

**FOUNDATION INVESTIGATION REPORT  
NEW AND REPLACEMENT CULVERTS  
HIGHWAY 17/417 TWINNING  
FROM LANARK ROAD 29 TO DIVISION STREET  
G.W.P. 647-92-01**

**Geocres Number: 31F-153**

**Report to**

**McCormick Rankin Corporation**

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**PART 1: FOUNDATION INVESTIGATION**

**1 INTRODUCTION**

This report presents the factual information obtained from a foundation investigation conducted at the proposed locations of new and replacement culverts along Highway 17 between Lanark Road 29 and Division Street in Renfrew County.

Trinning of Highway 17 will involve forming new eastbound lanes along the existing highway alignment and construction of new westbound lanes to the north of the existing highway. Replacement of existing culverts or installation of new culverts will be required at 12 locations including two sites outside the project limits.

The purpose of the investigation was to explore the subsurface conditions at the proposed culvert locations and, based on the data obtained, to provide borehole logs, borehole location plans, stratigraphic profiles, and written descriptions of the subsurface conditions.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a sub-consultant to McCormick Rankin Corporation (MRC), under the Ministry of Transportation Ontario (MTO) Agreement Number 4005-A-000349.

**2 SITE DESCRIPTION**

Ten of the proposed culvert sites are located along existing Highway 17 and the immediate crossroads from Division Street to Baskin Drive, south and west of the Town of Arnprior. Two of the culverts will be located about 6 km to the west of this section, at Scheel Drive and Highway 17.

The culvert sites are located within the physiographic region known as the Ottawa Valley Clay Plains, which consists of a glacio-lacustrine clay plain interrupted by east-west trending scarps and ridges of rock. The bedrock primarily consists of crystalline limestone of the Ordovician Period to the south and east of Arnprior, and limestone interbedded with metamorphosed greywacke to the west of Arnprior.

The topography is typically flat with drainage courses following areas of slight depression. Surrounding lands are typically agricultural and grassland with occasional woodlots and isolated trees. Scattered houses, commercial buildings and farm buildings are present along the highway.

The designations and approximate locations of the new and replacement culverts, as well as the size of the existing culverts to be replaced, are as follows:

**Table 1.1 – Culvert Locations**

Site Number	Location	Existing Culvert Size (m)	Embankment Height (m)
29-418/C1	Hwy 17, Sta. 28+215	6.0 x 1.6 Box	2.0
29-418/C2	Hwy 17, Sta. 28+250	-	-
29-419/C1	Hwy 17, Sta. 28+738	2 - 1.5 dia. CSPs	2.7
29-419/C2	Hwy 17, Sta. 28+738	-	-
29-420/C1	Hwy 17, Sta. 29+106	2 - 1.35 dia. CSPs	3.0
29-420/C2	Hwy 17, Sta. 29+106	-	-
29-420/C3	New N-W Ramp at White Lake Road	-	-
29-422/C1	Baskin Drive (just north of Highway 417)	2 - 1.2 dia. CSPs	1.5
29-422/C2	Hwy 17, Sta. 29+825	-	-
29-422/C3	Hwy 17, Sta. 29+785	1.8 dia. CSP	3.2
29-413/C3	Scheel Drive	2.4 dia. CSP	3.0
29-416/C	Dochart Creek East Tributary	-	-

### 3 INVESTIGATION PROCEDURES

#### 3.1 Field Investigation

The initial site investigation and field testing for this project were carried out between May 10 and June 1, 2005 and consisted of drilling three boreholes at each of ten culvert locations and two boreholes at another culvert location (Baskin Drive). The boreholes were terminated upon meeting auger refusal on probable bedrock at depths ranging from 1.8 to 18.8 m. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings in Appendix C.

A supplementary field investigation was subsequently carried out during the period January 17 to 27, 2006 and included four boreholes drilled to auger refusal at two revised culvert locations (Sites 29-420/C1 and 29-422/C1), two boreholes to refusal at the location of a culvert not identified in the original Terms of Reference (Site 29-422/C3), and coring of the bedrock in three boreholes previously drilled at two culvert locations (Sites 29-418/C1 and C2). Information from a borehole drilled for the High Mast Light Foundation Investigation (borehole P9) was also used for the current study. The additional borehole locations are shown on the drawings in Appendix C.

In general, the proposed locations of the ends and middle of the culverts were staked in the field by MRC. Where locations were not staked, the boreholes were positioned in the field by Thurber personnel relative to site features shown on the site plans provided. The locations and elevations were subsequently established by MRC.

George Downing Estate Drilling Limited supplied and operated the drilling and sampling equipment used for the investigation. Hollow stem augers were used to advance the boreholes and samples were obtained using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). In situ vane shear testing was carried out to assess the undrained shear strength of soft to firm cohesive deposits. Samples of the firm soils were also obtained using a thin-walled (Shelby) tube sampler.

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor recorded the borehole stratigraphy, logged the recovered samples, and transported the labelled samples to Thurber's laboratory. The groundwater conditions in the boreholes were observed during drilling.

A 3.1 to 3.4 m length of rock core was obtained from four boreholes (boreholes 29-418/C1S(A), C2S(A), C2N(A), and borehole P9) using NQ rock coring equipment. The recovered rock core was described in the field, packaged in core boxes, and returned to our laboratory for examination and testing.

Standpipe piezometers consisting of 19 mm PVC pipe were installed in selected boreholes to monitor groundwater levels. The piezometer installation details are shown on the borehole logs, Appendix A. The boreholes were backfilled with bentonite grout to the ground surface.

### **3.2 Laboratory Testing**

All recovered soil samples were subjected to visual identification and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A.

Selected samples were subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing where appropriate. The test results are shown on the Record of Borehole sheets in Appendix A and on the figures in Appendix B.

Laboratory consolidation testing was carried out on one sample of the cohesive soil recovered from the boreholes (borehole 29-422/C2M, 4.9 to 5.2 m depth). The results are provided in Appendix B. Laboratory oedometer tests were also conducted on four samples of the cohesive soils from the White Lake Road area during the Foundation Investigation for the High Embankments (GeoCres No. 31F-150). As subsurface conditions are consistent throughout the area, the oedometer results for the high embankment study are considered representative of the soils at the culvert sites.

The recovered rock core samples were subjected to Point Load Testing to assist evaluation of the compressive strength of the bedrock.

## 4 DESCRIPTION OF SUBSURFACE CONDITIONS

### 4.1 General

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A and the Borehole Locations and Soil Strata Drawings in Appendix C. A generalized description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the borehole logs takes precedence over this general description and interpretation of the site conditions. Subsurface conditions may vary between borehole locations.

In general terms, the soil stratigraphy encountered at the culvert locations consists of a surficial fill or topsoil layer underlain by silty clay that mantles probable bedrock.

More detailed descriptions of the individual strata are presented below.

### 4.2 Topsoil and Peat

Topsoil was encountered surficially in most boreholes. The topsoil layer ranged in thickness from 75 to 300 mm, typically 200 to 300 mm, in boreholes that did not encounter fill. In the boreholes that encountered fill, the topsoil was present as a 50 to 100 mm thick layer (200 mm in one borehole) overlying the fill.

In borehole 29-420/C3S, a 300 mm thick layer of peat was encountered at the ground surface. A moisture content of 96% was measured in this layer.

### 4.3 Sand and Gravel Fill, Sand Fill, and Silty Clay Fill

Fill was encountered as sand and gravel in boreholes drilled on the shoulder of Highway 17, as sand in boreholes drilled on Baskin and Scheel Drives, and as regraded silty clay in boreholes drilled off of the roads.

The sand and gravel fill encountered on the highway shoulder (boreholes 29-418/C1M, 29-419/C1M and 29-420/C1M) extended to depths of 1.1 to 2.2 m. SPT N-values obtained in the granular material ranged from 9 to 29 blows/0.3 m of penetration, indicating a loose to compact condition. In borehole 29-419/C1M, the sand and gravel was underlain by a further 1.1 m of compact sand fill (N=18 and 10 blows/0.3 m) to 2.2 m depth. In borehole 29-420/C1M, the sand and gravel was underlain by 0.8 m of firm silty clay fill and a further 0.2 m of very loose sand fill, to a total fill depth of 3.2 m. Moisture contents in the granular material ranged from 2 to 7%.

Borehole 29-422/C1M drilled on the shoulder of Baskin Drive encountered 1.5 m of loose sand fill (N=6). A 3.0 m thick layer of compact sand fill (N=26) with cobbles was encountered below a surficial 25 mm asphalt layer in borehole 29-413/C3M drilled on Scheel Drive.

Silty clay fill was encountered below the surficial topsoil in four boreholes drilled at Site 29-419 and in two boreholes (boreholes 29-420/C1N and 29-422/C1S) drilled at other

sites. The clay fill extended to depths of 0.2 to 1.4 m. The consistency of the cohesive fill ranged from firm to very stiff based on SPT N-values ranging from 5 to 19 blows/0.3 m. Moisture contents varied from about 10 to 40%.

A 1.5 m thick deposit of compact sand fill (N=13 and 24) was encountered at one isolated location (borehole 29-420-C2S).

#### 4.4 Silty Clay to Clayey Silt

The predominant soil deposit at the culvert sites comprises cohesive silty clay that was encountered in all boreholes either surficially or below the upper fill and topsoil layers. The clay deposit ranged in thickness from 1.5 to 16.6 m and was underlain by till or probable bedrock at depths of 1.8 to 18.8 m.

The upper 0.7 to 0.8 m of the clay deposit was dark brown and soft to firm below the fill in boreholes 29-418/C1M, 29-422/C1M and 2-422/C1S. This may indicate intermixing or placement of topsoil within the original roadbed or organic materials developed in former wet depressed areas.

SPT N-values obtained in the clay generally decreased with depth, ranging from 19 blows/0.3 m to 0 (self-weight of hammer). The shear strength of the clay measured by in situ vane testing generally follows this pattern, with values ranging from 110 to 26 kPa, typically 40 to 90 kPa. Based on the vane results, the consistency of the clay varies from stiff to firm.

The results of consolidation testing conducted on a sample of the silty clay (BH29-422/C2M) are included in Appendix B and summarized in Table 4.1. Results from previous testing conducted in the area during the High Embankments Investigation are included in the table.

**Table 4.1 – Consolidation Test Parameters**

Borehole	Sample Depth (m)	w (%)	$\gamma$ (kN/m <sup>3</sup> )	$e_o$	$P_o'$ (kPa)	$P_c'$ (kPa)	OCR	$C_c$	$C_r$
29-422/C2M	4.9-5.2	47	17.3	1.29	52	200	3.8	0.70	0.050
High Embankments at White Lake Road Interchange	4.6-5.2	53	16.8	1.47	45	260	5.8	1.05	0.035
	4.6-5.2	38	18.4	1.05	60	180	3.0	0.45	0.085
	6.4-6.7	47	17.7	1.29	70	170	2.4	0.85	0.110
	8.5-9.1	52	16.8	1.48	100	180	1.8	0.92	0.045

The results of grain size distribution analyses conducted on the silty clay are presented on Figures B1 to B7, Appendix B. The percentage of clay size particles ranged from 32 to 59%. The results of Atterberg Limits tests conducted on the clay, presented on Figures B9 to B17, indicate significant variation in plasticity, from low (clayey silt) to high plastic

(silty clay). The Plastic Limit ranged from 16 to 30 (typically 18 to 23), and the Liquid Limit ranged from 28 to 67 (typically about 35 to 55). Moisture contents in the clay typically ranged from 30 to 60%.

#### 4.5 Silty Clay Till to Sand Till

Glacial till deposits were encountered below the silty clay unit in 13 boreholes. The upper boundary of the till was encountered at depths of 2.7 to 14.0 m, and the till mantled probable bedrock at depths of 2.9 to 16.6 m. The thickness of the till deposit encountered in the boreholes ranged from 0.2 to 4.0 m.

The composition of the till varied from cohesive silty clay (borehole 29-422/C2M) to non-cohesive sand (borehole 29-419/C2N), typically clayey to sandy silt. Where driven a full 0.3 m, SPT N-values in the till ranged from 2 to 13 blows/0.3 m, indicating a loose to compact/soft to stiff condition. In borehole 29-413/C3N, N-values ranged from 16 to 32 blows/0.3 m, indicating a very stiff to hard condition. N-values exceeding 50 blows/0.3 m were encountered immediately above the refusal depths in many boreholes, indicating very dense material or driving on cobbles, boulders or bedrock.

Cobbles were encountered in the till in several boreholes. Cobbles and boulders are common in glacial tills and should be anticipated.

Grain size distribution curves and Atterberg Limits results for samples of the till are presented in Figures B8 and B18, respectively.

#### 4.6 Probable Bedrock

Refusal was met on probable bedrock below the silty clay and till deposits in all boreholes. The depth to refusal ranged from 1.8 to 18.8 m with the depths at individual culvert sites varying as follows:

**Table 4.1 – Depth to Probable Bedrock**

Site Number	Probable Bedrock	
	Depth (m)	Elevation (m)
29-418/C1	2.9 to 13.1	94.7 to 104.4
29-418/C2	3.8 to 15.2	91.8 to 102.9
29-419/C1	8.5 to 18.8	89.4 to 97.9
29-419/C2	8.8 to 10.1	96.6 to 98.3
29-420/C1	5.8 to 8.7	99.9 to 101.5
29-420/C2	3.4 to 7.6	98.7 to 102.6
29-420/C3	1.8 to 2.1	103.4 to 103.7
29-422/C1	4.2 to 6.1	98.4 to 99.6
29-422/C2	6.8 to 10.8	94.5 to 96.5
29-422/C3	6.8 to 16.6	87.2 to 94.7
29-413/C3	5.2 to 7.3	108.0 to 111.4
29-416/C	4.3 to 5.8	110.3 to 111.8

A 3.1 to 3.4 m length of rock core was recovered from four boreholes (boreholes 29-418/C1S(A), C2N(A) and C2S(A), and borehole P9). The bedrock consists of crystalline limestone described as fresh to slightly weathered, very thinly to thinly bedded, and whitish grey with black banding.

Core recovery was 97 to 100% and measured RQD values ranged from 51 to 100%, indicating a fair to excellent quality rock. The unconfined compressive strength of the rock cores, assessed from the results of Point Load testing, ranged from 67 to 148 MPa, indicating strong to very strong rock.

Bedrock was not proven by coring at the remaining culvert locations and therefore the possibility exists that refusal was met on cobbles and boulders in some boreholes.

#### 4.7 Water Levels

Upon completion of drilling, water was measured at depths of 0.5 to 9.4 m in 26 of the 38 boreholes drilled. The groundwater levels measured in the piezometers installed in the boreholes are summarized in Table 4.2.

**Table 4.2 – Piezometer Water level Readings**

Borehole	Date	Water Level Measured in Piezometer	
		Depth (m)	Elevation
29-418/C1S	01-June-2005	1.22	106.1
29-418/C2S	01-June-2005	0.44	106.6
29-419/C1N	19-May-2005	4.55	101.9
	01-June-2005	2.60	103.8
29-419/C2N	19-May-2005	4.35	102.5
	01-June-2005	2.65	104.2
29-420/C1S	19-May-2005	1.42	105.6
	01-June-2005	1.95	105.1
29-420/C2M	19-May-2005	1.32	105.3
	01-June-2005	1.19	105.4
29-420/C3S	19-May-2005	0.15	105.4
	01-June-2005	0.31	105.2
29-422/C1S	01-June-2005	1.23	103.0
29-422/C2M	01-June-2005	1.68	103.5
29-413/C3N	01-June-2005	0.00	115.3
29-416/C1M	01-June-2005	0.00	116.1

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.

## 5 MISCELLANEOUS

Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. George Azzopardi and Mr. Stephane Loranger of Thurber.

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

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



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



**Appendix A**

**Record of Borehole Sheets**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <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

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


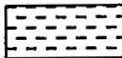



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (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

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
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)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
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.

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
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.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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 29-418/C1N

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 831.2 E 314 075.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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			20	40						60	80	100	20
107.8																		
0.0	TOPSOIL (250mm)																	
107.5																		
0.3	Silty CLAY, trace sand Stiff Brown Moist																	
			1	SS	13		107											
			2	SS	10		106											
							105											
	Firm, grey, wet		3	SS	5		104											
							103											
			4	SS	2		102											
							101											
			5	SS	1		100											
							99											
			1	TH	PH		98											
			6	SS	1													

Continued Next Page

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-418/C1N

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 831.2 E 314 075.4 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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 (%)  GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20   40   60   80   100	W P                      W                      W L						
						○ UNCONFINED      + FIELD VANE									
						● QUICK TRIAXIAL      × LAB VANE									
						20   40   60   80   100	20   40   60								
95.8			7	SS	1		97							0   4   52   44	
12.0	Sandy SILT, some clay, trace gravel and cobbles Loose Grey Wet (TILL)		8	SS	4		96								
94.7							95								
13.1	END OF BOREHOLE AT 13.11 m. AUGER REFUSAL AT 13.11 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.														

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

# RECORD OF BOREHOLE No 29-418/C1M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 835.0 E 314 034.0 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 19.05.05 - 19.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
109.1													
0.0	<b>SAND and GRAVEL</b> Loose Brown Moist (FILL)		1	SS	9		109						
107.7							108						
1.4	Silty <b>CLAY</b> , trace of roots and wood fragments, topsoil stained Firm Dark Brown Moist		2	SS	4		107						
106.9							106						
2.2	Silty <b>CLAY</b> , trace sand Stiff to Firm Brown Moist		3	SS	8		105						
			4	SS	5		104						
							103						
	Grey, Wet		5	SS	2								
	occasional cobbles		6	SS	50/								
102.8													
6.3	END OF BOREHOLE AT 6.30 m. AUGER REFUSAL AT 6.30 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 5.79 m AND WATER LEVEL AT 5.33 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE												

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-418/C1S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 828.3 E 314 026.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 30.05.05 - 30.05.05 CHECKED BY MRA

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			20	40	60	80	100		
107.3														
0.0	TOPSOIL (200mm)													
0.2	Silty CLAY, trace sand Firm Brown Moist		1	SS	6		107							
			2	SS	7		106							
							105							
104.6														
2.7 104.4	Sandy SILT, some clay (TILL)													
2.9	END OF BOREHOLE AT 2.95 m. AUGER REFUSAL AT 2.95 m ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.22 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) 01/06/05 1.22													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-418/C1S(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 828.3 E 314 026.4 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM  
 DATUM Geodetic DATE 19.01.06 - 19.01.06 CHECKED BY MRA

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			W <sub>P</sub>	W	W <sub>L</sub>		
107.3							20	40	60	80	100				
0.0	See Record of Borehole No.29-418/C1S														
104.0															
3.3	<b>CRYSTALLINE LIMESTONE BEDROCK.</b> Fresh to slightly weathered, very thinly to thinly bedded, whitish grey with black banding  Subvertical joint at 4.17 to 4.24 m  Vertical joint at 4.40 to 4.75 m		1	RUN											
			2	RUN											
			3	RUN											
100.8															
6.5	END OF BOREHOLE AT 6.48 m. BOREHOLE GROUTED TO SURFACE.														

ONTMT4S 5182-PHASE II.GPJ 15/03/06

# RECORD OF BOREHOLE No 29-418/C2N

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 850.7 E 314 107.7 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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			20	40	60	80	100		
106.7														
0.0 106.4	TOPSOIL (250mm)													
0.3	Silty CLAY, trace sand Stiff to Firm Brown Moist													
			1	SS	11		106							
			2	SS	9		105							0 1 40 59
							104							
			3	SS	4		103							
102.9 3.8	END OF BOREHOLE AT 3.83 m. AUGER REFUSAL AT 3.83 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 3.66 m AND WATER LEVEL AT 0.84m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-418/C2N(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 850.7 E 314 107.7 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM  
 DATUM Geodetic DATE 17.01.06 - 17.01.06 CHECKED BY MRA

SOIL PROFILE		SAMPLES				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		20	40	60	80	100		
106.7 0.0	See Record of Borehole No.29-418/C2N												
101.4 5.3	CRYSTALLINE LIMESTONE BEDROCK, Fresh to slightly weathered, very thinly to thinly bedded, whitish grey with black banding		1	RUN									
			2	RUN									
			3	RUN									
98.0 8.7	END OF BOREHOLE AT 8.66 m. BOREHOLE GROUTED TO SURFACE.												

+ 3, x 3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

ONTMT4S 5182-PHASE II.GPJ 15/03/06

# RECORD OF BOREHOLE No 29-418/C2M

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 845.1 E 314 092.6 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
106.8														
0.0	TOPSOIL (225mm)													
0.2	Silty CLAY, trace sand Stiff Brown Moist		1	SS	14		106							
			2	SS	11		105							
							104							
	Firm, Grey, Wet		3	SS	4		103							
			4	SS	2		102							0 6 54 40
							101	3.3						
			5	SS	1		100	3.7						
							99							
	occasional cobbles		6	SS	2		98							
97.8														
9.0	END OF BOREHOLE AT 9.04 m. AUGER REFUSAL AT 9.04 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 8.38 m AND WATER LEVEL AT 1.96 m UPON													

Continued Next Page

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-418/C2M

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 845.1 E 314 092.6 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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 (%) GR SA SI CL
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>			
	COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.															

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-418/C2S

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 839.5 E 314 077.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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	20 40 60 80 100						
107.0													
0.0	TOPSOIL (225mm)												
0.2	Silty CLAY, trace sand Very Stiff to Stiff Brown Moist		1	SS	16								
			2	SS	13								
			3	SS	6								
	Firm, Grey, Wet		4	SS	2								
			5	SS	1								
			6	SS	1								
			7	SS	1								

ONTMT4S 5182CUVERTS.GPJ 04/10/05

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-418/C2S

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 839.5 E 314 077.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 25.05.05 - 25.05.05 CHECKED BY MRA

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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)					
							20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>			
95.1			8	SS	0												
11.9	Clayey SILT, trace gravel and cobbles, some sand seams Stiff Grey Wet (TILL)		9	SS	12												0 5 48 47
94.1																	
12.9	END OF BOREHOLE AT 12.93 m. AUGER REFUSAL AT 12.93 m ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) 01/06/05 0.44																



**METRIC**[illegible]

# RECORD OF BOREHOLE No 29-419/C1N

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 460.9 E 314 420.0 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100					
106.4	TOPSOIL (50mm)													
106.1	Silty CLAY, trace sand, occasional rootlets, occasional cobble		1	SS	6									
0.3	Firm													
	Brown (FILL)													
	Silty CLAY, trace sand		2	SS	16									
	Very Stiff to Stiff													
	Brown-Grey													
	Becoming Firm, Grey		3	SS	8									
			4	SS	4									
			5	SS	2									
			6	SS	2									
			7	SS	1									
97.9	END OF BOREHOLE AT 8.54 m. AUGER REFUSAL AT 8.54 m ON PROBABLE BEDROCK OR BOULDER.													
8.5	Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.													
	WATER LEVEL READINGS:													

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

ONTMT4S 5182CUVERTS.GPJ 04/10/05

RECORD OF BOREHOLE No 29-419/C1N

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 460.9 E 314 420.0 ORIGINATED BY GA  
HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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			20 40 60 80 100	W P	W	W L	20 40 60					
	DATE DEPTH(m) 19/05/05 4.55 01/06/05 2.60																

UNIM14S 518ZCUVERTS.GPJ 04/10/05

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-419/C1M

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 436.2 E 314 397.6 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 19.05.05 - 19.05.05 CHECKED BY MRA

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						
108.2														
0.0	SAND and GRAVEL Compact Brown Moist (FILL)													
107.1			1	SS	18									
1.1	SAND, trace silt, trace gravel Compact Brown Moist (FILL)		2	SS	10									
106.0														
2.2	Silty CLAY, trace sand Stiff to Firm Brown		3	SS	9									
			4	SS	5									
			5	SS	1									
			6	SS	1									
			7	SS	1									
			8	SS	1									

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-419/C1M

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 436.2 E 314 397.6 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 19.05.05 - 19.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub>		
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) 20 40 60		
			9	SS	1		98	+				
							97					
			10	SS	WH		96					
							95	+				
			11	SS	WH		94	+				
							93					
			12	SS	WH		92	+				
							91					
			13	SS	1		90					
			14	SS	18							
89.4 18.8	END OF BOREHOLE AT 18.82 m. AUGER REFUSAL AT 18.82 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 17.07 m WATER LEVEL AT 6.25 m UPON COMPLETION. BOREHOLE GROUTED.											

UN:MT4S 5182CUVERTS.GPJ 12/10/05

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-419/C1S

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 429.0 E 314 388.5 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 11.05.05 - 11.05.05 CHECKED BY MRA

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 × LAB VANE	WATER CONTENT (%)					
106.2														
0.0	Silty CLAY, trace sand, occasional rootlets Stiff Brown Moist		1	SS	9		106							
			2	SS	9		105							
			3	SS	12		104							
	Becoming Firm, Grey		4	SS	2		103	3.3						0 0 50 50
			5	SS	2		102	4.7						
			6	SS	2		101	3.7						
			7	SS	1		100	4						
			8	SS	2		99							
							98							
							97							

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

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-419/C1S

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 429.0 E 314 388.5 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 11.05.05 - 11.05.05 CHECKED BY MRA

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			20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60				
89.6			9	SS	2			4					
			10	SS	2								
			11	SS	2			3.7					
			12	SS	14								
16.6	Becoming Stiff												
	END OF BOREHOLE AT 16.59m. AUGER REFUSAL AT 16.59m ON PROBABLE BEDROCK. BOREHOLE OPEN TO BOTTOM UPON COMPLETION. WATER LEVEL IN OPEN BOREHOLE AT 8.7m DEPTH UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.												

ONTMT4S 5182CUVERTS.GPJ 04/10/05

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-419/C2N

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 488.0 E 314 439.6 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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					
106.8								20 40 60 80 100					
0.0	TOPSOIL (50mm)							○ UNCONFINED + FIELD VANE					
0.1	Silty CLAY, some sand, occasional gravel, occasional rootlets, occasional cobbles		1	SS	10			● QUICK TRIAXIAL x LAB VANE					
106.0	Stiff							20 40 60 80 100					
0.8	Brown (FILL)												
	Silty CLAY, trace sand		2	SS	12		106						
	Stiff												
	Mottled Brown/Grey		3	SS	13		105						
	Becoming Firm		4	SS	4		104						
							103						
	Becoming Grey		5	SS	2		102						
							101						
							100						
							99						
							98						
97.8													
97.0	SAND, trace silt, trace gravel		8	SS	50/								
97.6	Reddish Grey (TILL)												
9.2	END OF BOREHOLE AT 9.19 m. AUGER REFUSAL AT 9.19m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 9.19 m.				.050								

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-419/C2N

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 488.0 E 314 439.6 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100					
	WATER LEVEL IN OPEN BOREHOLE AT 1.83 m DEPTH UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) 19/05/05 4.35 01/06/05 2.65													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-419/C2M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 476.3 E 314 427.2 ORIGINATED BY GA  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 18.05.05 - 18.05.05 CHECKED BY MRA

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								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
107.1							20	40	60	80	100					
0.0 0.1	TOPSOIL (75mm) Silty CLAY, sandy, trace gravel, occasional rootlets, occasional cobbles Very Stiff Brown		1	SS	19											
106.5 0.6	(FILL) Silty CLAY, trace sand Stiff Brown		2	SS	13											
			3	SS	9											
	Becoming Firm, Grey		4	SS	10											
			5	SS	4											
			6	SS	2											
			1	TW	PH											
98.3 8.8	END OF BOREHOLE AT 8.84 m. AUGER REFUSAL AT 8.84 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 8.84 m AND WATER LEVEL AT 2.44 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.															

ONTMT4S 5182CUVERTS.GPJ 12/10/05

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



# RECORD OF BOREHOLE No 29-419/C2S

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 466.5 E 314 417.1 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 18.05.05 - 18.05.05 CHECKED BY MRA

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			20	40	60	80	100					
96.6 10.1	END OF BOREHOLE AT 10.06 m. AUGER REFUSAL AT 10.06 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 10.06 m AND WATER LEVEL AT 1.83 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.	ZZZ															
							96										

# RECORD OF BOREHOLE No 29-420/C1N

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 241.6 E 314 709.0 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 16.05.05 - 16.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
107.3													
0.0 0.1	TOPSOIL (75mm) Silty CLAY, trace sand, occasional rootlets Stiff Brown (FILL)		1	SS	13		107						
106.5													
0.8	Silty CLAY, trace sand Very Stiff to Stiff Brown		2	SS	20		106						
			3	SS	12		105						
			4	SS	6		104						
							103						
	Becoming Firm, Grey		5	SS	2		102						
101.5													
5.8	END OF BOREHOLE AT 5.79 m. AUGER REFUSAL AT 5.79 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 5.79 m AND WATER LEVEL AT 5.49 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.												

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-420/C1M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 217.0 E 314 696.0 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 19.05.05 - 19.05.05 CHECKED BY MRA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
108.5								20 40 60 80 100						
0.0	SAND, trace gravel Compact Brown Moist (FILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
			1	SS	29		108							
			2	SS	20		107							
106.3														
2.2	Silty CLAY Firm Brown (FILL)		3	SS	6		106							
105.5														
3.0	SAND, trace silt Very Loose Brown Moist (FILL)		4	SS	2		105							
105.3	Silty CLAY, some sand seams Firm Grey													
3.2														
			5	SS	2		104							
			6	SS	1		102							0 4 48 48
			7	SS	1		101							
99.8							100							
8.7	END OF BOREHOLE AT 8.66 m. AUGER REFUSAL AT 8.66 m ON PROBABLE BEDROCK. BOREHOLE OPEN TO 8.66 m AND DRY UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-420/C1M(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 223.0 E 314 669.0 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 26.01.06 - 26.01.06 CHECKED BY MRA

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						
107.8								20	40	60	80	100		
0.0	TOPSOIL: (150 mm)													
0.2	Silty CLAY, trace sand seams Very Stiff to Firm Brown													
			1	SS	17		107							
			2	SS	15		106							
	Becoming Grey		3	SS	7		105							0 1 44 55
			4	SS	3		104							
	Wet		5	SS	3		103							
							102							
			6	SS	1		101							0 3 61 36
100.5														
7.3	END OF BOREHOLE AT 7.26 m. AUGER REFUSAL AT 7.26 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 6.76 m AND WATER LEVEL AT 0.46 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.													

ONTMT4S 5182-PHASE II.GPJ 14/03/06

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

20  
15  
10

(%) STRAIN AT FAILURE

**METRIC**

SOIL PROFILE						DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE			$\gamma$	% GR SA SI C	
107.0										
0.0	TOPSOIL (150mm)									
0.2	Silty CLAY, trace sand, occasional rootlets, occasional oxide staining Stiff Grey		1 SS 8							
106.2										
0.8	Silty CLAY, trace sand Very Stiff to Stiff Grey		2 SS 16							
	Becoming Stiff to Firm		3 SS 13							
			4 SS 6							
			5 SS 4							
100.8			6 SS 50/							
6.2	END OF BOREHOLE AT 6.25 m. AUGER REFUSAL AT 6.25 m ON PROBABLE BEDROCK. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		.150							
WATER LEVEL READINGS: DATE      DEPTH (m) 19/05/05    1.42 01/06/05    1.95										

ONTMT4S 5182CUVERTS.GPJ 04/10/05

+ 3, × 3: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 29-420/C1S(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 213.1 E 314 657.4 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 26.01.06 - 26.01.06 CHECKED BY SP

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					
107.3								20 40 60 80 100					
0.0	TOPSOIL: (200 mm)												
0.2	Silty CLAY, trace sand seams Very Stiff to Stiff Brown		1	SS	16		107						
			2	SS	14		106						
			3	SS	7		105						
	Becoming Grey, Firm, Wet		4	SS	3		104						
			5	SS	3		103						
			6	SS	1		101						
99.9							100						
7.4	END OF BOREHOLE AT 7.37 m. AUGER REFUSAL AT 7.37 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 7.32 m AND WATER LEVEL AT 1.68 m. BOREHOLE GROUTED TO SURFACE.												

ONTMT4S 5182-PHASE II.GPJ 14/03/06

# RECORD OF BOREHOLE No P9

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 284.94 E 314 739.51 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY WM  
 DATUM Geodetic DATE 10.01.06 - 10.01.06 CHECKED BY SP

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						
105.9								20 40 60 80 100						
0.0	TOPSOIL: (125mm)													
0.1	Silty CLAY, occasional sand lenses Stiff Brown		1	SS	5									
							105							
			2	SS	8									
							104							0 4 49 48
							103							
102.6	some gravel and sand		3	SS	50/ .150									
3.4	END OF SOIL SAMPLING AT 3.35 m. CORING STARTED AT 3.35 m. CRYSTALLINE LIMESTONE BEDROCK, Fresh to slightly weathered, very thinly to thinly bedded, whitish grey with black banding		1	RUN			102							RUN 1# TCR=100%, SCR=100%, RQD=72%, UCS=114.1MPa
														RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=119.2MPa
			2	RUN			101							
							100							RUN 3# TCR=100%, SCR=100%, RQD=100%, UCS=111.5MPa
99.4			3	RUN										
6.5	END OF BOREHOLE AT 6.50 m. BOREHOLE GROUTED TO SURFACE.													

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-420/C2N

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 280.7 E 314 725.9 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 16.05.05 - 16.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
106.3	TOPSOIL (75mm) Silty CLAY, trace sand, trace rootlets Firm Brown		1	SS	6		106							
105.5	Silty CLAY, trace sand Very Stiff to Stiff Brown		2	SS	17		105							
0.8			3	SS	9		104							0 1 51 49
	Becoming Firm		4	SS	5		103							
							102							
	Becoming Grey		5	SS	2		101							0 4 49 47
							100							
			6	SS	2		99							
98.7														
7.6	END OF BOREHOLE AT 7.62 m. AUGER REFUSAL AT 7.62 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 7.62 m AND WATER LEVEL AT 3.66 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.													

ONTMT4S 5182CUVERTS.GPJ 04/10/05



# RECORD OF BOREHOLE No 29-420/C2S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 255.1 E 314 703.3 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 18.05.05 - 18.05.05 CHECKED BY MRA


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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
106.5	TOPSOIL (100mm) SAND, trace gravel, trace silt Compact Brown Moist (FILL)		1	SS	13		106							
			2	SS	24		105							
105.0	Silty CLAY, trace sand Very Stiff to Stiff Brown		3	SS	17		104							
1.5			4	SS	7		103							
			5	SS	4		102							
101.3	Becoming Firm, Grey													
5.2	END OF BOREHOLE AT 5.18 m. AUGER REFUSAL AT 5.18 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 5.18 m. BOREHOLE GROUTED TO SURFACE.													

# RECORD OF BOREHOLE No 29-420/C3N

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 339.4 E 314 778.3 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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											
								20 40 60 80 100											
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
					WATER CONTENT (%)														
					PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT w <sub>P</sub> w                      w <sub>L</sub>														
105.5	Silty <b>CLAY</b> , trace sand, trace rootlets, occasional iron oxide staining Firm to Very Stiff Brown		1	SS	4		105												
0.0																			
			2	SS	17														
103.4			3	SS	15		104												
2.1	END OF BOREHOLE AT 2.13 m. AUGER REFUSAL AT 2.13 m ON PROBABLE BEDROCKR BOULDER. BOREHOLE OPEN TO 2.13 m. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																		

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-420/C3M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 317.8 E 314 772.0 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 17.05.05 - 17.05.05 CHECKED BY MRA

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    × LAB VANE										WATER CONTENT (%)		
105.5	Silty <b>CLAY</b> , trace sand, trace rootlets, occasional iron oxide staining Stiff Brown		1	SS	8		105													
0.0																				
			2	SS	13															
103.7			3	SS	50/ .150		104													
1.8	END OF BOREHOLE AT 1.83 m. AUGER REFUSAL AT 1.83m. BOREHOLE OPEN TO 1.83 m AND WATER LEVEL AT 1.52 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																			

+<sup>3</sup> . x<sup>3</sup> : Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-420/C3S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 296.7 E 314 765.9 ORIGINATED BY GA  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM/HS  
 DATUM Geodetic DATE 18.05.05 - 18.05.05 CHECKED BY MRA

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 (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE		WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				
105.5								20	40	60	80	100		
0.0	PEAT, occasional wood fibres													
105.2	Dark Brown		1	SS	3									
0.3	Silty <b>CLAY</b> , trace sand, occasional iron oxide staining													
	Stiff		2	SS	11									
	Grey-Brown													
103.7			3	SS	50/									
1.8	END OF BOREHOLE AT 1.83 m. AUGER REFUSAL AT 1.83 m ON PROBABLE BEDROCK OR BOULDER. WATER LEVEL IN OPEN BOREHOLE AT 0.61m DEPTH UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 0.61 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m) 19/05/05      0.15 01/06/05      0.31				150									

# RECORD OF BOREHOLE No 29-422/C1N(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 281.6 E 315 431.0 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 26.01.06 - 26.01.06 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
103.8 0.0 0.1	TOPSOIL: (100 mm) Silty CLAY, trace sand seams Stiff to Firm Brown													
			1	SS	9		103							
			2	SS	7		102							
			3	SS	5		101							
	Becoming Grey		4	SS	4		100							
99.6 4.2	END OF BOREHOLE AT 4.17 m. AUGER REFUSAL AT 4.17 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 3.81 m AND WATER LEVEL AT 1.22 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.													

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-422/C1S(A)

1 OF 1

METRIC

W.P. 647-92-00 LOCATION N 5 031 260.3 E 315 408.0 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 26.01.06 - 26.01.06 CHECKED BY MRA

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		20	40	60	80	100		
104.5													
0.0	TOPSOIL: (150 mm)												
0.2	Silty CLAY, trace sand seams Stiff to Firm Brown												
			1	SS	9								
			2	SS	7								
			3	SS	7								
	Becoming Grey		4	SS	7								
	Wet		5	SS	2								
98.4			6	SS	50/								
6.1	END OF BOREHOLE AT 6.12 m. AUGER REFUSAL AT 6.12 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 5.94 m AND WATER LEVEL AT 1.37 m. BOREHOLE GROUTED TO SURFACE.				.025								

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

# RECORD OF BOREHOLE No 29-422/C1M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 253.5 E 315 428.0 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 30.05.05 - 30.05.05 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT      LIMIT			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			WATER CONTENT (%)				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE							
104.5							20   40   60   80   100	20   40   60   80   100	20   40   60						
0.0	<b>SAND</b> , some gravel Loose Brown Moist (FILL)														
103.0			1	SS	6						○				
1.5	Silty <b>CLAY</b> , topsoil stained, with woods fragments Soft Dark Grey Moist		2	SS	3						○				
102.3															
2.2	Silty <b>CLAY</b> , trace sand Firm Grey Moist to Wet														
			3	SS	3										
			4	SS	1										
99.3															
5.2	Clayey <b>SILT</b> , trace gravel, some sand seams Grey (TILL)														
98.2			5	SS	50/ .150						○				
6.3	END OF BOREHOLE AT 6.32 m. AUGER REFUSAL AT 6.32 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 5.87 m AND WATER LEVEL AT 3.25 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.														

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-422/C1S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 248.5 E 315 421.8 ORIGINATED BY SL  
 HWY 17/417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 30.05.05 - 30.05.05 CHECKED BY MRA

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      × LAB VANE		WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>				
104.2								20   40   60   80   100						
0.0	TOPSOIL (200mm)													
0.2	Silty <b>CLAY</b> , trace sand, with roots Firm Grey Moist (FILL)		1	SS	5									
102.8														
1.4	Silty <b>CLAY</b> , with roots and rootlets, with wood fragments at top Soft Dark Brown Moist		2	SS	3									
102.1														
2.1	Silty <b>CLAY</b> , trace sand Firm Grey Moist to Wet		3	SS	5									
			4	SS	2									
98.6														
5.6	END OF BOREHOLE AT 5.61 m. AUGER REFUSAL AT 5.61 m ON PROBABLE BEDROCK OR BOULDERS.  Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH ( m ) 01/06/05      1.23													

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

# RECORD OF BOREHOLE No 29-422/C2N

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 202.6 E 315 397.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 24.05.05 - 24.05.05 CHECKED BY MRA

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	WATER CONTENT (%)					
105.3														
0.0	TOPSOIL (250mm)													
105.0														
0.3	Silly CLAY, trace sand, trace roots Very Stiff Brown Moist		1	SS	16									
			2	SS	16									0 1 43 57
	Stiff		3	SS	9									
	Firm, Grey, Wet		4	SS	5									
			5	SS	7									
			6	SS	5									0 5 49 46
			7	SS	1									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-422/C2N

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 202.6 E 315 397.4 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 24.05.05 - 24.05.05 CHECKED BY MRA

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	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	20 40 60		
95.0													
10.3	Clayey SILT, trace gravel and sand, occasional cobbles												
94.5	Hard		8	SS	50/								
10.8	Grey Wet (TILL)				.025								
END OF BOREHOLE AT 10.84 m. BOREHOLE OPEN TO 10.2 m AND WATER LEVEL AT 9.40 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.													

ONTMT4S 5182CUVERTS.GPJ 12/10/05

# RECORD OF BOREHOLE No 29-422/C2M

1 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 182.2 E 315 386.2 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 24.05.05 - 24.05.05 CHECKED BY MRA

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	20 40 60 80 100	20 40 60					
105.2														
0.0 104.9	TOPSOIL (250mm)													
0.3	Silty CLAY, trace sand Very Stiff Brown Moist		1	SS	17									
			2	SS	21									
			3	SS	7									
	Firm, Grey, Wet													
			1	TW	PH									
			4	SS	1									
			5	SS	1									
96.1														
9.1	Silty CLAY, trace gravel and sand Soft Grey Wet (TILL)		6	SS	2									

ONTMT4S 5182CUVERTS.GPJ 04/10/05

Continued Next Page

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

# RECORD OF BOREHOLE No 29-422/C2M

2 OF 2

METRIC

W.P. 647-92-01 LOCATION N 5 031 182.2 E 315 386.2 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 24.05.05 - 24.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100					
94.6							95							
10.6	END OF BOREHOLE AT 10.62 m. AUGER REFUSAL AT 10.62 m ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen. BOREHOLE BACKFILLED WITH BENTONITE. WATER LEVEL READINGS: DATE DEPTH (m) 01/06/05 1.68													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

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

20  
15-5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-422/C2S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 031 162.3 E 315 375.2 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 24.05.05 - 24.05.05 CHECKED BY MRA

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 (%)				
103.3							20 40 60 80 100	20 40 60 80 100	20 40 60					
0.0	TOPSOIL (200mm)													
0.2	Silty CLAY, trace sand Very Stiff Brown Moist													
	Firm		1	SS	17									
			2	SS	5									
	Grey, Wet													
			3	SS	7								0 4 49 46	
			4	SS	2									
96.5														
6.8	END OF BOREHOLE AT 6.81 m. AUGER REFUSAL AT 6.81 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 6.25 m AND WATER LEVEL AT 5.80 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-422/C3M

1 OF 2

METRIC

W.P. 647-92-00 LOCATION N 5 031 129.1 E 315 361.5 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 27.01.06 - 27.01.06 CHECKED BY SP

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 × LAB VANE							
105.8								20 40 60 80 100		20 40 60					
0.0	TOPSOIL: (150 mm)														
0.2	Silty CLAY, some sand seams Stiff to Firm Brown														
			1	SS	6		105								
			2	SS	8		104								
			3	SS	10		103								
	Becoming Grey		4	SS	5		102							0 0 53 46	
							101								
			5	SS	2										
	Wet						100		5.1 +						
			6	SS	1		99								
							98		3.8 +						
			7	SS	3									0 1 67 32	
							97		4 +						
			8	SS	1										
							96								

Continued Next Page

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

20  
15  
10


(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-422/C3M

2 OF 2

METRIC

W.P. 647-92-00 LOCATION N 5 031 129.1 E 315 361.5 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 27.01.06 - 27.01.06 CHECKED BY SP

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						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
									PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
									W <sub>P</sub>	W	W <sub>L</sub>			
									WATER CONTENT (%)					
									20 40 60					
94.7	trace gravel		9	SS	54/ .225		95							
11.1	END OF BOREHOLE AT 11.13 m. AUGER REFUSAL AT 11.13 m ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 10.59 m AND WATER LEVEL AT 6.30 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.													

# RECORD OF BOREHOLE No 29-422/C3S

1 OF 2

METRIC

W.P. 647-92-00 LOCATION N 5 031 115.1 E 315 351.6 ORIGINATED BY SLL  
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM  
 DATUM Geodetic DATE 27.01.06 - 27.01.06 CHECKED BY MRA


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 (%)					
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	w <sub>p</sub>	w	w <sub>L</sub>			
103.8							20	40	60	80	100	20	40	60	
0.0															
103.5	TOPSOIL: (250 mm)														
0.3	Silty CLAY, trace sand seams Very Stiff to Firm Brown														
			1	SS	19										
			2	SS	16										
			3	SS	13										
	Becoming Grey		4	SS	5										
	Wet		5	SS	2										
			6	SS	2										
			7	SS	1										
			8	SS	1										

Continued Next Page

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

ELEV. DEPTH	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 (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE 20   40   60   80   100	WATER CONTENT (%) 20   40   60			
1.0	CLAY		1	U	10							
1.5	CLAY		2	U	15							
2.0	CLAY		3	U	20							
2.5	CLAY		4	U	25							
3.0	CLAY		5	U	30							
3.5	CLAY		6	U	35							
4.0	CLAY		7	U	40							
4.5	CLAY		8	U	45							
5.0	CLAY		9	U	50							
5.5	CLAY		10	U	55							
6.0	CLAY		11	U	60							
6.5	CLAY		12	U	65							
7.0	CLAY		13	U	70							
7.5	CLAY		14	U	75							
8.0	CLAY		15	U	80							
8.5	CLAY		16	U	85							
9.0	CLAY		17	U	90							
9.5	CLAY		18	U	95							
10.0	CLAY		19	U	100							

[illegible]

ONTMT4S 5182-PHASE II.GPJ 17/03/06

+ 3, × 3: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 29-413/C3N

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 033 461.8 E 307 914.8 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 27.05.05 - 27.05.05 CHECKED BY MRA

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
115.3													
0.0	TOPSOIL (300mm)												
115.0													
0.3	Silty CLAY, trace sand Soft to Firm Grey Wet		1	SS	2								
			2	SS	3								
			1	TW	PH								
112.0													
3.3	Clayey SAND and SILT, trace gravel Very Stiff to Hard Grey Wet (TILL)		3	SS	16								
			4	SS	29								
			5	SS	32								
108.0													
7.3	END OF BOREHOLE AT 7.34 m. AUGER REFUSAL AT 7.34 m ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) 01/06/05 0.00												

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-413/C3M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 033 445.5 E 307 907.5 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 01.06.05 - 01.06.05 CHECKED BY MRA

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								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE		
117.6	ASPHALT (25 mm)						20	40	60	80	100	20	40	60				
117.6	SAND, trace silt Compact Brown Moist (FILL)		1	SS	26							○						
	Trace gravel, occasional cobbles, very dense		2	SS	85/ 250							○						
114.6																		
3.0	Silty CLAY, trace sand Firm Grey Moist		3	SS	4								○					
			4	SS	1													
111.7																		
5.9	Sandy SILT, trace gravel and clay		5	SS	50/							○						
111.4	Very Dense																	
6.2	Grey Wet (TILL)				.075													
	END OF BOREHOLE AT 6.25 m. AUGER REFUSAL AT 6.25 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 4.42 m AND WATER LEVEL AT 3.81 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.																	

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 29-413/C3S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 033 433.6 E 307 907.8 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 26.05.05 - 26.05.05 CHECKED BY MRA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
116.5														
0.0	TOPSOIL (275mm)													
116.2														
0.3	Silty CLAY, trace sand Firm Brown Moist		1	SS	6		116							
			2	SS	4		115							
	Becoming Grey						114							
			3	SS	2		113							0 1 54 45
							112							
111.5			4	SS	14									
5.0	Sandy SILT, some clay, trace gravel and cobbles Compact Grey Wet (TILL)													
111.3														
5.2	END OF BOREHOLE AT 5.21 m. AUGER REFUSAL AT 5.21m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 4.88 m AND WATER LEVEL AT 3.76 UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

**METRIC**[illegible]

ONTMT4S 5182CUVERTS.GPJ 04/10/05

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

# RECORD OF BOREHOLE No 29-416/C1M

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 033 368.0 E 307 640.0 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JU/HS  
 DATUM Geodetic DATE 26.05.05 - 26.05.05 CHECKED BY MRA

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 (%)					
116.1														
0.0	TOPSOIL (250mm)						116							
115.8														
0.3	Silty CLAY, trace sand Firm Brown Moist		1	SS	6		115							
	Becoming Grey		2	SS	2		114							0 2 47 51
							113							
			1	TW	PH		112							
111.8														
4.3	Sandy SILT, some clay and gravel Compact Grey Wet (TILL)		3	SS	13		111							
110.3														
5.8	END OF BOREHOLE AT 5.79 m. AUGER REFUSAL AT 5.79 m ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 25 mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) 01/06/05 0.00													

ONTMT4S 5182CUVERTS.GPJ 04/10/05

# RECORD OF BOREHOLE No 29-416/C1S

1 OF 1

METRIC

W.P. 647-92-01 LOCATION N 5 033 353.8 E 307 622.7 ORIGINATED BY SL  
 HWY 17/ 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JL/HS  
 DATUM Geodetic DATE 26.05.05 - 26.05.05 CHECKED BY MRA

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    × LAB VANE									WATER CONTENT (%)
116.5								20	40	60	80	100					
0.0	TOPSOIL (200mm)																
0.2	Silty CLAY Firm Brown Moist						116										
			1	SS	4												
			2	SS	4		115										
	Becoming Grey		3	SS	2		114										
							113										0 2 48 50
112.1																	
4.4	Sandy SILT, some clay, trace gravel and cobbles Loose Grey Wet (TILL)		4	SS	7		112										
111.0																	
5.5	END OF BOREHOLE AT 5.49 m. AUGER REFUSAL AT 5.49m. BOREHOLE OPEN TO 5.49 m AND WATER LEVEL AT 5.40 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE.																

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

20  
15  
10  
(%) STRAIN AT FAILURE

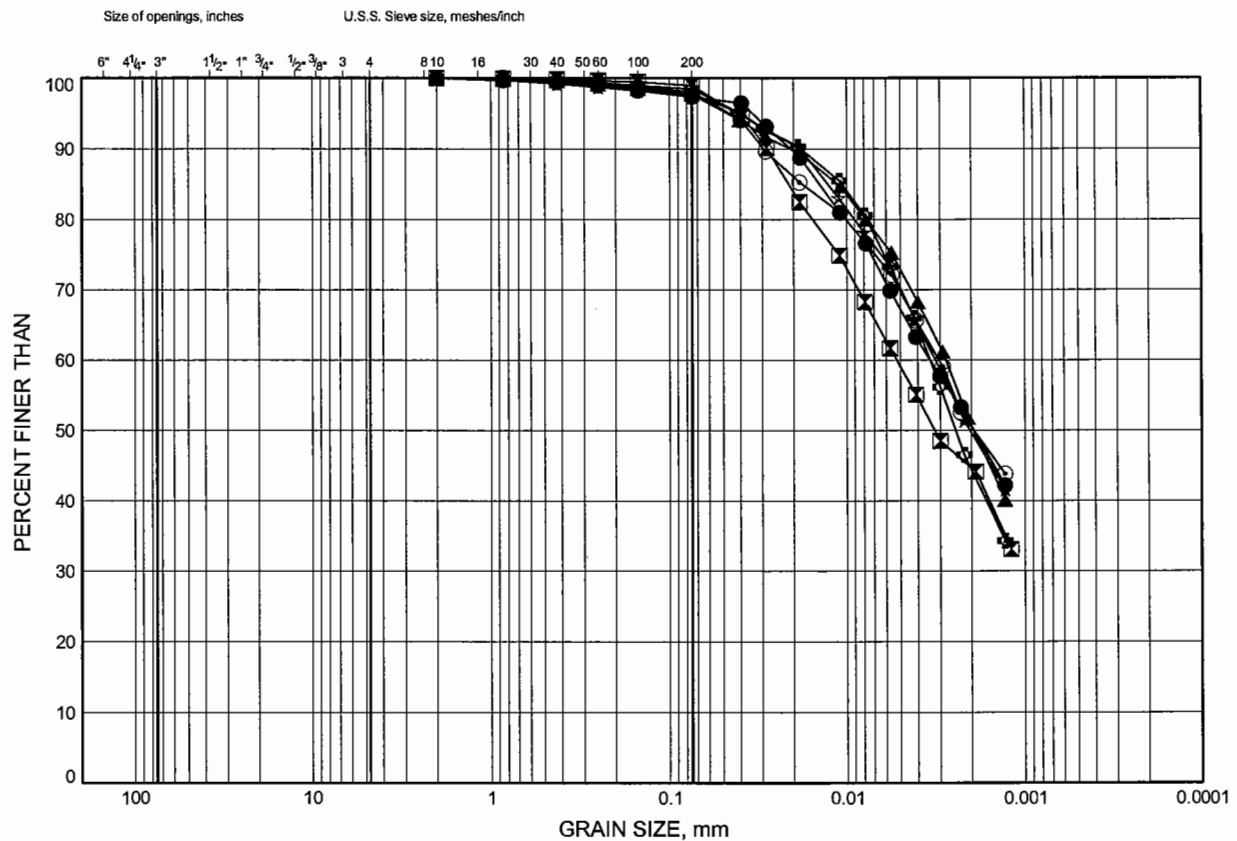
## **Appendix B**

### **Laboratory Test Results**

# HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B1

### Silty Clay

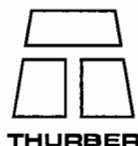


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-413/C3M	4.88	112.72
⊠	29-413/C3S	3.35	113.15
▲	29-416/C1M	1.83	114.27
★	29-416/C1S	3.35	113.15
⊙	29-418/C1M	3.35	105.75
⊕	29-418/C1N	4.88	102.92

Date October 2005

Project 647-92-01



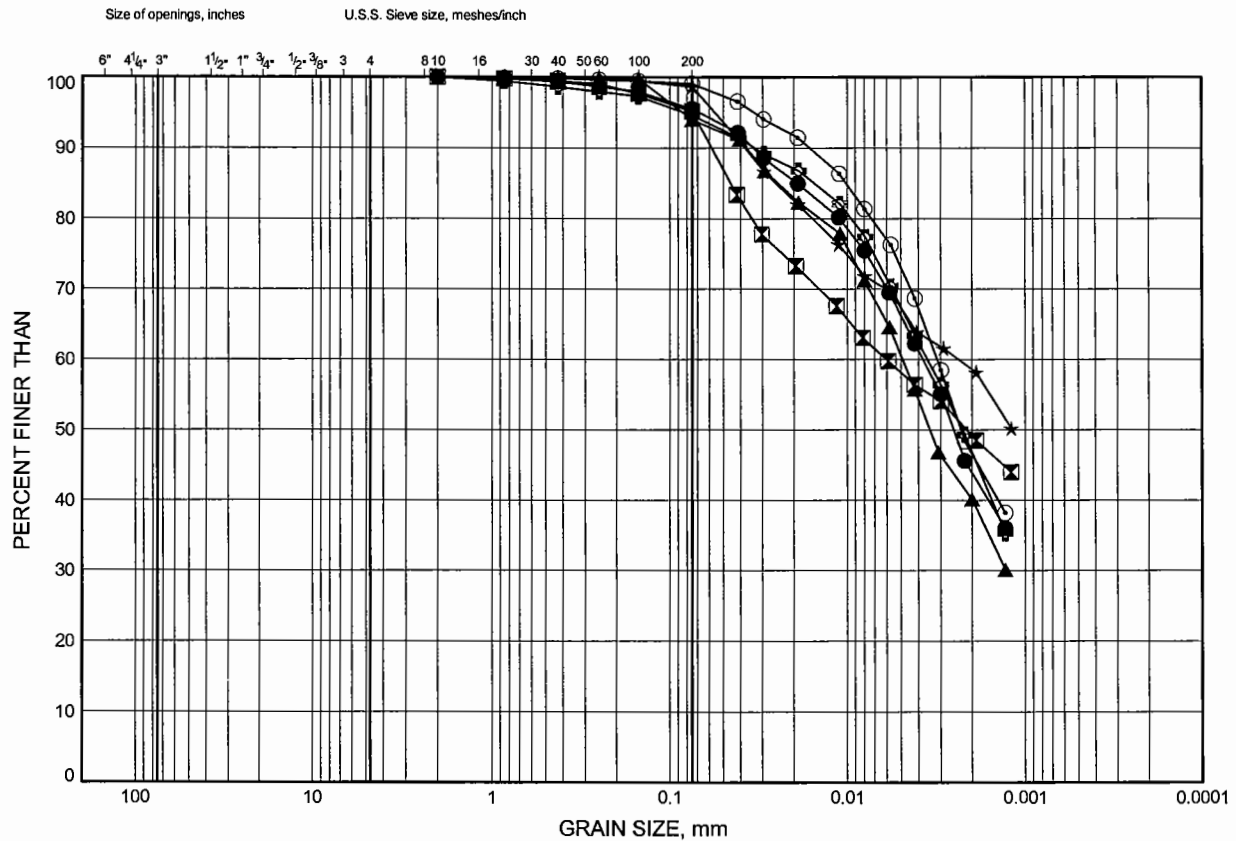
Prep'd WM

Chkd. MRA

# HWY 17 Twinning, Amprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B2

### Silty Clay



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-418/C1N	10.97	96.83
⊠	29-418/C1S	1.83	105.47
▲	29-418/C2M	4.88	101.92
★	29-418/C2N	1.83	104.87
⊙	29-418/C2S	4.88	102.12
⊛	29-418/C2S	10.97	96.03

Date October 2005

Project 647-92-01



THURBER

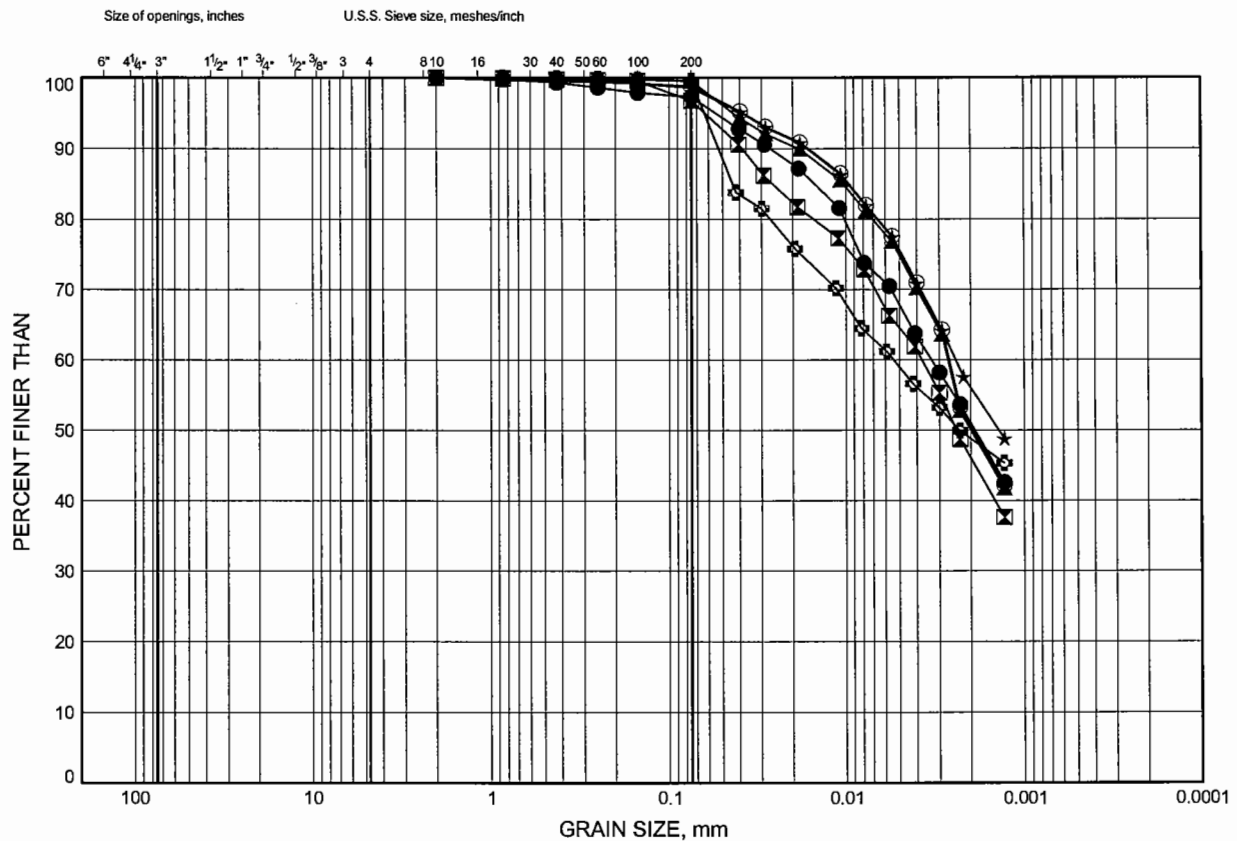
Prep'd WM

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B3

### Silty Clay



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-419/C1M	3.35	104.85
⊠	29-419/C1N	6.25	100.15
▲	29-419/C1S	3.35	102.85
★	29-419/C2M	3.35	103.75
⊙	29-419/C2N	3.35	103.45
⊕	29-419/C2S	1.07	105.63

Date October 2005

Project 647-92-01



Prep'd WM

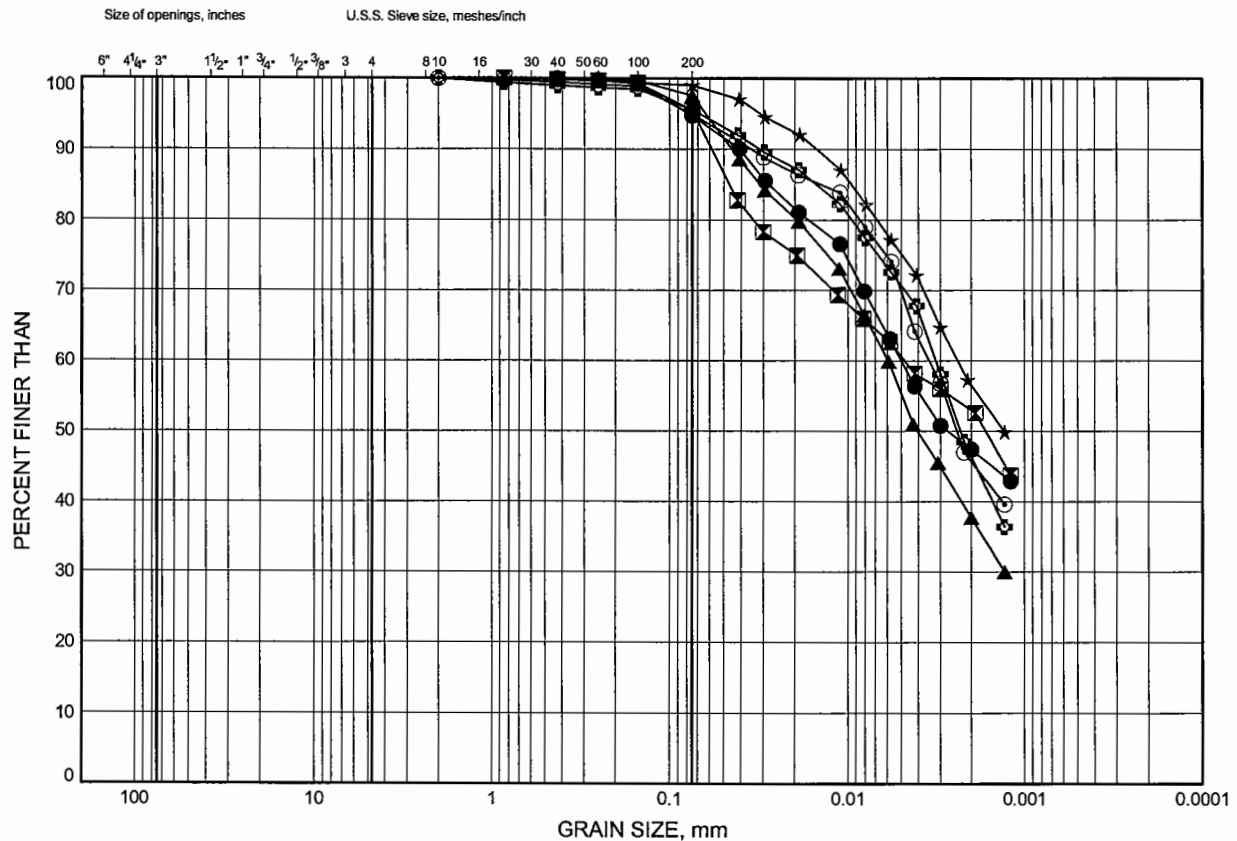
Chkd. MRA



# HWY 17 Twinning, Arnprior to Renfrew GRAIN SIZE DISTRIBUTION

FIGURE B5

## Silty Clay



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-422/C1M	3.35	101.15
⊠	29-422/C1S	3.35	100.85
▲	29-422/C2M	6.40	98.80
★	29-422/C2N	1.83	103.47
⊙	29-422/C2N	7.92	97.38
⊛	29-422/C2S	4.88	98.42

Date October 2005

Project 647-92-01



THURBER

Prep'd WM

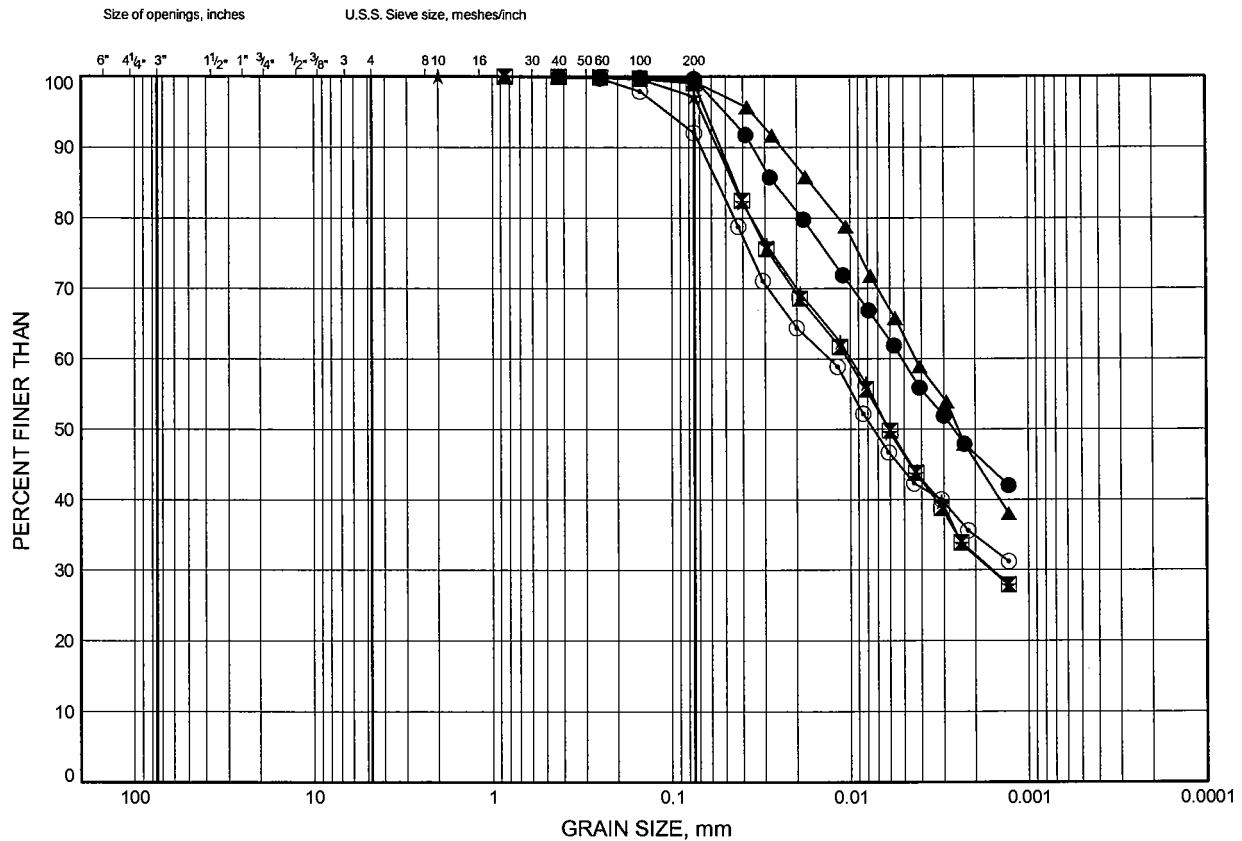
Chkd. MRA



# HWY 17-417 WBL GRAIN SIZE DISTRIBUTION

FIGURE B7

## SILTY CLAY

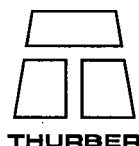


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-422 C3M	3.35	102.15
⊠	29-422 C3M	7.92	97.58
▲	29-422 C3S	2.59	102.91
★	29-422 C3S	9.45	96.05
⊙	29-422/C2M	4.88	100.32

Date March 2006

Project 647-92-00



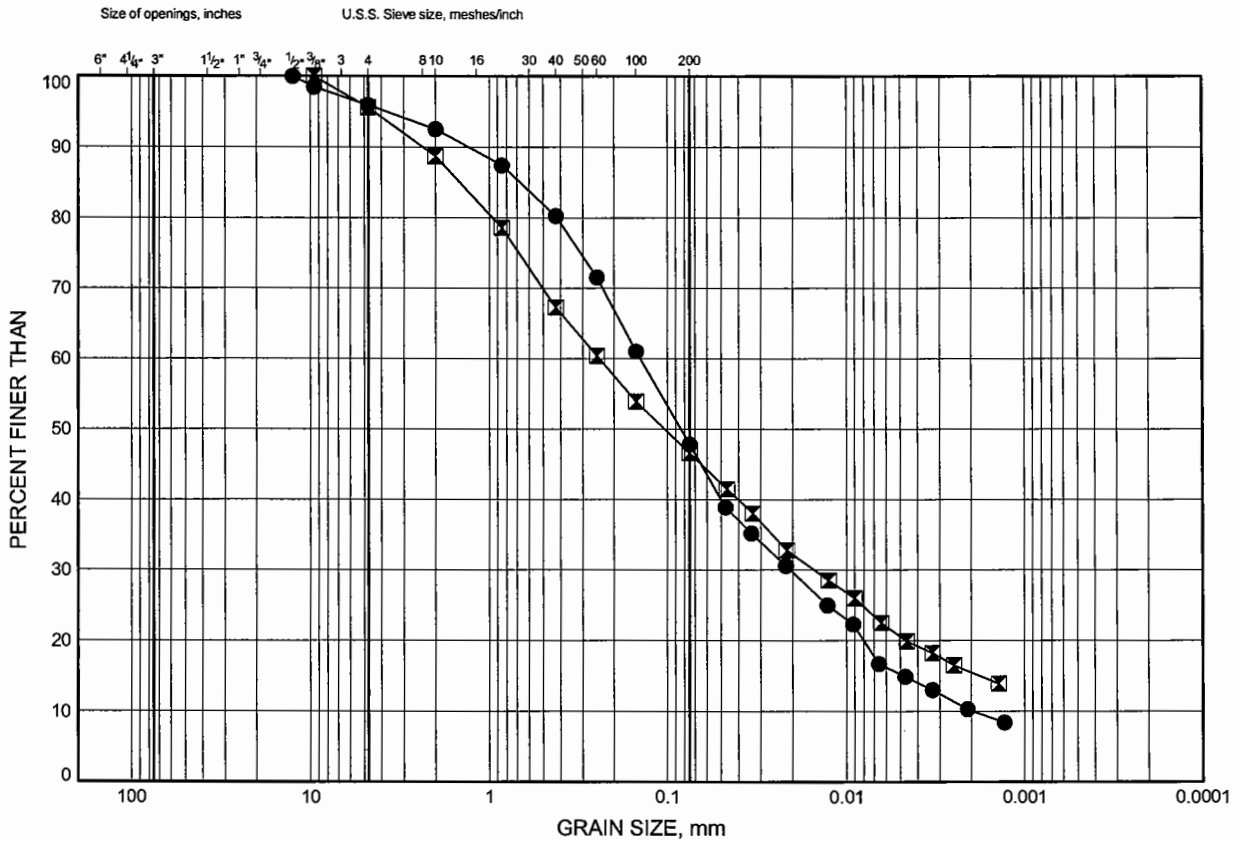
Prep'd JHL

Chkd. MRA

# HWY 17-417 WBL GRAIN SIZE DISTRIBUTION

FIGURE B8

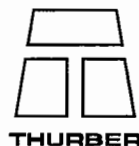
### CLAYEY SAND AND SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-413/C3N	4.88	110.42
☒	29-422/C3S	14.17	91.33

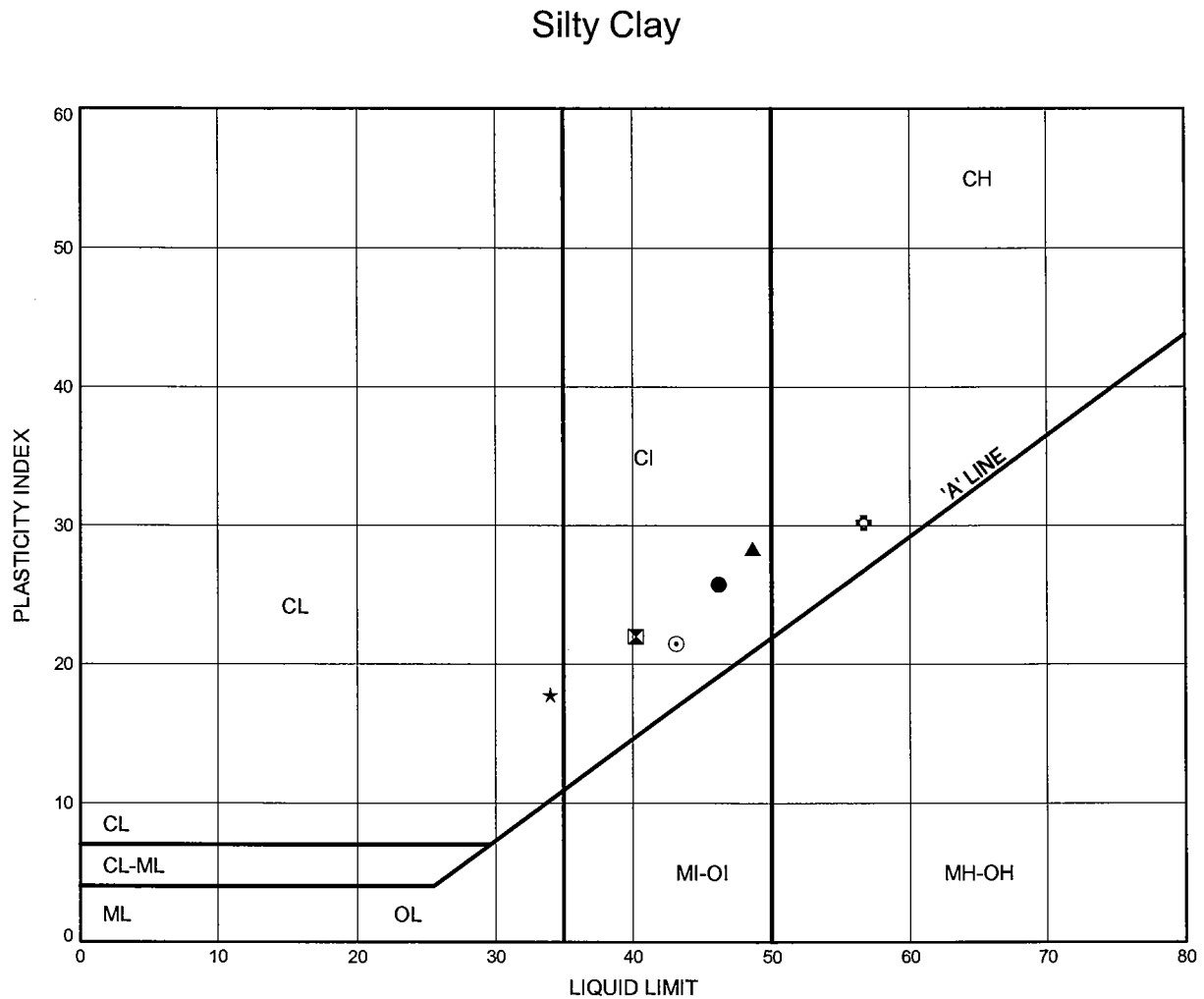
Date March 2006  
 Project 647-92-00



Prep'd JHL  
 Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

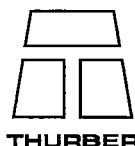
FIGURE B9



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-413/C3M	4.88	112.72
⊠	29-413/C3S	3.35	113.15
▲	29-416/C1M	1.83	114.27
★	29-416/C1N	3.35	112.75
⊙	29-416/C1S	3.35	113.15
⊕	29-418/C1M	3.35	105.75

Date March 2006

Project 647-92-01



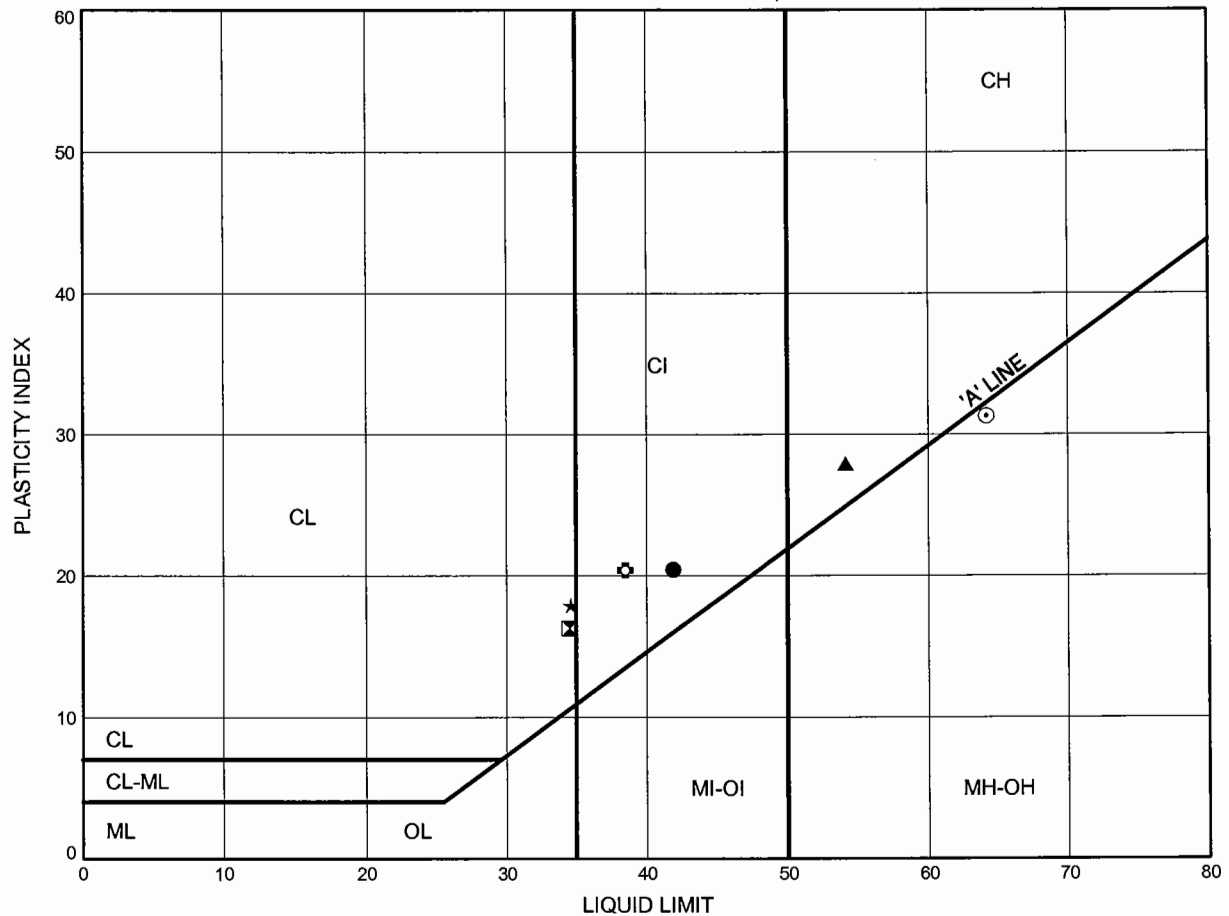
Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

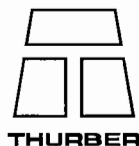
FIGURE B10

Silty Clay



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-418/C1N	4.88	102.92
⊠	29-418/C1N	10.97	96.83
▲	29-418/C1S	1.83	105.47
★	29-418/C2M	4.88	101.92
⊙	29-418/C2N	1.83	104.87
⊕	29-418/C2S	4.88	102.12

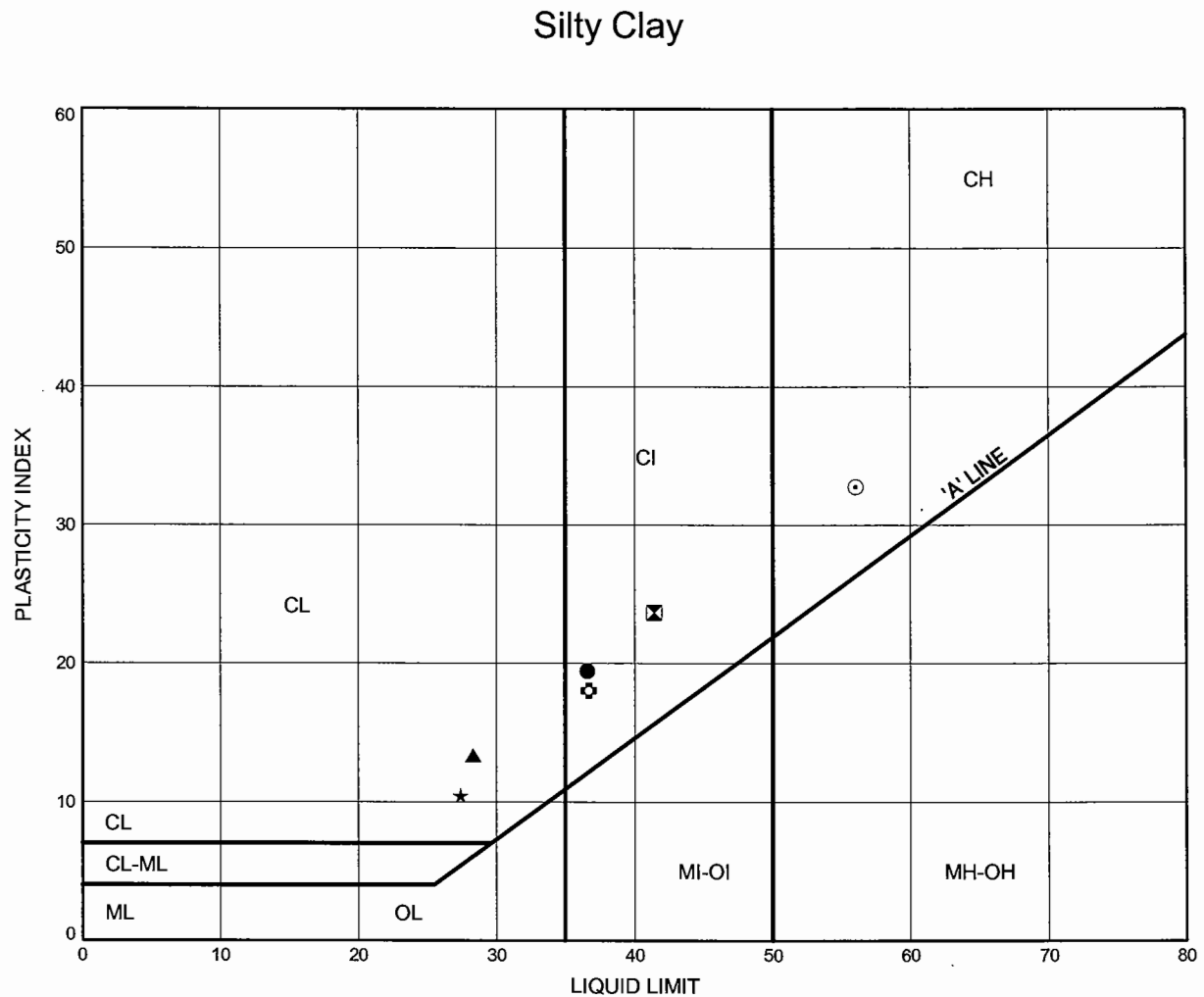
Date March 2006  
 Project 647-92-01



Prep'd JHL  
 Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

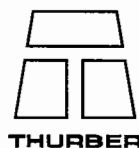
FIGURE B11



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-418/C2S	10.97	96.03
⊠	29-419/C1M	3.35	104.85
▲	29-419/C1M	9.45	98.75
★	29-419/C1M	12.50	95.70
⊙	29-419/C1N	1.83	104.57
⊞	29-419/C1N	6.40	100.00

Date March 2006

Project 647-92-01

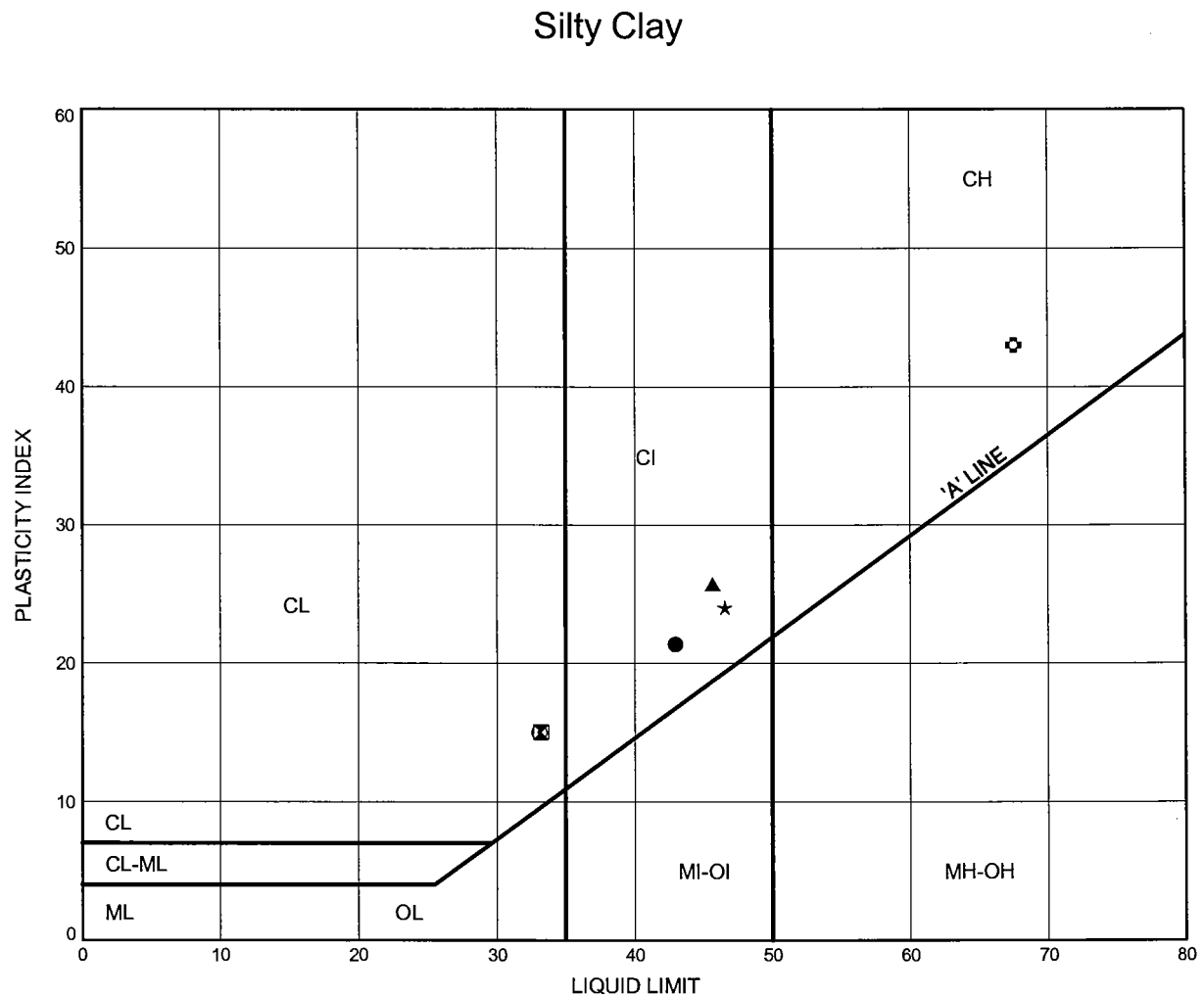


Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

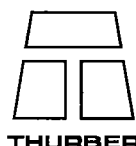
FIGURE B12



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-419/C1S	3.35	102.85
⊠	29-419/C1S	10.97	95.23
▲	29-419/C2M	3.35	103.75
★	29-419/C2N	3.35	103.45
⊙	29-419/C2N	7.92	98.88
⊛	29-419/C2S	1.07	105.63

Date March 2006

Project 647-92-01

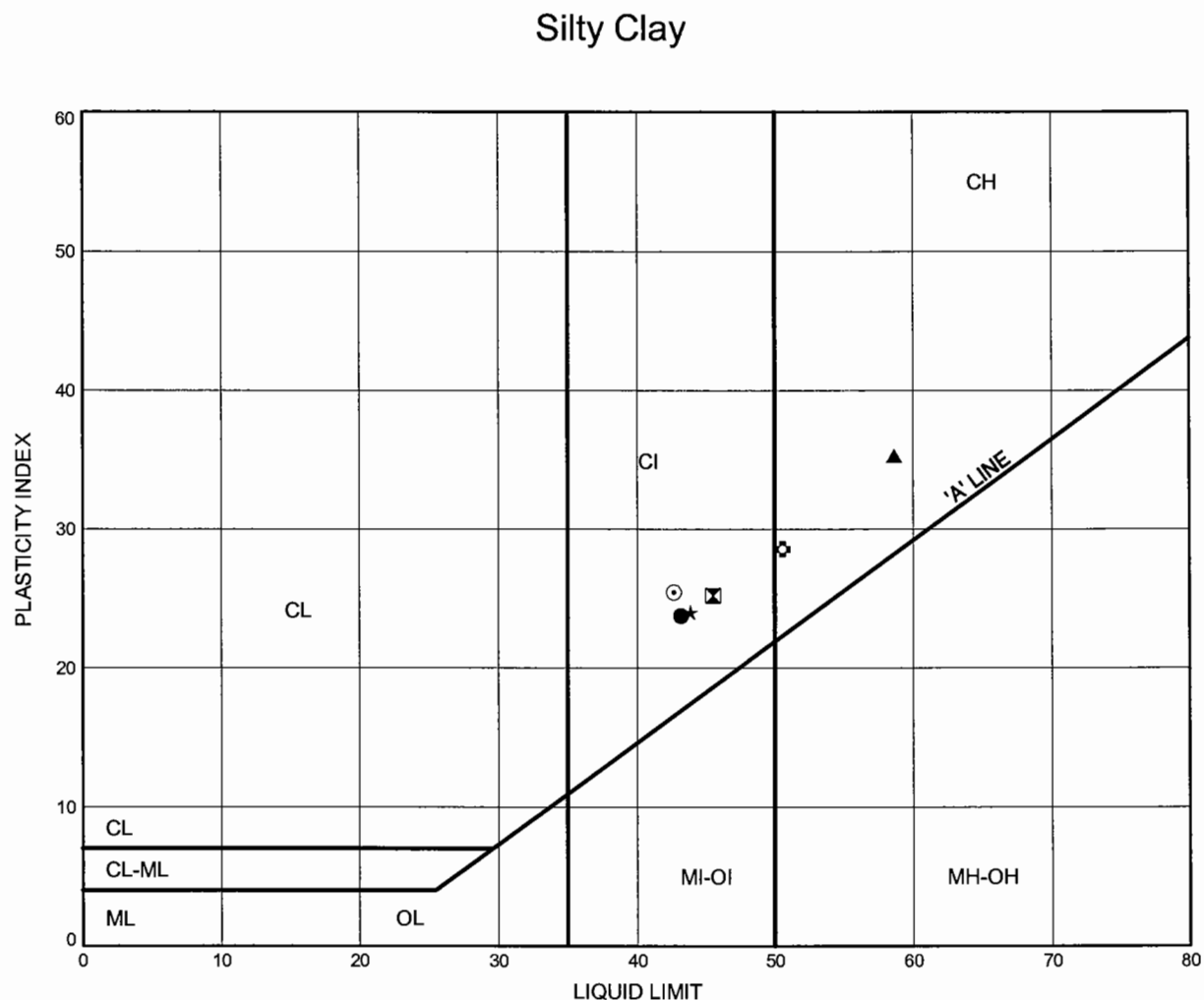


Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

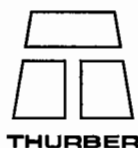
FIGURE B13



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-419/C2S	7.92	98.78
⊠	29-420/C1M	3.51	104.99
▲	29-420/C1M	6.40	102.10
★	29-420/C1N	1.83	105.47
⊙	29-420/C1N	4.88	102.42
⊛	29-420/C2M	1.83	104.77

Date March 2006

Project 647-92-01

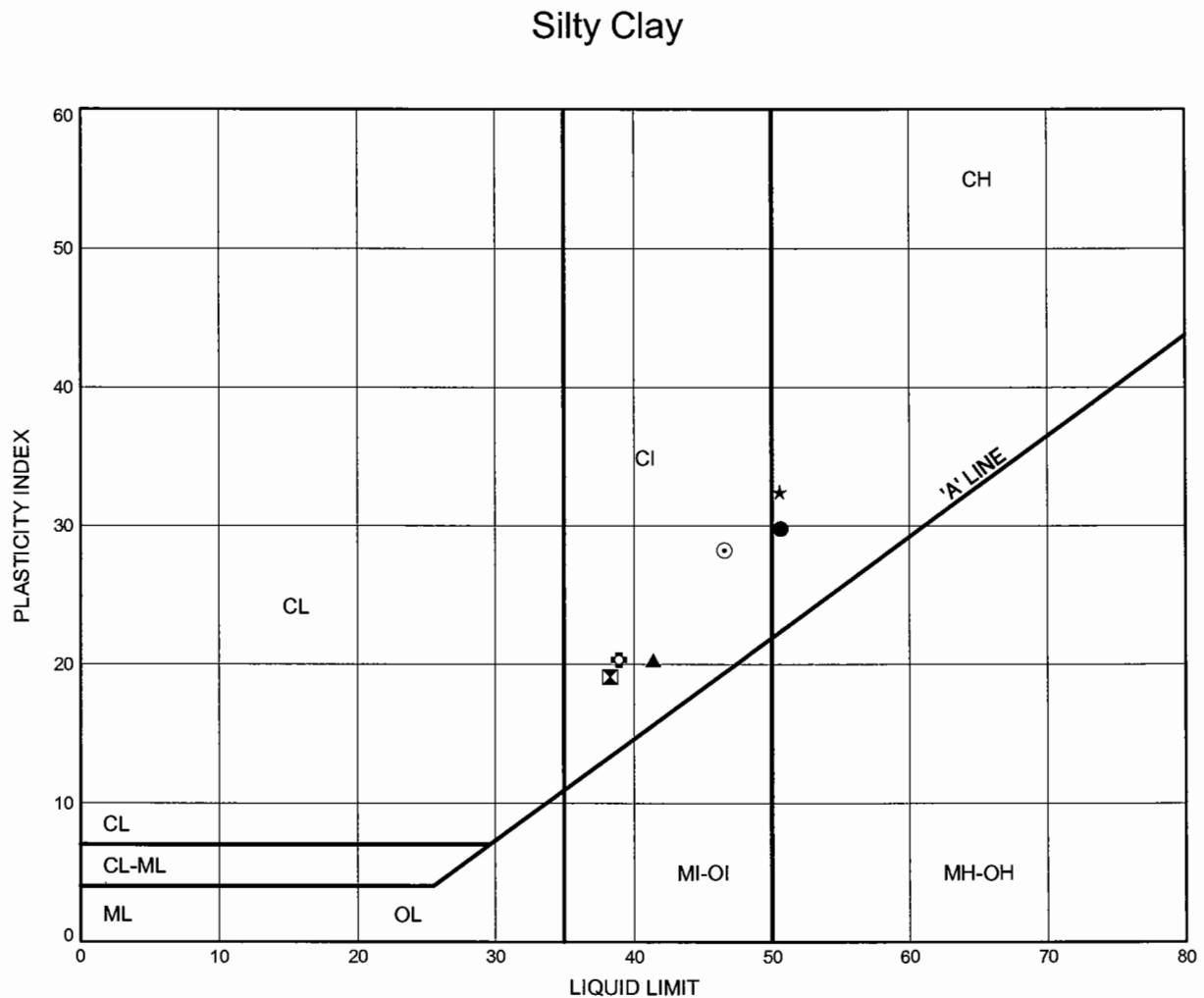


Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

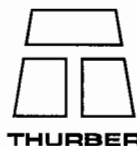
FIGURE B14



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-420/C2N	1.83	104.47
⊠	29-420/C2N	4.88	101.42
▲	29-420/C3N	1.07	104.43
★	29-422/C1M	3.35	101.15
⊙	29-422/C1S	3.35	100.85
⊛	29-422/C2M	6.40	98.80

Date March 2006

Project 647-92-01

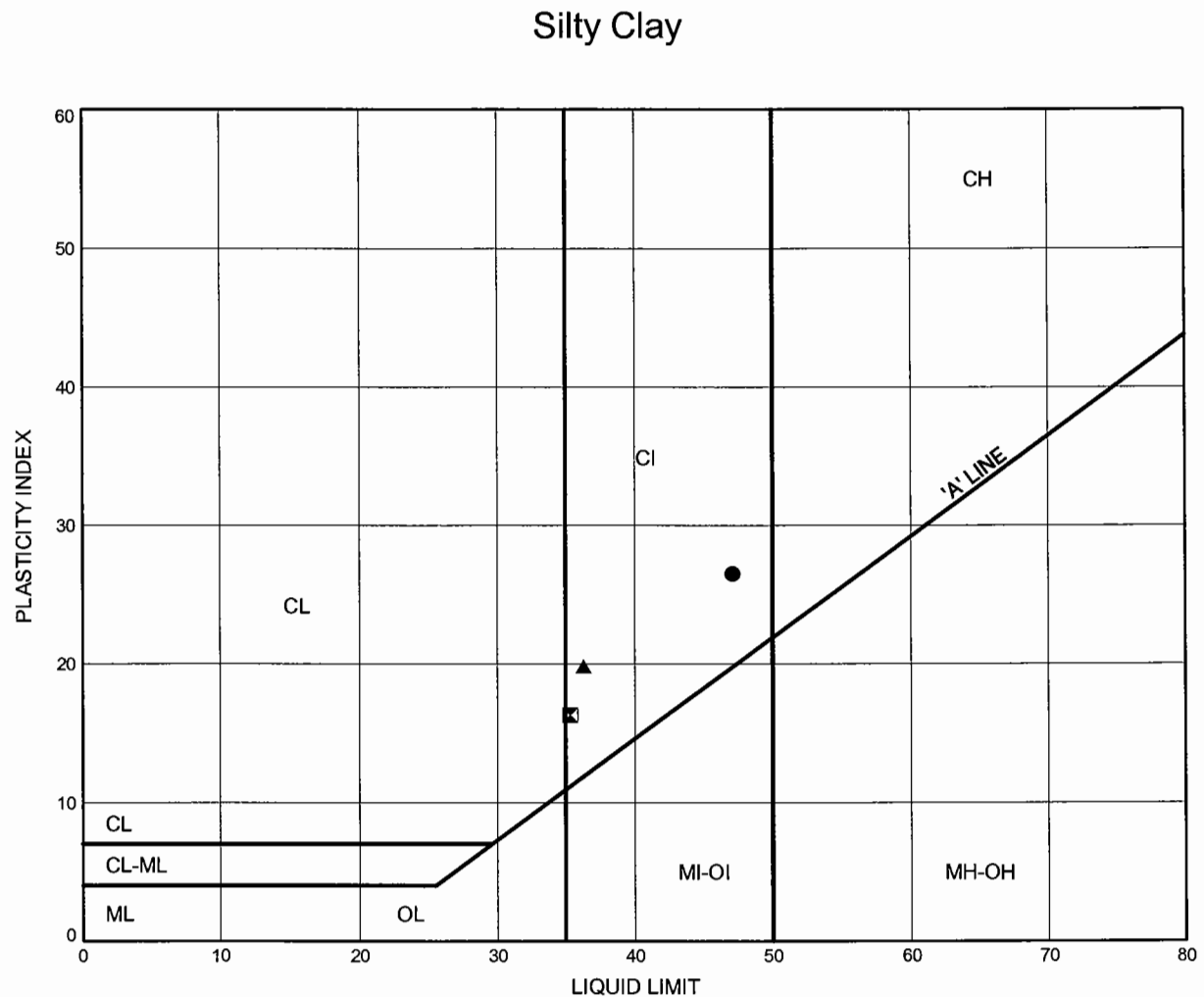


Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

FIGURE B15



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-422/C2N	1.83	103.47
⊠	29-422/C2N	7.92	97.38
▲	29-422/C2S	4.88	98.42

Date March 2006

Project 647-92-01



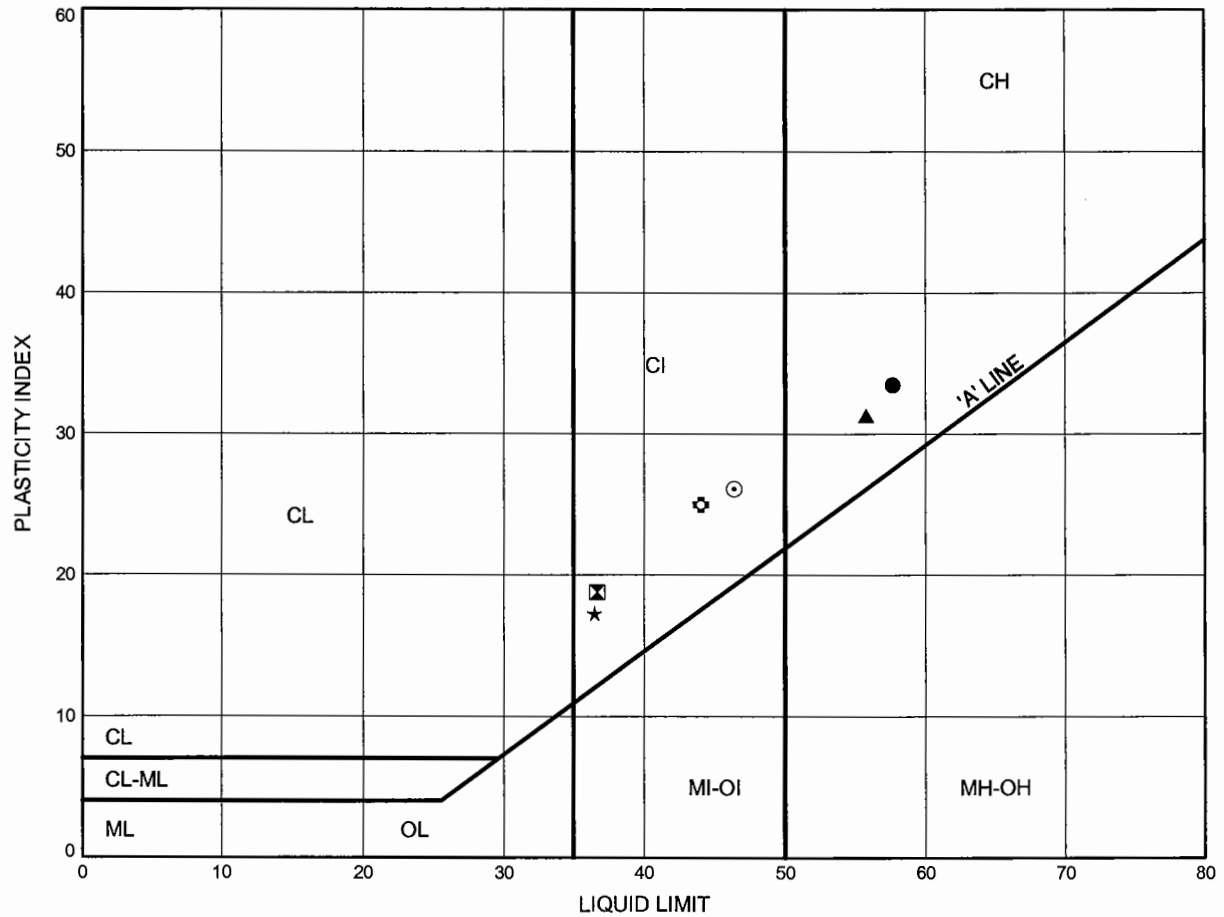
Prep'd JHL

Chkd. MRA

HWY 17-417 WBL  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B16

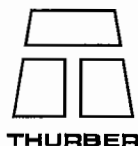
**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-420/C1M(A)	2.59	105.21
⊠	29-420/C1M(A)	6.40	101.40
▲	29-420/C1S(A)	2.59	104.71
★	29-420/C1S(A)	6.40	100.90
⊙	29-422/C1N(A)	2.59	102.21
⊕	29-422/C1S(A)	3.35	101.15

Date March 2006

Project 647-92-00



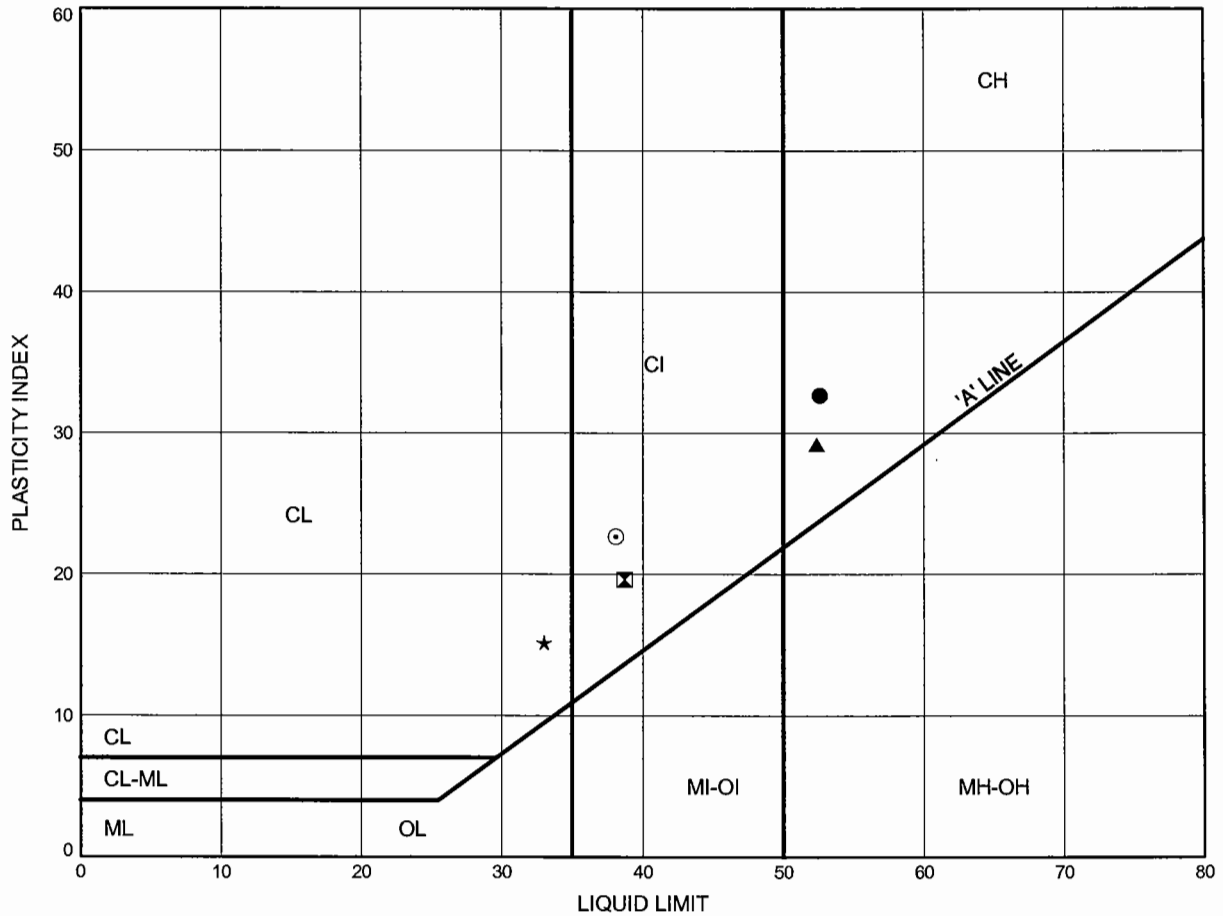
Prep'd JHL

Chkd. MRA

# HWY 17-417 WBL ATTERBERG LIMITS TEST RESULTS

FIGURE B17

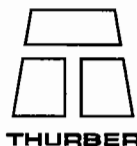
## SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-422 C3M	3.35	102.15
⊠	29-422 C3M	7.92	97.58
▲	29-422 C3S	2.59	102.91
★	29-422 C3S	9.45	96.05
⊙	29-422/C2M	4.88	100.32

Date March 2006

Project 647-92-00



THURBER

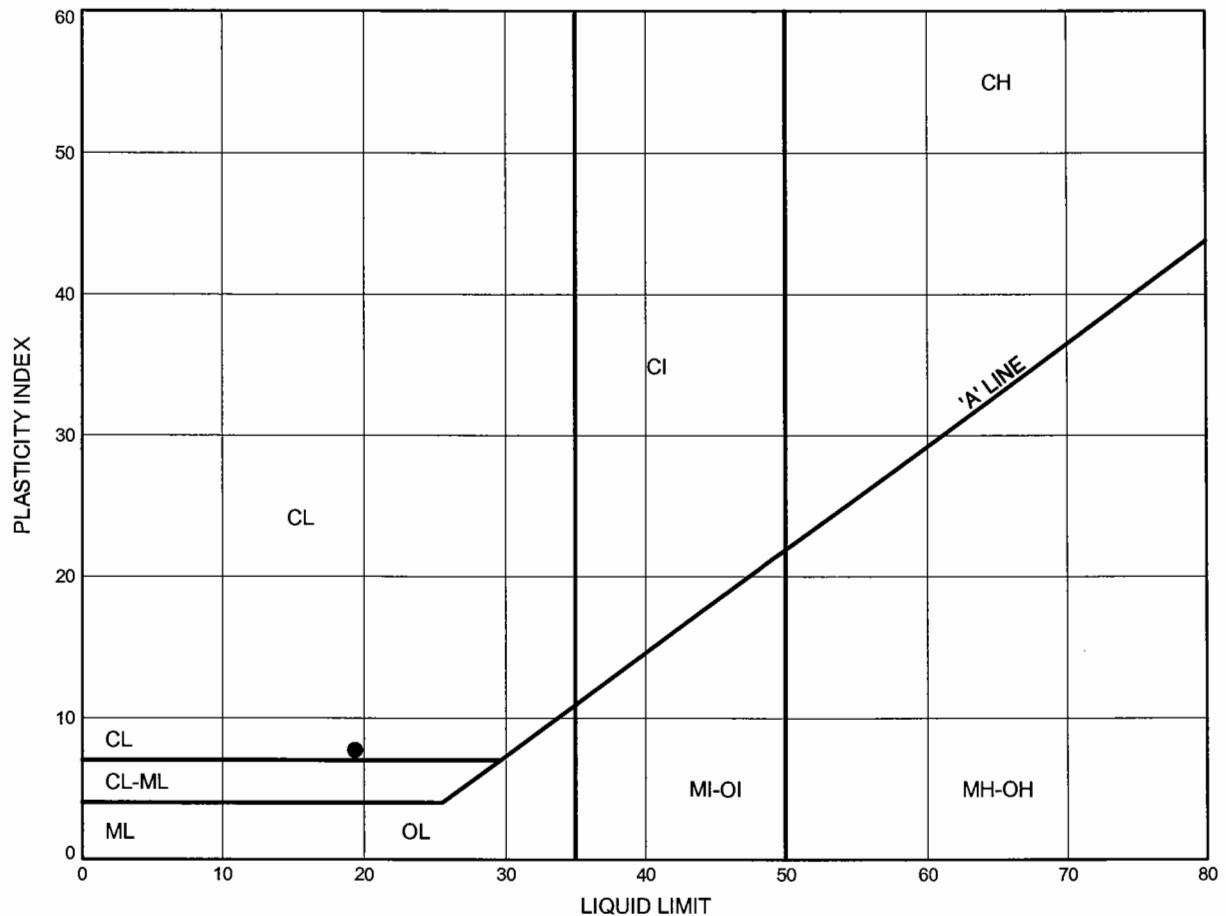
Prep'd JHL

Chkd. MRA

# HWY 17 Twinning, Arnprior to Renfrew ATTERBERG LIMITS TEST RESULTS

FIGURE B18

Clayey SAND and SILT Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	29-413/C3N	4.88	110.42

Date March 2006

Project 647-92-01



THURBER

Prep'd JHL

Chkd. MRA



## Consolidation Test Report

CLIENT: **McCormick Rankin Corporation (MRC)**

FILE NUMBER: 18-45-1 / 19-1351-82

PROJECT: Highway 17-417, Annprior

REPORT DATE: 20-Dec-05

TEST DATES: December 1, 2005 - December 14, 2005

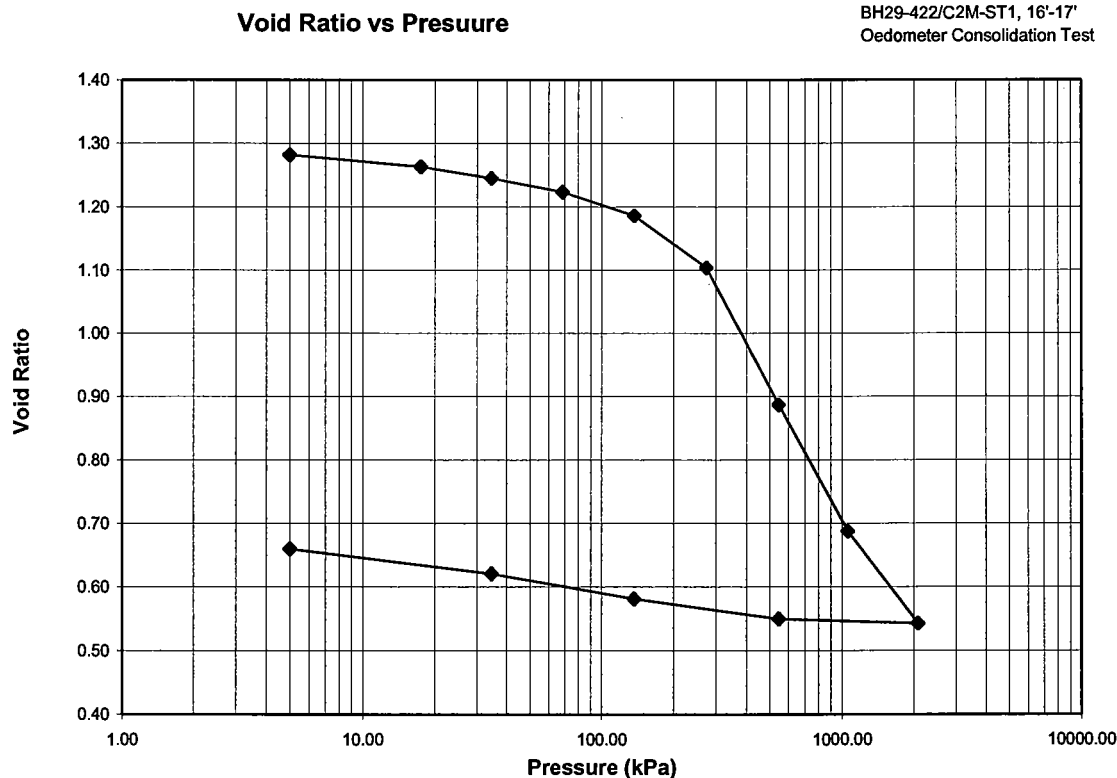
SAMPLE: BH29-422/C2M-ST1, 16'-17'  
Silty Clay, trace sand, grey, uniform, plastic, (CI), Lab Vane: 35 - 40 kPa (Firm)  
Grain Size: 35 % Clay, 58 % Silt & 7 % Sand

PROCEDURE: Tested in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m <sup>3</sup> )	1759.8	2100.9
Dry Dens. (kg/m <sup>3</sup> )	1199.2	1626.3
Moisture Cont. (%)	46.8	29.2
Void Ratio	1.285	0.685
Saturation (%)	99.7	

Note: A Specific Gravity of 2.74 was measured for the void ratio and saturation calculations

18-45-1 / 19-1351-82 (MRC)  
Highway 17-417- Annprior  
BH29-422/C2M-ST1, 16'-17'  
Oedometer Consolidation Test



TEST DONE BY: EA  
REVIEWED BY: JPL



## Consolidation Test Report

Highway 17-417, Arnprior  
18-45-1 / 19-1351-82

BH29-422/C2M-ST1, 16'-17'

**TRIMMING:** The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer

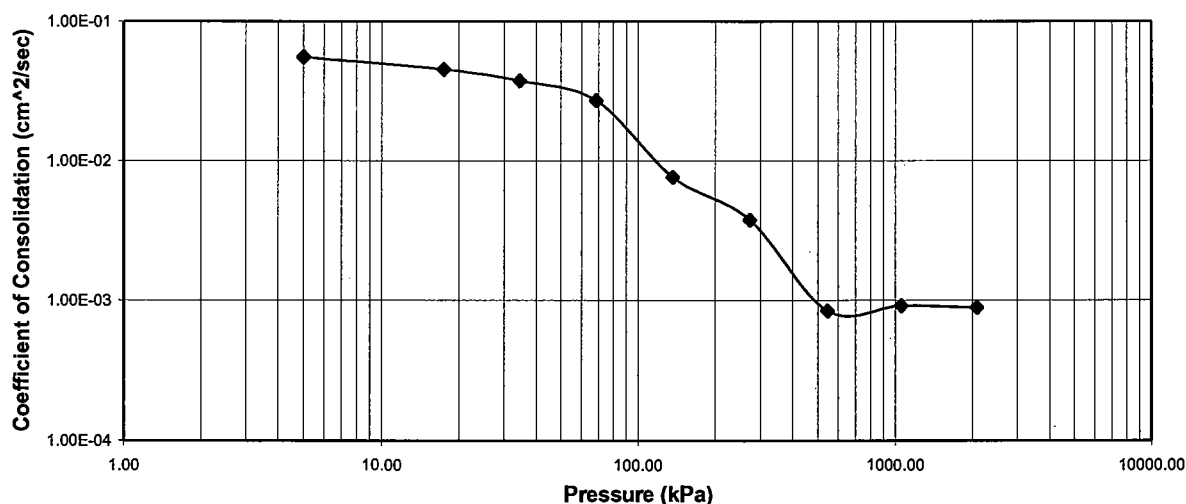
**LOADING:** A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied and the duration of each load step was 24 hours

**CALCULATIONS:** Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. Hgt (mm)	Avg. Hgt. (mm)	T90 (min)	Cv (cm <sup>2</sup> /sec)	Void Ratio	mv (m <sup>2</sup> /kN)	k (cm/s)
0.00	19.800	19.800			1.285		
5.00	19.777	19.789	0.25	5.53E-02	1.282	6.56E-04	3.56E-06
17.49	19.616	19.696	0.30	4.53E-02	1.263	4.73E-04	2.10E-06
34.46	19.458	19.537	0.36	3.75E-02	1.245	2.82E-04	1.03E-06
68.42	19.269	19.363	0.49	2.70E-02	1.223	2.38E-04	6.31E-07
136.78	18.949	19.109	1.69	7.63E-03	1.186	2.63E-04	1.97E-07
273.12	18.241	18.595	3.24	3.77E-03	1.104	3.49E-04	1.29E-07
545.39	16.370	17.306	12.60	8.40E-04	0.887	1.70E-04	1.40E-08
1057.63	14.650	15.510	9.30	9.14E-04	0.688	6.20E-05	5.55E-09
2080.12	13.401	14.026	7.84	8.87E-04	0.543	1.95E-06	1.70E-10
545.39	13.460	13.431			0.550		
136.78	13.736	13.598			0.582		
34.46	14.076	13.906			0.621		
5.00	14.410	14.243			0.660		

Coefficient of Consolidation vs Pressure

18-45-1 / 19-1351-82 (MRC)  
Highway 17-417- Arnprior  
BH29-422/C2M-ST1, 16'-17'  
Oedometer Consolidation Test



Notes: Cv and k calculated using  $t_{90}$  values

TEST DONE BY: EA  
REVIEWED BY: JPL



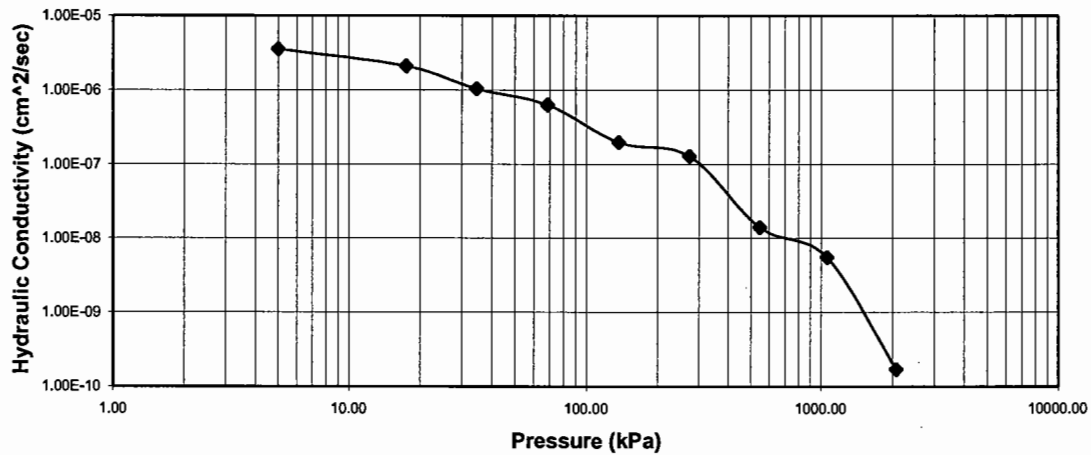
## Consolidation Test Report

Highway 17-417, Annprior  
18-45-1 / 19-1351-82

BH29-422/C2M-ST1, 16'-17'

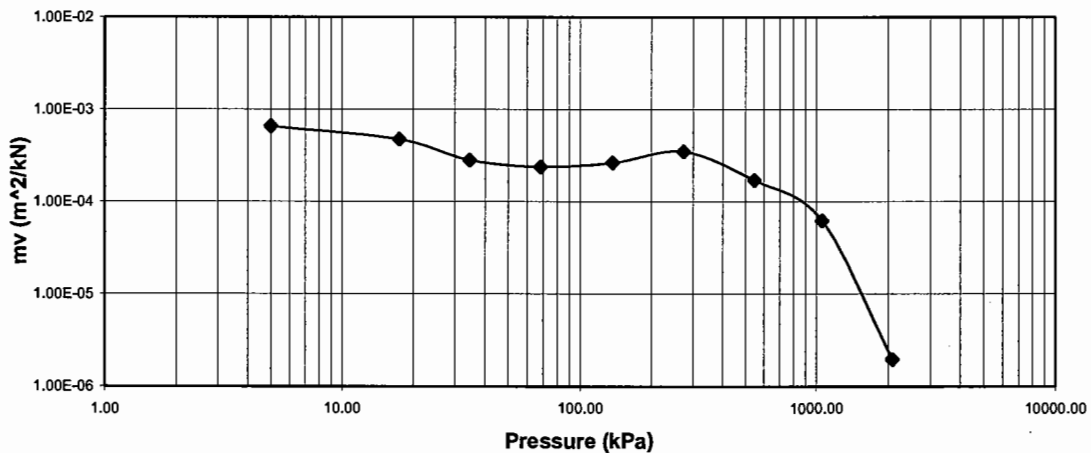
### Hydraulic Conductivity vs Pressure

18-45-1 / 19-1351-82 (MRC)  
Highway 17-417- Annprior  
BH29-422/C2M-ST1, 16'-17'  
Oedometer Consolidation Test



### mv vs Pressure

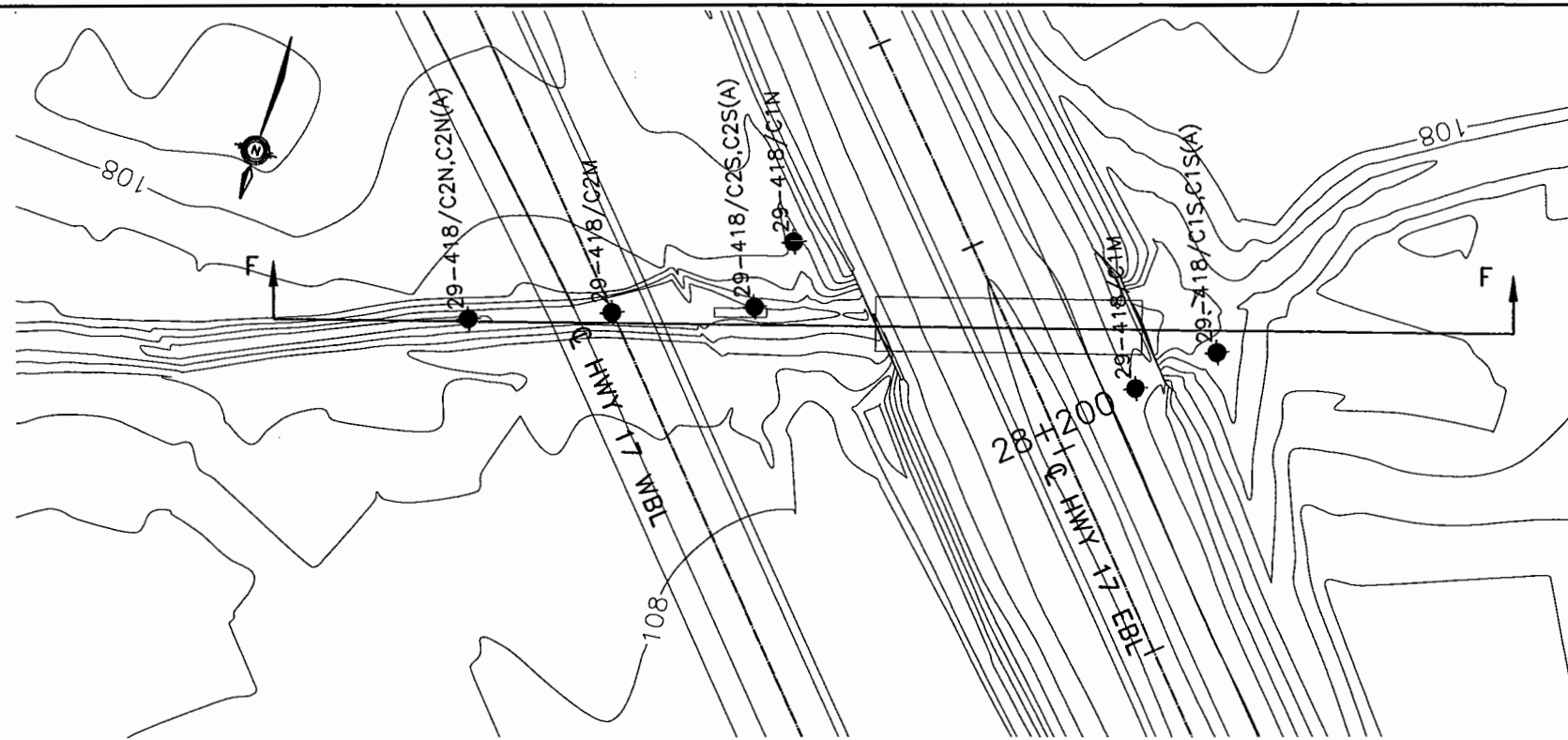
18-45-1 / 19-1351-82 (MRC)  
Highway 17-417- Annprior  
BH29-422/C2M-ST1, 16'-17'  
Oedometer Consolidation Test



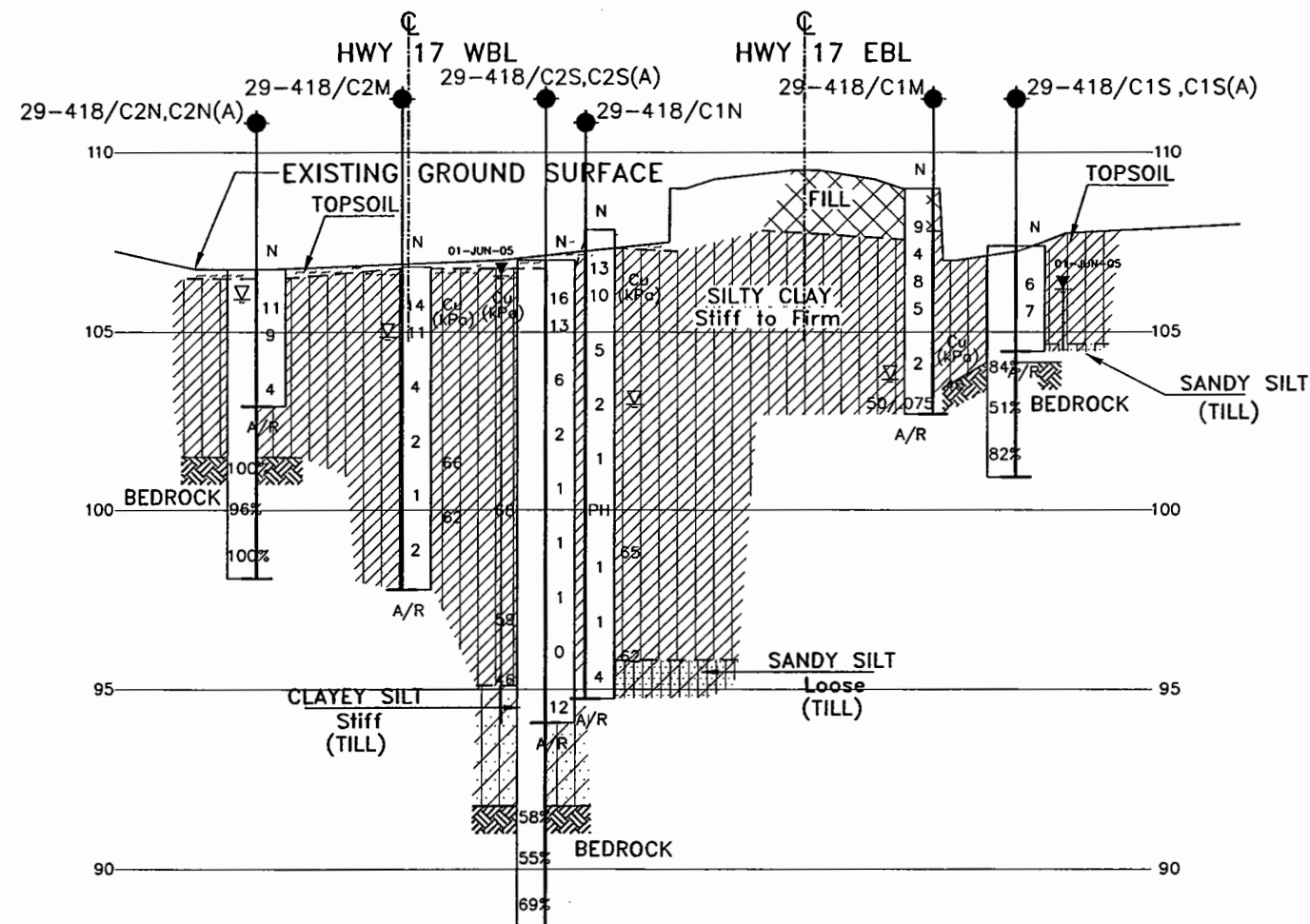
TEST DONE BY: EA  
REVIEWED BY: JPL

## **Appendix C**

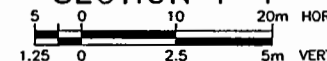
### **Borehole Locations and Soil Strata Drawings**



PLAN ( SITE 29-418/C1, C2 )



SECTION F-F



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

HWY.17  
GWP NO. 647-92-01

HIGHWAY 17/417 TWINNING  
CULVERT SITE 29-418/ C1,C2  
BOREHOLE LOCATIONS AND SOIL STRATA

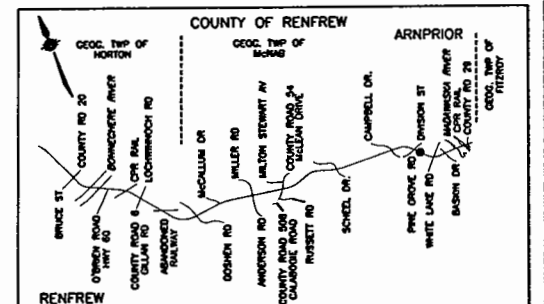
SHEET



MCCORMICK RANKIN  
CORPORATION



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Bore Hole
⊕	Dynamic Cone Penetration Test (cone) or Probe Hole
⊕	Bore Hole & Cone
N	Blows/0.3m (Std pen Test, 475J/blow)
CONE	Blows/0.3m (60° Cone, 475J/blow)
Cu	Undrained Shear Strength from Field Vane
PH	Pressure, Hydraulic
↓	WL in Piezometer at Time of Investigation (Date)
↑	Head Artesian Water
↑	Piezometer
↓	WL in Open Borehole Upon Completion of Drilling
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	EAST	NORTH
29-418/C1S	107.3	314026.4	5031828.3
29-418/C1S(A)	107.3	314026.4	5031828.3
29-418/C1M	109.1	314034.0	5031835.0
29-418/C1N	107.8	314075.4	5031831.2
29-418/C2N	106.7	314107.7	5031850.7
29-418/C2N(A)	106.7	314107.7	5031850.7
29-418/C2M	106.8	314092.6	5031845.1
29-418/C2S	107.0	314077.4	5031839.5
29-418/C2S(A)	107.0	314077.4	5031839.5

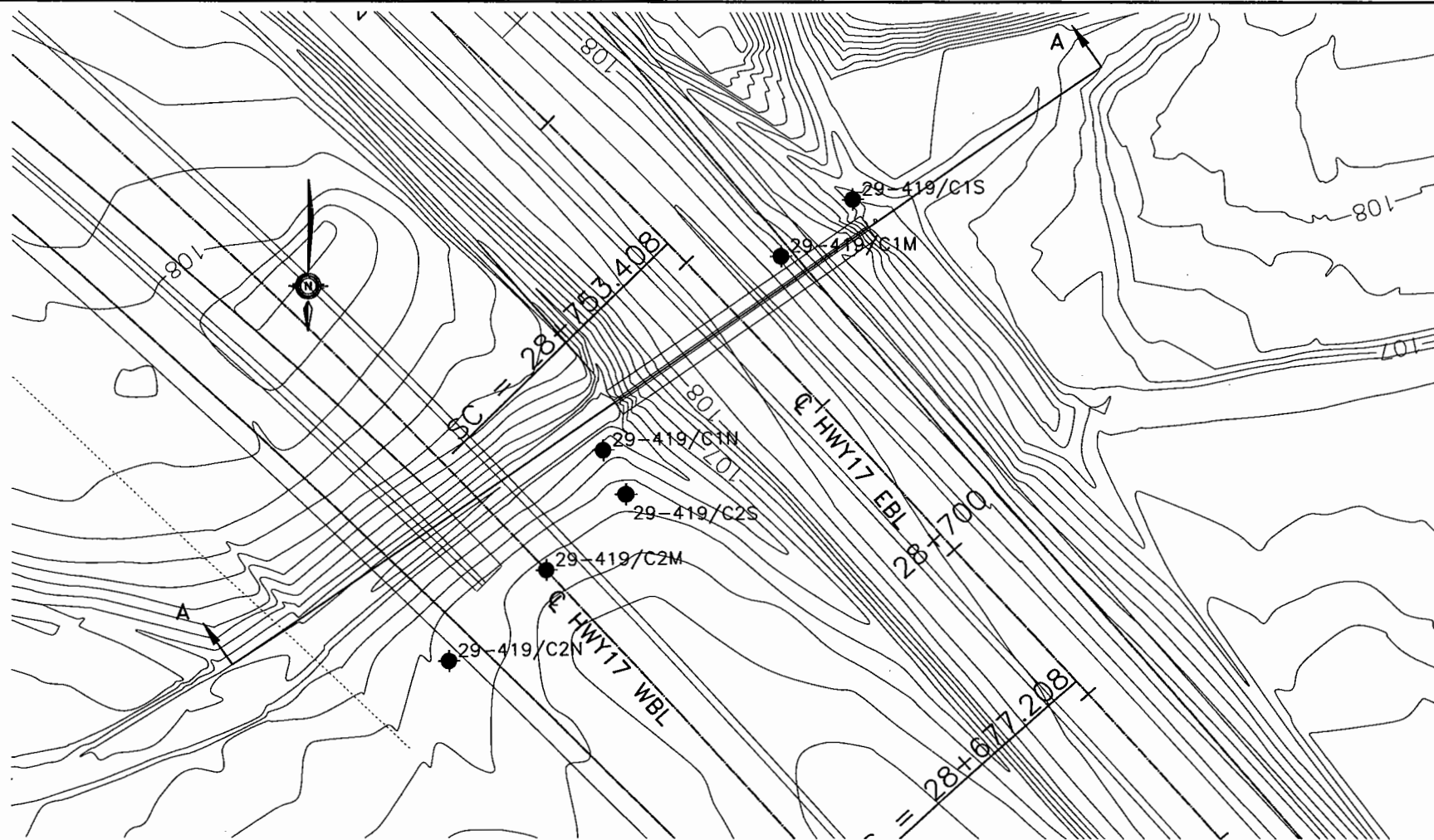
NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

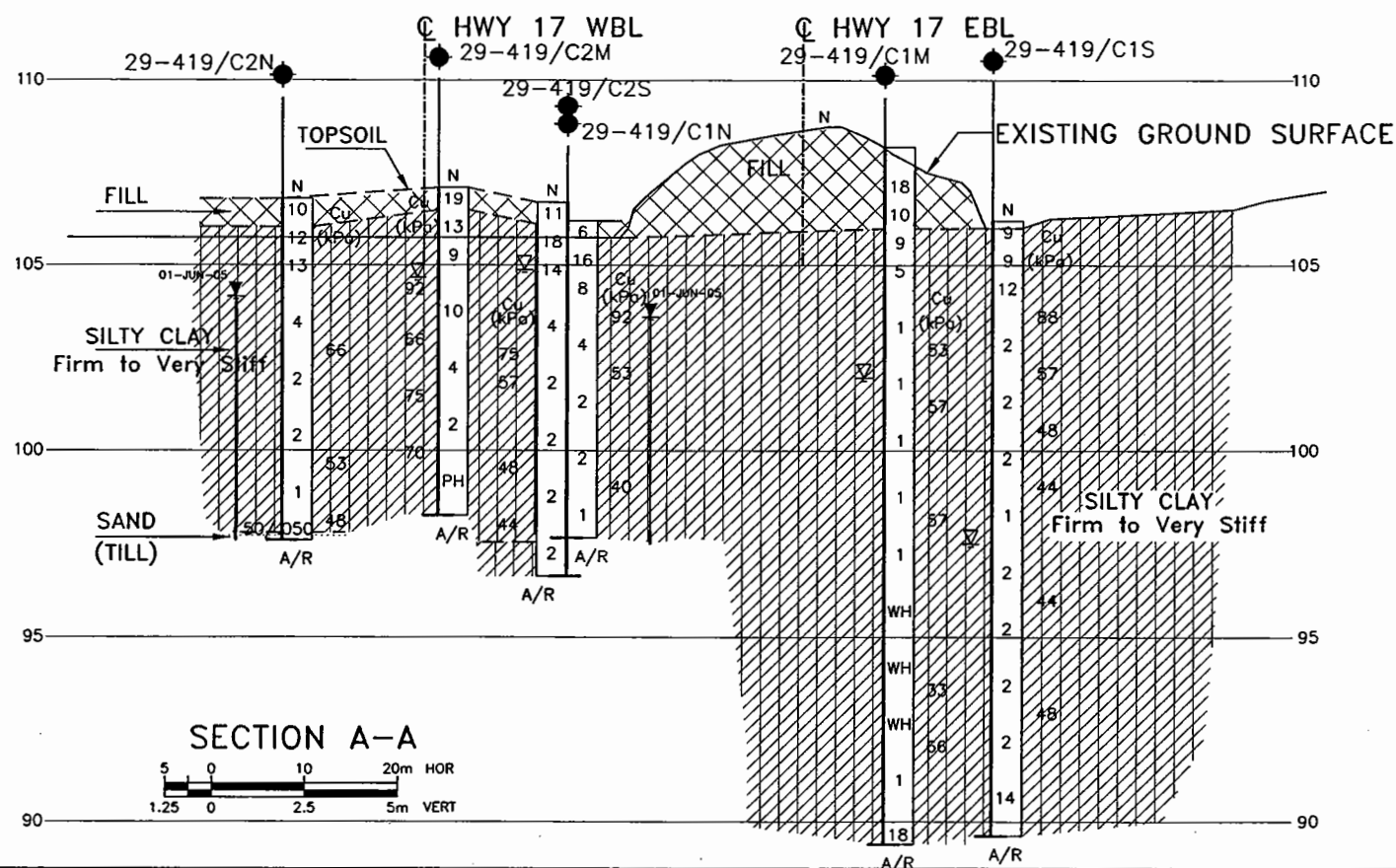
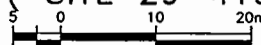


DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

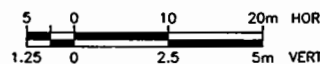
REVISIONS	DATE	BY	DESCRIPTION
JUN, 05	SP	ISSUED AS DRAFT FOR REVIEW	
DESIGN MA	CHK AEG	CODE CHBDC	LOAD
DRAWN HS	CHK MA	SITE 29-418	STRUCT
			SCHEME
			DWG C1



PLAN ( SITE 29-419/C1, C2 )



SECTION A-A



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

HWY.17  
GWP NO. 647-92-01

HIGHWAY 17/417 TWINNING  
CULVERT SITE 29-419/C1, C2  
BOREHOLE LOCATIONS AND SOIL STRATA

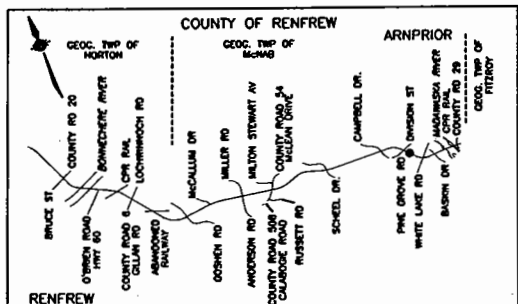
SHEET



McCORMICK RANKIN  
CORPORATION



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (cone) or Probe Hole
- Bore Hole & Cone
- Blows/0.3m (Std pen Test, 475J/blow)
- Blows/0.3m (60' Cone, 475J/blow)
- Cu Undrained Shear Strength from Field Vane
- PH Pressure, Hydraulic
- WL in Piezometer at Time of Investigation (Date)
- Head Artesian Water
- Piezometer
- WL in Open Borehole Upon Completion of Drilling
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	EAST	NORTH
29-419/C2N	106.8	314439.6	5031488.0
29-419/C2M	107.1	314427.2	5031476.3
29-419/C2S	106.7	314417.1	5031466.5
29-419/C1N	106.4	314420.0	5031460.9
29-419/C1M	108.2	314397.6	5031436.2
29-419/C1S	106.2	314388.5	5031429.0

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
JUN, 05	SP		ISSUED AS DRAFT FOR REVIEW
DESIGN MA	CHK AEG	CODE CHBDC	LOAD
DRAWN HS	CHK MA	SITE 29-419	STRUCT
			SCHEME
			DWG C2

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

HWY.17  
GWP NO. 647-92-01  
HIGHWAY 17/417 TWINNING  
CULVERT SITE 29-420/C1, C2, C3  
BOREHOLE LOCATIONS AND SOIL STRATA

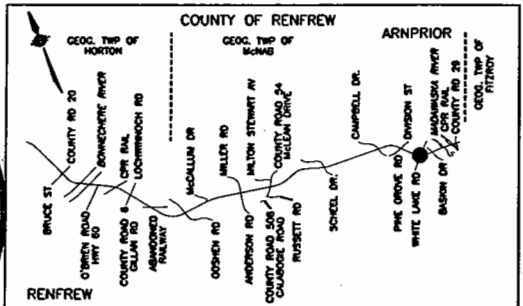
SHEET

MRC  
McCORMICK RANKIN  
CORPORATION

THURBER  
THURBER ENGINEERING LTD.

LICENSED PROFESSIONAL ENGINEER  
M. R. ANDERSON  
MAR 17/06  
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER  
P. K. CHATTERJI  
MAR 17/06  
PROVINCE OF ONTARIO



KEYPLAN

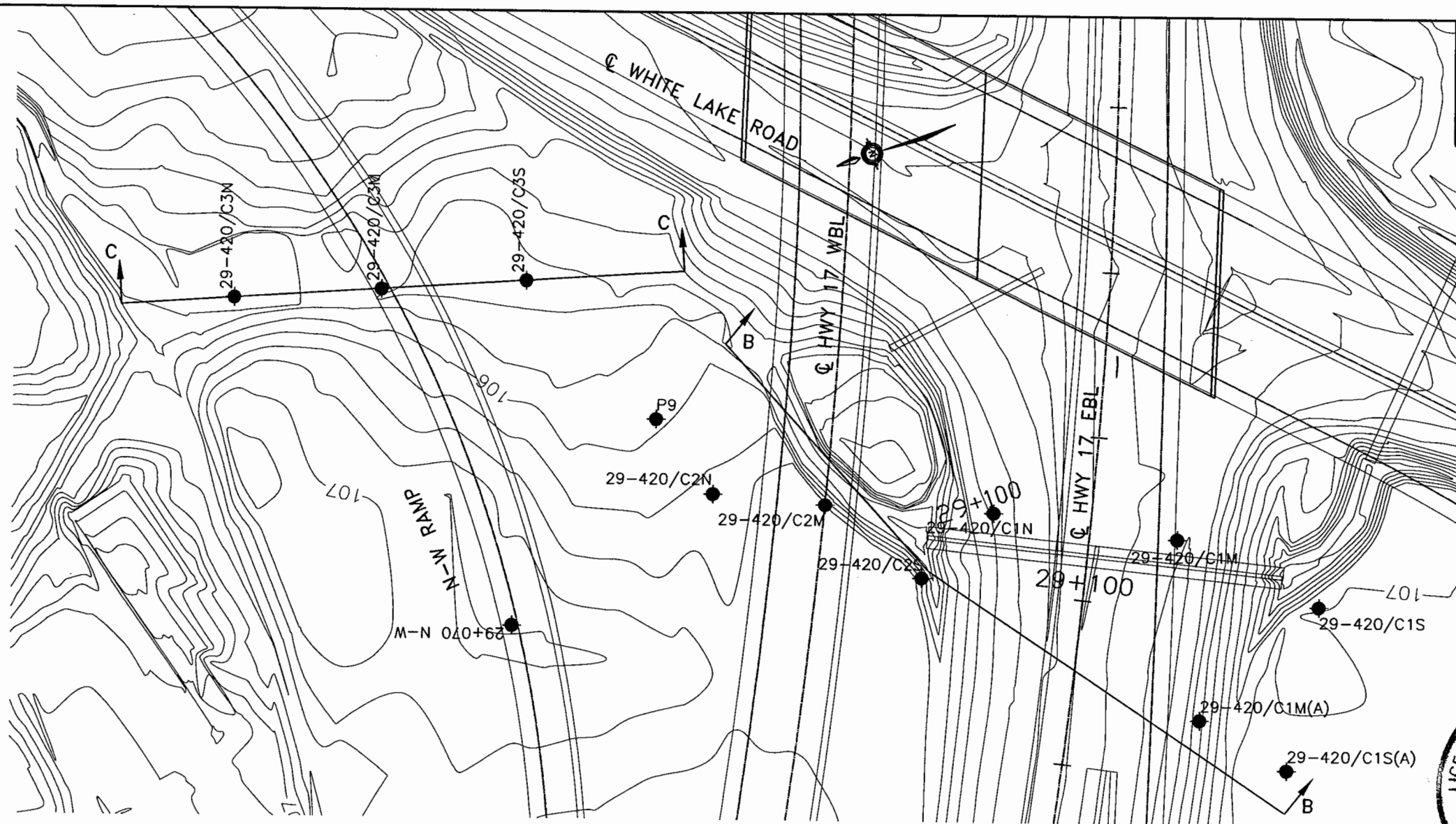
LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (cone) or Probe Hole
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std pen Test, 475J/blow)
- CONE Blows/0.3m (60° Cone, 475J/blow)
- Cu Undrained Shear Strength from Field Vane
- PH Pressure, Hydraulic
- WL in Piezometer at Time of Investigation (Date)
- Head Artesian Water
- Piezometer
- WL in Open Borehole Upon Completion of Drilling
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

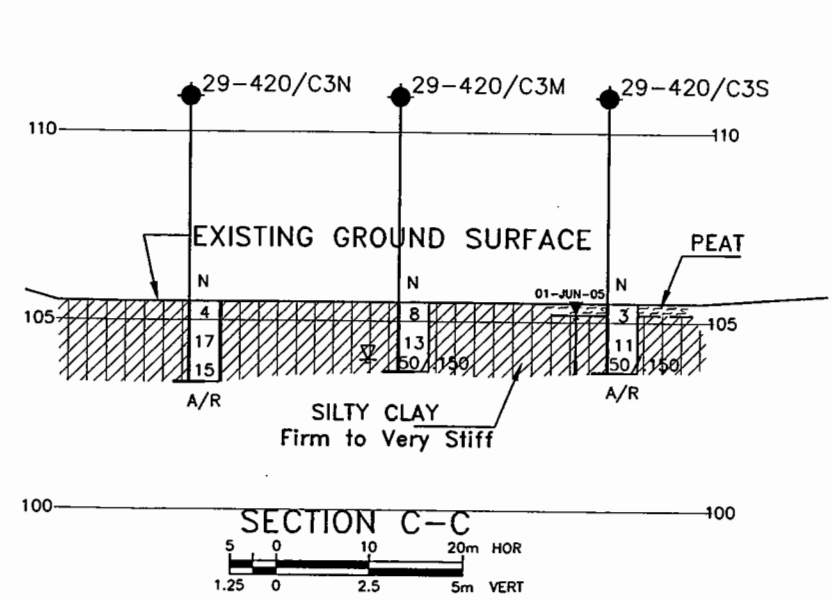
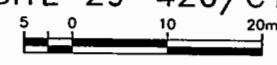
NO	ELEVATION	EAST	NORTH
29-420/C1N	107.3	314709.0	5031241.6
29-420/C1M	108.5	314696.0	5031217.0
29-420/C1M(A)	107.8	314669.0	5031223.0
29-420/C1S	107.0	314679.1	5031200.2
29-420/C1S(A)	107.3	314657.4	5031213.1
29-420/C2N	106.3	314725.9	5031280.7
29-420/C2M	106.6	314718.7	5031265.3
29-420/C2S	106.5	314703.3	5031255.1
29-420/C3N	105.5	314778.3	5031339.4
29-420/C3M	105.5	314772.0	5031317.8
29-420/C3S	105.5	314765.9	5031296.7
P9	105.9	314739.5	5031285.0

NOTE

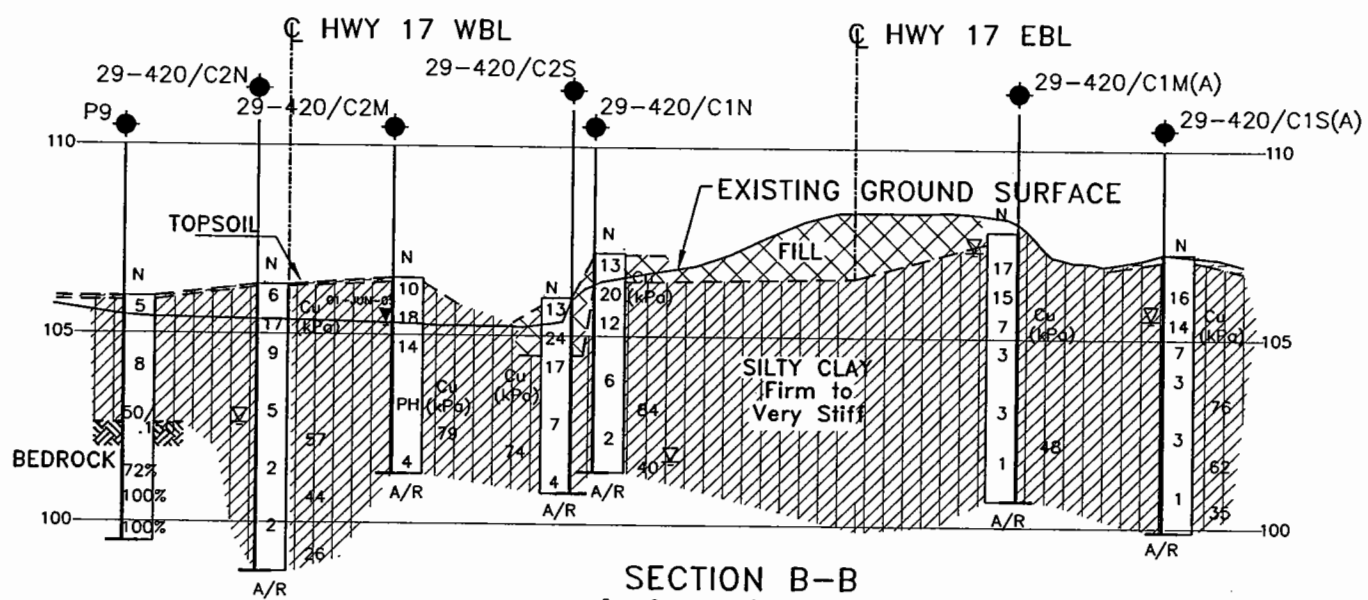
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.



PLAN ( SITE 29-420/C1, C2, C3 )



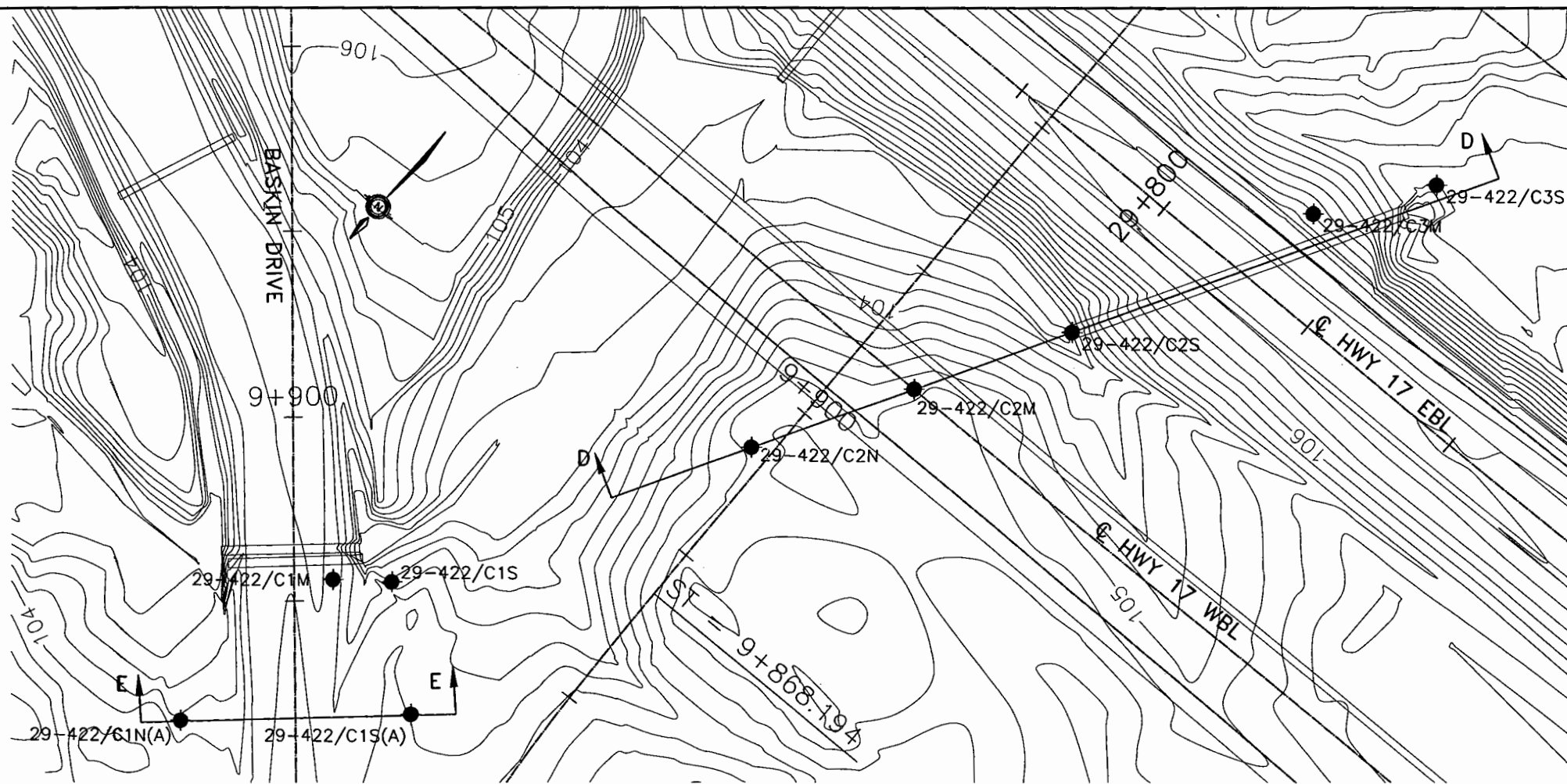
SECTION C-C



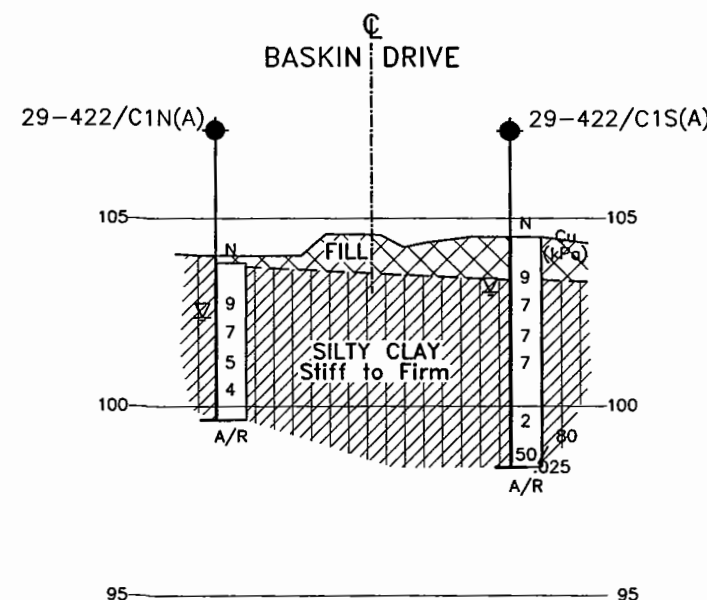
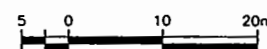
SECTION B-B

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

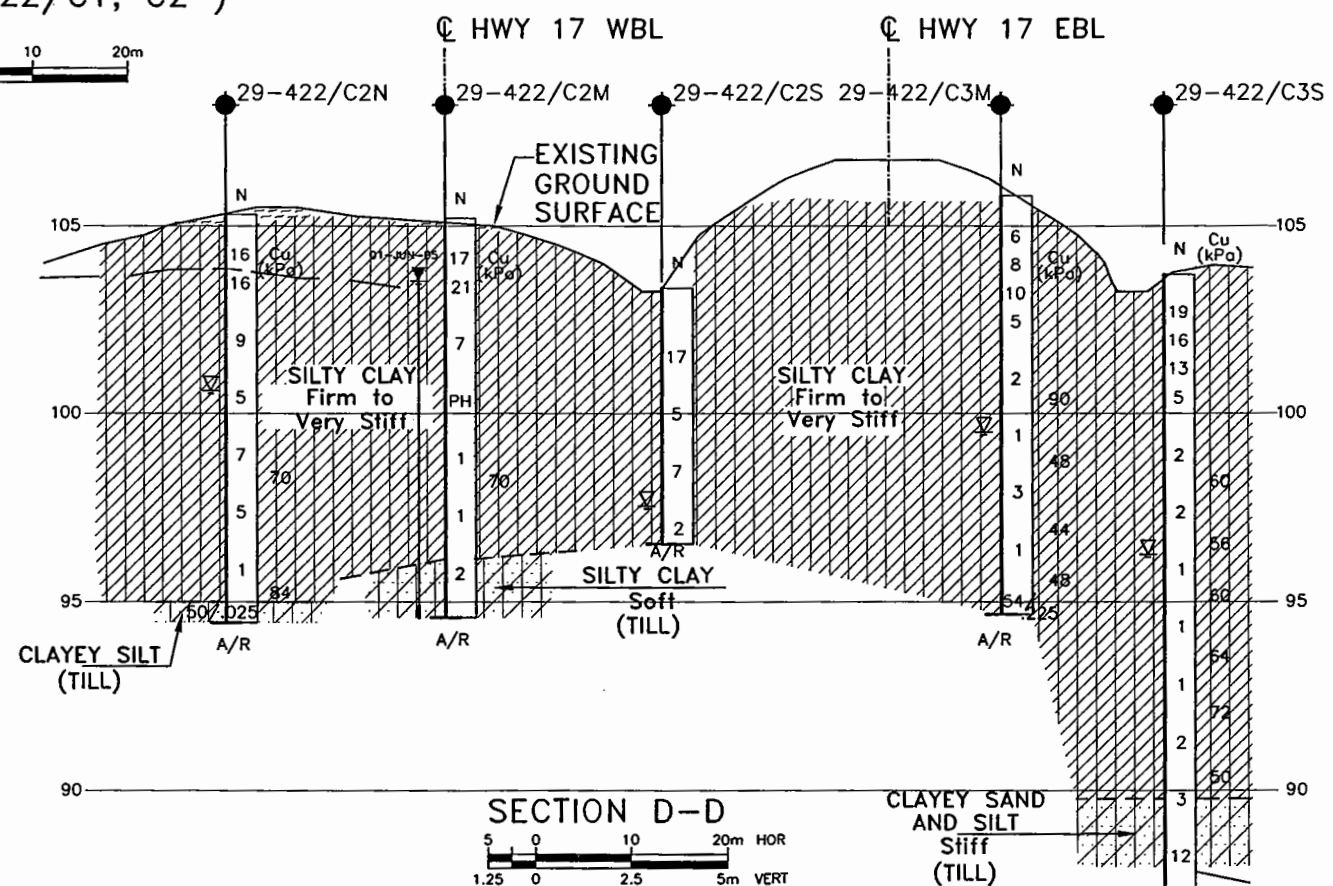
REVISIONS	DATE	BY	DESCRIPTION
JUN 05	SP	ISSUED AS DRAFT FOR REVIEW	
DESIGN MA	CHK AEG	CODE CHBDC	LOAD
DRAWN HS	CHK MA	SITE 29-420	STRUCT SCHEME DWG C3



PLAN ( SITE 29-422/C1, C2 )



SECTION E-E  
1.25 0 2.5 5m VERT



SECTION D-D  
1.25 0 2.5 5m VERT

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



HWY.17  
GWP NO. 647-92-01

HIGHWAY 17/417 TWINNING  
CULVERT SITE 29-422/C1,C2,C3  
BOREHOLE LOCATIONS AND SOIL STRATA

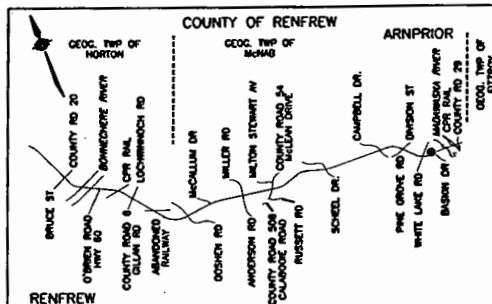
SHEET



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KEYPLAN

# LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (cone) or Probe Hole
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std pen Test, 475J/blow)
- CONE Blows/0.3m (60° Cone, 475J/blow)
- Cu Undrained Shear Strength from Field Vane
- PH Pressure, Hydraulic
- WL in Piezometer at Time of Investigation (Date)
- Head Artesian Water
- Piezometer
- WL in Open Borehole Upon Completion of Drilling
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

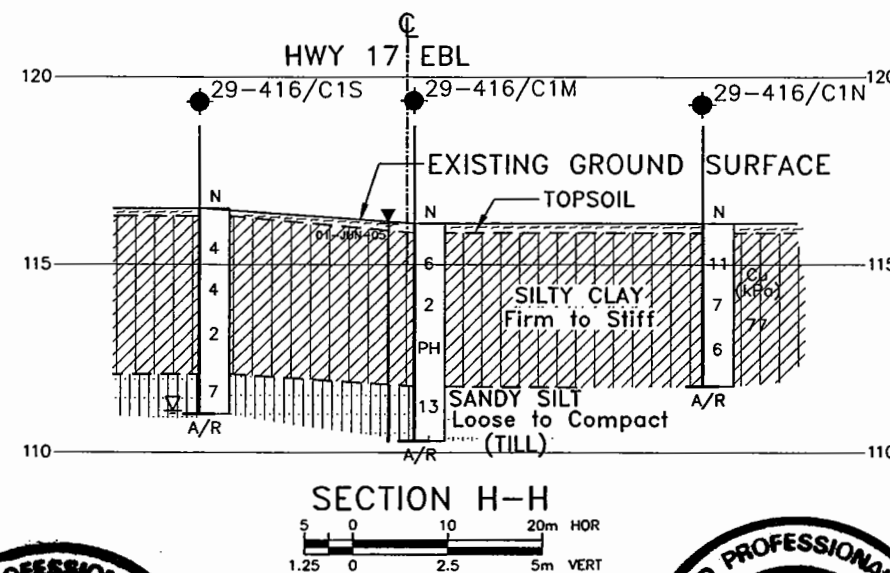
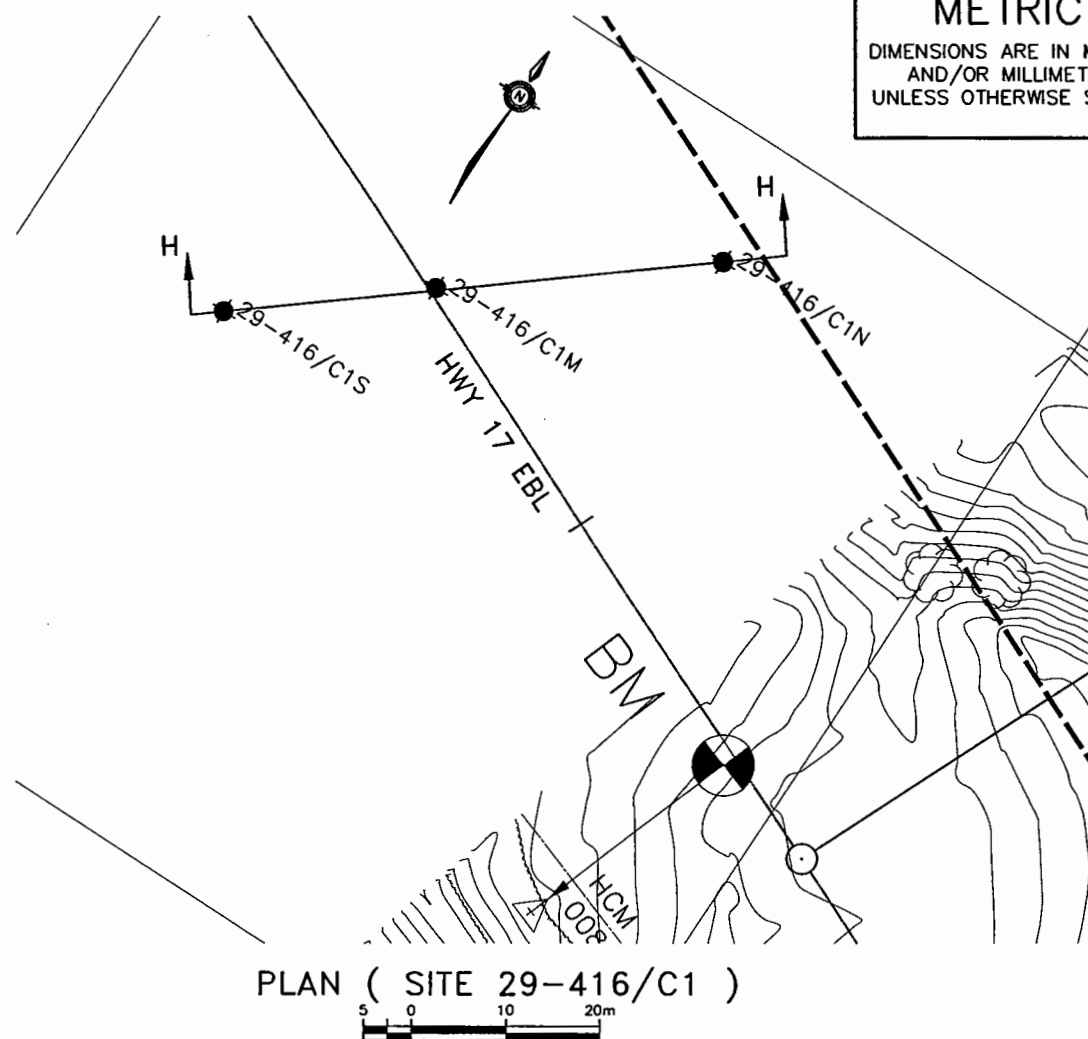
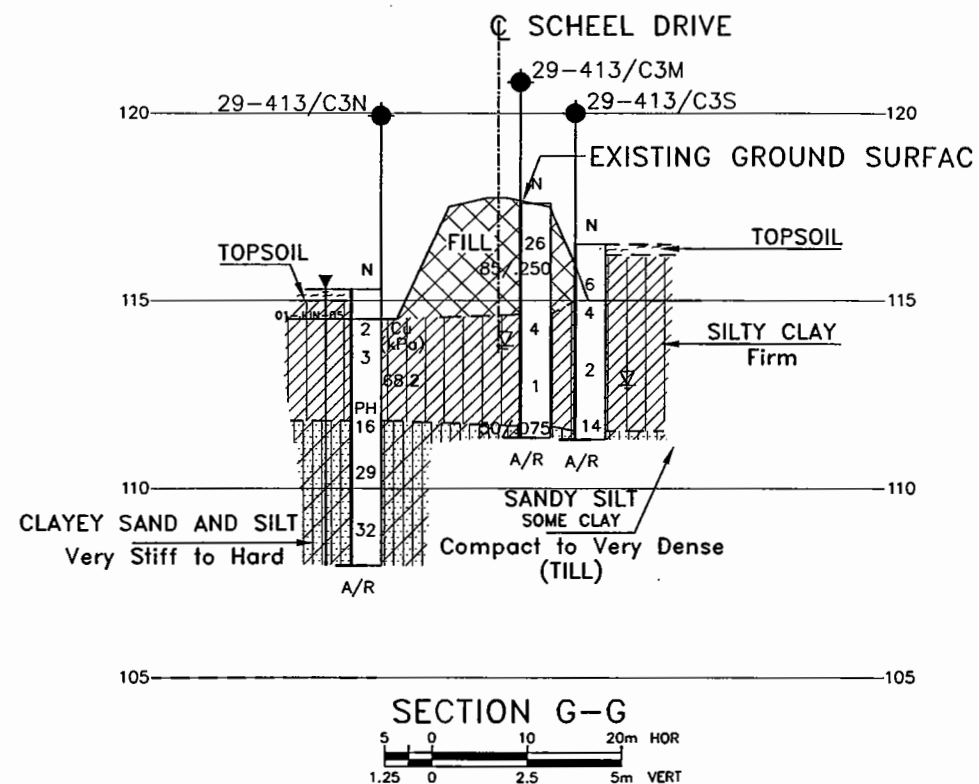
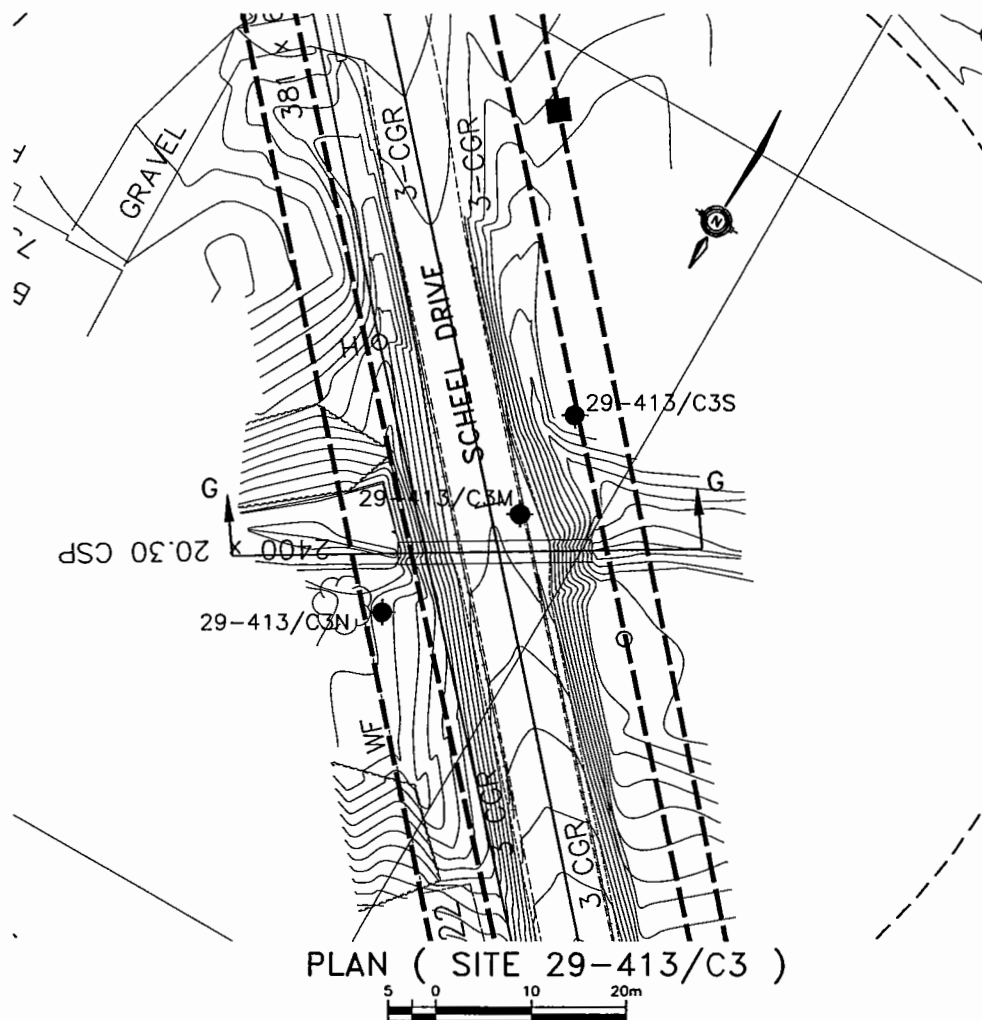
NO	ELEVATION	EAST	NORTH
29-422/C1M	104.5	315428.0	5031253.5
29-422/C1S	104.2	315421.8	5031202.6
29-422/C1N(A)	103.8	315431.0	5031281.6
29-422/C1S(A)	104.5	315408.0	5031260.3
29-422/C2N	105.3	315397.4	5031202.3
29-422/C2M	105.2	315386.2	5031182.2
29-422/C2S	103.3	315375.2	5031162.3
29-422/C3M	105.8	315361.5	5031129.1
29-422/C3S	103.8	315351.6	5031115.1

## NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION
JUN, 05	SP	ISSUED AS DRAFT FOR REVIEW	
DESIGN MA	CHK AEG	CODE CHBDC	LOAD
DRAWN HS	CHK MA	SITE 29-422	STRUCT
			SCHEME
			DWG C4

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

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

HWY.17  
GWP NO. 647-92-01

HIGHWAY 17 TWINNING  
CURVERT SITE 29-413/C3;  
29-416/C1  
BOREHOLE LOCATIONS AND SOIL STRATA

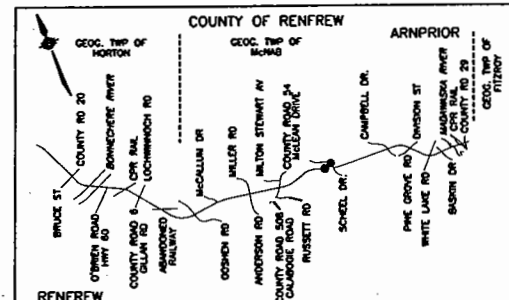
SHEET



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CORPORATION



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Bore Hole
⊕	Dynamic Cone Penetration Test (cone) or Probe Hole
●	Bore Hole & Cone
N	Blows/0.3m (Std pen Test, 475J/blow)
CONE	Blows/0.3m (60° Cone, 475J/blow)
Cu	Undrained Shear Strength from Field Vane
PH	Pressure, Hydraulic
↓	WL in Piezometer at Time of Investigation (Date)
↑	Head Artesian Water
↑	Piezometer
↓	WL in Open Borehole Upon Completion of Drilling
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	EAST	NORTH
29-413/C3N	115.3	307914.8	5033461.8
29-413/C3M	117.6	307907.5	5033445.5
29-413/C3S	116.5	307907.8	5033433.6
29-416/C1N	116.1	307663.9	5033386.8
29-416/C1M	116.1	307640.0	5033368.0
29-416/C1S	116.5	307622.7	5033353.8

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION
JUN, 05	SP	ISSUED AS DRAFT FOR REVIEW
DESIGN	MA	CHK AEG
DRAWN	HS	CHK SP
CODE	CHBDC	LOAD
SITE	29-413	STRUCT.
SCHEME		DWG C5