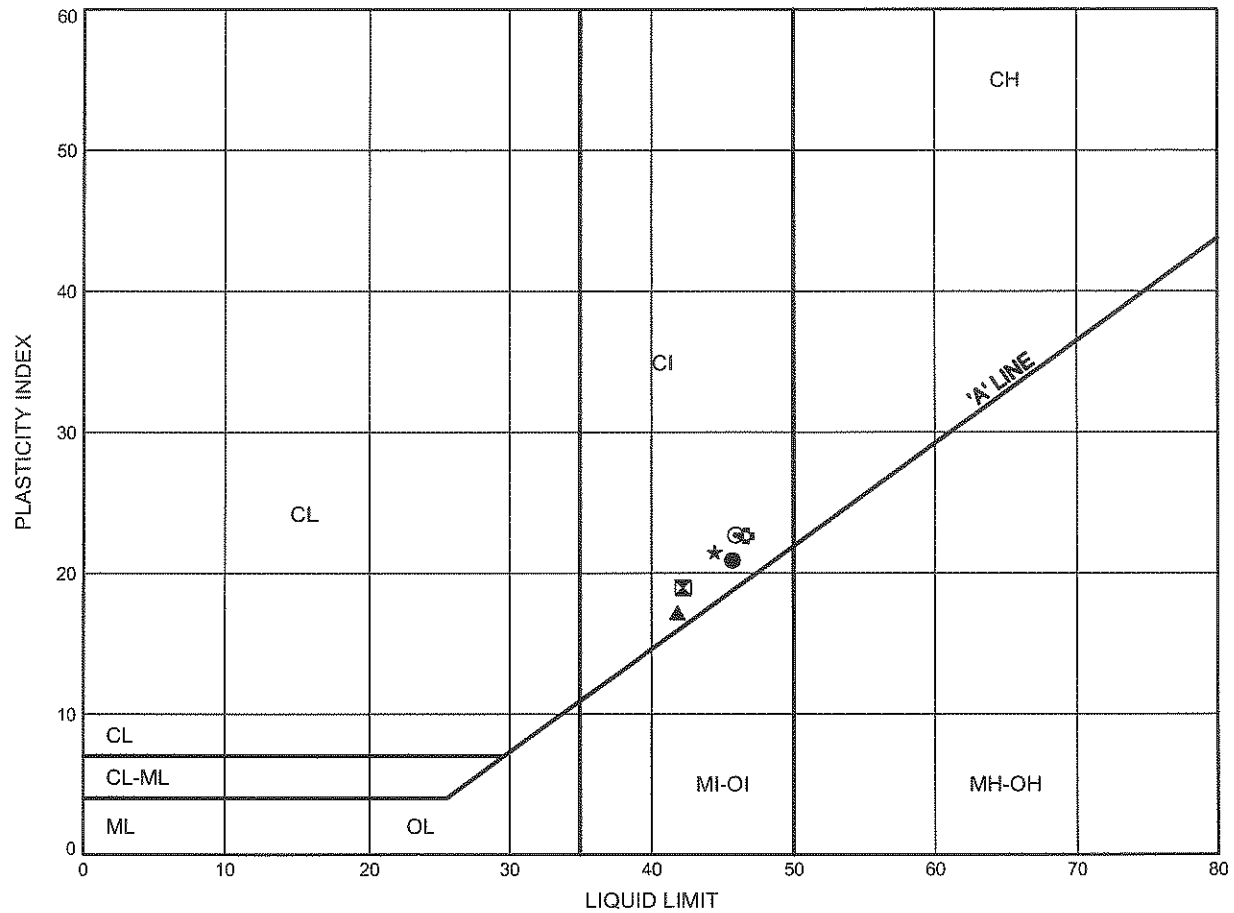


W.P.# .473-93-00.....  
 Prepared By .MFA.....  
 Checked By .DEE.....

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B10

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-01	1.07	303.34
⊠	08-03	1.07	309.79
▲	08-04	0.30	309.33
★	08-04	2.59	307.04
⊙	08-05	1.07	307.00
⊕	08-05	2.59	305.48

Date April 2009  
 Project 473-93-00

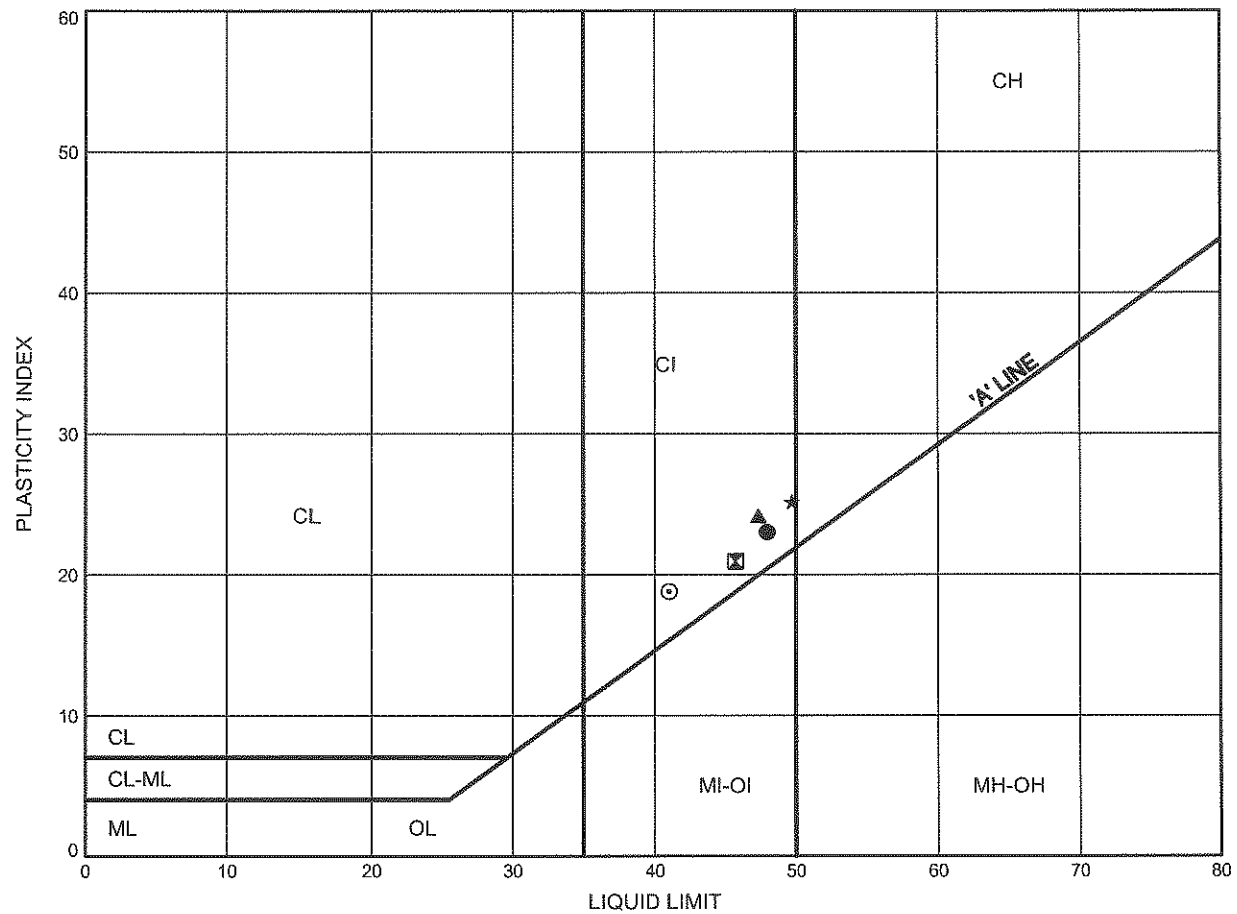


Prep'd MFA  
 Chkd. DEE

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B11

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-07	2.59	307.18
⊠	08-08	1.07	306.83
▲	08-11	2.59	305.65
★	08-12	1.83	305.21
⊙	08-14	1.07	302.82

Date April 2009  
 Project 473-93-00

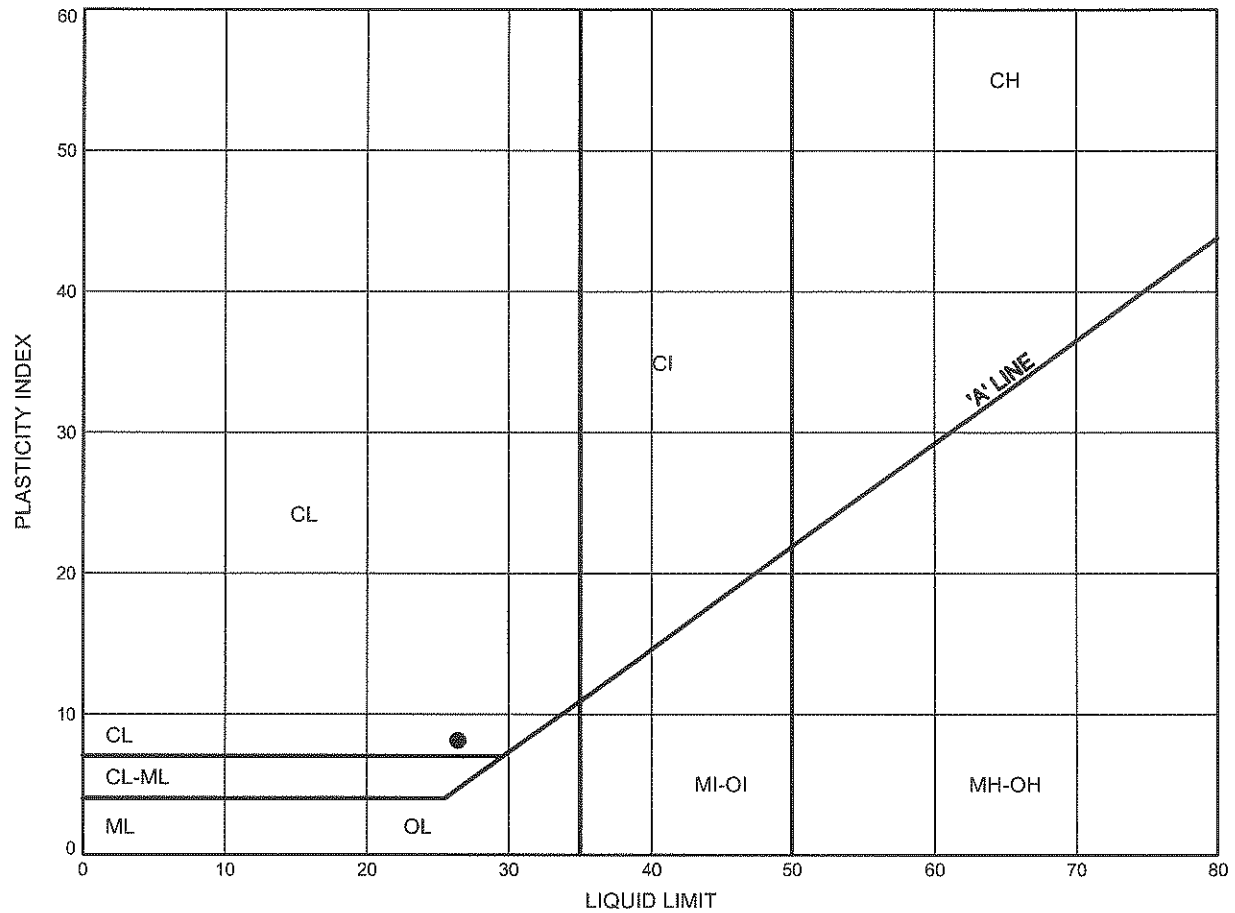


Prep'd MFA  
 Chkd. DEE

Hwy 11-Four-Laning from 0.5km N of Hwy 520 northerly 5.7km  
**ATTERBERG LIMITS TEST RESULTS**

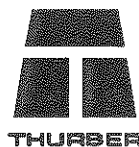
FIGURE B12

**CLAYEY SILT**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-10	1.83	302.53

Date April 2009  
 Project 473-93-00

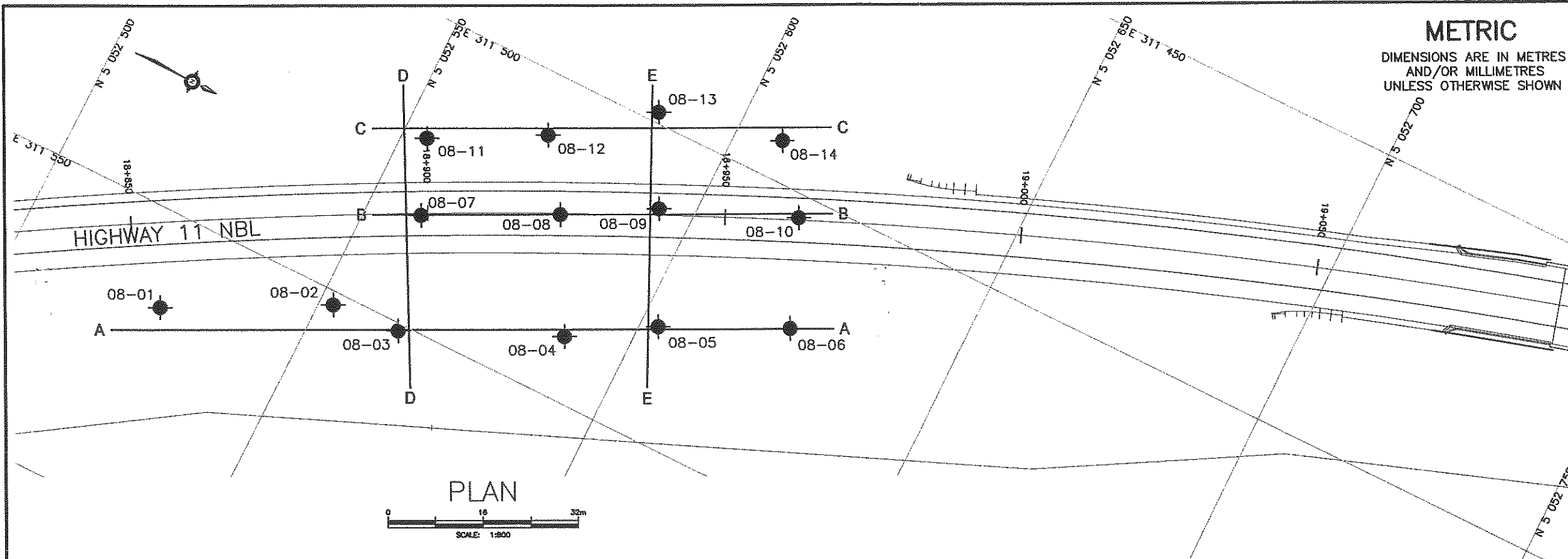


Prep'd MFA  
 Chkd. DEE

## **Appendix C**

### **Borehole Locations and Soil Strata Drawings**

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

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

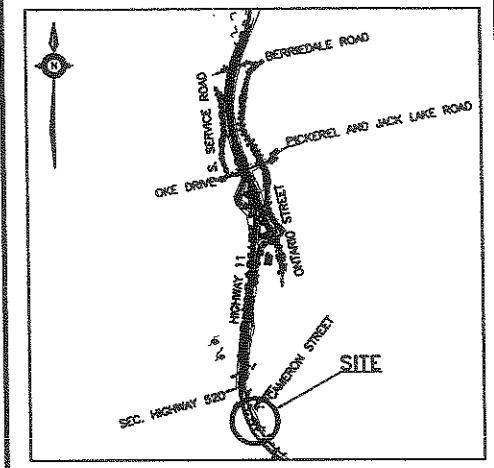
CONT No  
GWP No 473-93-00

HIGHWAY 11  
FOUR-LANING  
AT CAMERON STREET  
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP

THURBER ENGINEERING LTD.  
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

SHEET



KEYPLAN

LEGEND

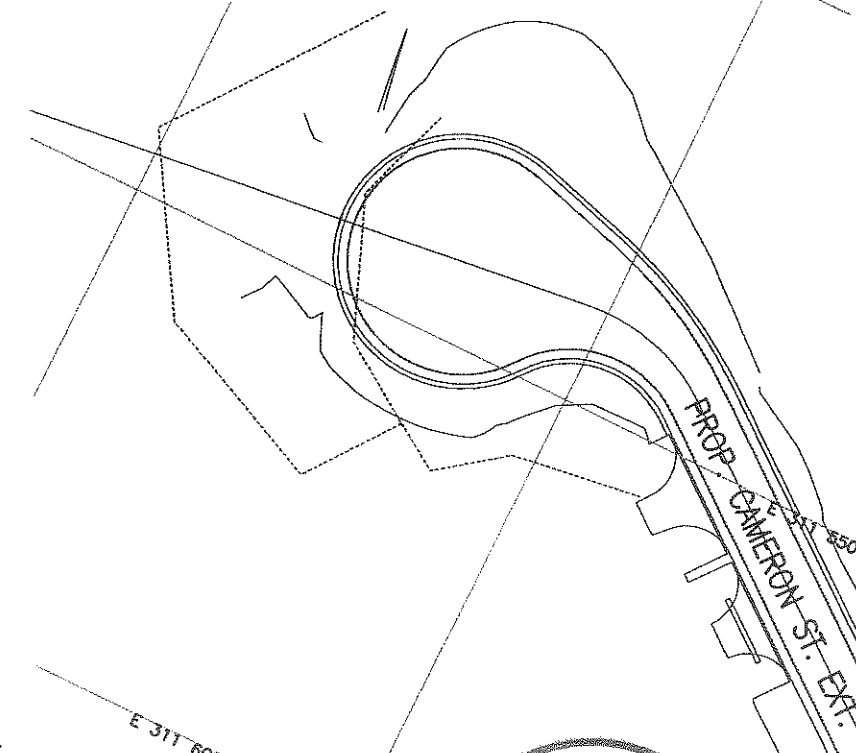
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- H Head Artesian Water
- P Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-01	304.4	5 052 526.7	311 565.6
08-02	309.8	5 052 552.3	311 552.2
08-03	310.9	5 052 564.1	311 551.2
08-04	309.6	5 052 589.5	311 539.5
08-05	308.1	5 052 603.0	311 530.9
08-06	301.6	5 052 622.9	311 521.3
08-07	309.8	5 052 558.9	311 531.9
08-08	307.9	5 052 579.8	311 521.3
08-09	305.7	5 052 594.3	311 512.9
08-10	304.4	5 052 616.0	311 503.8
08-11	308.2	5 052 554.1	311 519.7
08-12	307.0	5 052 572.0	311 510.1
08-13	303.8	5 052 587.0	311 498.2
08-14	303.9	5 052 607.7	311 493.3

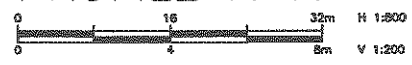
NOTES

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

GEOCRES No. 31E-298



PROFILE A-A



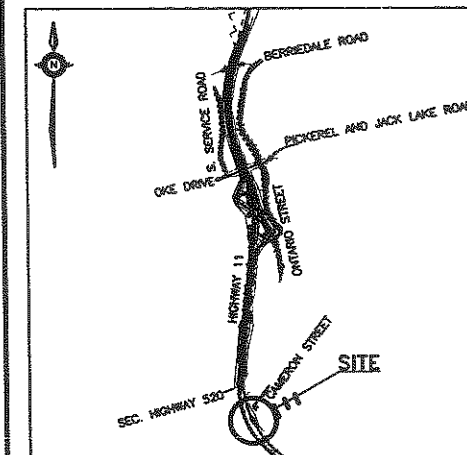
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DESIGN	DEC	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
DATE	AUG. 2009	DATE	AUG. 2009
DWG	1	INSTRUCT	DWG 1

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

CONT No  
GWP No 473-93-00

HIGHWAY 11  
FOUR-LANING  
AT CAMERON STREET  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



### KEYPLAN LEGEND

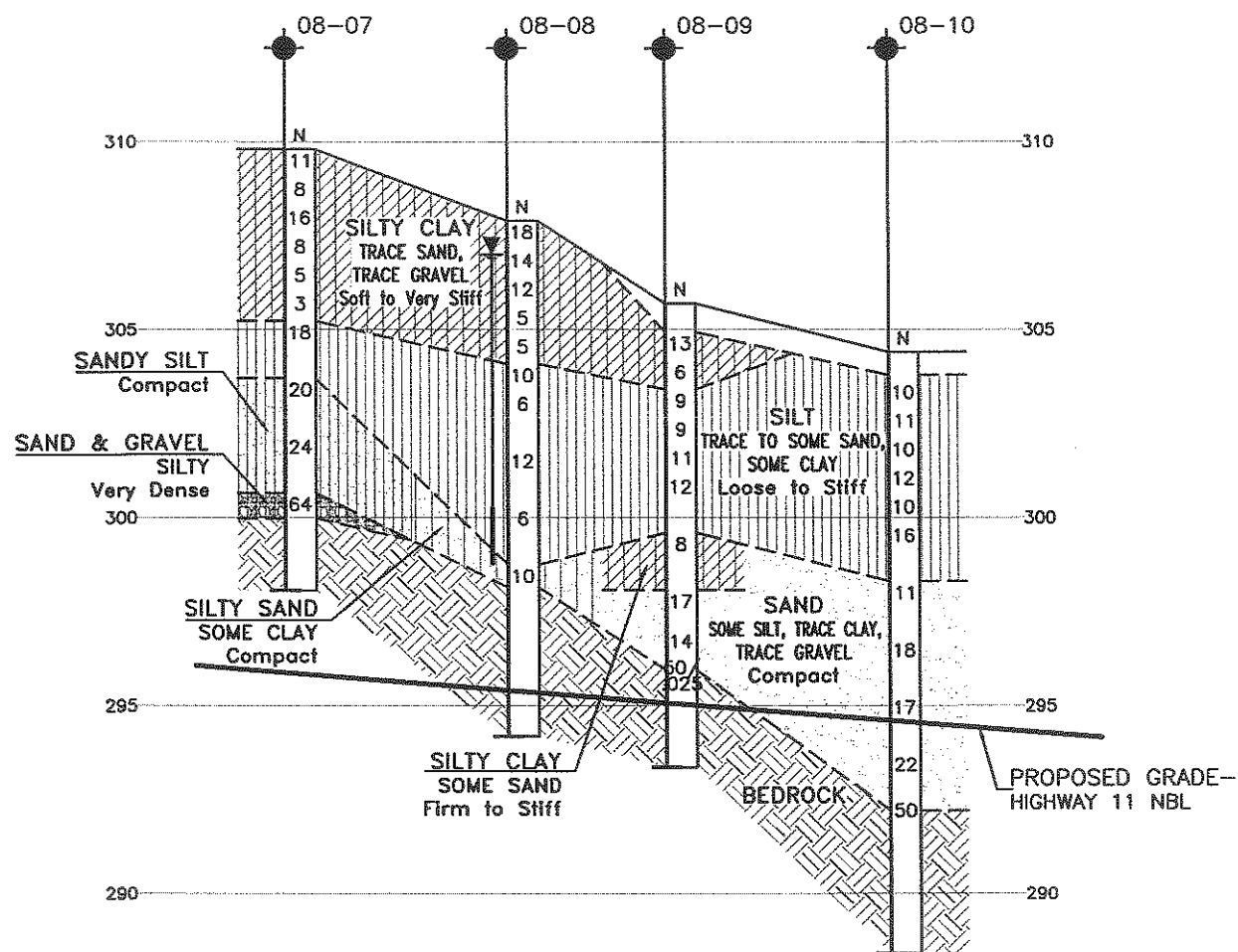
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-01	304.4	5 052 526.7	311 565.6
08-02	309.8	5 052 552.3	311 552.2
08-03	310.9	5 052 564.1	311 551.2
08-04	309.6	5 052 589.5	311 539.5
08-05	308.1	5 052 603.0	311 530.9
08-06	301.6	5 052 622.9	311 521.3
08-07	309.8	5 052 558.9	311 531.9
08-08	307.9	5 052 579.8	311 521.3
08-09	305.7	5 052 594.3	311 512.9
08-10	304.4	5 052 616.0	311 503.8
08-11	308.2	5 052 554.1	311 519.7
08-12	307.0	5 052 572.0	311 510.1
08-13	303.8	5 052 587.0	311 498.2
08-14	303.9	5 052 607.7	311 493.3

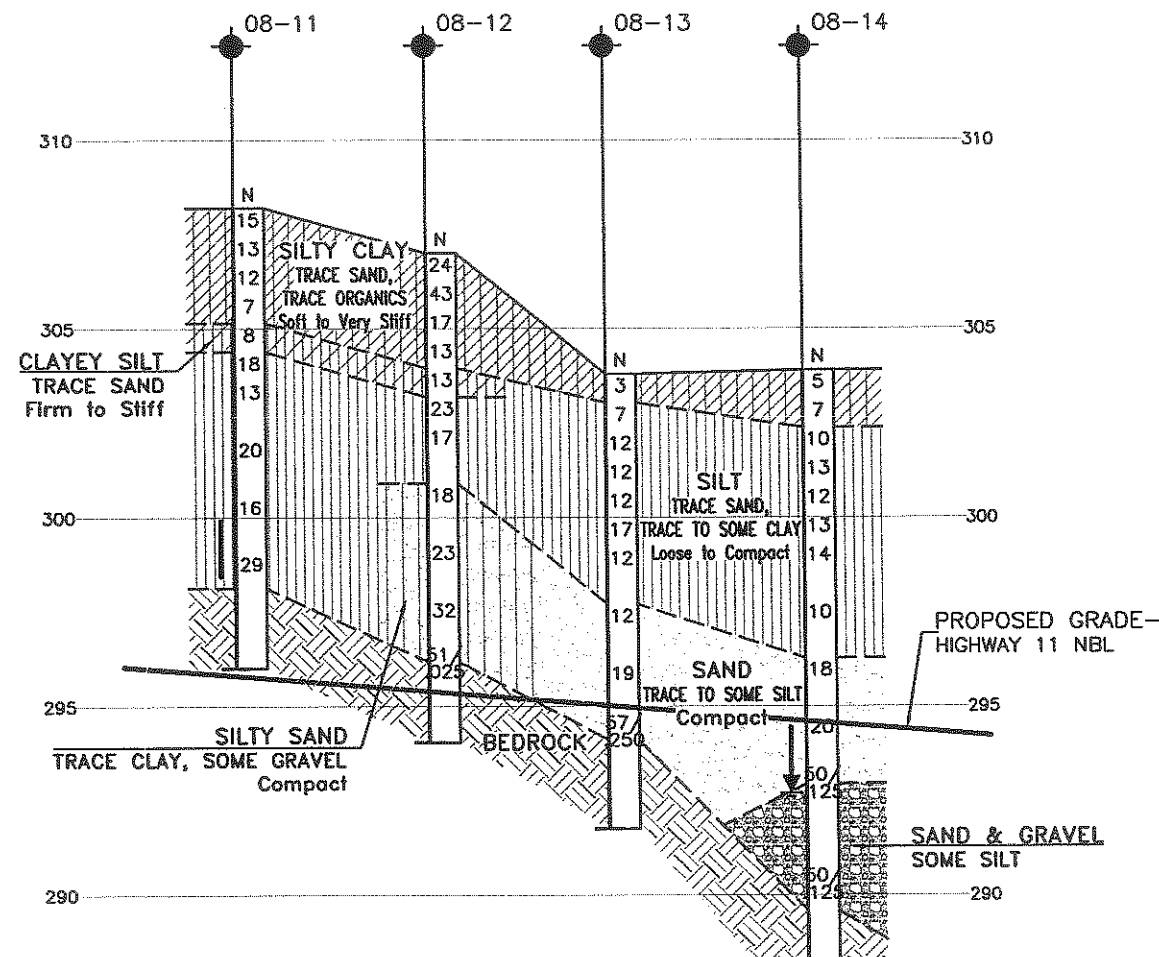
### NOTES

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

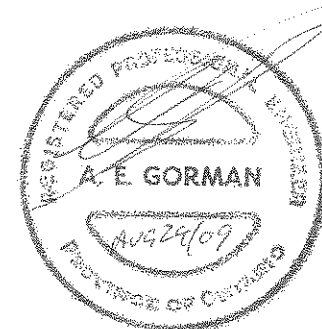
GEOCREs No. 31E-298



PROFILE B-B



PROFILE C-C



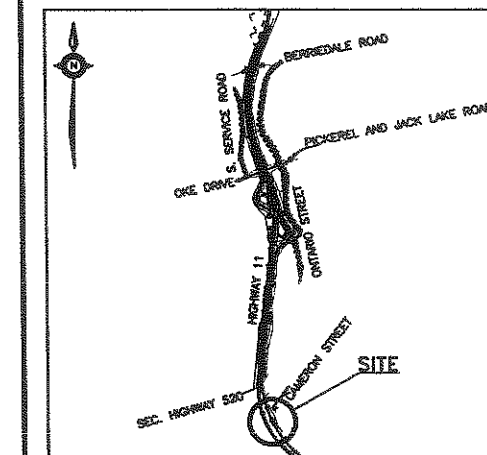
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DEE	CHK	AEG
DRAWN	MFA	CHK	PKC

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

CONT No  
GWP No 473-93-00

HIGHWAY 11  
FOUR-LANING  
AT CAMERON STREET  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



### 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
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

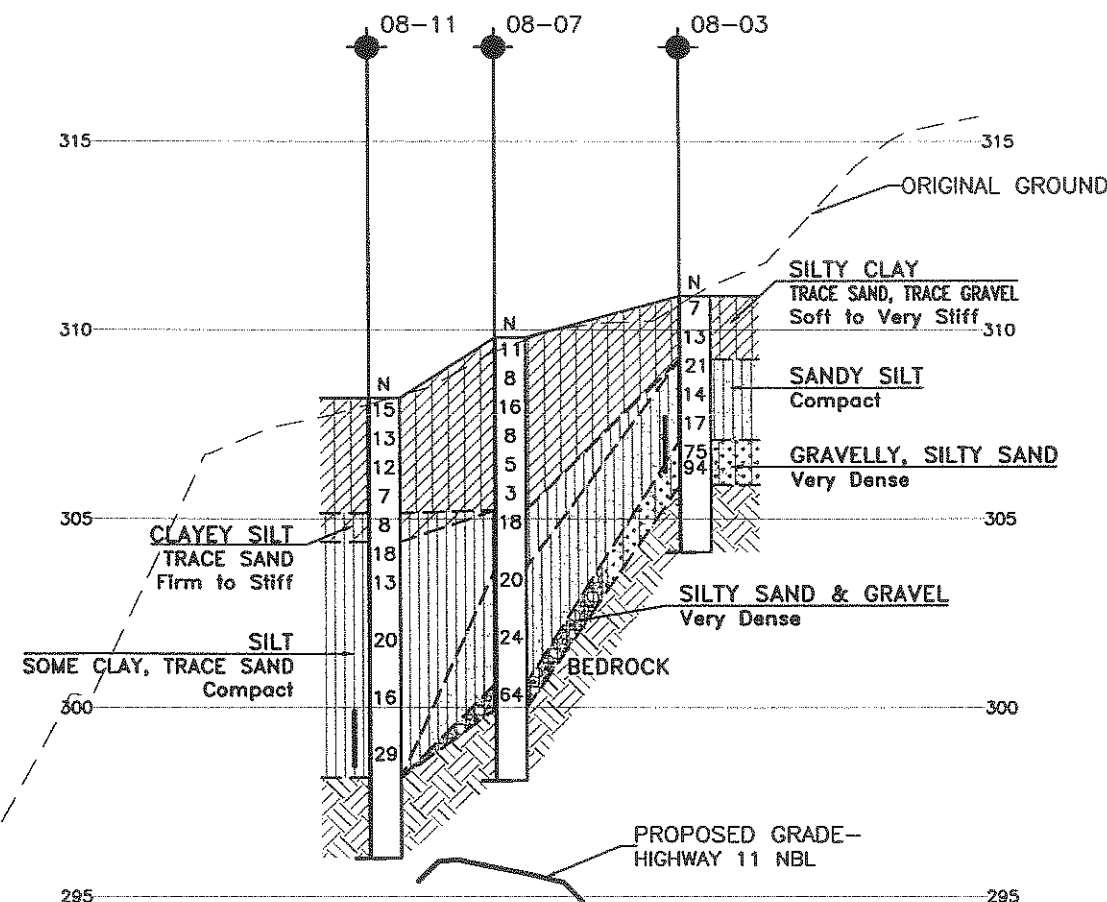
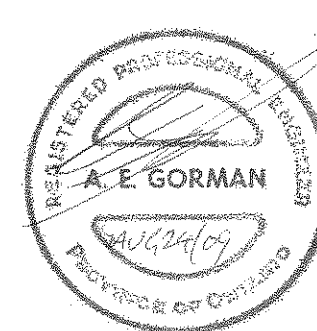
NO	ELEVATION	NORTHING	EASTING
08-01	304.4	5 052 526.7	311 565.6
08-02	309.8	5 052 552.3	311 552.2
08-03	310.9	5 052 564.1	311 551.2
08-04	309.6	5 052 589.5	311 539.5
08-05	308.1	5 052 603.0	311 530.9
08-06	301.6	5 052 622.9	311 521.3
08-07	309.8	5 052 558.9	311 531.9
08-08	307.9	5 052 579.8	311 521.3
08-09	305.7	5 052 594.3	311 512.9
08-10	304.4	5 052 616.0	311 503.8
08-11	308.2	5 052 554.1	311 519.7
08-12	307.0	5 052 572.0	311 510.1
08-13	303.8	5 052 587.0	311 498.2
08-14	303.9	5 052 607.7	311 493.3

### NOTES

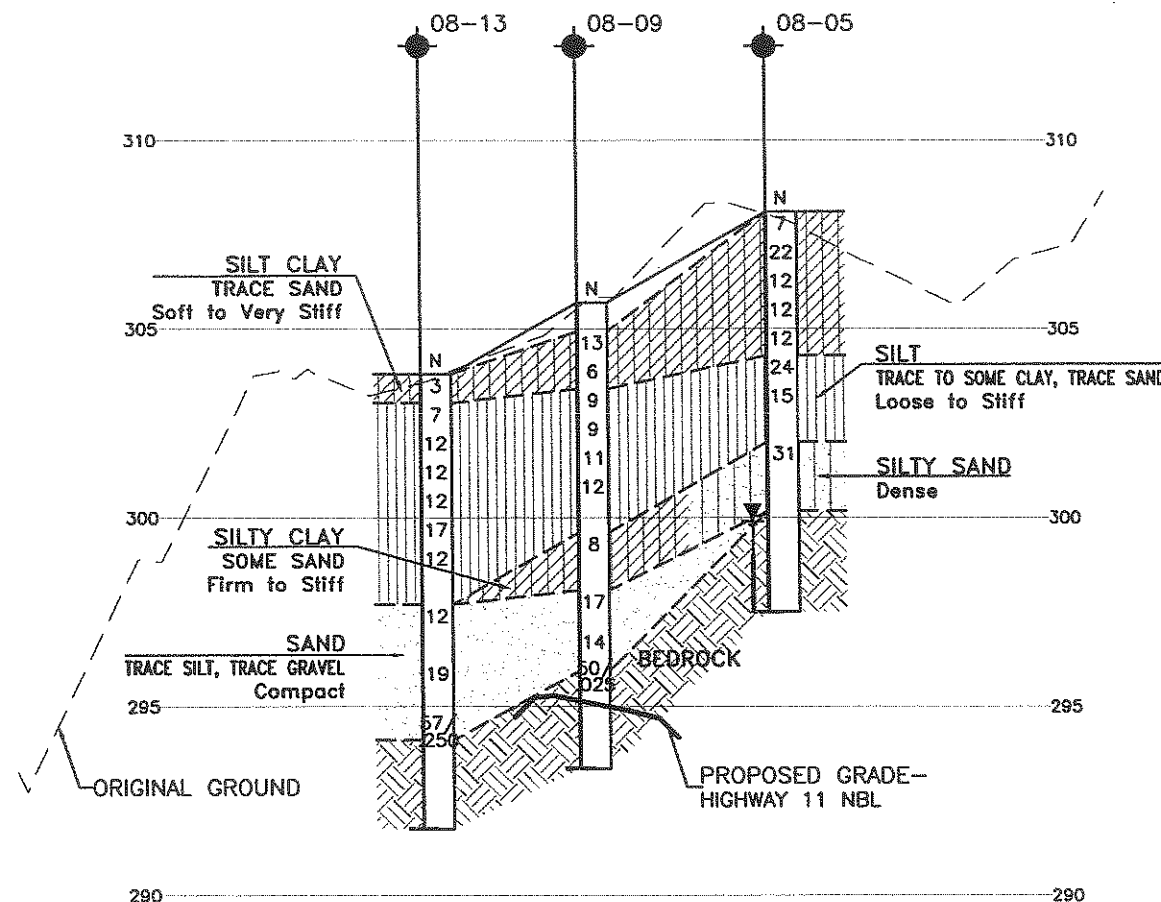
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31E-298

DATE	BY	DESCRIPTION
DESIGN	DEE	CHK AEG
DRAWN	MFA	CHK PKC
DATE	AUG. 2009	
STRUCT	DWG 3	



### SECTION D-D



### SECTION E-E

