

Terraprobe

**Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing**

GEOCRUS No:
30M5-262

**FOUNDATION INVESTIGATION & DESIGN REPORT
OVERHEAD/CANTILEVERED SIGN SUPPORT STRUCTURES
QUEEN ELIZABETH HIGHWAY
FROM BRANT STREET TO BURLOAK DRIVE
AGREEMENT No. 2006-E-0026, W.P. 2831-02-01
MINISTRY OF TRANSPORTATION, ONTARIO
CENTRAL REGION**

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted along the alignment of the Queen Elizabeth Highway (QEW) for proposed overhead and cantilevered sign support structures. This project is the Ministry of Transportation of Ontario undertaking to rehabilitate and widen the QEW from Brant Street to Burloak Drive.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide borehole location plans, records of boreholes, laboratory test results and a description of the subsurface conditions.

Terraprobe conducted the investigation as a sub-consultant to Giffels Associates Limited, under The Ministry of Transportation of Ontario Agreement No. 2006-E-0026, W.P. 2831-02-01.

2 SITE DESCRIPTION

This project is located in the Regional Municipality of Halton, City of Burlington, Ontario, and extends a distance of approximately 8.2 km from Sta.11+700 to Sta.10+330. Within the project limits, this divided highway comprises of six lanes, and fully paved shoulders. There is an existing storm sewer located close to the median centreline of the highway. There are four QEW interchanges within the project limits: Guelph Line, Walkers Line, Appleby Line and Burloak Drive.

The highway crosses over several major facilities. These include a bridge over the CN Rail tracks (Stn. 12+350), and the following creek culvert crossings: Tuck Creek (Stn. 15+370), Shoreacres Creek (Stn. 16+765), West Appleby Creek (Stn. 17+870), Appleby Creek (18+275), and Sheldon Creek (18+725). There are several other smaller culvert and utility crossings beneath the highway.

The site is located in the physiographic region of Southern Ontario referred to as the Iroquois Plain¹. This strip of land is approximately 3 km wide and is located between the shoreline of the

¹ Chapman and Putnam, "The Physiography of South Ontario", 3rd Edition, 1984.



former glacial lake, Lake Iroquois and Lake Ontario. The topography is flat to moderately rolling and the terrain slopes gently towards Lake Ontario.

The soils generally consist of fine grained silts and clays, underlain by silty clay glacial till. The overburden soils are further underlain by bedrock of the Queenston Formation which is predominantly shale, and is known to exist at relatively shallow depths within the project limits. Very often the basal portion of this till is distinctly red in colour from large amounts of incorporated Queenston shale.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period July 30, 2007 to October 26, 2007 and consisted of drilling and sampling a total of 37 boreholes to depths ranging from 3.1 m to 10.8 m. Boreholes drilled for the cantilevered sign support structures are denoted as CS-1 to CS-6. Overhead sign boreholes are denoted as OS-1 to OS-14. The drilling and sampling and bedrock coring operations could not be completed together within the allowable nightly lane closure times. Separate visits were therefore required to undertake bedrock coring and these boreholes are identified with letters, for example CS-6A, or OS-11B. The approximate borehole locations are shown on the attached Borehole Locations Drawings in Appendix C.

Based on drawings provided by Giffels Associates Limited the borehole locations were established in the field by Terraprobe, and the locations were surveyed by JD Barnes, who provided Terraprobe with their coordinates and geodetic elevations. Utility locates were obtained by Terraprobe prior to drilling.

The drilling, sampling and in-situ testing operations were conducted using both truck-mounted and track-mounted drill rigs owned and operated by D.B.W. Drilling Limited of Ajax, Ontario. Solid stem auger drilling techniques were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils. Boreholes were also advanced approximately 3.1 m into bedrock by NQ size diamond coring techniques. Groundwater conditions in the open boreholes were observed throughout the drilling operations and upon completion of the boreholes.

Members of Terraprobe's engineering staff observed the drilling, and supervised the sampling, in-situ testing and coring operations on a full time basis. The supervisors logged the boreholes and processed the recovered soil samples and rock cores for transport to Terraprobe's Brampton laboratory for further examination and testing.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and natural moisture content determination. Selected samples were subjected to gradation analysis and Atterberg Limits tests were also conducted on selected samples retrieved from the cohesive deposits. The results of this testing program are shown on the Record of Borehole sheets in Appendix A. The grain size distribution curves and plasticity charts are illustrated in Appendix B.



5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by a flexible pavement, fill material, and native overburden deposits of very stiff to hard silty clay glacial till, compact sandy silt till and hard silty clay till (till/shale complex). The overburden soils are further underlain by shale bedrock of the Queenston Formation.

5.1 Pavement Structure

Boreholes were drilled through the existing paved inner shoulder of the QEW east bound and west bound. The pavement structure consists of 100 to 430 mm of asphaltic concrete, underlain by 300 to 1700 mm of granular fill. In Borehole CS-3 and CS-4, 420 mm and 160 mm of concrete was encountered beneath the asphalt, respectively. The concrete in these two boreholes is further underlain by granular fill ranging from 100 to 200 mm in thickness.

Grain size distribution curves of samples of this fill material are presented in Figure B1 and B2. The results show grain size distributions consisting of 0 to 37% gravel, 49 to 81% sand, and 14 to 19% silt and clay size particles.

Standard Penetration tests in the granular fill yielded 'N' values of 11 to more than 100 blows for 0.3 m penetration, indicating a compact to very dense relative density. The measured moisture content of samples from this fill varied from 1% to 8% by weight.

5.2 Silty Clay and Clayey Silt Fill

Silty clay and clayey silt fill were encountered across the site in some of the boreholes. The fill extends to depths ranging from 0.9 to 2.9 m (Elev. 103.5 m to Elev. 118.3 m). Locally in OS-1 and OS-13 the fill extends to a depth of 7.1 m below ground surface i.e. Elev. 104.6 m and Elev. 111.7 m respectively.

Grain size distribution curves of samples of this fill material are presented in Figures B3 and B4. These results show grain size distributions consisting of 0 to 9% gravel, 9 to 48% sand, 32 to 57% silt and 15 to 51% clay size particles.

Samples of the silty clay and clayey silt fill were also subjected to Atterberg Limits tests and the results are illustrated in Figure B5 and B6. The summarized index values from these tests are presented herein.



Liquid Limit:	19 to 49%
Plastic Limit:	14 to 25%
Plasticity Index:	5 to 24%
Natural Moisture Content:	11 to 26%

These values are characteristic of clayey soils of low to intermediate plasticity.

Standard Penetration tests in the silty clay and clayey silt fill material yielded 'N' values ranging from 5 to 22 blows for 0.3 m penetration and pocket penetrometer tests conducted on samples of this fill gave undrained shear strengths ranging from 75 kPa to 225 kPa. Based on these results the fill is considered to have a firm to very stiff consistency.

The moisture content of samples of this fill ranged from 10% to 36% by weight.

5.3 Silty Sand and Silt and Sand Fill

Fill material consisting of silty sand and silt were encountered beneath the pavement structure in boreholes OS-2, and OS-13. The fill is cohesionless and contains some gravel, trace to some clay, and occasional asphalt inclusions and extends to depths of 2.1 m in both boreholes or to elevations ranging from 103.5 m to 116.7 m.

Grain size distribution curves of samples of this fill material are presented in Figure B7. These results show grain size distributions consisting of 12 to 15% gravel, 41 to 46% sand, 26 to 27% silt and 15 to 18% clay sized particles.

Standard Penetration tests in the fill material yielded 'N' values ranging from 16 to 75 blows for 0.3 m penetration. Based on these results the fill is considered to have a compact to very dense relative density.

The moisture content of samples of this fill ranged from 10% to 14% by weight.

5.4 Silty Clay Till

Silty clay glacial till was encountered across the site extending to depths ranging from 2.1 to 4.0 m below ground surface or to elevations ranging from Elev. 101.8 m to Elev. 113.0 m. In Borehole OS-1 (high fill near the CN Rail Bridge), the till locally extends to a depth of 8.6 m (Elev. 103.1 m) below ground surface.

Grain size distribution curves of tested samples of this silty clay till are shown in Figure B8. The results generally show a grain size distribution consisting of 0 to 6% gravel, 2 to 23% sand, 43 to 73% silt and 22 to 31% clay size particles. Random cobble and boulder inclusions can also be expected to occur in till soils.

Samples of the silty clay till were also subjected to Atterberg Limits tests and the results are plotted on the plasticity chart in Figure B9. The index values from these tests are summarized below:



Liquid Limit:	26 to 47%
Plastic Limit:	16 to 25%
Plasticity Index:	10 to 22%
Natural Moisture Content:	11 to 22%

These values are characteristic of clayey soils of generally low plasticity.

Standard Penetration tests in the silty clay till gave 'N' values ranging from 15 to 72 blows for 0.3 m penetration and pocket penetrometer tests on relatively undisturbed samples yielded undrained shear strengths ranging from 175 kPa to more than 225 kPa. Based on these results the silty clay till is considered to have a very stiff to hard consistency.

The moisture content of samples from this deposit ranged from 11% to 22% by weight.

5.5 Sandy Silt Till

A 0.9m thick layer of sandy silt glacial till containing some gravel and trace clay was encountered in Borehole CS-3 where it extends to a depth of 2.9 m (Elev. 103.3 m) below ground surface.

The results of a grain size distribution test conducted on a sample obtained from this deposit are illustrated in Figure B10. These results show a grain size distribution consisting of 18% gravel, 27% sand, 54% silt and 1% clay size particles.

A sample of the sandy silt till was also subjected to Atterberg Limits tests and the results are plotted on the plasticity chart in Figure B11. The results indicate non plastic silt.

A Standard Penetration test in the sandy silt till gave an 'N' value of 24 blows for 0.3 m penetration indicating a compact relative density. The moisture content of a sample from this stratum was 14% by weight.

5.6 Silty Clay Till - Till/Shale Complex

The lower portions of the glacial till, above the shale bedrock, are difficult to distinguish from the upper, highly weathered shale. This transition zone of material is sometimes referred to as till/shale complex. The unit may often be described as residual soil or completely weathered shale bedrock. Shale and limestone slabs may occur within this deposit.

The till/shale complex extends to depths ranging from 1.4 to 9.4 m below ground surface or to elevations ranging from Elev. 100.9 m to 117.8 m.

The results of grain size distribution tests conducted on samples obtained from this deposit are shown in Figure B12 and B13. These results show a grain size distribution consisting of 0 to 21% gravel, 18 to 33% sand, 40 to 66% silt and 10 to 32% clay size particles.



Samples of the till/shale complex were also subjected to Atterberg Limits tests and the results are plotted on the plasticity chart in Figure B14. The index values from these tests are summarized below:

Liquid Limit:	23 to 28%
Plastic Limit:	14 to 18%
Plasticity Index:	6 to 11%
Natural Moisture Content:	8 to 25%

These values are characteristic of silty clay soils of low plasticity.

Standard Penetration tests in the till/shale complex gave 'N' values ranging from 25 to more than 100 blows for 0.3 m penetration and pocket penetrometer tests on relatively undisturbed samples yielded undrained shear strengths greater than 225 kPa. Based on these results the till/shale complex is considered to have a generally very stiff to hard consistency.

The moisture content of samples from this deposit ranged from 7% to 24% by weight.

5.7 Bedrock

The bedrock beneath the site is of the Queenston Formation, a deposit predominantly comprised of thickly bedded to massive brick red shale of Ordovician age. The rock contains within the shale matrix occasional layers of limestone, sandstone and siltstone, and occasionally green calcareous shale layers. There is typically a horizontal zone of weathering at the contact between the weak rock of the Queenston Formation and the glacial soil overburden. In the Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects*, there is reproduced from Skempton, Davis and Chandler, *a typical weathering profile of a low durability shale*, that characterizes the shale surface into three grades of weathering and four zones described as follows:

	Zone	Description	Notes
Fully Weathered	IVb	soil like matrix only	indistinguishable from glacial drift deposits, slightly clayey, may be fissured
Partially Weathered	IVa	soil like matrix with occasional pellets of shale less than 3 mm diameter	little or no trace of rock structure, although matrix may contain relic fissures
	III	soil like matrix with frequent angular shale particles up to 25 mm diameter	moisture content of matrix greater than the shale particles
	II	angular blocks of unweathered shale with virtually no matrix separated by weaker chemically weathered but intact shale	spheroidal chemical weathering of shale pieces emanating from relic joints and fissures, and bedding planes
Unweathered (sound)	I	shale	regular fissuring



At the base of the Glacial Till deposit there is sometimes found a zone of silty clay and fragmented shale that can be interpreted as the lowest portion of the till or as partially weathered rock of Zone III. The distinction is subjective and depends on the investigator. The surface of the bedrock as indicated on the Borehole Logs from this investigation is to be consistently interpreted as the surface of Zone II in the profile.

Shale bedrock was encountered within the depth of investigation in all boreholes except Borehole OS-4. In each borehole, the bedrock was penetrated by solid stem augering, and samples were obtained by split spoon sampling. The bedrock was also cored approximately three metres using NQ-sized diamond drilling techniques.

Tabulated below are the bedrock depth and elevation at the borehole locations.

BH No.	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
OS-1	9.4	102.4
CS-1	5.2	101.5
OS-2 & OS-2A	3.8	101.8
CS-2 & CS-2A	4.9	100.9
CS-3 & CS-3A	3.9	102.3
OS-3 & OS-3A	2.1	106.0
CS-4 & CS-4A	2.9	105.8
OS-4	Below 6.2	Below 105.8
OS-5 & OS-5A	4.2	109.2
OS-6 & OS-6A	3.6	111.2
CS-5 & CS-5A	2.9	112.2
OS-7 & OS-7A	2.3	114.6
OS-8 & OS-8A	1.5	116.3
OS-9 & OS-9A	2.9	113.9
OS-10 & OS-10A	1.4	117.8
CS-6 & CS-6A	2.1	116.1
OS-11 & OS-11A & OS-11B	0.6	117.7
OS-12 & OS-12A	0.7	117.8
OS-13	7.1	111.7
OS-14 & OS-14A	2.0	117.2

The bedrock is described as partially weathered generally in the top 2± metres, and unweathered below. It is medium to thickly bedded with low to medium strength shale and occasional interbeds of medium to high strength greenish grey limestone. Total core recovery typically ranged from 87% to 100%. The RQD values generally ranged from 0% to 75%, indicating very poor to fair rock quality. Vertical and subvertical joints, as well as multiple horizontal bedding planes, were observed in the rock cores which contributed to the relatively low RQD values.



5.8 Water Levels


In general, the groundwater table along the alignment follows the ground surface topography. At the west project limit, the groundwater table is estimated to be about Elev. 107.1 m falling gradually to about Elev. 103.6 m near Sta. 13+150. Progressing further easterly the groundwater table rises to about Elev. 116.8 m, near Sta. 16+375 and then falls to about Elev. 114.5 m at Sta. 16+750, near Shoreacres Creek. Easterly, beyond Shoreacres Creek the water table rises to about Elev. 118.6 m near Sta. 17+175. The groundwater table then falls gradually to about Elev. 113.0 m at Station 18+750 (near Sheldon Creek) then rises gradually to about Elev. 118.2 m at the east project limit.


Perched water can also be expected to occur where permeable layers of sand and gravelly sand are underlain by relatively impermeable layers of silty clay and clayey silt soils.

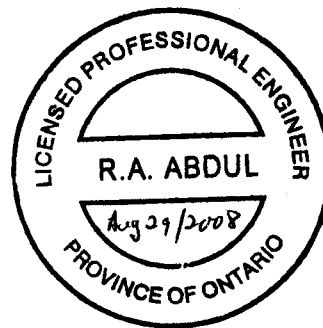
All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.




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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

6 GENERAL

This report provides geotechnical recommendations for the design of overhead and cantilevered sign support structures being proposed along the QEW between Brant Street and Burloak Drive, City of Burlington, Ontario.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of the investigations.

7 SUMMARIZED SUBSURFACE CONDITIONS

In general, the site is underlain by a flexible pavement, fill, and native overburden deposits of very stiff to hard silty clay glacial till, compact sandy silt till and hard silty clay till (till/shale complex). These overburden soils are further underlain by shale bedrock of the Queenston Formation.

The groundwater is estimated to generally follow the ground surface topography falling towards the creeks located within the project limits. Perched water can also be expected to occur where permeable layers of sand and gravelly sand are underlain by relatively impermeable layers of silty clay and clayey silt soils. The groundwater will also fluctuate seasonally and after severe weather events.

8 DESIGN CONSIDERATIONS

Generally, the overhead and cantilevered sign support structures can be supported on caissons (i.e. drilled and cast-in-place concrete pile) foundations. The depth of the caisson would vary depending on the design of the cantilever or overhead sign, and the subsurface conditions encountered. The design can be carried out in accordance with the following documents and papers.



- Canadian Highway Bridge Design Code and Commentary (2000). CAN/CSA-S6-00 and S6.1-00.
- Ministry of Transportation, Ontario (2007) "Sign Support Manual", Bridge Office, Engineering Standards Branch.
- BROMS, B.B.: Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM2, Paper No. 3825, March 1964.
- BROMS, B.B.: Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM3, Paper No. 3909, March 1964.
- BROMS, B.B.: Design of Laterally Loaded Piles, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 91. Paper No. SM3, May 1965.

The recommended soil parameters for the design of augered caisson foundation units are given in Table 8.0.

Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m)		Type of Soil	Consistency or Compactness Condition	q _u (kPa)	φ (degrees)	γ (kN/m ³)	Water Level Depth (Elevation) (m)
	From	To						
OS-1	111.5	111.0	Fill	Inferred Compact	-	29	18.5	4.6* (107.1)*
	111.0	108.4	Cohesive	Firm to Stiff	200	-	18.5	
	108.4	107.7	Cohesionless	Inferred Compact	-	29	18.0	
	107.7	104.6	Cohesive	Very Stiff	400	-	20.0	
	104.6	103.1	Cohesive	Very Stiff	400	-	22.0	
	103.1	102.4	Cohesive	Hard	500	-	22.5	
CS-1	102.4	100.9	Cohesive	Hard	1000	-	23.0	2.4* (104.3)*
	106.4	104.8	Fill	Very Dense	-	32	19.0	
	104.8	102.7	Cohesive	Very Stiff	400	-	21.0	
	102.7	101.5	Cohesive	Hard	500	-	22.5	
OS-2 & OS-2A	101.5	100.5	Cohesive	Hard	1000	-	23.0	1.6* (104.0)*
	105.4	104.6	Fill	Inferred Compact	-	29	18.5	
	104.6	104.2	Fill	Very Dense	-	30	19.0	
	104.2	103.5	Fill	Compact	-	29	18.5	
	103.5	101.8	Cohesive	Hard	500	-	22.5	
	101.8	98.0	Cohesive	Hard	1000	-	23.0	
CS-2 & CS-2A	98.0	96.5	Cohesive	Hard	1500	-	23.0	2.4* (103.6)*
	105.5	104.3	Fill	Very Dense	-	30	19.0	
	104.3	103.8	Fill	Compact	-	29	18.5	
	103.8	101.8	Cohesive	Very Stiff	400	-	20.5	
	101.8	100.9	Cohesive	Hard	500	-	22.5	
	100.9	99.8	Cohesive	Hard	1000	-	23.0	
CS-3 & CS-3A	99.8	97.1	Cohesive	Hard	1500	-	23.0	1.5* (104.7)*
	105.4	105.1	Fill	Compact	-	29	18.5	
	105.1	104.2	Fill	Stiff	150	-	18.5	
	104.2	103.3	Cohesionless	Compact	-	31	20.0	
	103.3	102.3	Cohesive	Hard	500	-	22.5	
	102.3	100.8	Cohesive	Hard	1000	-	23.0	
	100.8	99.3	Cohesive	Hard	1500	-	23.0	



Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m)		Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m ³)	Water Level Depth (Elevation) (m)
	From	To						
OS-3 & OS-3A	107.7	107.1	Fill	Compact	-	29	18.5	1.0* (107.1)*
	107.1	106.7	Fill	Very Stiff	200	-	18.5	
	106.7	106.0	Cohesive	Very Stiff	500	-	22.0	
	106.0	103.6	Cohesive	Hard	1000	-	23.0	
	103.6	101.9	Cohesive	Hard	1500	-	23.0	
CS-4 & CS-4A	108.1	108.0	Fill	Inferred Compact	-	29	18.5	0.9* (107.8)*
	108.0	107.3	Fill	Stiff	150	-	18.5	
	107.3	105.8	Cohesive	Very Stiff to Hard	500	-	22.5	
	105.8	104.2	Cohesive	Hard	1000	-	23.0	
	104.2	102.6	Cohesive	Hard	1500	-	23.0	
OS-4	111.8	110.9	Fill	Compact to Dense	-	29	18.5	1.5* (110.5)*
	110.9	109.9	Fill	Very Stiff	150	-	18.5	
	109.9	108.0	Cohesive	Very Stiff to Hard	400	-	22.0	
	108.0	105.8	Cohesive	Hard	500	-	22.5	
OS-5 & OS-5A	113.2	112.6	Fill	Compact	-	29	18.5	1.1* (112.3)*
	112.6	110.5	Cohesive	Very Stiff to Hard	400	-	22.0	
	110.5	109.2	Cohesive	Hard	500	-	22.5	
	109.2	106.8	Cohesive	Hard	1000	-	23.0	
	106.8	105.8	Cohesive	Hard	1500	-	23.0	
OS-6 & OS-6A	114.5	114.2	Fill	Compact	-	29	18.5	0.9* (113.9)*
	114.2	112.7	Fill	Firm to Stiff	100	-	18.5	
	112.7	111.2	Cohesive	Very Stiff	500	-	22.5	
	111.2	110.2	Cohesive	Hard	1000	-	23.0	
	110.2	107.7	Cohesive	Hard	1500	-	23.0	
CS-5 & CS-5A	115.0	114.5	Fill	Compact	-	29	18.5	0.9* (114.2)*
	114.5	113.0	Cohesive	Stiff to Very Stiff	400	-	21.5	
	113.0	112.2	Cohesive	Hard	500	-	22.5	
	112.2	110.1	Cohesive	Hard	1000	-	23.0	
	110.1	108.9	Cohesive	Hard	1500	-	23.0	
OS-7 & OS-7A	116.7	116.4	Fill	Compact	-	29	18.5	0.9* (116.0)*
	116.4	115.5	Fill	Stiff	150	-	18.5	
	115.5	114.6	Cohesive	Hard	500	-	22.5	
	114.6	110.7	Cohesive	Hard	1000	-	23.0	
	110.7	109.3	Cohesive	Hard	1500	-	23.0	
OS-8 & OS-8A	117.5	116.3	Fill	Compact	-	29	18.5	1.0* (116.8)*
	116.3	114.4	Cohesive	Hard	1000	-	23.0	
	114.4	112.3	Cohesive	Hard	1500	-	23.0	
OS-9 & OS-9A	116.5	116.2	Fill	Compact	-	29	18.5	2.3* (114.5)*
	116.2	113.9	Fill	Firm to Stiff	100	-	18.5	
	113.9	110.3	Cohesive	Hard	1000	-	23.0	
	110.3	108.0	Cohesive	Hard	1500	-	23.0	
OS-10 & OS-10A	118.9	118.6	Fill	Compact	-	29	18.5	0.6* (118.6)*
	118.6	118.3	Fill	Stiff	100	-	18.5	
	118.3	117.8	Cohesive	Stiff	250	-	19.5	
	117.8	114.0	Cohesive	Hard	1000	-	23.0	
	114.0	112.5	Cohesive	Hard	1500	-	23.0	
CS-6 & CS-6A	117.9	117.6	Fill	Compact	-	29	18.5	1.5* (116.7)*
	117.6	116.1	Fill	Stiff	200	-	18.5	
	116.1	113.0	Cohesive	Hard	1000	-	23.0	
	113.0	112.2	Cohesive	Hard	1500	-	23.0	
OS-11, OS-11A & OS-11B	118.0	117.7	Fill	Compact	-	29	18.5	0.4* (117.9)*
	117.7	115.1	Cohesive	Hard	1000	-	23.0	
	115.1	112.8	Cohesive	Hard	1500	-	23.0	



Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m)		Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m ³)	Water Level Depth (Elevation) (m)
	From	To						
OS-12 & OS-12A	118.1	117.8	Fill	Dense	-	30	19.0	0.5* (118.0)*
	117.8	114.6	Cohesive	Hard	1000	-	23.0	
	114.6	112.7	Cohesive	Hard	1500	-	23.0	
OS-13	118.5	116.7	Fill	Compact to Dense	-	29	18.5	5.8* (113.0)*
	116.7	111.7	Fill	Stiff	200	-	18.5	
	111.7	111.1	Cohesive	Hard	1000	-	23.0	
OS-14 & OS-14A	118.9	118.5	Fill	Dense	-	30	19.0	1.0* (118.2)*
	118.5	117.2	Cohesive	Very Stiff	300	-	21.0	
	117.2	115.5	Cohesive	Hard	1000	-	23.0	
	115.5	113.1	Cohesive	Hard	1500	-	23.0	

♦ = estimated

The notations used in Table 8.0 are defined below:

ϕ = apparent angle of friction for cohesionless soils in degrees.

q_u = unconfined compressive strength in kPa ($q_u = 2 \times C_u$) for cohesive soils

C_u = undrained shear strength in kPa.

γ = bulk unit weight of soil in kN/m³.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson and caisson sidewall adhesion within the upper 1.2 m below final grade, should be neglected in the foundation design. It is also recommended that all surficial weak or variable soils be neglected in determining lateral resistance.

When designing for the portion of a caisson below the groundwater level, the submerged unit weight should be used.

The required depth of the drilled shaft will be governed by lateral loads, including wind loads. Appropriate load and resistance factors should be applied for caisson design.

9 CONSTRUCTION CONSIDERATIONS

The boreholes indicate the presence of fill material, silty clay till (and till/shale complex), sandy silty till and shale bedrock of the Queenston Formation. The glacial till deposits can be expected to contain random cobbles and boulders. Cobbles and boulders if encountered during excavation can increase the level of construction effort required for caisson installation, such as increasing the time required for drilling etc. Bidders should be advised of these conditions and be required to provide adequate equipment to handle the obstructions.

The cohesive silty clay and clayey silt fill material, silty clay till (and till/shale complex) deposit and the bedrock are expected to be self-supporting. Due to the relatively low permeability of these strata minor water seepage is expected in caisson holes, even below the groundwater table.

Where relatively more pervious and granular soils (e.g. sand and gravelly sand, and sand and silt till) are encountered dry cave-ins may occur in unsupported holes made in these cohesionless soils



above the groundwater table. Below the groundwater table, these water bearing soils can be expected to yield water. The use of dewatering techniques to lower the groundwater table during construction is unlikely to be economically viable due to the limited construction effort required.

Where the water bearing layers are rather thin and the soil is relatively fine grained, it may be possible to effect construction by pouring the concrete rapidly upon completion of the excavation. In other cases, however, the coarse tills and the sand and gravelly sand layers may cause cave-ins and/or excessive groundwater seepage.

In view of these conditions, it is recommended that temporary liner(s) be available on site to support the caisson sidewalls and to provide seepage cut-off as and where required.

The concrete should be poured expeditiously on completion of the caisson hole. It is recommended that the concrete be placed by the tremie method as soon as the hole reaches its desired depth. The liner should be withdrawn as concrete is placed. During liner withdrawal, the level of concrete in the caisson hole must always be at least 0.6 m above the bottom of the temporary liner.

We recommend that the following notes be included in the contract documents:


- At the foundation locations the strata may consist of fill material, silty clay till (also till shale complex), sand and silt till and shale bedrock. Groundwater is likely to be encountered above the base of the excavations.
- The contractor shall maintain the stability of the soil along the sides and in the bases of the holes for the concrete footings at all times from the commencement of their construction to the placing of the concrete.
- Dewatering and/or temporary liners may be required to maintain a sufficiently dry condition for proper construction of the caisson hole and the placement of concrete.

It is envisaged that caisson construction will likely to be carried out in the till/shale complex and the shale bedrock which are known to contain hard seams and layers and shale and limestone slabs. Bidders should be advised of these conditions and be required to provide adequate equipment. It is probable that some combination of augering with rock teeth, coring bits, pneumatic breakers or chisels will be required.

Caisson construction should be monitored by qualified geotechnical personnel to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.



Terraprobe Limited

for 

Engineering Analysis and Report Preparation by:
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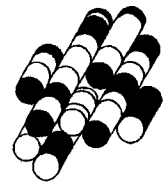


Michael Tanos, P.Eng.,
Principal, Designated MTO Contact



APPENDICES

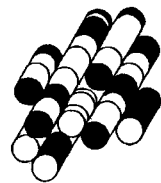
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APPENDIX A

Record of Borehole Sheets

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RECORD OF BOREHOLE No OS-1

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4800854.8 E:279609.8 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 27.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	w_p	w	w_L		
111.7	Ground Surface													
0.0	230mm ASPHALT													
0.2	FILL - Gravelly Sand, some silt, inferred compact, brown, damp		1	AS	-		111							
111.0														
0.7	FILL - Silty Clay, sandy, trace gravel, firm to stiff, greyish brown		2	SS	11				150kPa					
			3	SS	6		110		175kPa					9 26 38 27
	trace shale fragments, reddish brown		4	SS	13		109							
108.4			5	SS	13		108							0 55 30 15
3.4	FILL - Silty Sand, some clay, trace rootlets, inferred compact, brown, damp													
107.7			6	SS	21		107		225kPa					
4.0	FILL - Clayey Silt, trace sand, trace gravel, very stiff, greyish brown, moist		7	SS	19		106		225kPa					
104.6							105							
7.1	SILTY CLAY sandy, trace gravel, trace rootlets, organic stained, very stiff, grey / black, moist (GLACIAL TILL)		8	SS	23		104		200kPa				22.0	3 23 43 31
103.1							103							
8.6	SILTY CLAY TILL with shale, hard, reddish brown, damp to moist (TILL-SHALE COMPLEX)		9	SS	100/ 13cm		102		>225kPa					
102.4														
9.4	SHALE BEDROCK reddish brown (Queenston Formation)						101							
100.9			10	SS	100/ 8cm									
10.8	End of Borehole													
	Borehole was open and dry upon completion of drilling.													

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No CS-1

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801026.0 E:279840.1 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 14.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
106.7	Ground Surface							20	40	60	80	100					
0.0 106.4	330mm ASPHALT							20	40	60	80	100					
0.3	FILL - Sand and Gravel, trace silt, very dense, brown, dry to damp		1	SS	82		106										
			2	SS	100/ 13cm												
104.8	organic stained, dark brown		3	SS	51		105										
1.9			4	SS	18		104									20.7	
			5	SS	17											21.1	3 18 57 22
102.7	SILTY CLAY some sand to sandy, trace gravel, very stiff, brown, moist (GLACIAL TILL)						103										
4.0			6	SS	72		102									6 22 59 13	
101.5	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)						101										
5.2																	
100.5	SHALE BEDROCK reddish brown (Queenston Formation)																
6.2	End of Borehole		7	SS	100/ 10cm												
	Borehole was open and dry upon completion of drilling.																

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RECORD OF BOREHOLE No OS-2

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801107.9 E:279916.9 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 26.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN	× LAB VANE						W _p	W	W _L
105.6	Ground Surface					20	40	60	80	100	10	20	30						
0.0	200mm ASPHALT																		
0.2	FILL - Gravelly Sand, some silt, inferred compact, brown, damp		1	AS	-														
104.6	FILL - Sand and Silt, occasional asphalt inclusions, very dense, brown, damp		2	SS	75														
1.1	FILL - Silty Sand, some clay, some gravel, compact, brown / dark brown, moist		3	SS	14														
104.2	----- wet sandy silt seam at 2.0m																		
1.4	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		4	SS	43														
103.5			5	SS	164														
2.1																			
101.8	SHALE BEDROCK reddish brown, (Queenston Formation)		6	SS	136														
3.8																			
99.4	End of Borehole		7	SS	100/ 5cm														
6.2	Borehole was open and dry upon completion of drilling.																		

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RECORD OF BOREHOLE No OS-2A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801107.9 E:279916.9 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 26.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	w_p	w	w_L		
105.6 0.0	Ground Surface															
	Augered to 6.1m, refer to BH OS-2 for inferred soil stratigraphy.															
99.5 6.1	SHALE BEDROCK															
	Reddish brown, partially weathered to unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone.		1	RUN	NQ											
	Shale = 92% Limestone = 8% (Queenston Formation)		2	RUN	NQ											
96.5 9.1	End of Borehole															

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No CS-2

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801156.0 E:279972.0 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 14.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
105.8	Ground Surface							20	40	60	80	100				
105.5	260mm ASPHALT															
0.3	FILL - Gravelly Sand, some silt, compact to very dense, brown, dry		1	SS	75		105									28 56 16 0
			2	SS	100/ 13cm											
103.8			3	SS	18		104									
2.0	SILTY CLAY trace sand, very stiff, brown, moist (GLACIAL TILL) interbedded silt and clay seams		4	SS	19		103									
			5	SS	21											
101.8							102									
4.0	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		6	SS	100/ 13cm		101									
100.9																
4.9	SHALE BEDROCK reddish brown (Queenston Formation)						100									
99.6																
6.2	End of Borehole		7	SS	100/ 2.5cm											
	Borehole was open and dry upon completion of drilling.															

RECORD OF BOREHOLE No CS-2A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801156.0 E:279972.0 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 10.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
105.8 0.0	Ground Surface																
	Augered to 5.6m, refer to BH CS-2 for inferred soil stratigraphy.																
100.2 5.6	SHALE BEDROCK																
	Reddish brown, partially weathered to 6.0m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 25mm thick clay seam at 6.1m. Highly fractured zones (50-125mm thick) at 6.6m, 7.8m, 8.2m, and 8.4m. Shale = 92% Limestone = 8% (Queenston Formation)		1	RUN	NQ												RUN#1 TCR=100% SCR=100% RQD=50%
			2	RUN	NQ												RUN#2 TCR=100% SCR=100% RQD=75%
97.1 8.7	End of Borehole																

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RECORD OF BOREHOLE No CS-3

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801323.9 E:280107.9 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 03.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
106.2	Ground Surface						106							
0.0														
105.8	430mm ASPHALT													
0.4														
105.4	420mm CONCRETE		1	AS	-									
0.9	FILL - Gravelly Sand, trace silt, compact, brown, dry		2	SS	21		105							
105.1	FILL - Clayey Silt, trace sand, trace gravel, trace organics, stiff, dark brown / black, damp to moist		3	SS	11									
104.2														
2.0	SANDY SILT some gravel, trace clay, compact, brown, moist (GLACIAL TILL)		4	SS	24		104							
103.3														
2.9	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		5	SS	97		103							
102.3														
3.9	SHALE BEDROCK reddish brown (Queenston Formation)						102							
101.6														
4.6	End of Borehole		6	SS	100/ 2.5cm									
	Borehole was open and dry upon completion of drilling.													


ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No CS-3A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801783.4 E:280476.6 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 17.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
106.2 0.0	Ground Surface															
	Augered to 3.9m, refer to BH CS-3 for inferred soil stratigraphy.															
102.3 3.9	SHALE BEDROCK Reddish brown, partially weathered to 5.4m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Shale = 86% Limestone = 14% (Queenston Formation)		1	RUN	NQ											RUN#1 TCR=100% SCR=83% RQD=43%
			2	RUN	NQ											RUN#2 TCR=100% SCR=93% RQD=56%
99.3 6.9	End of Borehole															

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-3

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801723.6 E:280435.6 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 14.08.07 CHECKED BY RA


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
108.1	Ground Surface							20	40	60	80	100					
0.0	380mm ASPHALT						108										
107.7																	
0.4	FILL - Gravelly Sand, some silt, compact to dense, brown, damp		1	SS	30												
107.1			2	SS	19		107										9 43 32 16
1.0	FILL - Silty Clay and Sand, trace gravel, very stiff, dark brown, damp																
106.7																	
1.4	SILTY CLAY TILL - with shale, very stiff, reddish brown, damp (TILL-SHALE COMPLEX)		3	SS	26												21.8
106.0							106										
2.1	SHALE BEDROCK reddish brown (Queenston Formation)		4	SS	100/ 8cm												
			5	SS	100/ 5cm		105										
							104										
			6	AS	-		103										
101.9							102										
6.2	End of Borehole		7	SS	100/ 2.5cm												
	Borehole was open and dry upon completion of drilling.																

RECORD OF BOREHOLE No OS-3A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801723.6 E:280435.6 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 11.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
108.1	Ground Surface						20	40	60	80	100								
105.1	SHALE BEDROCK Reddish brown, partially weathered to 4.5m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Shale = 83% Limestone = 17% (Queenston Formation)		1	RUN	NQ											RUN#1 TCR=100% SCR=91% RQD=13%			
102.0			2	RUN	NQ											RUN#2 TCR=100% SCR=93% RQD=37%			
6.1			End of Borehole																

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ_ONTARIO MOT.GOT 14/04/08

RECORD OF BOREHOLE No CS-4

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801783.4 E:280476.6 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 03.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
108.7	Ground Surface							20 40 60 80 100						
0.0	430mm ASPHALT													
108.3														
0.4	160mm CONCRETE													
0.6	FILL - Sand and Gravel, trace silt, brown, damp		1	AS	-									26 32 28 14
0.7	FILL - Silty Clay, sandy, gravelly, stiff, dark brown, moist		2	SS	10			100kPa						
107.3														
1.4	SILTY CLAY TILL with shale, very stiff to hard, reddish brown, damp (TILL-SHALE COMPLEX)		3	SS	28			>225kPa					23.1	0 33 47 20
			4	SS	162			>225kPa						
105.8														
2.9	SHALE BEDROCK reddish brown (Queenston Formation)		5	SS	100/ 13cm									
104.1														
4.6	End of Borehole Borehole was open and dry upon completion of drilling.		6	SS	100/ 8cm									

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No CS-4A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4801783.4 E:280476.6 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 10.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	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							
108.7 0.0	Ground Surface						20	40	60	80	100	10	20	30	kN/m ³	GR SA SI CL		
105.6 3.1	SHALE BEDROCK Reddish brown, partially weathered to 4.5m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 50 deg. dipping, rust stained joint at 3.1m. Shale = 89% Limestone = 11% (Queenston Formation)		1	RUN	NQ											RUN#1 TCR=100% SCR=92% RQD=30%		
102.6 6.1	End of Borehole		2	RUN	NQ											RUN#2 TCR=100% SCR=98% RQD=48%		

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-4

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4802044.6 E:280697.1 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 14.08.07 CHECKED BY RA

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ_ONTARIO MOT.GDT 14/04/08

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN	× LAB VANE	WATER CONTENT (%)					
112.0	Ground Surface					20	40	60	80	100							
0.0	150mm ASPHALT																
0.2																	
110.9	FILL - Gravelly Sand, some silt, compact to dense, brown, damp		1	SS	31											31 54 (15)	
1.2			2	SS	22												
109.9	FILL - Clayey Silt, trace sand, trace gravel, very stiff, dark brown, moist		3	SS	22												
2.1	SILTY CLAY some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	21										22.5	6 22 45 27	
			5	SS	45												
108.0																	
4.0	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		6	SS	100/ 13cm												
105.8	--- wet		7	SS	100/ 2.5cm												
6.2	End of Borehole																
	Borehole was open and dry upon completion of drilling.																

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-5

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4802272.7 E:280876.5 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.08.07 - 02.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
113.4	Ground Surface							20 40 60 80 100						
0.0	250mm ASPHALT													
113.2														
0.3	FILL - Sand and Gravel, some silt, compact, brown, dry to damp		1	SS	11		113							37 49 (14)
112.6														
0.8	SILTY CLAY some sand, trace gravel, occasional fine sand seams, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	30		112						22.5	4 21 45 30
			3	SS	51									
			4	SS	72		111							
110.5														
2.9	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		5	SS	100/ 13cm		110							
109.2														
4.2	SHALE BEDROCK reddish brown (Queenston Formation)		6	SS	100/ 1cm		109							
107.2							108							
6.2	End of Borehole		7	SS	100/ 1cm									
	Borehole was open and dry upon completion of drilling.													

RECORD OF BOREHOLE No OS-5A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4802272.7 E:280876.5 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 09.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	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	20	40	60	80	100	10	20	30			
113.4 0.0	Ground Surface																					
	Augered to 3.4m, refer to BH OS-5 for inferred soil stratigraphy.																					
110.0 3.4	BOULDER		1	RUN	NQ																	
109.2 4.2	SHALE BEDROCK		2	RUN	NQ																	
	Reddish brown, partially weathered to 6.6m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone.																					
	Shale = 64% Limestone = 36% (Queenston Formation)																					
105.8 7.6	End of Borehole		3	RUN	NQ																	

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-6

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4802588.6 E:281133.7 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 02.08.07 CHECKED BY RA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
114.8	Ground Surface							20 40 60 80 100		20 40 60 80 100	10 20 30			
0.0 114.8	305mm ASPHALT													
114.5 0.3	FILL - Gravelly Sand, some silt, compact, brown, damp		1	SS	21									
114.2 0.6	FILL - Clayey Silt and Sand, trace organics, firm to stiff, dark brown, moist to wet		2	SS	14		114	75kPa					0 36 35 29	
			3	SS	5		113							
112.7 2.1	SILTY CLAY TILL with shale, very stiff, reddish brown, damp (TILL-SHALE COMPLEX)		4	SS	22		112	>225kPa				22.6	0 16 66 18	
			5	SS	30			>225kPa						
111.2 3.6	SHALE BEDROCK reddish brown (Queenston Formation)		6	SS	100/ 1cm		111							
							110							
108.6 6.2	End of Borehole Borehole was open and dry upon completion of drilling.		7	SS	100/ 1cm		109							

+ 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

1 OF 1

METRIC[illegible]

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CS-5


1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4802660.7 E:281198.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 15.08.07 CHECKED BY RA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	w_p	w	w_L		
115.1	Ground Surface													
0.0	100mm ASPHALT						115							
0.1	FILL-sand and Gravel, trace silt, compact, brown, dry		1	SS	26									
114.5	weathered		2	SS	16		114							
0.7														
	SILTY CLAY some sand, trace gravel, very stiff, brown / reddish brown, dry to moist (GLACIAL TILL)		3	SS	15								21.7	6 21 46 27
113.0							113							
2.1	SILTY CLAY TILL with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		4	SS	100/ 15cm									
112.2							112							
2.9	SHALE BEDROCK reddish brown (Queenston Formation)		5	SS	100/ 8cm									
							111							
			6	SS	100/ 2.5cm		110							
108.9							109							
6.2	End of Borehole		7	SS	100/ 1cm									
	Borehole was open and dry upon completion of drilling.													

+ 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No CS-5A										1 OF 1		METRIC		
W.P. 2831-02-01		LOCATION		Coords: N:4802660.7 E:281198.3				ORIGINATED BY JC						
DIST		HWY QEW		BOREHOLE TYPE Solid Stem Augers & NQ Coring				COMPILED BY DB						
DATUM Geodetic		DATE		17.10.07				CHECKED BY RA						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
115.1 0.0	Ground Surface													
112.1 3.0	SHALE BEDROCK Reddish brown, partially weathered to 5.0m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 25-50mm thick clay seams at 5.9m and 6.0m. Subvertical stained, smooth joints at 4.6m, 4.7m, and 4.9m. Shale = 93% Limestone = 7% (Queenston Formation)		1	RUN	NQ									RUN#1 TCR=100% SCR=53% RQD=7% RUN#2 TCR=100% SCR=88% RQD=61%
109.1 6.0	End of Borehole													

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-7

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4803329.2 E:281735.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 01.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								WATER CONTENT (%)						
116.9	Ground Surface													
0.0	250mm ASPHALT													
116.7	FILL - Gravelly Sand, some silt, compact, brown, damp		1	SS	21									
0.3														
116.4	FILL - Clayey Silt, some sand, trace gravel, stiff, dark brown, moist		2	SS	15									
0.6														
115.5	SILTY CLAY TILL - with shale, hard, reddish brown, damp (TILL-SHALE COMPLEX)		3	SS	87									
1.4														
114.6	SHALE BEDROCK reddish brown (Queenston Formation)		4	SS	136									
2.3			5	AS	-									
112.3	End of Borehole		6	SS	100/ 1cm									
4.6	Borehole was open and dry upon completion of drilling.													

RECORD OF BOREHOLE No OS-7A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4803329.2 E:281735.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 04.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
116.9	Ground Surface						20	40	60	80	100						
0.0	Augered to 4.6m, refer to BH OS-7 for inferred soil stratigraphy.																
112.3																	
4.6	SHALE BEDROCK																
	Reddish brown, partially weathered to 6.2m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Subvertical, rust-stained joint at 5.0m. Could not recover bottom 0.6m of rock core due to equipment malfunction.		1	RUN	NQ												
	Shale = 65% Limestone = 35%		2	RUN	NQ												
	(Queenston Formation)																
109.3	End of Borehole																
7.6																	

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GP J ONTARIO MOT.GDT 14/04/08

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-8

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4803664.8 E:282006.8 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 01.08.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	W _p	W	W _L		
117.8	Ground Surface															
0.0 117.5	290mm ASPHALT															
0.3	FILL - Gravelly Sand, some silt, trace clay, compact, brown, damp		1	SS	25											
			2	SS	18	117										31 52 13 4
116.3	SHALE BEDROCK reddish brown (Queenston Formation)		3	SS	100/ 5cm	116										
1.5			4	SS	100/ 5cm											
			5	SS	100/ 5cm	115										
			6	SS	100/ 2.5cm	114										
113.2 4.6	End of Borehole															
	Borehole was open and dry upon completion of drilling.															

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-8A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4803664.8 E:282006.8 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
DATUM Geodetic DATE 16.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
117.8 0.0	Ground Surface															
	Augered to 2.4m, refer to BH OS-8 for inferred soil stratigraphy.					117										
						116										
115.4 2.4	SHALE BEDROCK					115										
	Reddish brown, partially weathered to unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 25mm thick clay seams at 2.8m, 3.4m, 5.2m, 5.3m. Subvertical joint at 4.1m.		1	RUN	NQ	114										RUN#1 TCR=97% SCR=80% RQD=15%
	Shale = 84% Limestone = 16% (Queenston Formation)		2	RUN	NQ	113										RUN#2 TCR=100% SCR=97% RQD=28%
112.3 5.5	End of Borehole															

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ ONTARIO MOT GDT 1404/08

RECORD OF BOREHOLE No OS-9

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4803956.4 E:282242.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 01.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
116.8	Ground Surface																
116.0	280mm ASPHALT																
0.3 116.2 0.6	FILL - Sand and Gravel, trace silt, compact, brown, damp		1	SS	21		116										2 17 52 29
	FILL - Silty Clay and Sand, trace gravel, trace shale fragments, firm to stiff, reddish brown, moist		2	SS	13												
			3	SS	6		115										2 42 40 16
	trace organics, wet		4	SS	9		114										
113.9 2.9	SHALE BEDROCK reddish brown (Queenston Formation)		5	SS	110		113										
			6	SS	100/ 5cm		112										
110.6 6.2	End of Borehole		7	SS	100/ 1cm		111										
	Borehole was open and dry upon completion of drilling.																

+ 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

1 OF 1

METRIC

DATUM	Geodetic	DATE	16.10.07	CHECKED BY	RA
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ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No OS-10

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804282.2 E:282503.1 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 01.08.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
119.2	Ground Surface							20 40 60 80 100						
0.0	340mm ASPHALT						119							
118.9														
0.3	FILL - Gravelly Sand, some silt, compact, brown, damp		1	SS	28									
118.6														
0.6	FILL - Silty Clay, trace sand, trace wood fragments, stiff, dark brown, moist		2	SS	13									
118.3							118							
0.9														
117.8	SILTY CLAY TILL - with shale, stiff, reddish brown, moist (TILL-SHALE COMPLEX)		3	SS	66									
1.4														
	SHALE BEDROCK reddish brown (Queenston Formation)		4	SS	182		117							
			5	SS	100/ 5cm		116							
							115							
114.6	End of Borehole		6	SS	100/ 2.5cm									
4.6	Borehole was open and dry upon completion of drilling.													

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-10A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804282.2 E:282503.1 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
DATUM Geodetic DATE 03.10.07 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	w_p	w	w_L		
119.2	Ground Surface															
0.0	Augered to 4.6m, refer to BH OS-10 for inferred soil stratigraphy.					119										
						118										
						117										
						116										
						115										
114.6	SHALE BEDROCK Reddish brown, partially to fully weathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 25-75mm thick clay seams at 4.7m, 5.4m, and 5.6m. Shale = 88% Limestone = 12% (Queenston Formation)		1	RUN	NQ											RUN#1 TCR=100% SCR=95% RQD=0% RUN#2 TCR=100% SCR=75% RQD=0% RUN#3 TCR=87% SCR=55% RQD=13%
4.6			2	RUN	NQ	114										
			3	RUN	NQ	113										
112.5	End of Borehole															
6.7																

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ ONTARIO MOT GDT 14/04/08

RECORD OF BOREHOLE No CS-6

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804850.1 E:282957.4 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 31.07.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN × LAB VANE						
118.2	Ground Surface							20 40 60 80 100						
0.0	280mm ASPHALT						118							
117.9														
0.3	FILL-Sand and Gravel, trace silt, compact, brown, damp		1	SS	20									
117.6														
0.6	FILL - Silty Clay, some sand, stiff, dark brown, moist		2	SS	13									
							117							
			3	SS	10									
116.1														
2.1	SHALE BEDROCK reddish brown (Queenston Formation)		4	SS	154		116							
			5	SS	100/ 13cm		115							
							114							
113.6			6	SS	100/ 2.5cm									
4.6	End of Borehole													
	Borehole was open and dry upon completion of drilling.													


ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No CS-6A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804850.1 E:282957.4 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 20.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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 (%)
118.2 0.0	Ground Surface						20	40	60	80	100	10	20	30			
115.2 3.0	SHALE BEDROCK Reddish brown, partially weathered to 5.2m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Subvertical joints at 3.3m, and 4.1m. Shale = 76% Limestone = 24% (Queenston Formation)		1	RUN	NQ											RUN#1 TCR=95% SCR=87% RQD=18%	
112.2 6.0	End of Borehole															RUN#2 TCR=94% SCR=88% RQD=12%	

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-11

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804981.7 E:283062.5 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 31.07.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
118.3	Ground Surface																			
118.0	290mm ASPHALT																			
0.3	FILL - Gravelly Sand, some silt, compact, brown, damp		1	SS	15											31 52 13 4				
117.7																				
0.6	SHALE BEDROCK reddish brown (Queenston Formation)		2	SS	59															
			3	SS	145															
			4	SS	100/ 10cm															
115.2			6	SS	100/ 5cm															
3.1	End of Borehole Borehole was open and dry upon completion of drilling.																			

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS GPJ ONTARIO MOT GDT 14/04/08

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

+ 3 . X 3 .

Numbers refer to
Sensitivity

○ 3%

STRAIN AT FAILURE

RECORD OF BOREHOLE No OS-11A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804981.7 E:283062.5 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
DATUM Geodetic DATE 15.10.07 - 20.10.07 CHECKED BY RA


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
118.3 0.0	Ground Surface						118										
	Augered to 2.4m, refer to BH OS-11 for inferred soil stratigraphy.						117										
115.9 2.4	SHALE BEDROCK Reddish brown, partially weathered to 3.2m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Shale = 87% Limestone = 13% (Queenston Formation)		1	RUN	NQ		116										RUN#1 TCR=100% SCR=77% RQD=36%
114.2 4.1	End of Borehole		2	RUN	NQ		115										RUN#2 TCR=100% SCR=88% RQD=27%

RECORD OF BOREHOLE No OS-11B

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4804981.7 E:283062.5 ORIGINATED BY JC
DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
DATUM Geodetic DATE 15.10.07 - 20.10.07 CHECKED BY RA

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa											
118.3 0.0	Ground Surface																GR SA SI CL
	Augered to 4.0m, refer to BH OS-11 and OS-11A for inferred soil stratigraphy.						118										
							117										
							116										
							115										
114.3 4.0	SHALE BEDROCK Reddish brown, unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 25-50mm thick clay seams at 4.4m and 4.6m. Shale = 87% Limestone = 13% (Queenston Formation)		1	RUN	NQ		114										RUN#1 TCR=100% SCR=95% RQD=31%
112.8 5.5	End of Borehole						113										

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-12

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4805317.1 E:283330.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 31.07.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							w _p w w _L		
118.5	Ground Surface																
0.0	360mm ASPHALT																
118.1																	
0.4	FILL - Sand, some silt, dense, brown, dry to damp		1	SS	40									0 81 (19)			
117.8																	
0.7	SHALE BEDROCK reddish brown (Queenston Formation)		2	SS	55												
			3	SS	100/ 13cm												
			4	SS	100/ 8cm												
115.4	End of Borehole		6	SS	100/ 8cm												
3.1	Borehole was open and dry upon completion of drilling.																

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-12A

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4805317.1 E:283330.3 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 14.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
118.5	Ground Surface													
0.0	Augered to 2.7m, refer to BH OS-12 for inferred soil stratigraphy.						118							
							117							
							116							
115.8	SHALE BEDROCK						115							RUN#1 TCR=100% SCR=94% RQD=63%
2.7	Reddish brown, partially weathered to 3.9m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. Shale = 75% Limestone = 25% (Queenston Formation)		1	RUN	NQ		114							RUN#2 TCR=100% SCR=98% RQD=51%
			2	RUN	NQ		113							
112.7	End of Borehole													
5.8														

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-13

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4805513.9 E:283486.4 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 31.07.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
118.8	Ground Surface													
0.0	260mm ASPHALT													
118.5														
0.3	FILL - Gravelly Sand, some silt, compact, brown, damp		1	SS	29									
118.2														
0.6	FILL - Silty Sand, some clay, some gravel, compact to dense, brown, moist		2	SS	30									
			3	SS	16									12 46 27 15
116.7														
2.1	FILL - Silty Clay and Sand, occasional shale fragments, stiff, reddish brown, moist		4	SS	14									
			5	SS	10									0 48 37 15
			6	SS	9									
			7	SS	11									0 6 73 21
111.7														
7.1	SHALE BEDROCK reddish brown (Queenston Formation)													
111.1														
7.7	End of Borehole		8	SS	100/ 13cm									
	Borehole was open and dry upon completion of drilling.													

ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-14

1 OF 1

METRIC

W.P. 2831-02-01 LOCATION Coords: N:4805851.6 E:283754.0 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 30.07.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								20	40	60	80						
119.2	Ground Surface																
0.0	330mm ASPHALT																
118.9																	
0.3	FILL - Gravelly Sand, some silt, trace clay, dense, brown, damp		1	SS	36											32 53 13 2	
118.5																	
0.7	SILTY CLAY TILL with shale, very stiff to hard, red, damp to moist (TILL-SHALE COMPLEX)		2	SS	25												
			3	SS	30												
117.2																	
2.0	SHALE BEDROCK reddish brown (Queenston Formation)		4	SS	100/ 13cm												
116.1																	
3.1	End of Borehole		5	SS	100/ 13cm												
	Borehole was open and dry upon completion of drilling.																


ONTARIO MOT 1-07-2145 SIGNS AND LIGHTS.GPJ ONTARIO MOT.GDT 14/04/08

RECORD OF BOREHOLE No OS-14A

1 OF 1

METRIC

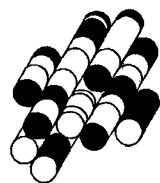
W.P. 2831-02-01 LOCATION Coords: N:4805851.6 E:283754.0 ORIGINATED BY JC
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers & NQ Coring COMPILED BY DB
 DATUM Geodetic DATE 02.10.07 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
119.2	Ground Surface							20	40	60	80	100				GR SA SI CL
0.0	Augered to 3.0m, refer to BH OS-14 for inferred soil stratigraphy.						119									
							118									
							117									
116.2							116									
3.0	SHALE BEDROCK Reddish brown, partially weathered to 3.7m, then unweathered, medium to thickly bedded, low to medium strength shale with occasional interbeds of medium to high strength greenish grey limestone. 12-38mm thick clay seams at 4.1m, 4.4m, and 5.5m. Shale = 78% Limestone = 22% (Queenston Formation)		1	RUN	NQ		115									RUN#1 TCR=95% SCR=99% RQD=0%
			2	RUN	NQ		114									RUN#2 TCR=100% SCR=97% RQD=7%
113.1																
6.1	End of Borehole															

APPENDIX B

Laboratory Test Results

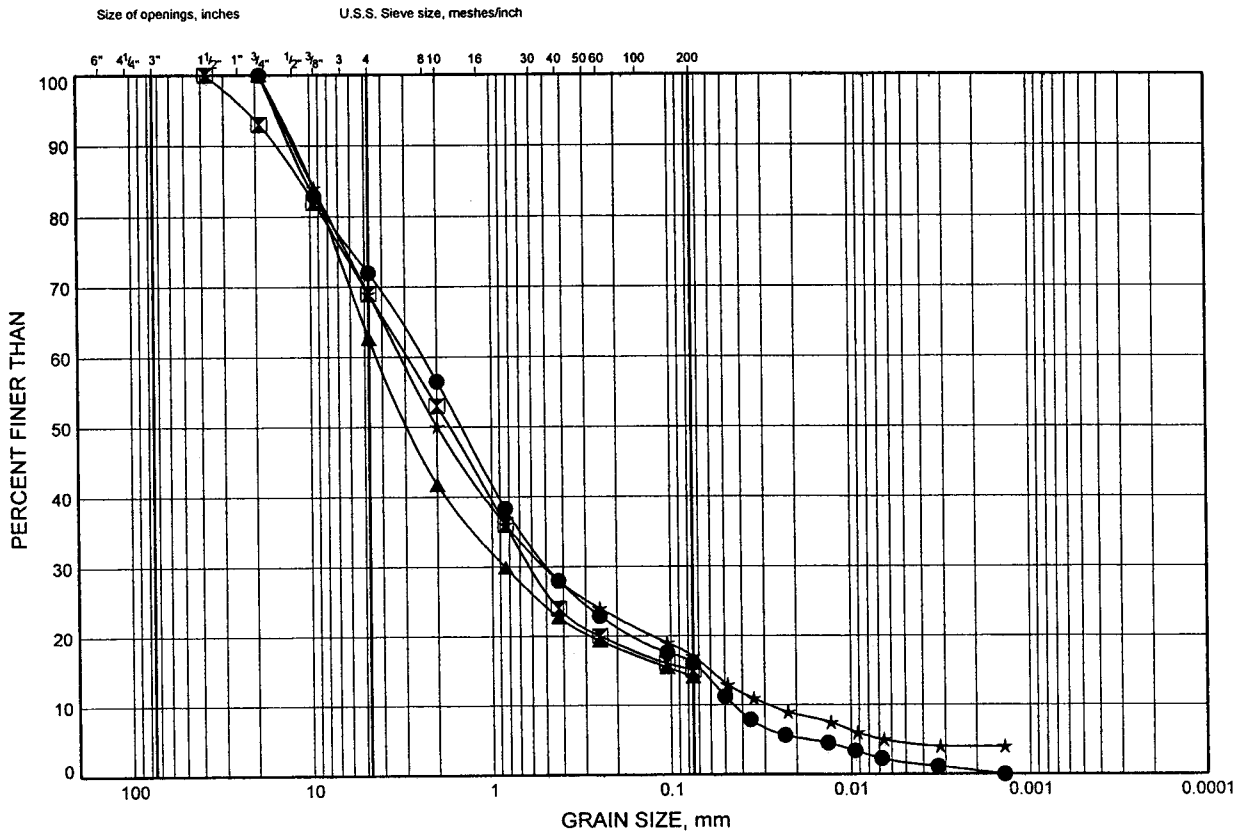
Terraprobe Limited



GRAIN SIZE DISTRIBUTION

FIGURE B1

Gravelly Sand (Fill)

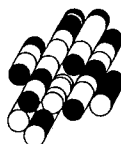


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-2	0.7	104.5
⊠	OS-4	0.9	111.1
▲	OS-5	0.5	112.9
★	OS-8	0.9	116.9

Date April 2008

Project 2831-02-01



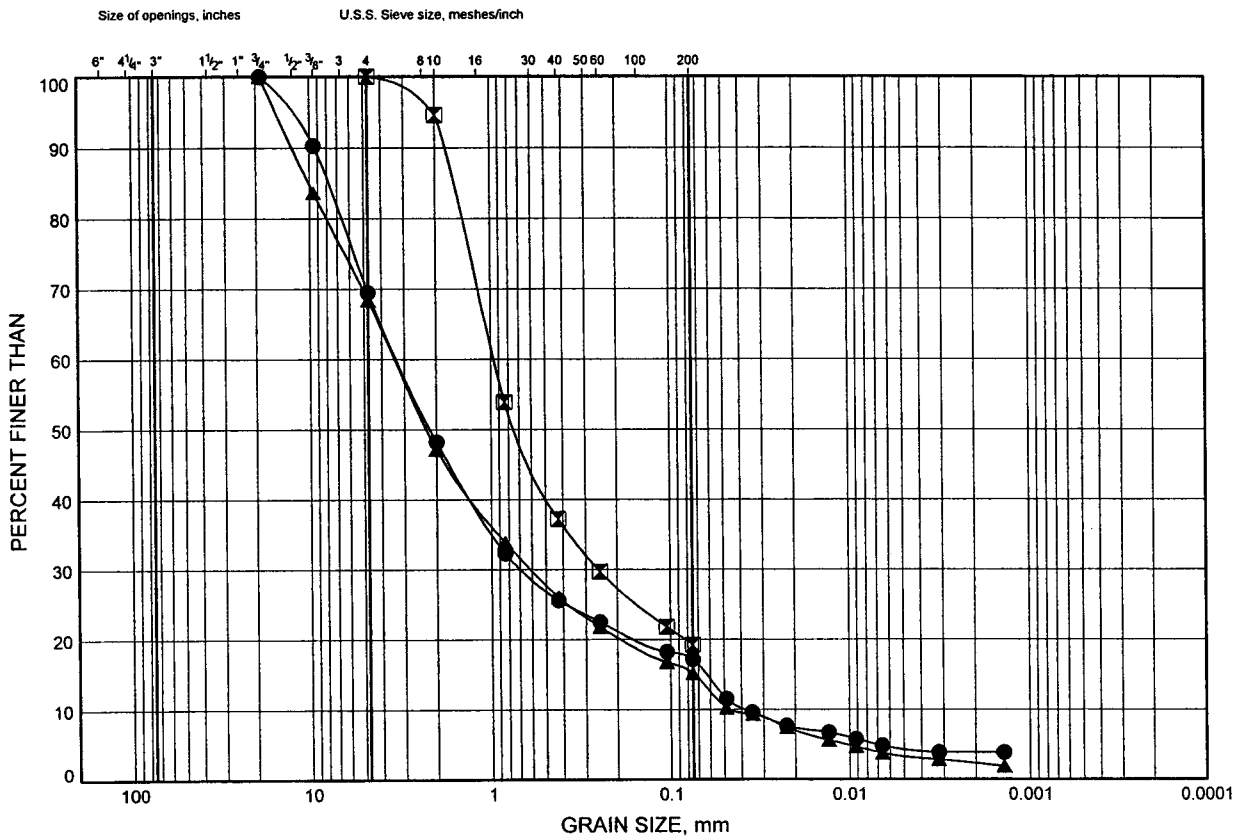
Prep'd DB

Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B2

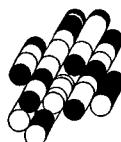
Gravelly Sand (Fill)



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	OS-11	0.5	117.9
⊠	OS-12	0.5	118.0
▲	OS-14	0.5	118.8

Date April 2008
Project 2831-02-01

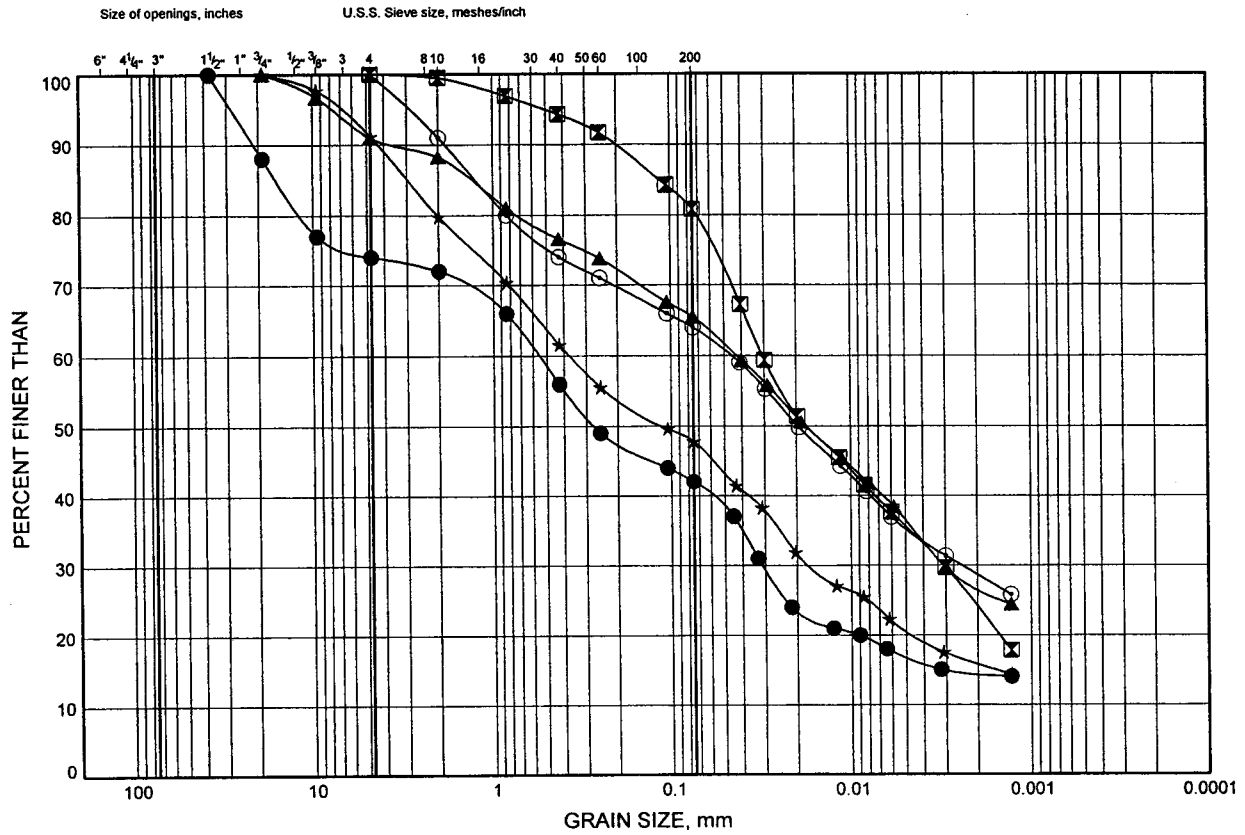


Prep'd DB
Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B3

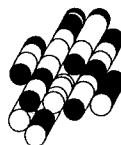
Silty Clay and Clayey Silt (Fill)



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-4	1.0	107.7
⊠	CS-6	1.7	116.5
▲	OS-1	1.7	110.0
★	OS-3	1.0	107.1
⊙	OS-6	0.9	113.9

Date April 2008
Project 2831-02-01

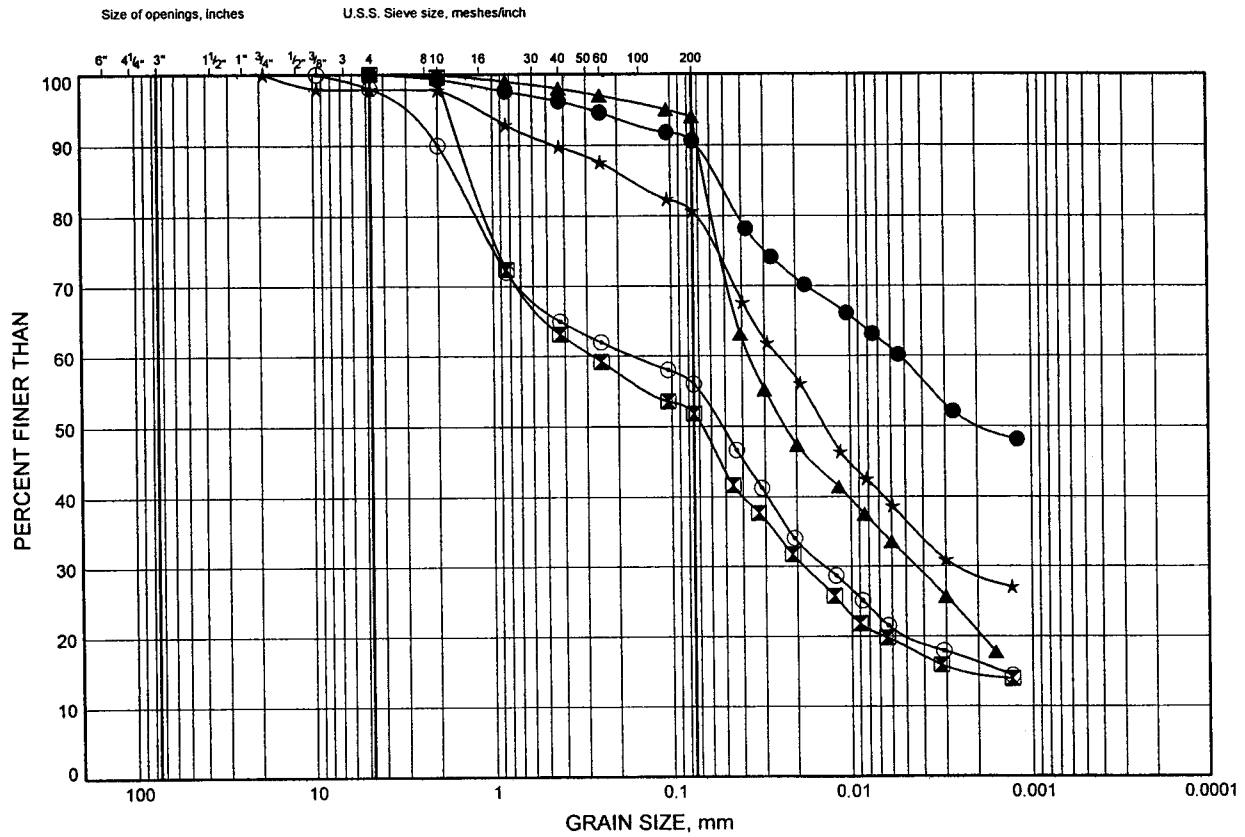


Prep'd DB
Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty Clay and Clayey Silt (Fill)

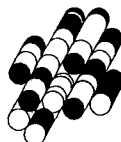


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
★	OS-9	0.7	116.1
⊙	OS-9	1.7	115.1
●	OS-10	0.7	118.5
⊠	OS-13	3.2	115.6
▲	OS-13	6.3	112.5

Date April 2008

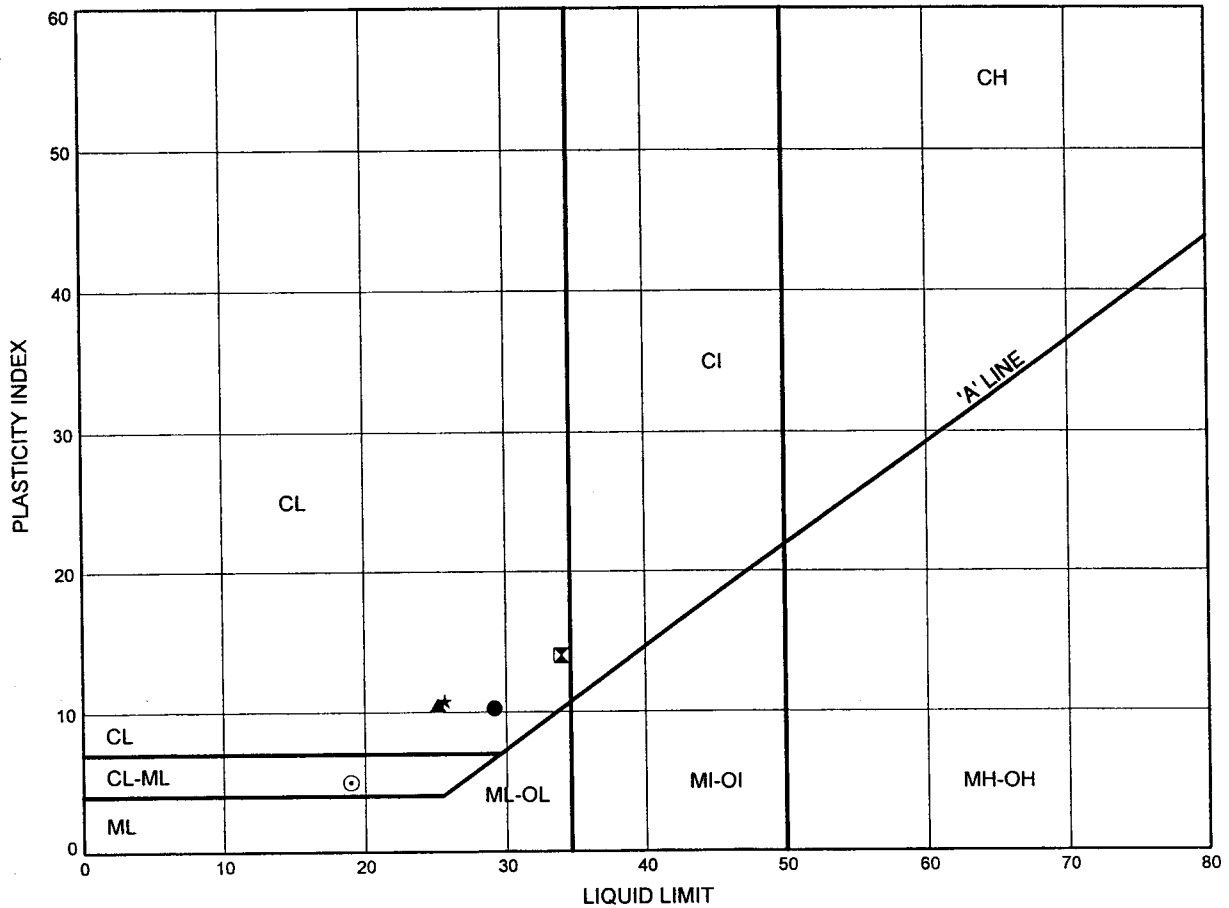
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Prep'd DB

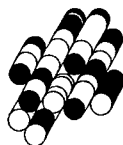
Chkd JC

FIGURE B5



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-4	1.0	107.7
⊠	CS-6	1.7	116.5
▲	OS-1	1.7	110.0
★	OS-3	1.0	107.1
⊙	OS-6	0.9	113.9

Date April 2008
Project 2831-02-01

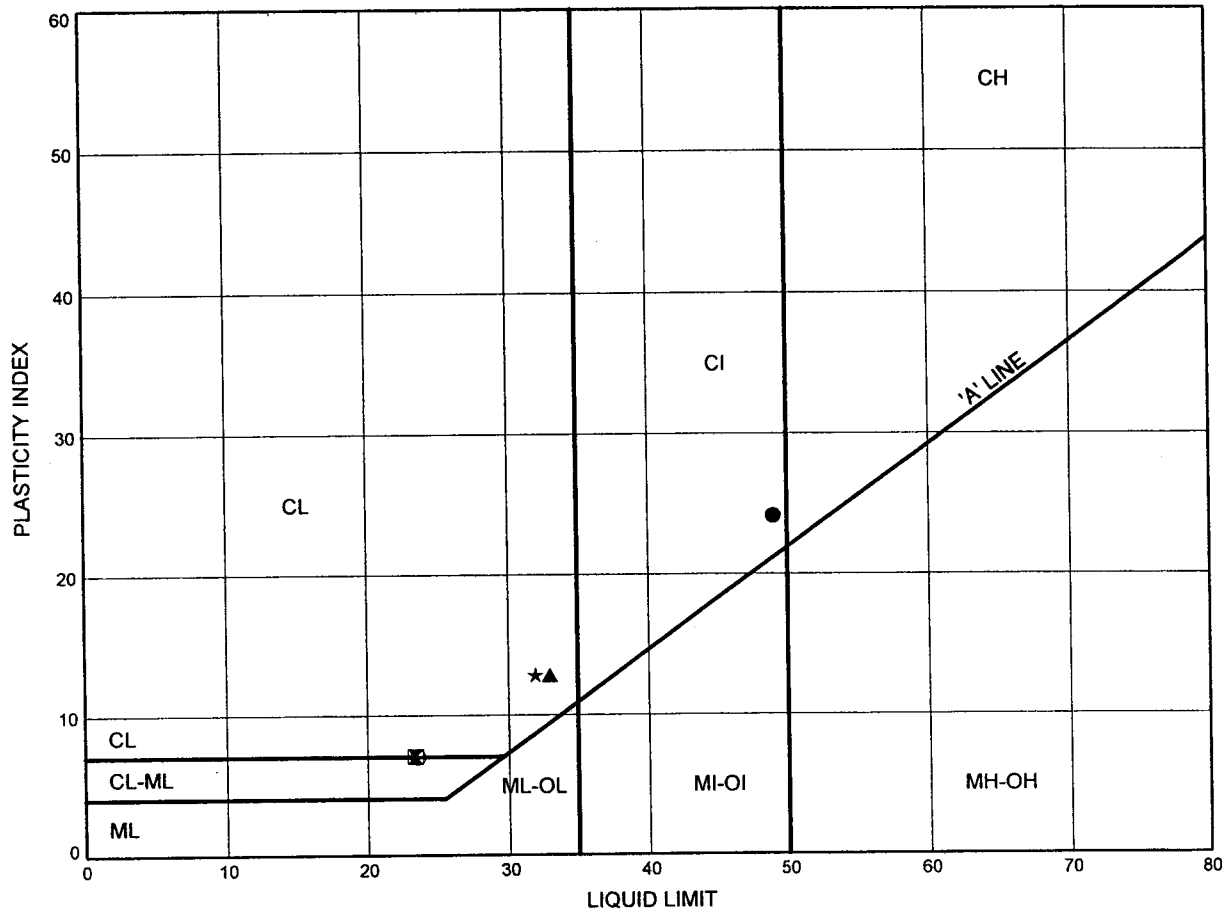


Prep'd DB
Chkd. JC

ATTERBERG LIMITS TEST RESULTS

FIGURE B6

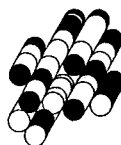
Silty Clay and Clayey Silt (Fill)



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
--------	----------	-----------	---------------

★	OS-9	0.7	116.1
⊙	OS-9	1.7	115.1
●	OS-10	0.7	118.5
⊠	OS-13	3.2	115.6
▲	OS-13	6.3	112.5

Date April 2008
Project 2831-02-01

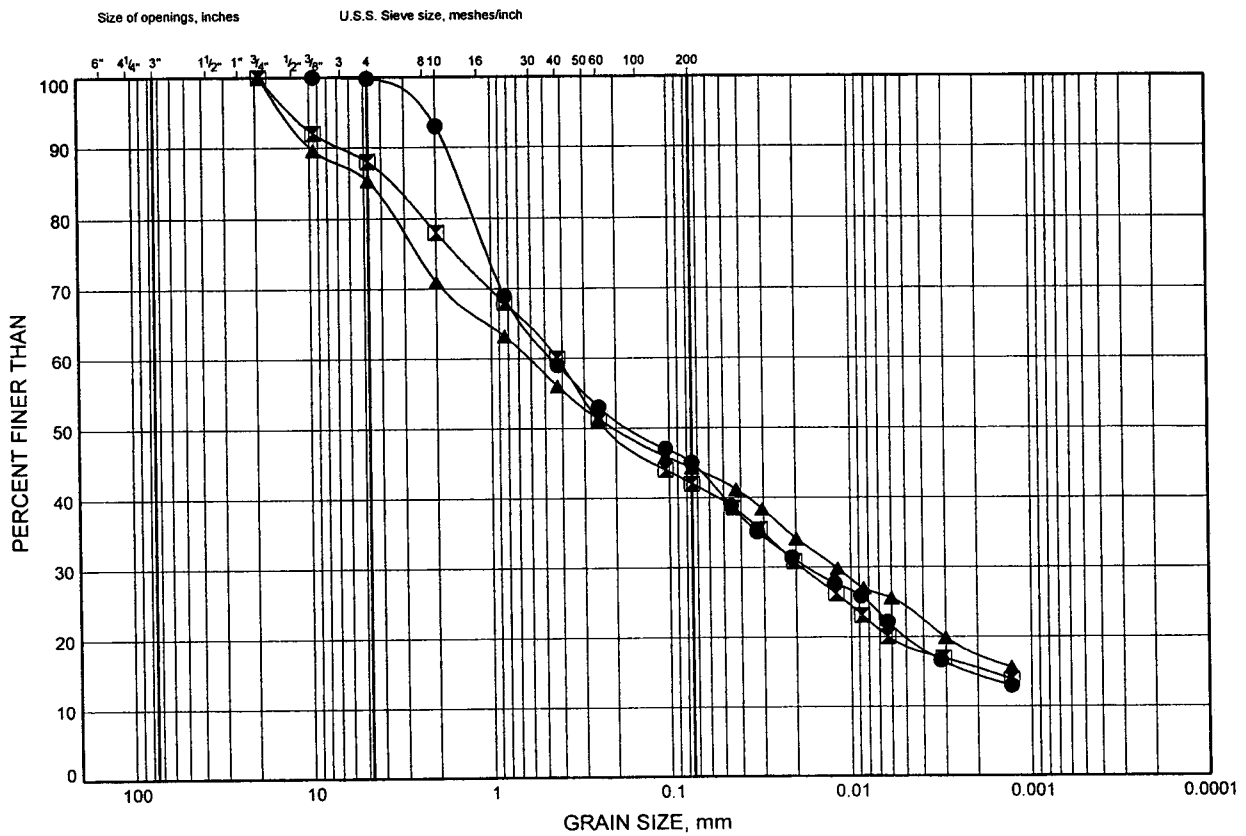


Prep'd DB
Chkd JC

GRAIN SIZE DISTRIBUTION

FIGURE B7

Silty Sand and Sand and Silt (Fill)

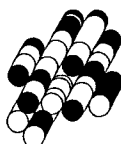


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	OS-1	3.4	108.3
▲	OS-2	1.7	103.9
◻	OS-13	1.7	117.1

Date April 2008

Project 2831-02-01



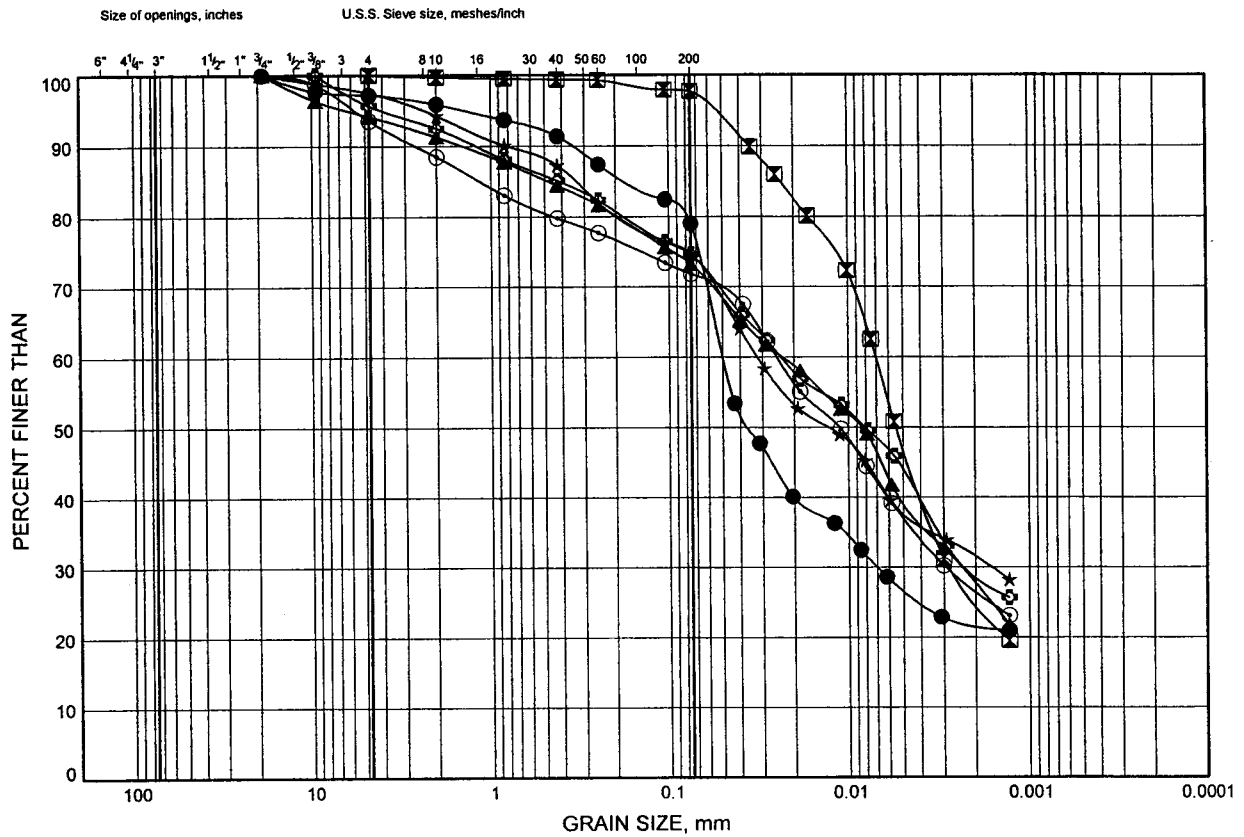
Prep'd DB

Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B8

Silty Clay Till

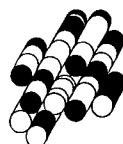


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-1	3.2	103.5
⊠	CS-2	3.2	101.9
▲	CS-5	1.7	113.4
★	OS-1	7.8	103.9
⊙	OS-4	2.5	109.5
⊕	OS-5	1.7	111.7

Date April 2008

Project 2831-02-01



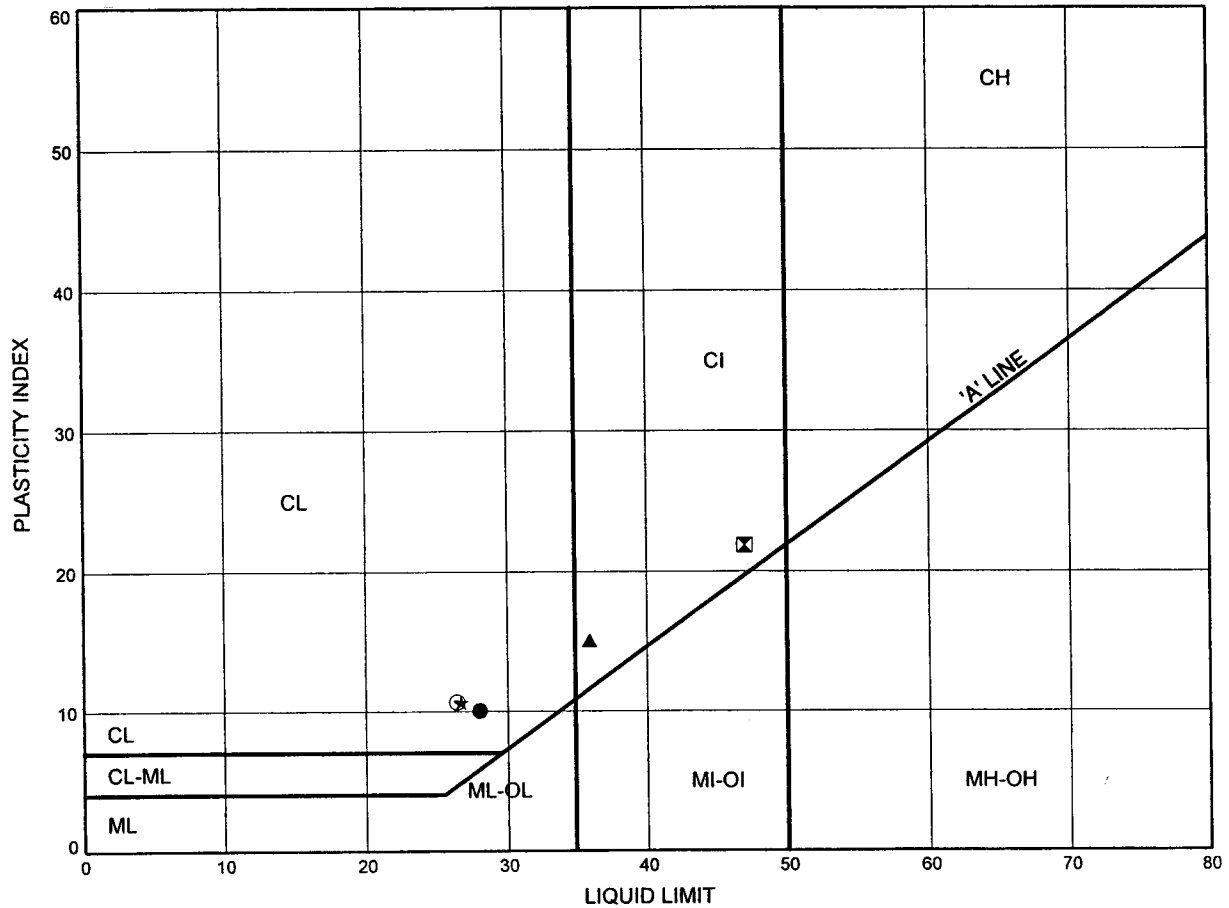
Prep'd DB

Chkd. JC

ATTERBERG LIMITS TEST RESULTS

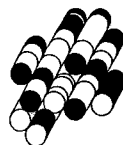
FIGURE B9

Silty Clay Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-1	3.2	103.5
⊠	CS-2	3.2	101.9
▲	OS-1	7.8	103.9
★	OS-4	2.5	109.5
⊙	OS-5	1.7	111.7

Date April 2008
Project 2831-02-01

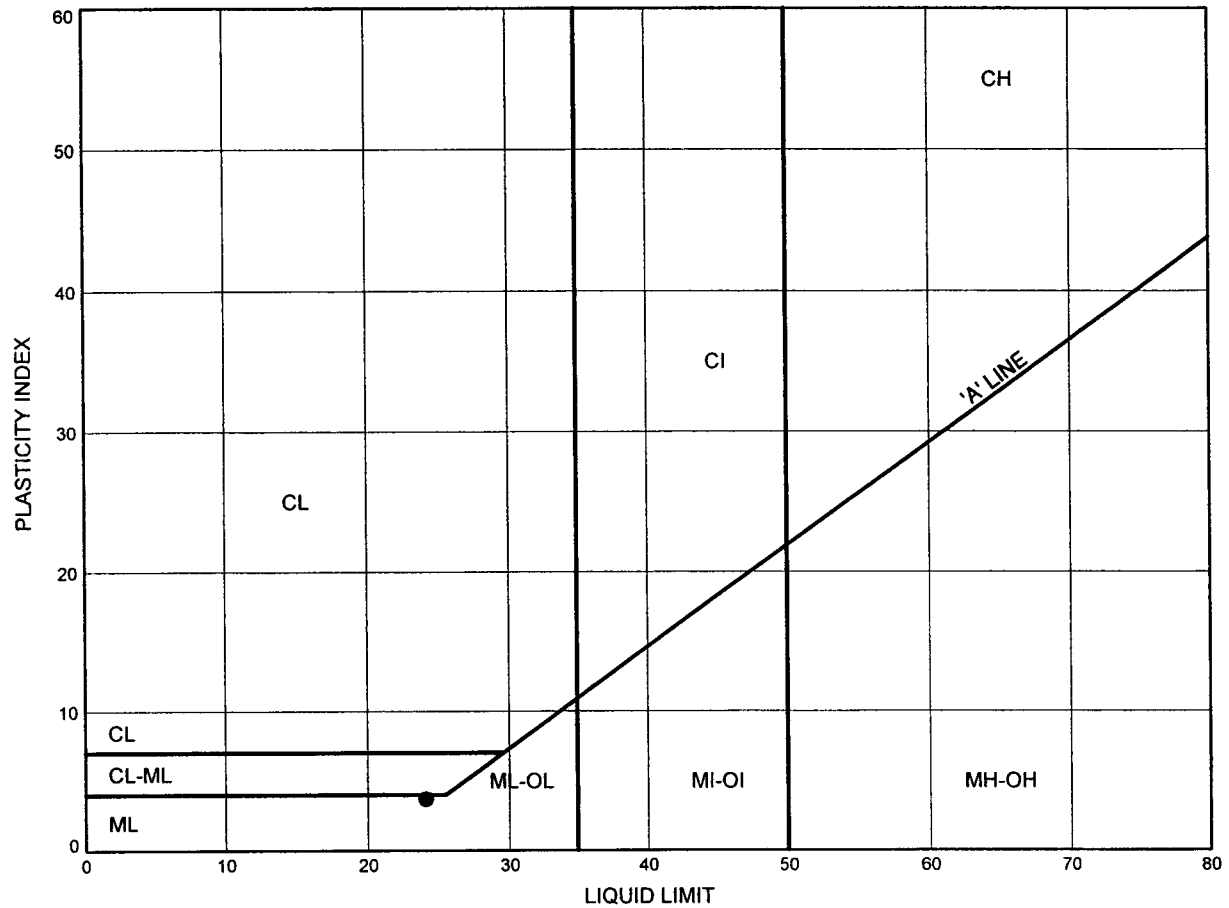


Prep'd DB
Chkd. JC

ATTERBERG LIMITS TEST RESULTS

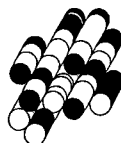
FIGURE B11

Sandy Silt Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-3	2.5	103.7

Date April 2008
Project 2831-02-01

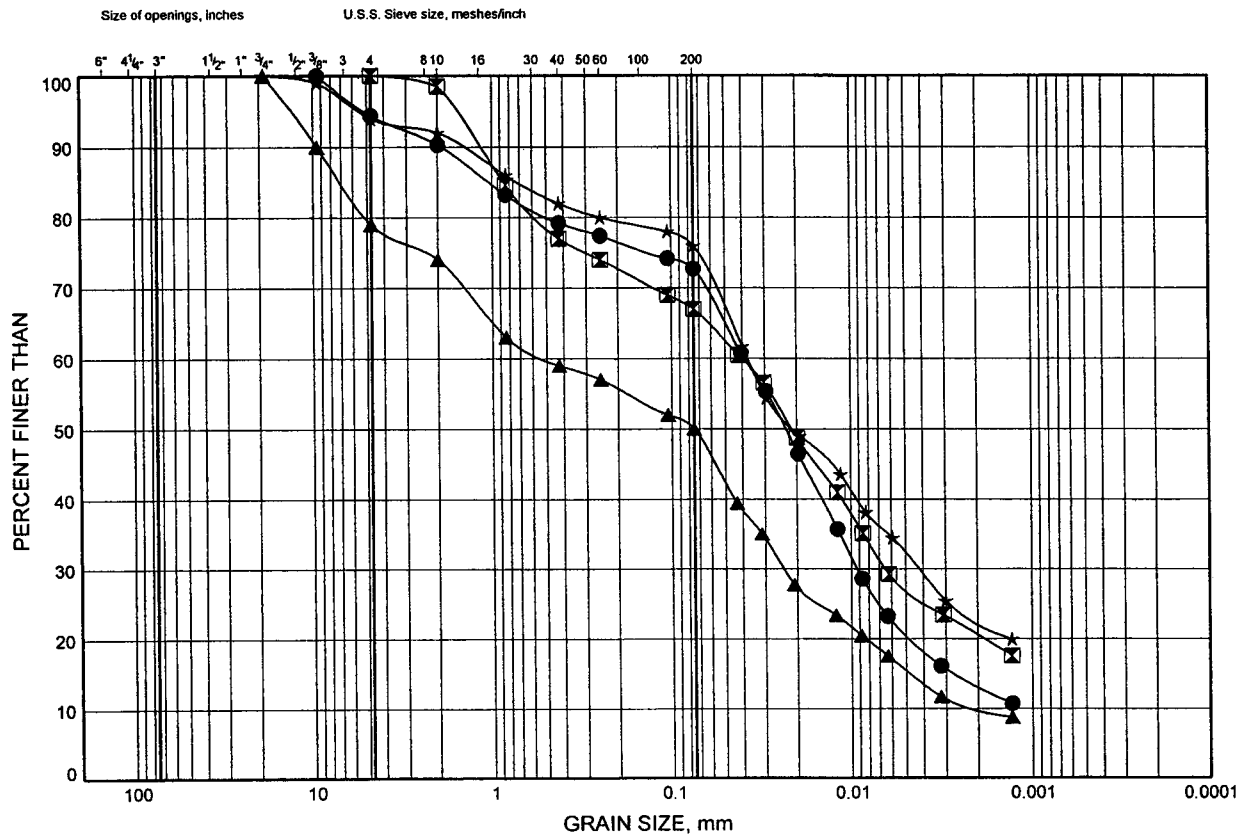


Prep'd DB
Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B12

Silty Clay Till (Till / Shale Complex)

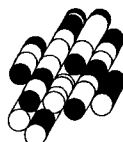


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-1	4.7	102.0
⊠	CS-4	1.7	107.0
▲	OS-2	2.5	103.1
★	OS-3	1.7	106.4

Date April 2008

Project 2831-02-01



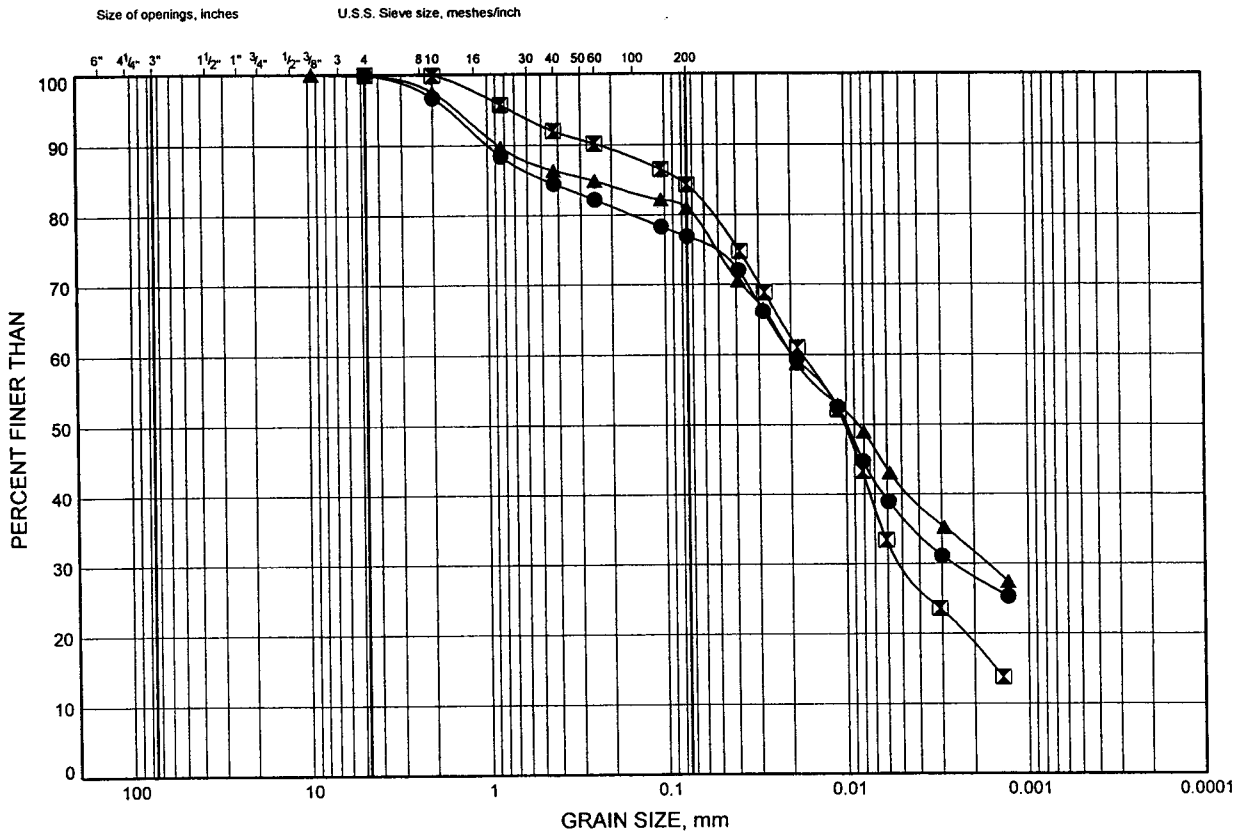
Prep'd DB

Chkd. JC

GRAIN SIZE DISTRIBUTION

FIGURE B13

Silty Clay Till (Till / Shale Complex)

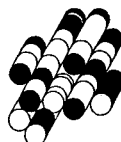


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
☒	OS-6	2.5	112.3
▲	OS-7	1.7	115.2
●	OS-10	1.1	118.1

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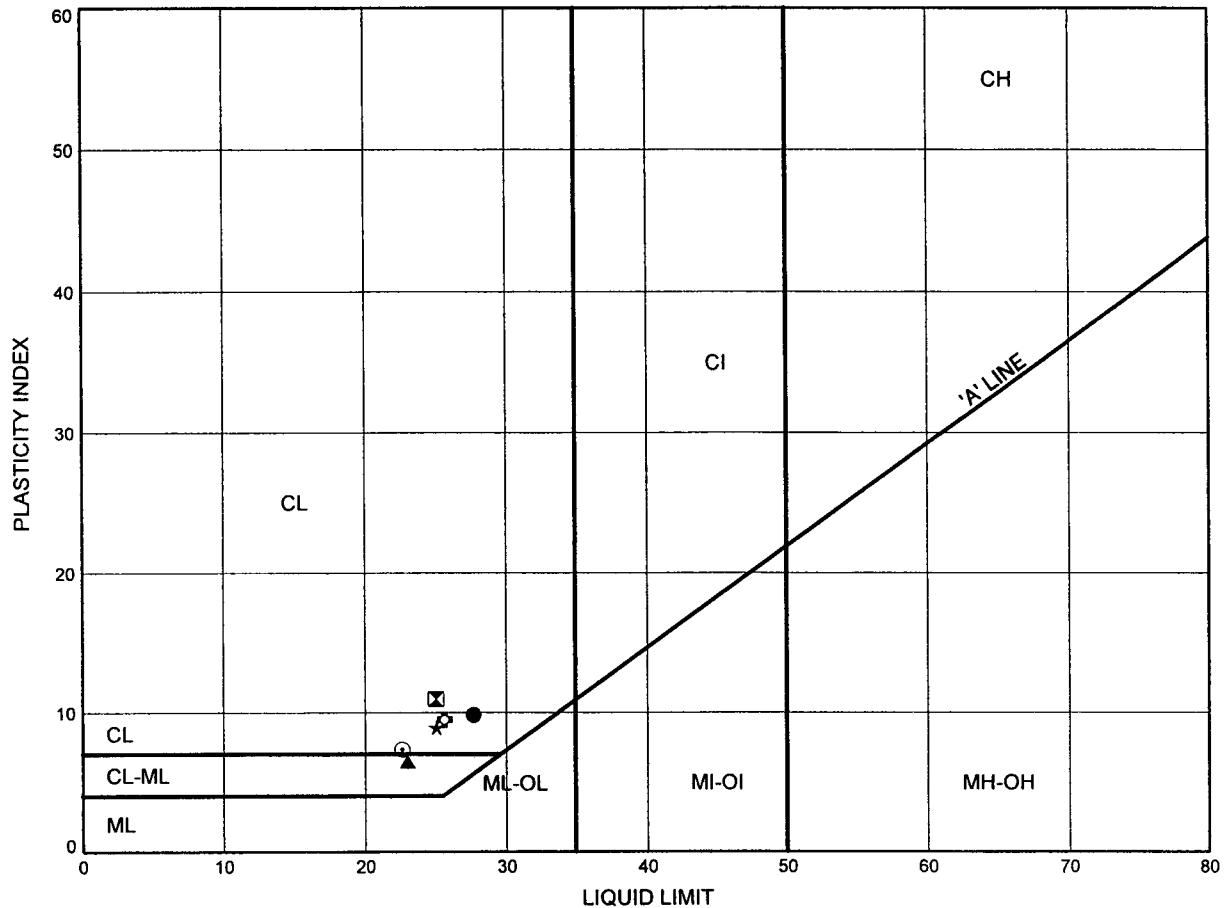
Prep'd DB

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ATTERBERG LIMITS TEST RESULTS

FIGURE B14

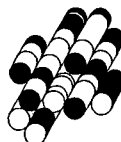
Silty Clay Till (Till / Shale Complex)



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	CS-1	4.7	102.0
▲	OS-2	2.5	103.1
★	OS-3	1.7	106.4
⊙	OS-6	2.5	112.3
☆	OS-7	1.7	115.2
⊠	OS-10	1.1	118.1

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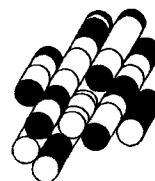
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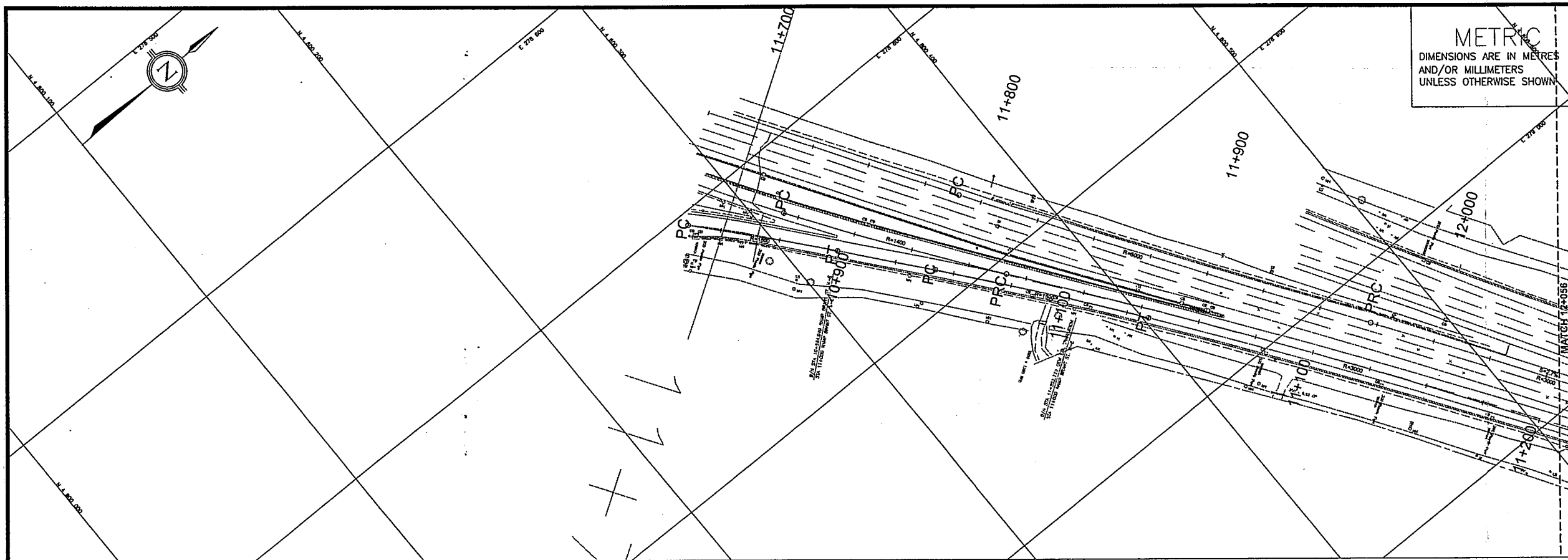
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APPENDIX C

**Drawing titled
“Borehole Locations”**

Terraprobe Limited





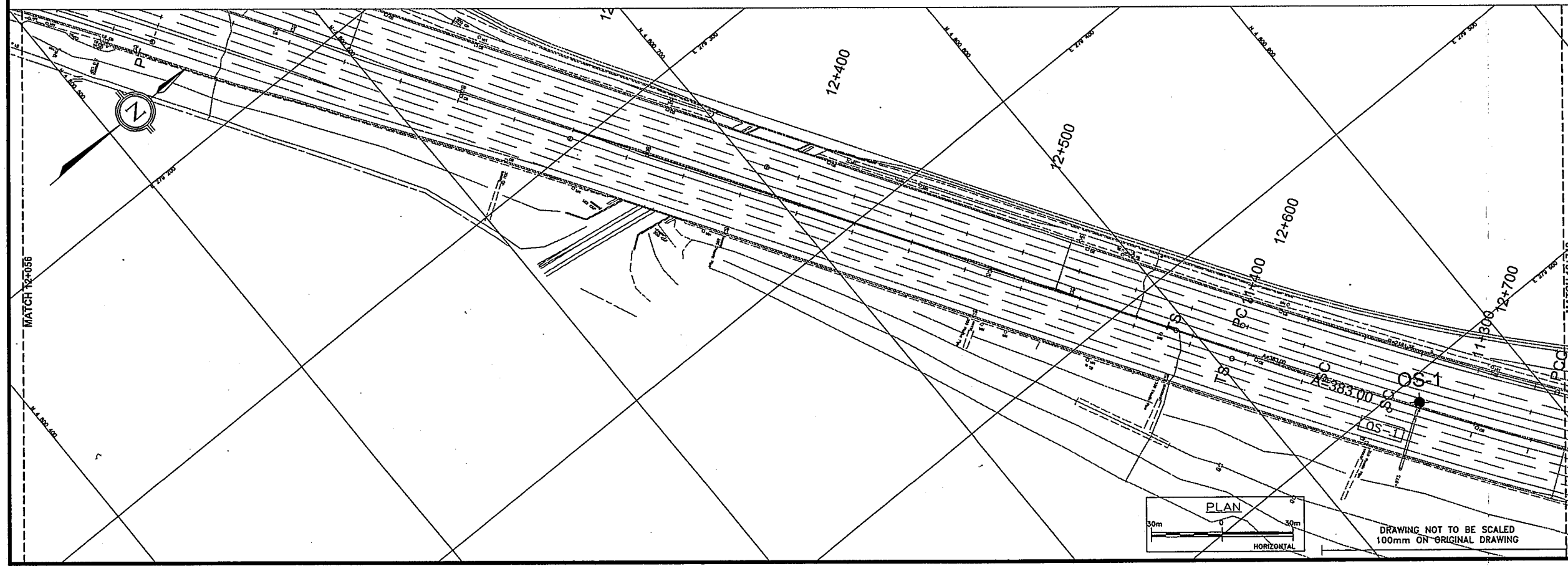
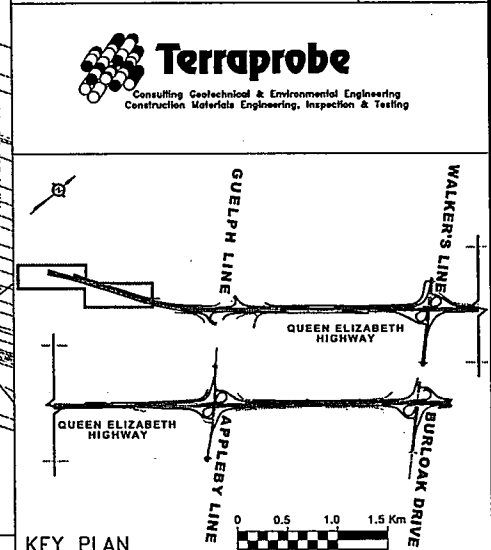
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETERS
UNLESS OTHERWISE SHOWN

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WP No 2831-02-01

QUEEN ELIZABETH HIGHWAY
BRANT STREET TO BURLOAK DRIVE
OVERHEAD/CANTILEVERED SIGN
SUPPORT STRUCTURES
BOREHOLE LOCATIONS

Giffels
An Ingenium Group Company

SHEET
1 OF 8



DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- Rock Quality Designation
- Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
OS 1	111.7	4800854.8	279609.8

NOTE

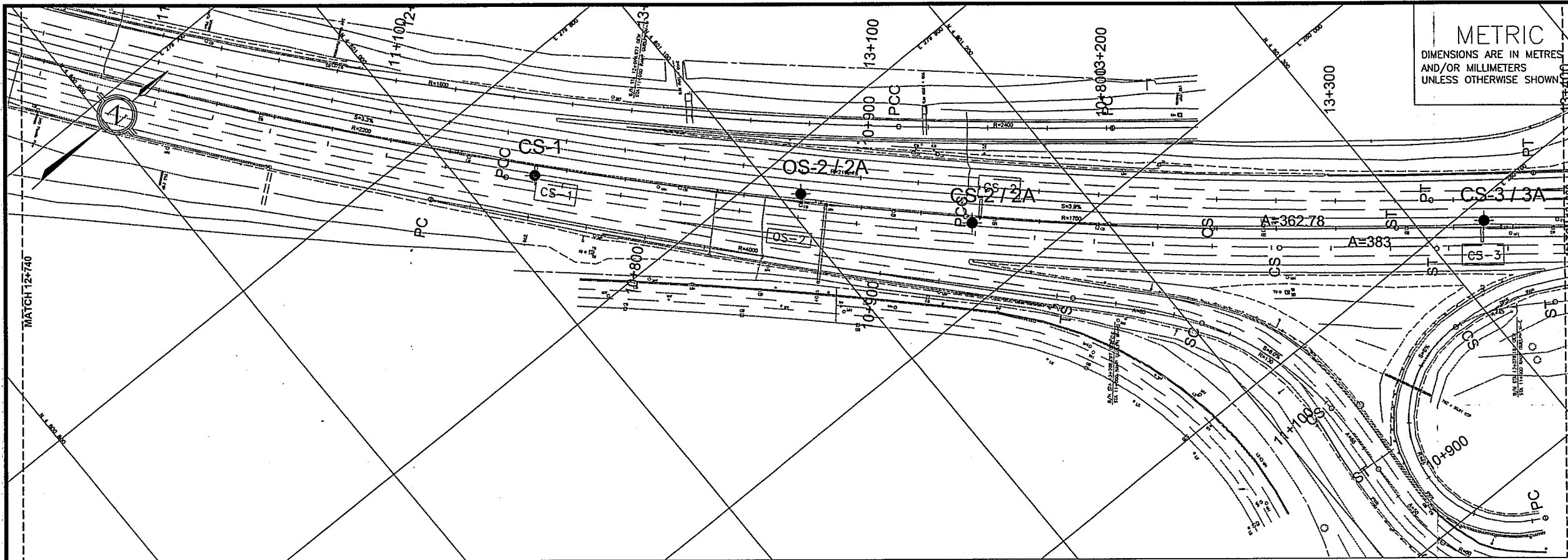
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

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DESIGN J.C.CODE CHBDC2006 LOAD DATE APRIL 2008

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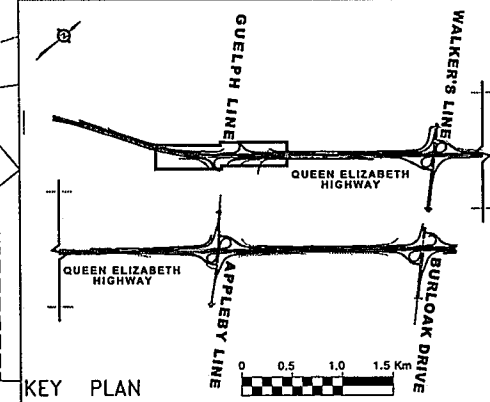


QUEEN ELIZABETH HIGHWAY
BRANT STREET TO BURLOAK DRIVE
OVERHEAD/CANTILEVERED SIGN SUPPORT
STRUCTURES
BOREHOLE LOCATIONS

SHEET
2 OF 8

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KEY PLAN

LEGEND

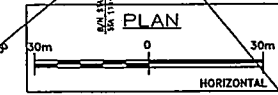
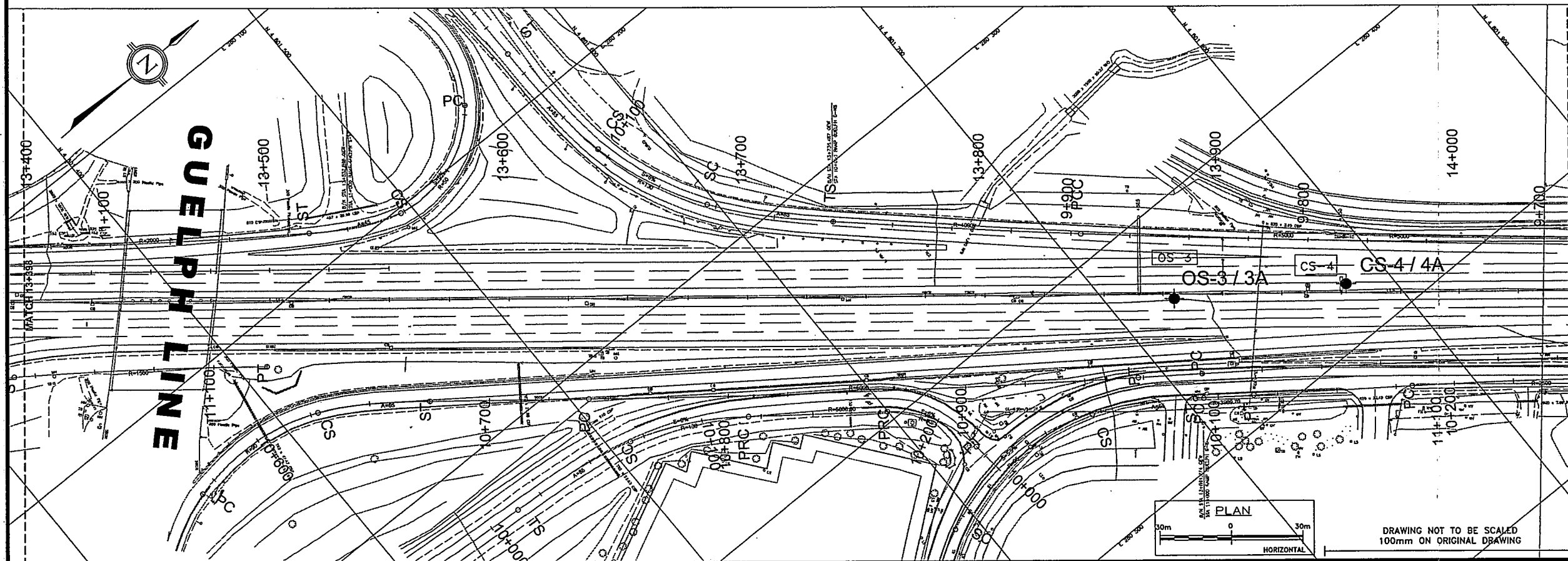
- Bore Hole
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- Bore Hole & Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- 90% Rock Quality Designation
- Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
CS 1	105.7	4801026.0	279840.1
CS 2	105.8	4801156.0	279972.0
CS 3	106.2	4801323.9	280107.9
CS 4	108.7	4801783.4	280476.6
OS 2	105.6	4801107.9	279916.9
OS 3	108.1	4801723.6	280435.6

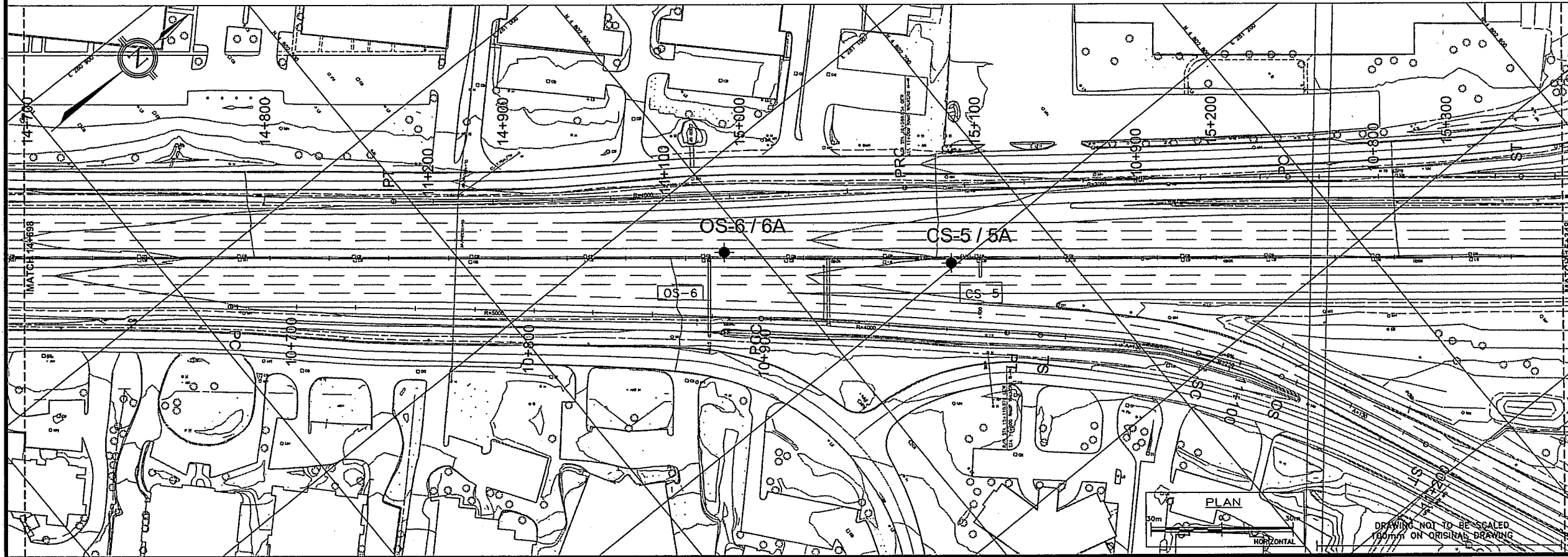
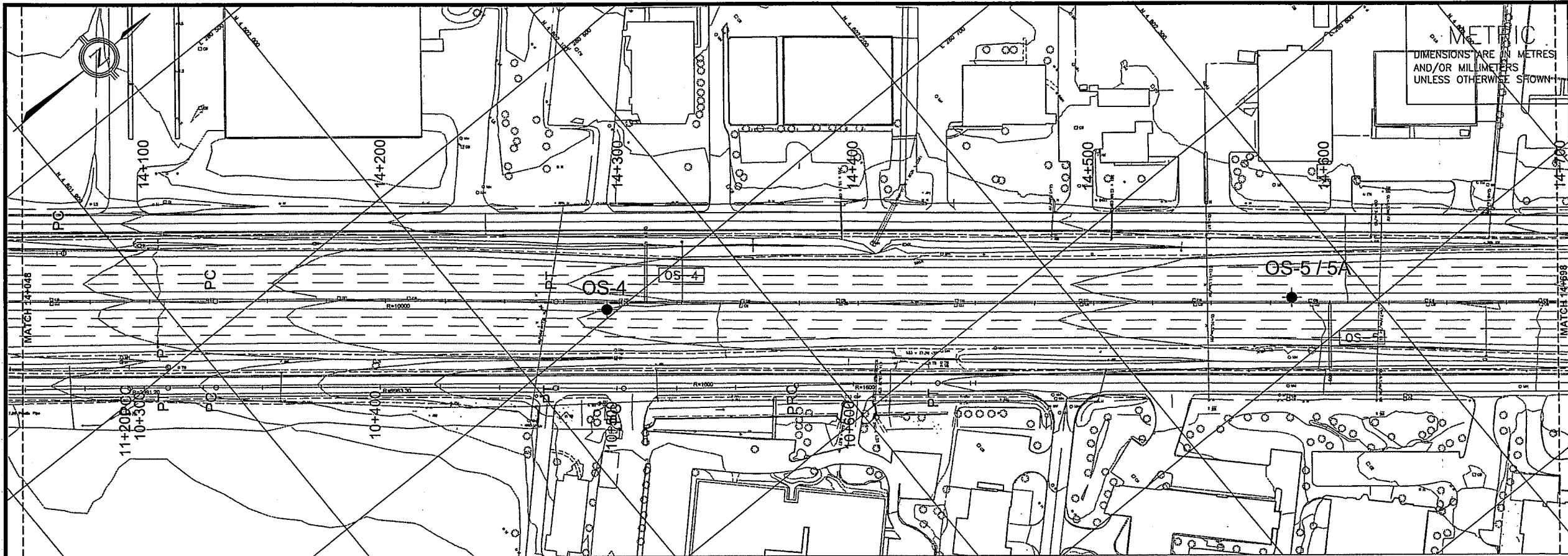
NOTE

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	DATE	BY	DESCRIPTION	
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OVERHEAD/CANTILEVERED SIGN
SUPPORT STRUCTURES
BOREHOLE LOCATIONS

SHEET
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LEGEND

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
OS 4	112.0	4802044.6	280697.1
OS 5	113.4	4802272.7	280876.5
OS 6	114.8	4802588.6	281133.7
CS 5	115.1	4802660.7	281198.3

NOTE

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J.C

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OS-5/5A

OS-4

OS-5

OS-6/6A

CS-5/5A

OS-6

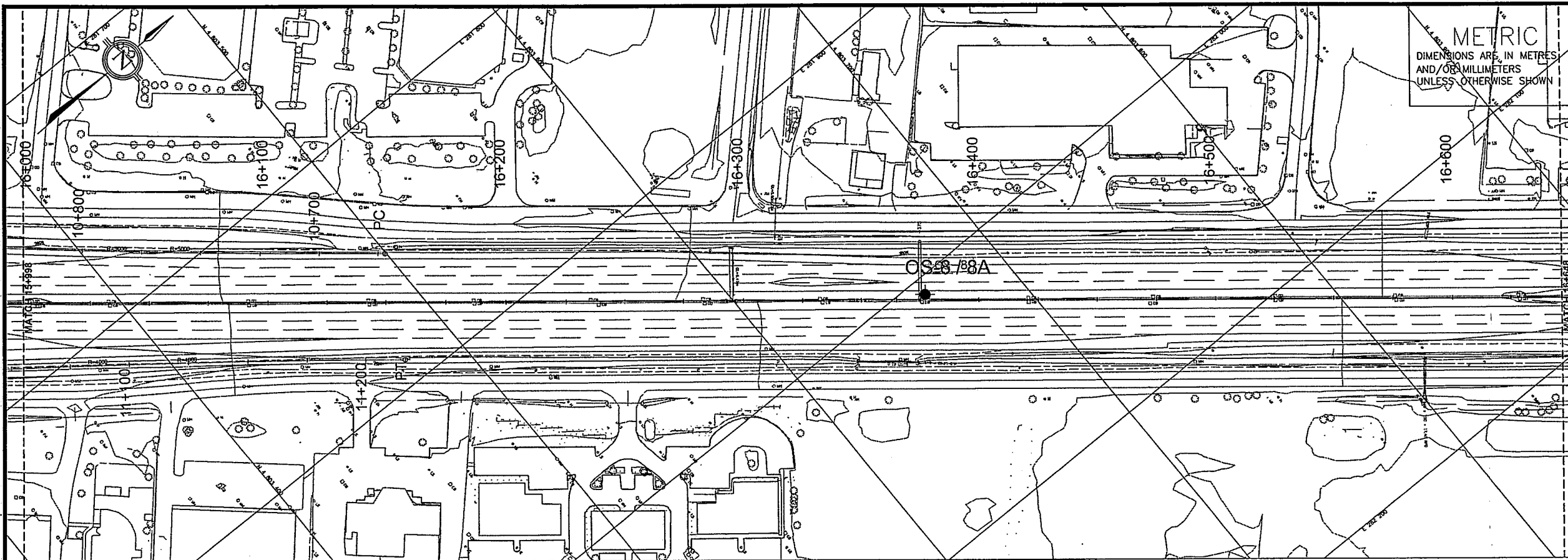
CS-5

PLAN

HORIZONTAL

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DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING



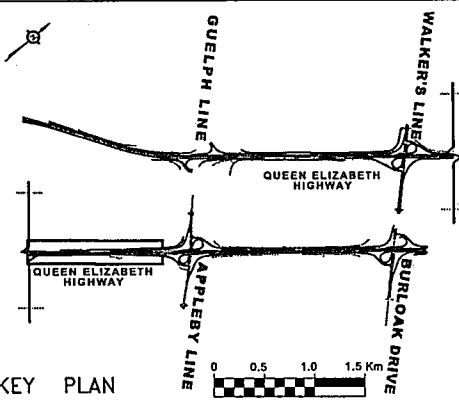
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WP No 2831-02-01



QUEEN ELIZABETH HIGHWAY
BRANT STREET TO BURLOAK DRIVE
OVERHEAD/CANTILEVERED SIGN
SUPPORT STRUCTURES
BOREHOLE LOCATIONS

SHEET
5 OF 8



KEY PLAN

LEGEND

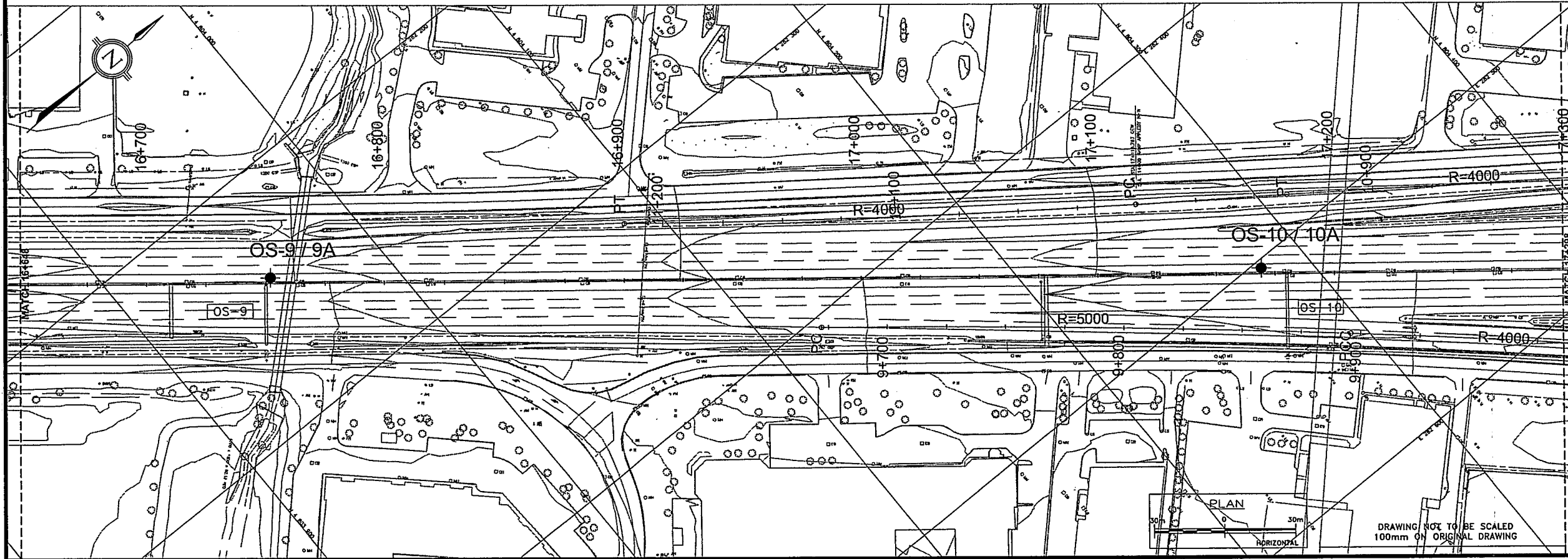
- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- Rock Quality Designation
- Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
OS 8	117.8	4803664.8	282006.8
OS 9	116.8	4803956.4	282242.3
OS 10	119.2	4804282.2	282503.1

NOTE

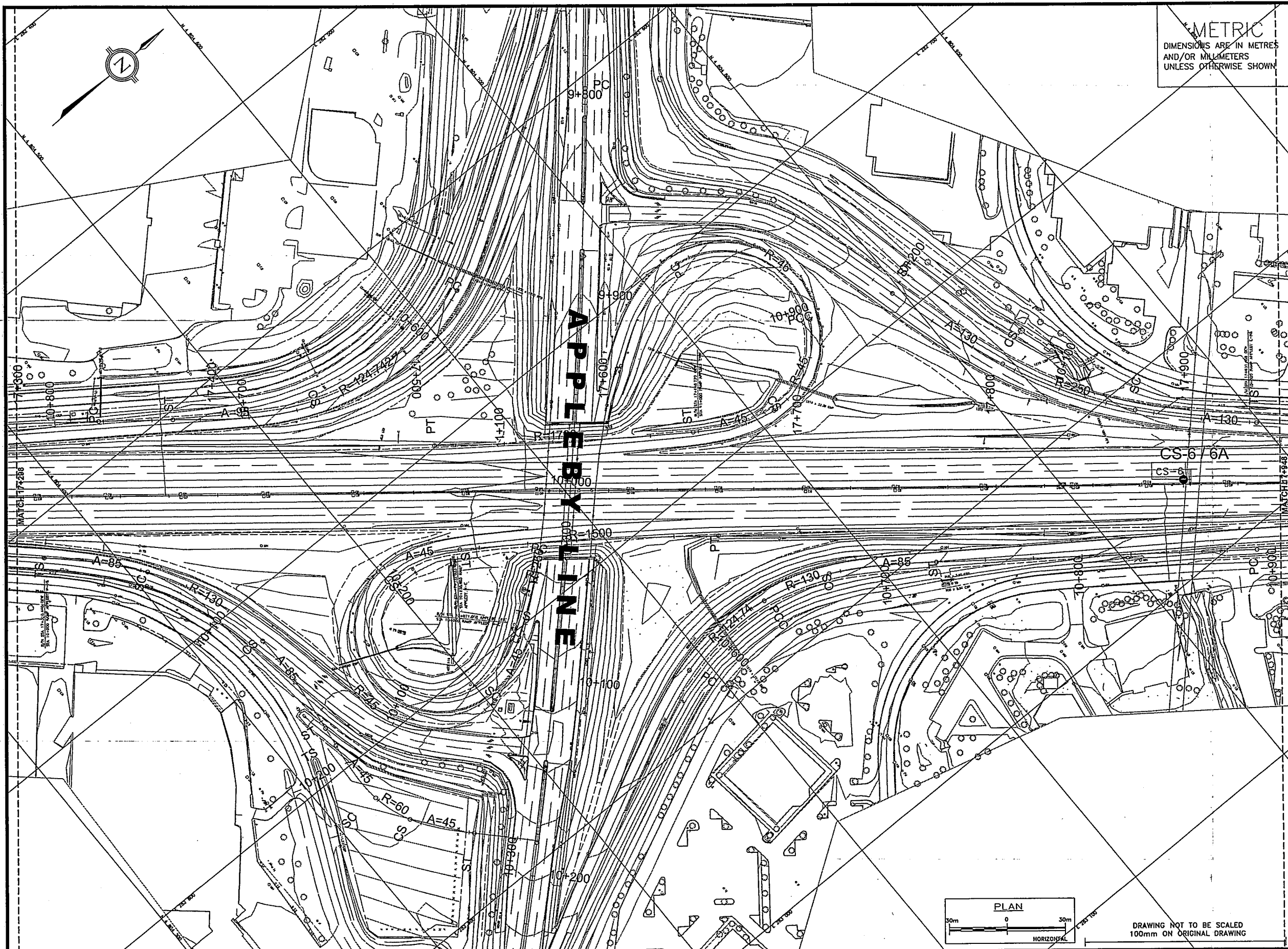
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REVISIONS	DATE			DESCRIPTION		
	DATE	BY	LOAD	DATE	APRIL 2008	STRUCT
DESIGN	J.C.	CODE	CHBDC2006			
DRAWN	S.F.	CHK	J.C.			



PLAN

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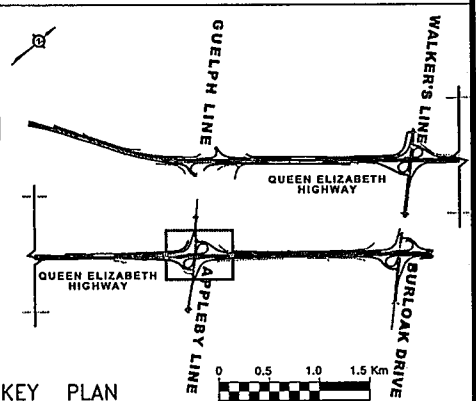
METRIC
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AND/OR MILLIMETERS
UNLESS OTHERWISE SHOWN

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WP No 2831-02-01



QUEEN ELIZABETH HIGHWAY
BRANT STREET TO BURLOAK DRIVE
OVERHEAD/CANTILEVERED SIGN
SUPPORT STRUCTURES
BOREHOLE LOCATIONS

SHEET
6 OF 8



KEY PLAN

LEGEND

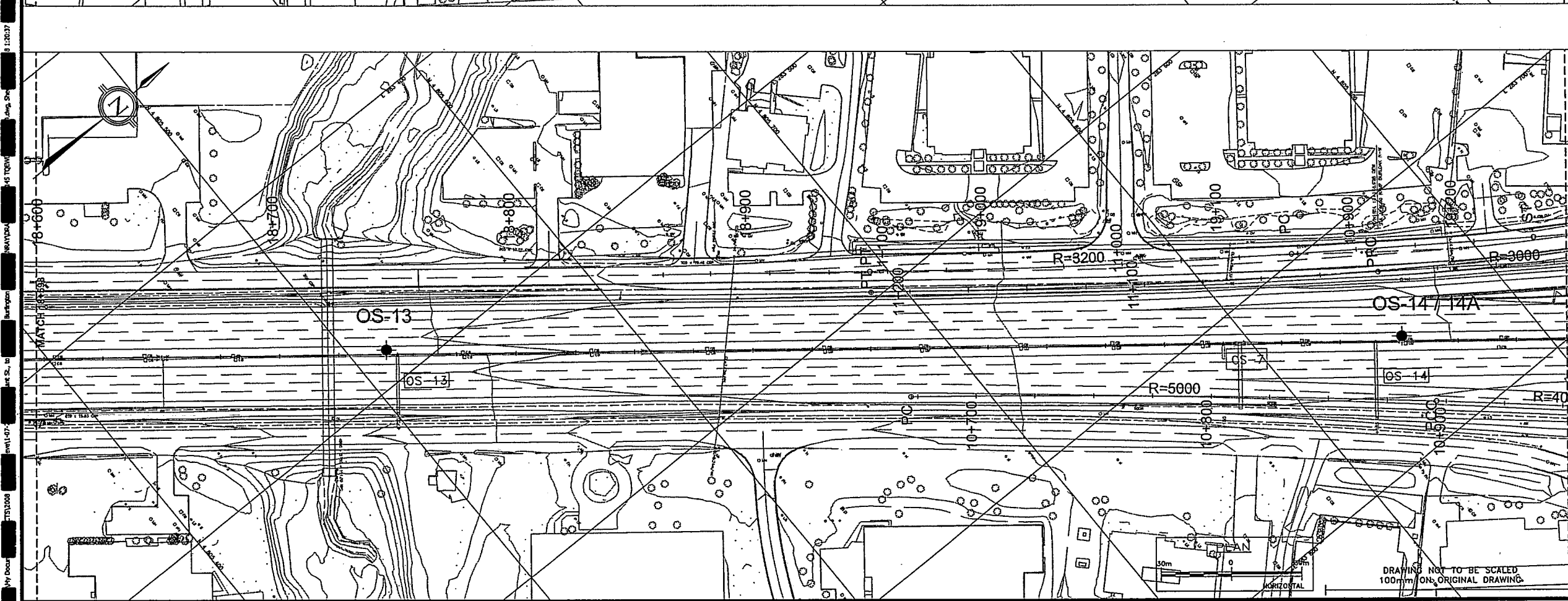
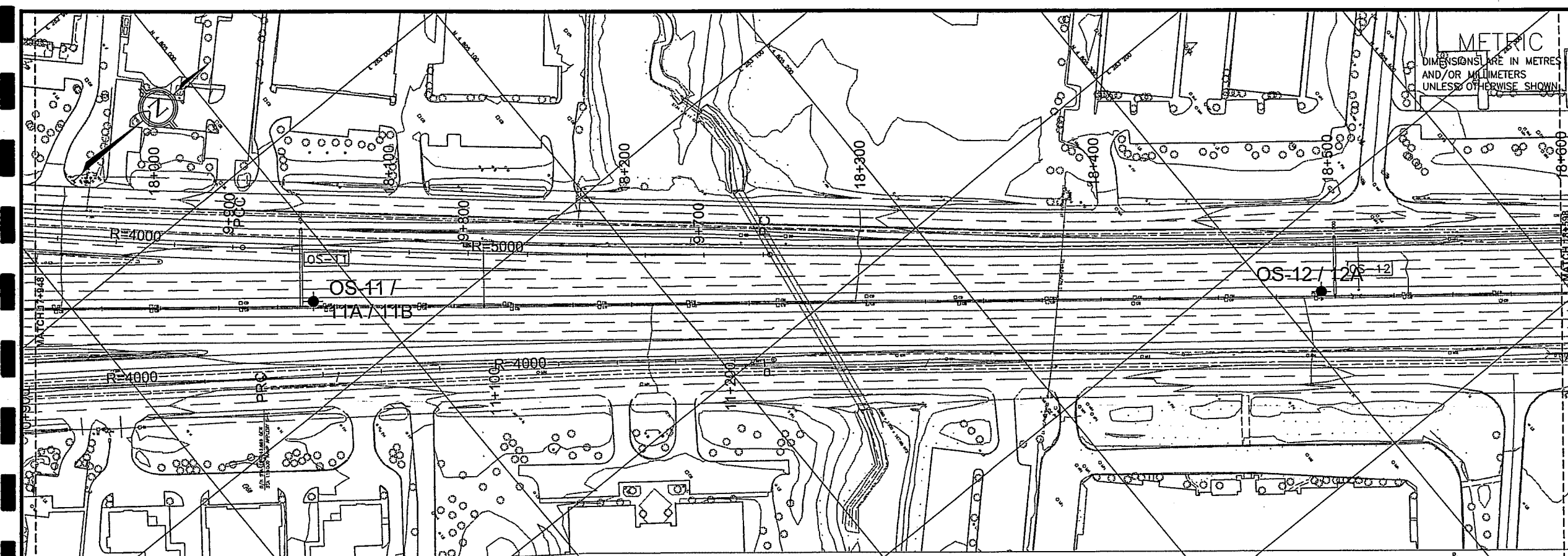
- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
CS 6	118.2	4804850.1	282957.4


NOTE

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	DATE	BY		DATE	BY	
DESIGN	J.C.	CODE	CHBDC2006	LOAD	DATE	APRIL 2008
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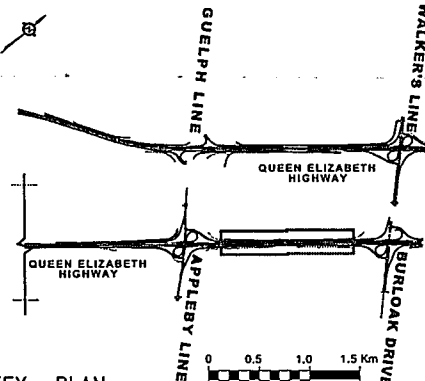
SHEET
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KEY PLAN



Bore Hole



Dynamic Cone Penetration Test (Cone)



Bore Hole & Cone

N

Blows/0.3m (Std Pen Test, 475 J/blow)

CONE

Blows/0.3m (60° Cone, 475 J/blow)

WL

WL at Time of Investigation

P

WL in Piezometer

P

Piezometer

90%

Rock Quality Designation

A/R

Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
OS 11	118.3	4804981.7	283062.5
OS 12	118.5	4805317.1	283330.3
OS 13	118.8	4805513.9	283486.4
OS 14	119.2	4805851.6	283754.0

NOTE

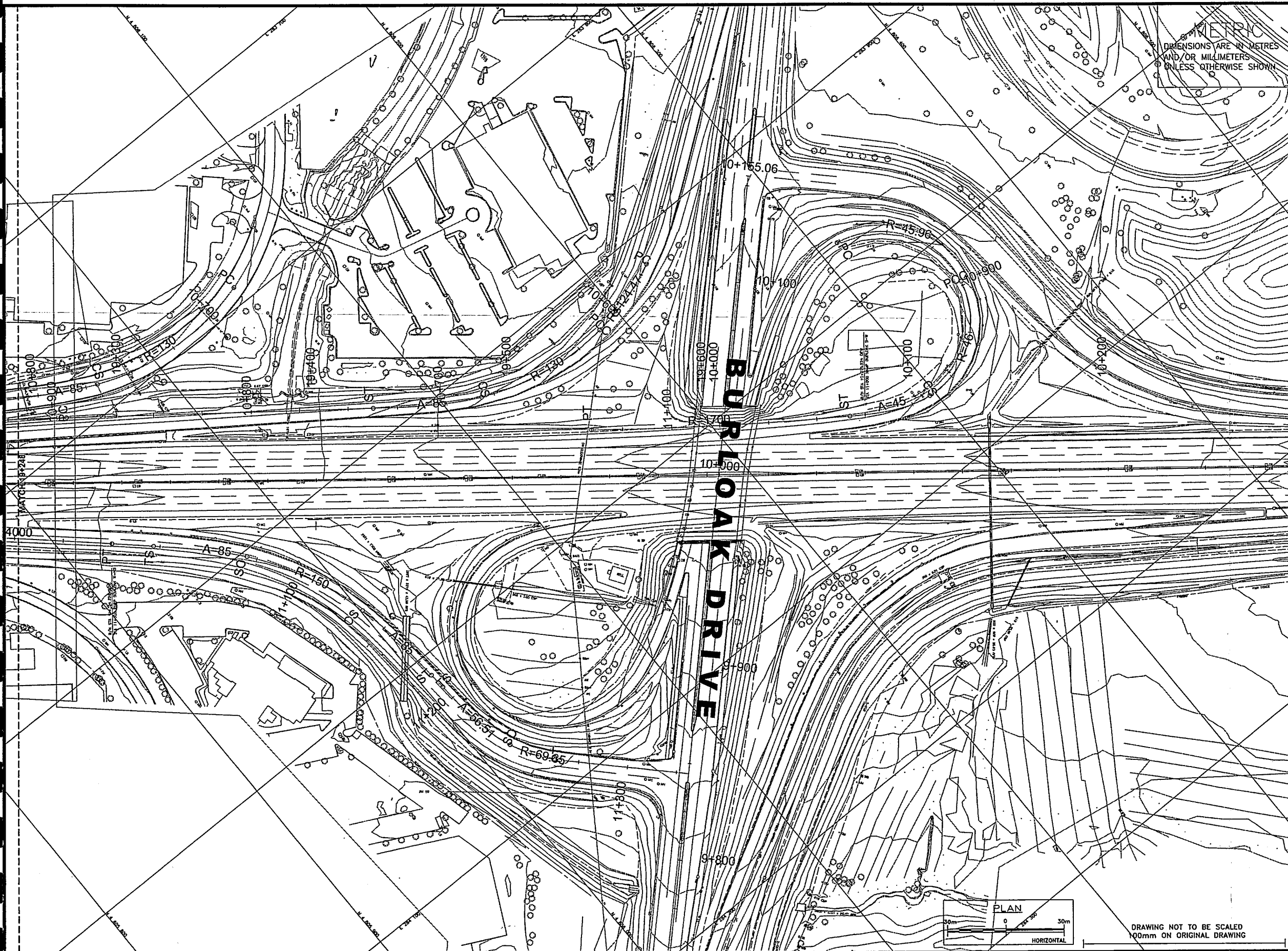
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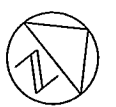
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DRAWN S.FCHK J.C		STRUCT

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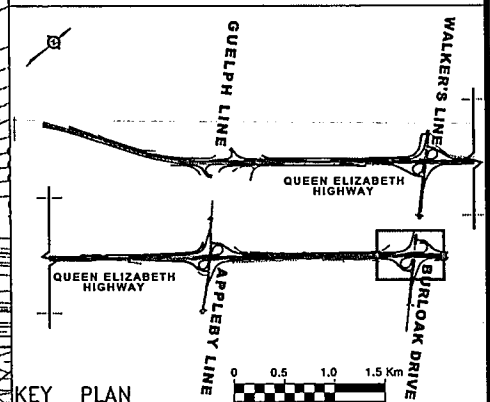
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WP No 2831-02-01



QUEEN ELIZABETH HIGHWAY
BRANT STREET TO BURLOAK DRIVE
OVERHEAD/CANTILEVERED SIGN
SUPPORT STRUCTURES
BOREHOLE LOCATIONS



LEGEND	
	Bore Hole
	Dynamic Cone Penetration Test (Cone)
	Bore Hole & Cone
'N'	Blows/0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
	WL at Time of Investigation
	WL in Piezometer
	Piezometer
90%	Rock Quality Designation
A/R	Auger Refusal

[illegible]

NOTE
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REVISIONS					
	DATE	BY	DESCRIPTION		
DESIGN	J.C.	CODE	CH8DC2006	LOAD	DATE APRIL 2008
DRAWN	S.F.	CHK	J.C.		STRUCT