

CONTRACT NO.

G.W.P. 3028-14-00

FOUNDATION INVESTIGATION REPORT

OJIBWAY PARKWAY/ETR OVERPASS

SITE NOS. 6-600/1 AND 2 (BRIDGE B-1)

NEW STRUCTURES AT THE WESTERN TERMINUS
OF HIGHWAY 401
(THE RT. HON. HERB GRAY PARKWAY)

Ministry Of Transportation





**November 2016
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FOUNDATION INVESTIGATION REPORT

**Ojibway Parkway/ETR Overpass
Sites 6-600/1 & 2 (Bridge B-1)
Highway 401 (Rt. Hon. Herb Gray Parkway)
GWP 3028-14-00
Ministry of Transportation, Ontario, West Region**

Submitted to:

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REPORT



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Geocres No: 40J6-71

Distribution:

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LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORD OF BOREHOLE SHEET AND RECORD OF CONE PENETRATION TEST

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Geocres No. 40J6-27



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APPENDIX F

Record of Previous Boreholes and Laboratory Testing

Golder Associates Project No. 09-1132-0039-1000

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Results of Analytical Laboratory Testing



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1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations as part of the detailed design work for GWP 3028-14-00. The project involves the design of a crossing for Bridge B-1, Sites 6-600/1 & 2 located at the western terminus of the Rt. Honourable Herb Gray Parkway (RHHGP); formerly Windsor-Essex Parkway, or WEP. This structure will deliver Herb Gray Parkway traffic over Ojibway Parkway, the Essex Terminal Railway (ETR) line and the Plaza Access Road (PAR). This report addresses the construction of Retained Soil Structures (RSS) located between the ETR and Ojibway Parkway.

The purpose of the foundation investigation is to explore the subsurface conditions at the location of the proposed structure by drilling boreholes, conducting in-situ testing and carrying out laboratory testing on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal and in Golder Associates' proposal P3-1132-0053 dated June 2015. Golder Associates has carried out extensive geotechnical investigations for the MTO's Windsor-Essex Parkway and the Canadian Inspection Plaza at the proposed Detroit River International Crossing (DRIC). These investigations included geotechnical information in the vicinity of Site B-1 and were utilized in the preparation of this report. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated August 14, 2015.



2.0 SITE DESCRIPTION

2.1 General

The proposed extension of the RHHGP is located in the Township of Sandwich, Ontario, just southwest of Windsor, Ontario. The location of the project is shown on the Key Plan, Figure 1. The bridge will cross Ojibway Parkway, the ETR and the PAR. The RHHGP alignment in the immediate vicinity of the bridge generally trends in west to east direction in the area of the site.

The project area around the bridge structure extends from approximately 350 metres west of Ojibway Parkway to 540 metres west of Machette Road. The topography of the site is relatively flat with ground surface elevations gently sloping between about 177 and 179 metres. The ground surface is generally covered with a mixture of low vegetation and small trees. The site is situated on former residential areas.

2.2 Site Geology

The project area is located in the physiographic region of Southwestern Ontario known as the St. Clair Clay Plains, further subdivided into the Essex Clay Plain (encompassing Essex County and the southwestern part of Kent County). The clay plain was locally deposited during the retreat of recent ice sheets (late Pleistocene Era) when a series of glacial lakes inundated the area. Dependent on the glacial ice thickness and glaciolacustrine (glacial lake water) depths, the materials may have been directly deposited at the ice-bedrock contact or, as the lake levels rose when the ice sheets retreated, the soil and rock debris within and at the base of the ice were deposited in a shallow glacial lake water environment. The Essex Clay Plain exhibits grain size distributions consistent with that of a cohesive glacial till but these deposits do not have densities and strengths indicative of materials generally deposited below a grounded ice sheet¹. It is most likely that in the Windsor area, the soils were deposited from the underside of floating ice through a shallow water depth as a broadly graded mud and, therefore, carried little or no weight of the overlying ice.

The quaternary geological mapping indicates a major soil stratum, consisting primarily of silty clay and clayey silt and ranging in thickness of about 20.5 to 22 metres, exhibits a 'till-like' structure by a random distribution of coarser particles within the primarily fine-grained silt and clay matrix (also called 'diamict'). Predominantly, the near-surface clayey soils are generally firm to hard and contain weathering structures consisting of fractures and possible desiccation cracks. Underlying this 'crust', the soil becomes grey-brown and firm to stiff in consistency, indicating historical groundwater level. Below the groundwater level, the majority of soils in the western and southern areas of metropolitan Windsor are soft to firm silty clays and clayey silts. Therefore, it is considered that this deposit is geologically slightly over-consolidated, due to the lack of significant overburden stresses in the project area. The apparent pre-consolidation in the 'crust' is indicated as a result from wetting and drying cycles, fluctuations in the historical groundwater level, and cementation from carbonates and other minerals during the weathering process.

¹ Morris, T.F. 1994. Quaternary Geology of Essex County, Southwestern Ontario; Ontario Geological Survey, Open File Report 5886, 130p



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More typically layered glaciolacustrine silty clay, silty sand, silt, or sand overly the extensive stratum of 'till-like' silty clay, or clayey silt. This interlayering of sands and silts indicate the glacial lake and glacial ice depositional environment. In some areas of the site, a relatively thin stratum on the order of 1 to 6 metres in thickness of very dense, or hard, basal glacial till containing limestone clasts, was found. This stratum overlies the bedrock and is generally referred to as the Catfish Creek Till².

The bedrock encountered, overlying the Precambrian bedrock, is relatively horizontally oriented sedimentary rock of the Paleozoic era. This sedimentary rock formed in shallow marine environments within what is now geologically referred to as the Michigan Basin, a regional bowl-shaped depression permeating through Southern Ontario. The indicated geological mapping suggests bedrock occurring around 30 metres depth, or 143 to 145 metres in elevation. Previous boreholes in the area indicated bedrock occurring at depths between 23 and 28 metres. The bedrock in this area is the limestones of the Devonian Dundee Formation of the Hamilton Group of Formations, and the underlying limestone of the Devonian Lucas Formation of the Detroit River Group of Formations³.

² Morris, T.F. 1994. Quaternary Geology of Essex County, Southwestern Ontario; Ontario Geological Survey, Open File Report 5886, 130p

³ Morris, T.F. and Cousineau, G.R. 1994. Drift thickness, Essex County area (west half), southern Ontario; Ontario Geological Survey, Preliminary Map P.3255, scale 1:50,000



3.0 INVESTIGATION PROCEDURES

The field work for the investigation was carried out between November 16th and 18th, 2015 during which time one borehole, BH15-001, and one Piezo-Cone Penetration Test (CPT), CPT-1001 were completed at the proposed abutments for the bridge extension structure. The locations of the current boreholes are shown on Drawing 1. The below table summarizes the borehole locations, ground surface elevations at the borehole locations, and the borehole depths.

Borehole	Location (m)		Ground Surface Elevation (m)	Depth of Borehole (m)
	Northing	Easting		
BH15-001	4682135.6	328411.5	178.81	27.08
CPT-1001	4682192.2	328420.3	178.79	19.5

The investigation was carried out using track-mounted drilling equipment (Soil Max 449) supplied and operated by a specialist drilling contractor. In the boreholes, samples of the overburden were obtained at generally 0.76 and 1.5 metre intervals of depth using 50 millimetres outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures of American Society for Testing and Materials (ASTM) Standard D1586. In the softer deposits, thin-wall tubes were used to procure relatively undisturbed samples. Rock coring procedures were conducted in accordance with ASTM D2113. The rock was cored utilizing NQ size equipment.

The recorded SPT N values are noted on the Record of Borehole sheets. According to ASTM D1586, the SPT resistance, or N value, is defined as the number of blows required by a 63.5 kilogram hammer dropped from a height of 760 millimetres to drive a split-spoon sampler a distance of 300 millimetres, after an initial 150 millimetres of penetration. In cases where it was not possible to achieve a full 450 millimetres of drive, a penetration resistance representing the number of blows to drive the sampler is recorded on the Record of Borehole. The penetration resistance obtained in the first 150 millimetres is normally neglected unless the sampler could only be driven 150 millimetres or less, in which case SPT testing was terminated after 100 blows. A hammer operated by a rope and cat-head system was used for BH15-001. The results of the SPT testing as presented on the Record of Borehole sheets are unmodified (not standardized for hammer efficiency, borehole diameter, rod length, etc.). The samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 40 millimetres. Therefore, particles that may exist within the soils that are larger than this dimension will not be sampled or represented in the grain size distributions. For the site stratigraphy, these larger sized particles may include glacial erratics such as cobbles and boulders.

Groundwater conditions in the borehole were observed throughout the drilling operations. The boreholes were backfilled in accordance with the current MTO procedures and Ontario Regulation 903 (as amended).

The field work was monitored on a full-time basis by experienced Golder Associates staff by locating the boreholes in the field, monitoring the drilling, sampling, in-situ testing operations, and logging of the boreholes. The samples were delineated in the field, placed in labelled containers, and transported to our London and Mississauga laboratories for further examination and testing. Index and classification tests consisting of water content



determinations, grain size distribution analyses and Atterberg limit determinations were carried out on selected soil samples. Samples were also sent to our Mississauga office for oedometer testing to determine consolidation properties of the soil and unconfined compression testing of the rock core. The results of the testing are shown on the Record of Borehole sheets with detailed results presented in Appendices A and B.

3.1 In-Situ Cone Penetration Test

The CPT is an in situ testing technique for site characterization studies. The CPT consists of a special cone tip equipped with electronic sensing elements to continuously measure tip resistance, local side friction on a steel sleeve behind the conical tip, and pore water pressure. It is pushed at a constant rate into the ground using a drill rig (ASTM D5778). A nearly continuous (data obtained at 2 cm intervals) approximate stratigraphic profile together with engineering properties, such as undrained shear strength, can be inferred from the results of the CPT. The CPT equipment was advanced using the hydraulic ram system on the drill rig.

A CPT was conducted north of BH15-001. This test location was denoted as CPT-1001. A shallow borehole was advanced through the surface soils using hollow stem augers to a depth of 4.6 metres below ground surface in order to facilitate the start of the CPT. The CPT was advanced to a refusal depth of 19.5 metres below the ground surface or elevation 159.3 metres. The Record of Cone Penetration Test sheet with profiles of tip resistance, pore water pressure during pushing, and sleeve-friction has also been appended.

3.2 Previous Investigations

Golder Associates has carried out several field exploration and laboratory testing programs for the proposed Detroit River International Crossing (DRIC), the Canadian Inspection Plaza, and RHHGP at the Bridge B-1 vicinity. Characterization of the ground conditions was carried out using conventional boreholes with SPT, CPT, in-situ shear strength testing using conventional and Nilcon field vanes, shear tests and in-situ cross-hole and vertical seismic profile testing. The laboratory testing included oedometer testing of the compressible soils. The bulk of this work was reported under Geocres Report No. 40J6-27⁴. The Record of Borehole and Record of Cone Penetration Test sheets for previous boreholes located within the west approach and Bridge B-1 areas are presented in Appendix E along with the relevant results of laboratory testing in their original format. The tables below summarize the locations, ground surface elevations and depths of the previous boreholes.

Table 1 - Summary of Exploration Locations Reported in Geocres Report No. 40J6-27

Borehole/CPT	Location (m)		Ground Surface Elevation (m)	Borehole Depth (m)	Type of Hammer
	Northing	Easting			
CPT-165	4 682 188	328 458	178.98	2.29 (Borehole) 23.18 (CPT)	Cat-Head

⁴ Geocres No. 40J6-27, 2009 and 2010: Windsor-Essex Parkway, Geotechnical Data Report (June 2009); and Addendums No. 1 – Soil Chemistry Data (February 2010), Addendum No. 2 – In Situ Cross-Hole and Vertical Seismic Profile Testing (March 2010), Addendum No. 3 – Supplementary Cone Penetration Testing (February 2010), Addendum No. 4 – Supplementary Geotechnical Investigation (March 2010), Addendum No. 5 – Supplementary Laboratory Investigation (April 2010), Addendum No. 6 – Supplementary Geotechnical Investigation (May 2010) and Addendum No. 7 – Supplementary Geotechnical Investigation (June 2010).



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Borehole/CPT	Location (m)		Ground Surface Elevation (m)	Borehole Depth (m)	Type of Hammer
	Northing	Easting			
BH-166	4 682 168	328 350	179.00	26.92	Cat-Head
BH-166A (Piezometer)	4 682 168	328 350	179.00	15.39	Cat-Head
CPT-348	4 682 160	328 513	179.15	2.90 (Borehole) 23.40 (CPT)	Cat-Head
BH-349	4 682 136	328 496	179.08	27.79	Cat-Head

Golder Associates' investigations of the Canadian Inspection Plaza to the west of Bridge B-1 were carried out on behalf of Transport Canada. The factual information was reported in Golder Associates Report No. 09-1132-0039-1000-R02 titled "Geotechnical Data Report, Canadian Inspection Plaza, Proposed International Border Crossing of the Detroit River, Windsor, Ontario", dated April 2010. The Record of Borehole and Record of Cone Penetration Test sheets for previous boreholes located within the west approach and Bridge B-1 areas are presented in Appendix F along with the relevant results of laboratory testing in their original format. The table below summarizes the locations, ground surface elevations and depths of the previous boreholes.

Table 2 - Summary of Exploration Locations Reported in Golder Report No. 09-1132-0039

Borehole/CPT	Location (m)		Ground Surface Elevation (m)	Borehole Depth (m)	Type of Hammer
	Northing	Easting			
GBH-167	4 682 025	328 316	179.03	27.86	Cat-Head
CPT-167	4 682 027	328 313	178.91	23.12	N/A
CPT-169	4 682 230	328 209	178.57	3.05 (Borehole) 23.42 (CPT)	Cat-Head
GBH-170	4 682 409	328 159	178.70	25.02	Cat-Head
GBH-171	4 682 265	328 114	178.14	3.05 (Borehole) 22.76 (CPT)	Cat-Head
GBH-172	4 682 120	328 054	178.23	30.08	Cat-Head
GBH-193	4 682 284	328 307	178.85	28.24	Cat-Head



4.0 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

Subsurface soil, rock and groundwater conditions encountered in the boreholes, together with the results of the in situ testing and laboratory testing carried out on selected samples, are given on the attached Record of Borehole sheets and Appendices A and B. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous samples and observations of drilling resistance and, therefore, may represent transitions between soil and rock types rather than exact planes of geological change. Further, the subsurface conditions will vary between and beyond the borehole locations.

The boreholes drilled at the site generally encountered the existing granular fill or topsoil overlying variable fill materials. Underlying the fill materials were native sand, sandy silt and silt layers of varying thicknesses. Beneath these layers, in sequence, occurs clayey silt, silty clay, clayey silt then limestone (bedrock). The stratigraphy encountered in BH15-001 was consistent with that revealed by previous investigations.

The locations and elevations of the boreholes, together with the interpreted stratigraphic profile, are shown on Drawing 1. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and the simplified stratigraphic sequence encountered in the vicinity of Bridge Site B-1 is summarized below:

- **Topsoil or Pavement** structures
- **Fill:** Very loose to compact fill materials consisting primarily of sand, silt and gravel with evidence of organic material were encountered. Variation in fill thicknesses indicate extent of past construction activities.
- **Native Granular Deposits:** Relatively thin layers, on the order of about 2 metres or less of very loose to dense but generally compact surficial granular soils composed primarily of sand, gravel and silt were encountered in many boreholes and CPT locations.
- Extensive deposits consisting of silty clay to clayey silt were encountered and have been separated into two geologic units for the purpose of this report:

Upper Silty Clay/Clayey Silt: Above approximately elevation 163 metres, the soft to very stiff clayey silt to silty clay deposit exhibits significantly greater variability in water content and is typically firm and of lower strength than the soils below. Based on sample interpretation and water content variability, it is likely that this deposit is highly layered with silt and plastic clay (i.e. laminated or varved). The Upper Silty Clay/Clayey Silt is generally of low plasticity (CL) but contains discrete layers with borderline (ML/CL), intermediate (CI) and high (CL) plasticity.

Lower Silty Clay/Clayey Silt: Below approximately elevation 163 metres, the firm to hard clayey silt to silty clay deposit exhibits relatively little variability in water content and is typically stiff and of higher strength than the above soils, and, based on this evidence, is more homogeneous and is more “till-like” in composition. This layer is consistently of low plasticity (CL).

- **Bedrock:** Dolomitic limestone bedrock was encountered at depths of between 23 and 26 metres below the existing ground surface, or at elevations ranging from about 152 to 156 metres.



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Table 3 summarizes the soil stratigraphic sequence encountered along with ranges in standard penetration test and water content test data. Tables 4 and 5 summarize field vane shear test data for the two geologic units within the silty clay to clayey silt deposit. Table 6 summarizes the results of laboratory oedometer tests. Field and laboratory test data are provided on the Record of Borehole sheets and in Appendices A, E and F.

Table 3 - Stratigraphic Summary

Strata ⁵	Thickness Range, Average (m)	SPT N Value Range, Average	Water Content Range, Average (%)	Plasticity Index Range, Average
Topsoil ⁶	0 – 0.9, 0.4	NA	NA	NA
Fill	0.1 – 1.7, 0.7	6 – 12; 10	16 – 22; 20	NA
Granular Deposits	0.5 – 2.1, 1.4	2 – 34, 15	12 – 25, 18	NA
Upper Silty Clay/Clayey Silt	10.0 – 14.1, 11.6	WH ⁷ – 17, 4	16 – 62, 32	6 - 47, 17
Lower Silty Clay/Clayey Silt	7.2 – 12.7, 10.7	WH – 76, 13	8 – 31, 20	10 – 17, 13

Table 4 – Summary of Field Vane Shear Strength Data (Upper Unit)

Borehole	Approximate Elevation	Shear Strength (kPa)	Vane Sensitivity
BH15-001	173.5	49	3.1
BH15-001	173.3	46	1.5
BH15-001	172.6	29	2.0
BH15-001	172.3	36	1.7
BH15-001	171.0	22	2.7
BH15-001	170.7	20	1.4
BH15-001	169.5	23	2.1
BH15-001	169.2	27	2.7
BH15-001	168.0	19	1.9
BH15-001	167.7	23	1.8
BH15-001	166.5	32	1.6
BH15-001	166.2	30	1.3

⁶ Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content, or for other nutrients, was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

⁷ WH indicates that the sampler was advanced using only the weight of the sampling hammer



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Table 5 – Summary of Field Vane Shear Strength Data (Lower Unit)

Borehole	Approximate Elevation	Undrained Shear Strength (kPa)	Vane Sensitivity
BH15-001	165.0	24	1.4
BH15-001	165.0	30	1.2
BH15-001	163.4	33	1.5
BH15-001	163.1	29	1.2
BH15-001	161.9	43	1.4
BH15-001	160.4	88	1.2
BH15-001	160.1	109	1.2
BH15-001	157.3	34	0.5
BH15-001	157.0	37	0.4

Table 6 - Oedometer Test Results

Borehole	Elevation (m)	Initial Void Ratio	Compression Index, C_c	Recompression Index, C_R	Interpreted Preconsolidation Pressure (kPa)
BH15-001	171.6	1.06	0.473	0.047	182
BH15-001	168.5	1.11	0.522	0.053	205
GBH-167	174.2	0.91	0.321	0.027	234
GBH-167	168.4	1.43	0.450	0.058	71*
GBH-167	163.8	0.58	0.135	0.018	228
BH-349	173.4	1.40	0.491	0.054	155
BH-349	168.5	0.77	0.219	0.021	132
BH-349	163.9	0.58	0.168	0.021	236

NOTE: *Note that this value is considered anomalously low and likely reflects sample disturbance.

The bedrock encountered in all boreholes was very fine to medium grained, brown to mottled coloured limestone with a slight to fresh weathering surface, slight to vuggy porosity with occasional pitting. The limestone exhibited some fossils and contained slight hydrocarbon staining. Table 7, below, summarizes rock core data for the limestone encountered.



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Table 7: Summary of Rock Core Data

Borehole	Sample	Elevation (m)	TCR (%)	SCR (%)	RQD (%)
BH15-001	19	155.3 – 154.8	40	0	0
	20	154.8 – 153.3	99	91	91
	21	153.3 – 151.7	92	82	75
BH-166	15	155.7 – 154.3	89	89	81
	16	154.3 – 153.6	100	98	97
	17	153.6 – 152.1	100	100	100
GBH-167	16	154.4 – 153.1	88	65	60
	17	153.1 – 151.5	94	93	91
	18	151.5 – 151.2	100	90	90
GBH-172	18	152.3 – 150.6	98	83	70
	19	150.6 – 149.1	93	92	93
	20	149.1 – 148.2	100	100	100
GBH-193	17	154.1 – 153.3	77	55	50
	18	153.3 – 151.5	100	100	100
	19	151.5 – 150.6	100	100	100
BH-349	20	156.1 – 154.6	100	93	92
	21	154.6 – 153.3	82	74	75
	22	153.3 – 152.7	100	92	98
	23	152.7 – 151.3	98	98	98
Average			92	84	82

4.2 Groundwater Conditions

The groundwater conditions in the overburden deposits were not established in BH15-001 during drilling due to the use of mud rotary drilling. However, artesian conditions were encountered at the bedrock interface. Groundwater monitoring instrumentation installed during the previous investigations consisted of a conventional piezometer in borehole GBH-166A, nested vibrating-wire piezometers (VWP) in GBH-349 and a single VWP in GBH-193. Table 8 presents the groundwater conditions observed on site during drilling activities.

Table 8: Summary of Elevations at which Groundwater First Encountered

Borehole	Ground Surface Elevation (m)	Encountered Elevation (m)	Date of Measurement
BH15-001	178.8	Artesian at 155.3	November 18, 2016
CPT-165	178.9	177.3	August 13, 2008
BH-166*	179.0	180.6	Sept 17, 2008
GBH-167*	179.0	177.7	May 25, 2009
CPT-169	178.6	177.4	June 4, 2009
GBH-170*	178.7	177.3	May 25, 2009



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Borehole	Ground Surface Elevation (m)	Encountered Elevation (m)	Date of Measurement
CPT-171	178.1	175.8	June 4, 2009
GBH-172*	178.2	177.2	May 19, 2009
GBH-193	178.9	177.5	June 8, 2009
CPT-348	179.2	177.8	April 27, 2010
BH-349	179.1	177.7	April 22, 2010

* Flowing artesian conditions encountered at bedrock interface or occurred during rock coring.

Flowing artesian conditions were encountered at the overburden-bedrock interface during drilling in boreholes BH15-001, GBH-167 and GBH-170, and during rock coring in boreholes BH-166 and GBH-172. The artesian water flow often occurred in conjunction with a hydrogen sulfide odour. Where artesian conditions were encountered, the boreholes were sealed with a cement-bentonite grout. Table 9 presents piezometer installation details and measured groundwater pressure head elevations.

Table 9: Summary of Groundwater Pressures

Borehole	Ground Surface Elevation (m)	Installation Tip Elevation (m)	Pressure Head Elevation (m)	Date of Measurement
BH15-001	178.81	151.88	182.07	November 18, 2015
			181.92	January 13, 2016
			182.38	May 16, 2016
BH-166A	179.00	163.6	163.76	Sept 19, 2008
			165.19	Sept 22, 2008
			178.43	Jan 28, 2009
GBH-193	178.85	151.0	178.95	June 9, 2009
			180.35	Aug 26, 2009
			180.35	Nov 1, 2009
BH-349	179.08	173.4	180.4	June 2, 2010
		168.5	180.4	June 2, 2010
		164.0	178.9	June 2, 2010
		155.6	179.8	June 2, 2010

Groundwater conditions observed during drilling do not represent long-term static water levels because of the influence of drilling operations, localized variability of stratigraphic conditions and local variations in soil permeability. Groundwater conditions observed within the native granular soils and fill and groundwater pressures within the granular soils (where present) near the bedrock surface and within the bedrock will all be influenced by seasonal conditions and precipitation. Therefore, groundwater levels within the native granular soils and groundwater pressures near and within the bedrock should be expected to vary and should be measured before and at the time of construction.



4.3 Subsurface Gases

Hydrogen sulfide gas was encountered in boreholes GBH-167, GBH-170 and GBH-172 at the soil-bedrock interface. The presence of the characteristic 'rotten egg' odour signified hydrogen sulfide, but the levels were less than 10 parts per million (ppm), which is required to trigger the monitoring equipment used by the field personnel. Hydrogen sulfide gas has been reported in other exploratory holes within the Dundee Formation due to its reputation as being the largest oil producing formation in Southwestern Ontario⁸. The hydrogen sulfide gas was encountered with observed artesian water flows discussed in Section 4.2.

The groundwater in the project area contains dissolved hydrogen sulphide (H₂S) that is liberated from the water on exposure to atmospheric pressure. Hydrogen sulphide gas can frequently be detected by odour at concentrations on the order of 0.5 ppm and can be corrosive at concentrations of about 2 ppm to 3 ppm (Powers et al, 2007) as measured in the groundwater. Other investigations carried out near Ojibway Parkway and Sandwich Street encountered H₂S gas in concentrations sufficient to trigger personnel health and safety monitoring equipment on several occasions. Active ventilation of drilling areas with construction fans and use of controlled density drilling fluids were required to continue drilling at some locations for these nearby explorations. Similar precautions were undertaken for this project. Measurement of hydrogen sulfide gas (H₂S) concentrations in 29 water samples taken from the observation wells and boreholes completed for Geocres No. 40J6-28 indicated a range from a minimum value less than the detection limit to a maximum value of 238 ppm. For samples in which H₂S was detected, excluding the maximum value of 238 ppm non-detection values, the maximum and minimum values were 5.54 ppm and 0.03 ppm, respectively.

Dissolved methane, CH₄, was also detected within the groundwater. Dissolved methane concentrations in the water ranged from less than 5 parts per billion (ppb) to a maximum measured value of 485 ppb. No trends in the data were observable with respect to the geographic observation well locations⁹.

4.4 Corrosivity Conditions

Analytical testing was carried out on a soil sample to assess the corrosivity of the soils for the design bridge structure. The analysis consisted of testing one sample from BH15-001, SA6 at a depth from 4.5 to 5 metres below the ground surface. The sample was submitted to a specialist analytical laboratory for testing and the summary is provided below:

Sample Location	BH101 – Sample 6
Sample Depth and Date	4.5 – 5.0 metres; Nov. 16, 2015
Soil Resistivity	840 ohm-cm
Soil Conductivity	1180 umho/cm
Redox Potential	+227 mV

⁸ Luczaj et al, AAPG Bulletin, V. 90, No.11 (November 2006) pp.1787-1801: Fractured hydrothermal dolomite reservoirs in the Devonian Dundee Formation of the central Michigan Basin.

⁹ Geocres No. 40J6-28, June 2009 (revised January 2011): Subsurface Conditions Interpretation Report.



FOUNDATION INVESTIGATION REPORT OJIBWAY PARKWAY/ETR OVERPASS, BRIDGE B-1

Sample Location	BH101 – Sample 6
Sulphate Concentration	1100 ug/g
Chloride Concentration	81 ug/g
Soil pH	7.75

The certificates of analyses are provided in Appendix G.



FOUNDATION INVESTIGATION REPORT OJIBWAY PARKWAY/ETR OVERPASS, BRIDGE B-1

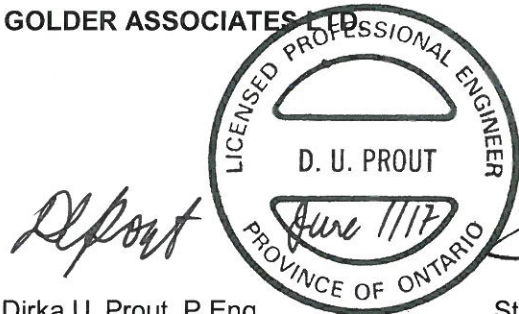
5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Lantech Drilling Services, an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Anthony Pusic, E.I.T, under the direction of Field Investigation Manager, Mr. David Mitchell. The CPT testing was carried out by Mr. Alex Szot, E.I.T.

Routine laboratory tests were carried out at Golder's London laboratory under the direction of Ms. Laura Pryla. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing Types C and D aggregates. The consolidation and unconfined compression testing was conducted in Golder's Mississauga laboratory under the supervision of Dr. J. Paul Dittrich, P.Eng. The Mississauga laboratory is a MTO registered laboratory, specializing in soil and rock testing including testing for Foundation Engineering Low and High complexity.

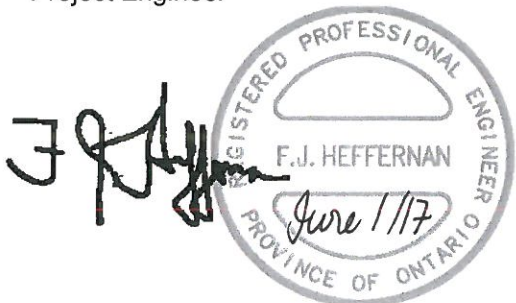
The report was prepared by Mr. William Hanson, E.I.T. under the direction of the Project Engineer, Ms. Dirka U. Prout, P.Eng. This report was reviewed by Dr. Storer J. Boone, P.Eng, a Principal with Golder Associates. An independent quality review of this report was carried out by Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

GOLDER ASSOCIATES LTD.



Dirka U. Prout, P.Eng.
Project Engineer

Storer J. Boone, Ph.D., P.Eng
Principal



Fintan J. Heffernan, P.Eng.
MTO Designated Contact

WH/DUP/SJB/FJH/cr

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[https://golderassociates.sharepoint.com/sites/12992g/ph/1000fdns/2-corr/5-rpts/3-part a/1311320053-1000-r01 \(revisedfinal\)may2917 part a fdns herb gray pkwy.docx](https://golderassociates.sharepoint.com/sites/12992g/ph/1000fdns/2-corr/5-rpts/3-part%20a/1311320053-1000-r01%20(revisedfinal)may2917%20part%20a%20fdns%20herb%20gray%20pkwy.docx)



LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a)	Index Properties
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$
$$\text{shear strength} = (\text{compressive strength})/2$$



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Density Index	N
Relative Density	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	C_u, S_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

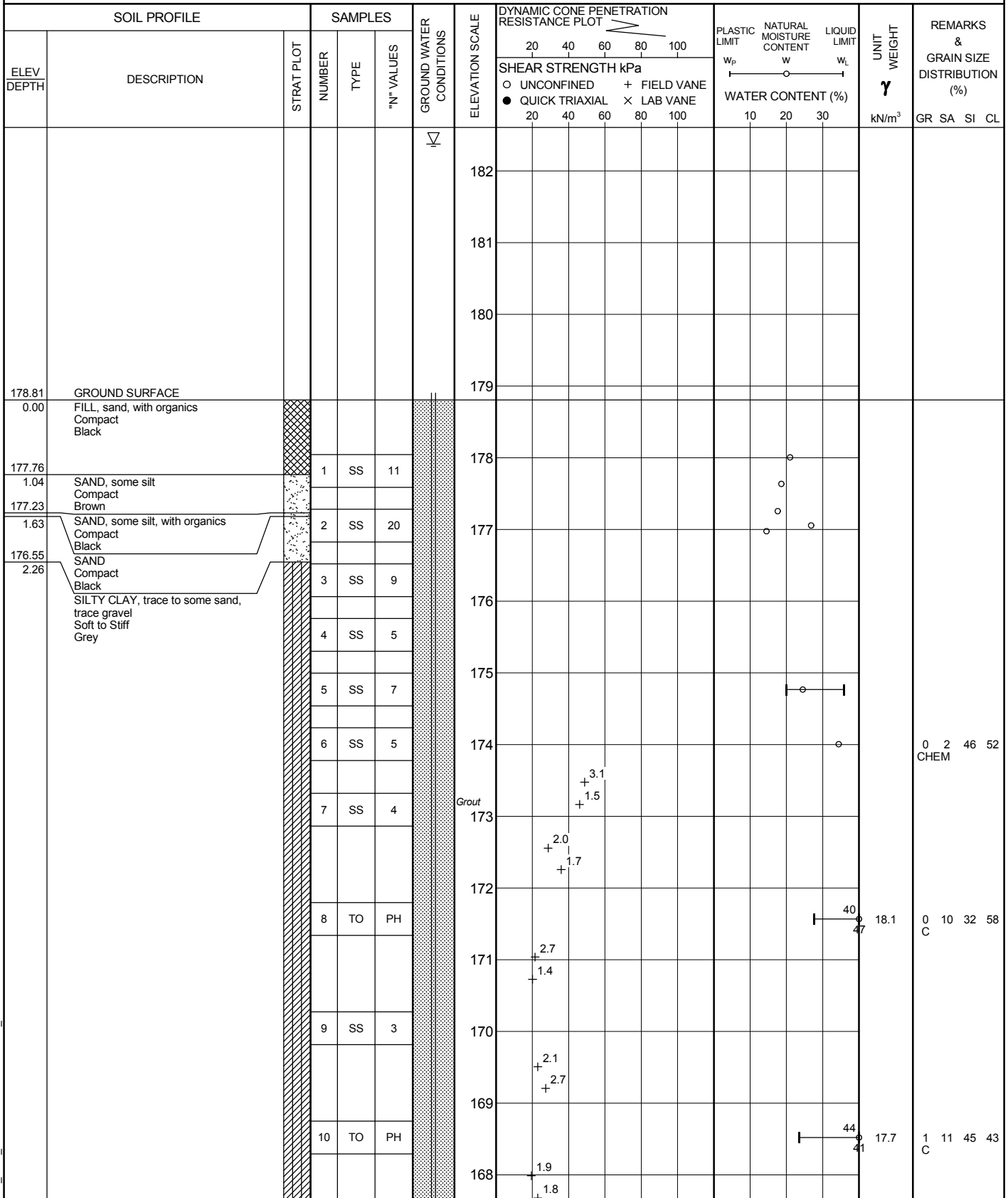
w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

PROJECT <u>13-1132-0053</u>		RECORD OF BOREHOLE No BH15-001		1 OF 3	METRIC
W.P. <u>3028-14-00</u>	LOCATION <u>N 4682135.6 , E 328411.5</u>	ORIGINATED BY <u>AP</u>			
DIST <u> </u> HWY <u>RHHGP</u>	BOREHOLE TYPE <u>HOLLOW STEM, MUD ROTARY, WASHBORE</u>	COMPILED BY <u>DCH</u>			
DATUM <u>GEODETIC</u>	DATE <u>November 16 - 18, 2015</u>	CHECKED BY <u></u>			

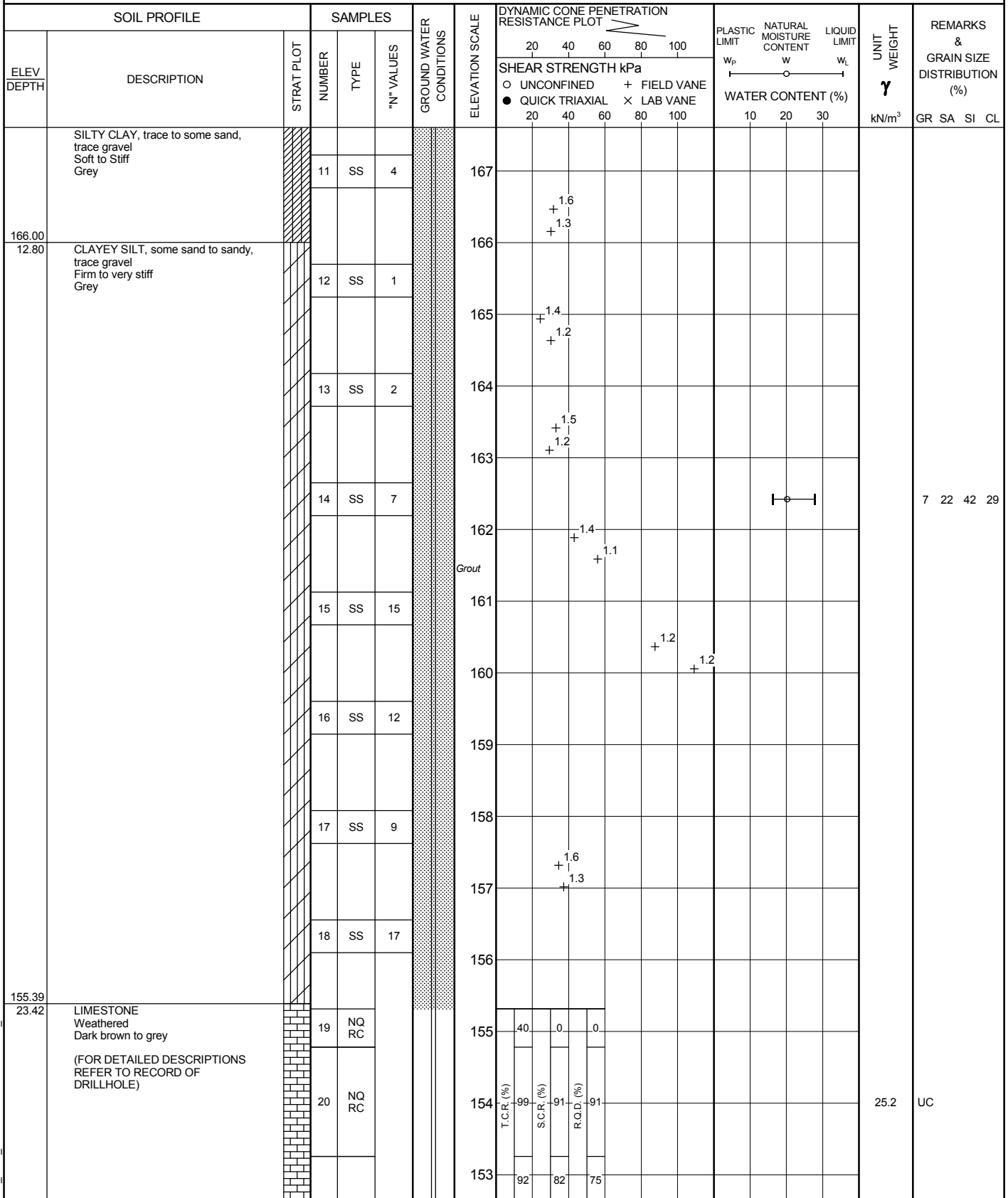


LDN_MTO_06 1311320053.GPJ LDN_MTO.GDT 06/06/16

Continued Next Page

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

PROJECT 13-1132-0053		RECORD OF BOREHOLE No BH15-001		2 OF 3	METRIC
W.P. 3028-14-00	LOCATION N 4682135.6 , E 328411.5	ORIGINATED BY AP			
DIST HWY RHHGP	BOREHOLE TYPE HOLLOW STEM, MUD ROTARY, WASHBORE	COMPILED BY DCH			
DATUM GEODETIC	DATE November 16 - 18, 2015	CHECKED BY			



LDN_MTO_06 1311320053.GPJ LDN_MTO_GDT 06/06/16

Continued Next Page

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

PROJECT <u>13-1132-0053</u>		RECORD OF BOREHOLE No BH15-001		3 OF 3	METRIC
W.P. <u>3028-14-00</u>	LOCATION <u>N 4682135.6 , E 328411.5</u>	ORIGINATED BY <u>AP</u>			
DIST <u></u> HWY <u>RHHGP</u>	BOREHOLE TYPE <u>HOLLOW STEM, MUD ROTARY, WASHBORE</u>	COMPILED BY <u>DCH</u>			
DATUM <u>GEODETIC</u>	DATE <u>November 16 - 18, 2015</u>	CHECKED BY <u></u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL			
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	×	LAB VANE	W _p	W		W _L						
						20	40	60	80	100		20	40	60	80	100	10	20	30				
151.73			21	NQ	RC																		
27.08	END OF BOREHOLE																						
	Artesian groundwater conditions observed at bedrock interface on November 17, 2015. Flow rate of 1 L/S and 1.4 L/S measured on November 17, 2015 and November 18, 2015, respectively Water level measured at elev. 182.07m on November 18, 2015 after installation. Water level measured at elev. 181.92m on January 13, 2016. Water level measured at elev. 182.38m on May 16, 2016.																						

PROJECT: 13-1132-0053
LOCATION: N 4682135.6 ;E 328411.5
INCLINATION: -90° AZIMUTH: ---

RECORD OF DRILLHOLE: BH15-001

DRILLING DATE: November 16 - 17, 2015
DRILL RIG:
DRILLING CONTRACTOR:

SHEET 3 OF 3
DATUM: GEODETIC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																		NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	ELEVATION	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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DEPTH SCALE

1 : 75



LOGGED: AP

CHECKED:

PROJECT: 13-1132-0053

RECORD OF CONE PENETRATION TEST CPT15-1001

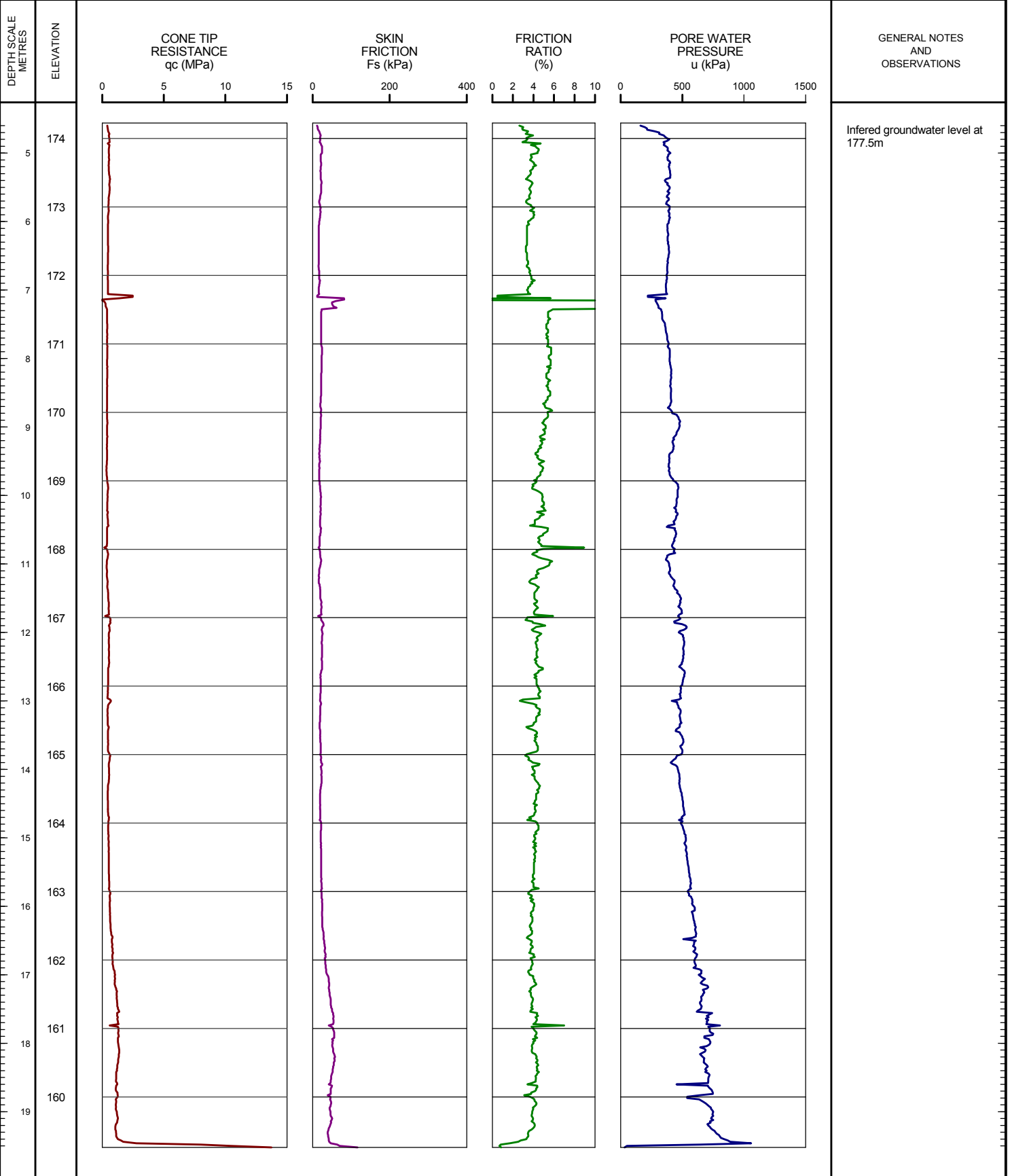
SHEET 1 OF 1

LOCATION: N 4682192.2 , E 328420.3

TEST DATE: November 16, 2015

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.79m PREDRILL DEPTH: 4.56m CORRECTION FACTOR A: 0.59 CORRECTION FACTOR B: 0.014



LDN_CPT_01 1311320053.GPJ GLDR_LON.GDT 24/02/16 DATA INPUT:

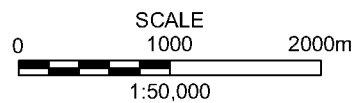
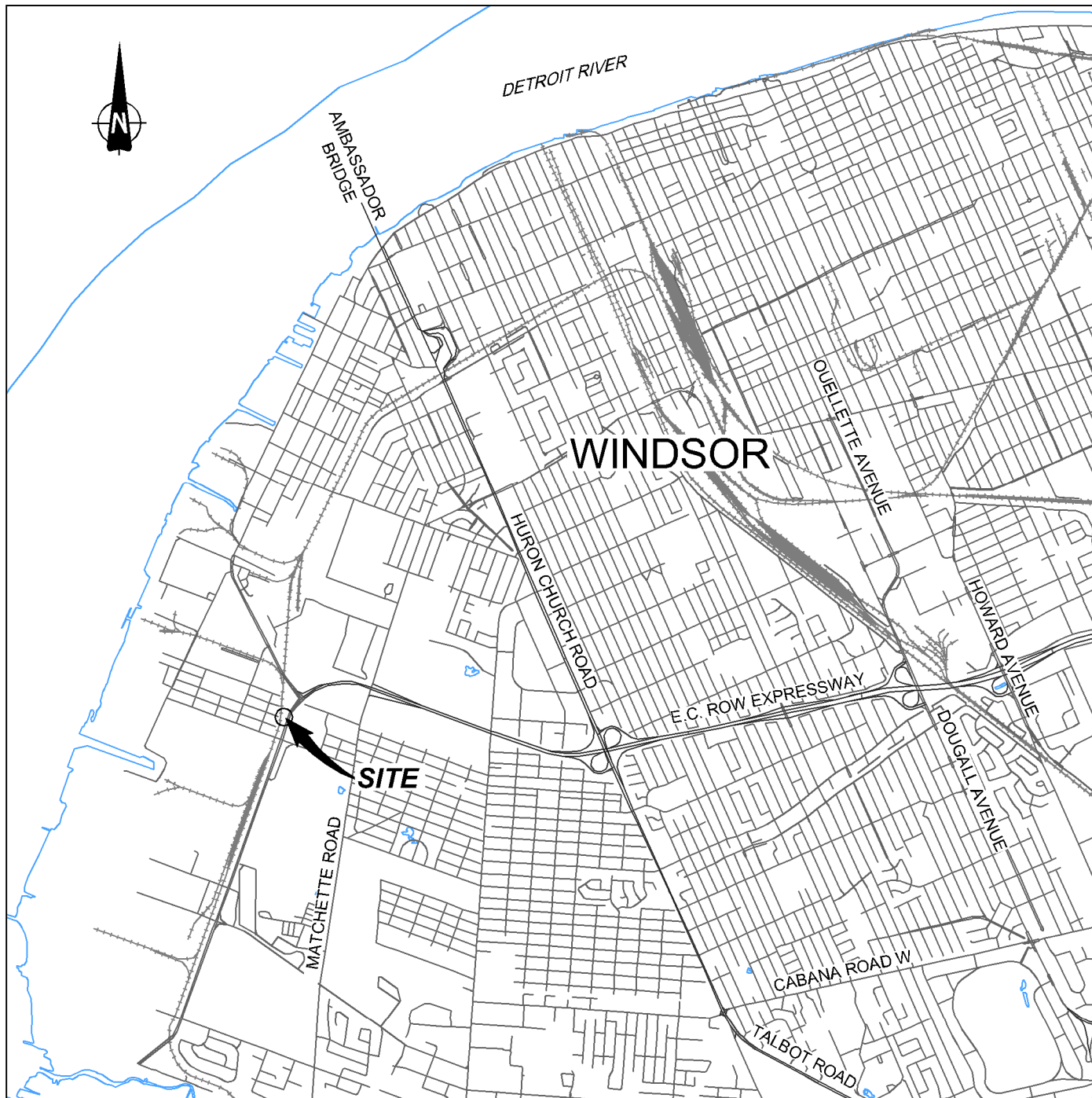
DEPTH SCALE

1 : 75



OPERATOR: AS

CHECKED:



REFERENCE

PLAN BASED ON CANMAP STREETFILES V.2008.

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2
HIGHWAY 401 (RHHGP)
GWP 3028-14-00

TITLE

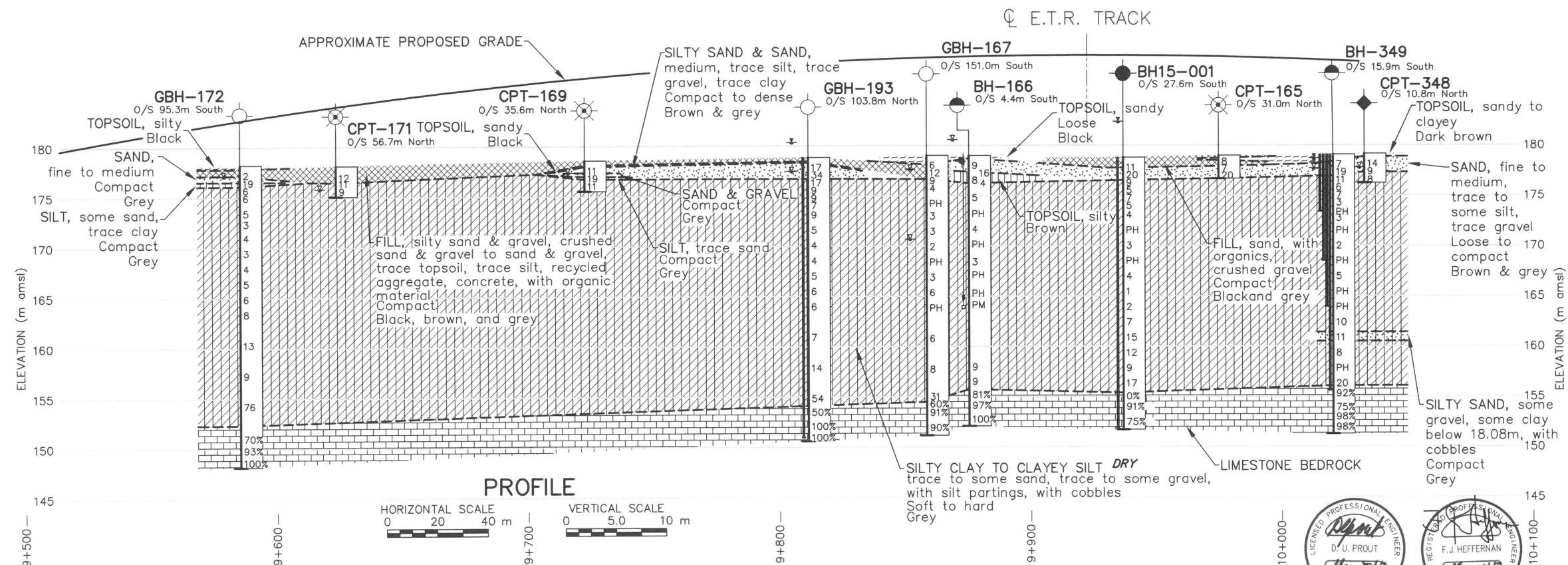
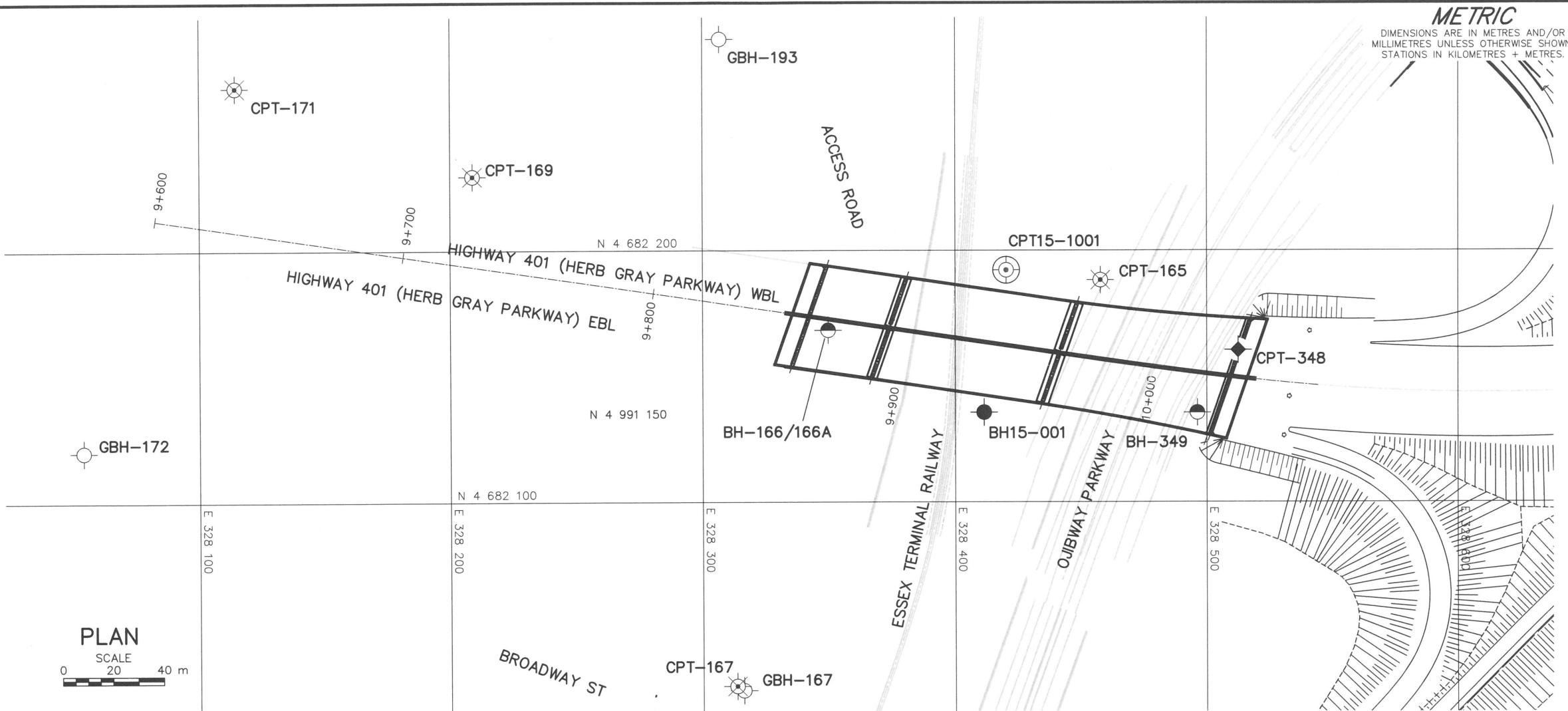
KEY PLAN



**Golder
Associates**

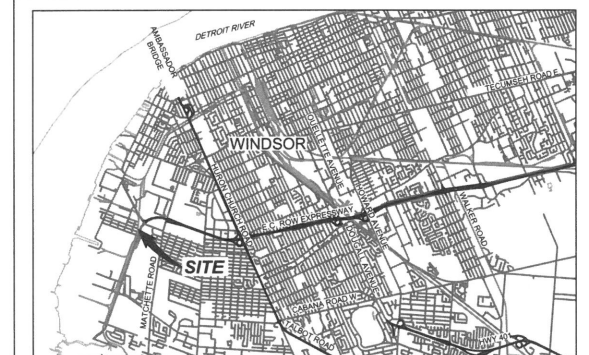
PROJECT No. 13-1132-0053			FILE No. 1311320053-1000-F01001	
CADD	DCH	May 2016	SCALE	AS SHOWN
CHECK			REV.	0

FIGURE 1

CONT No.
WP No. 3028-14-00

OJIBWAY PARKWAY/ETR OVERPASS

SHEET

HIGHWAY 401
BOREHOLE LOCATIONS AND SOIL STRATA**Golder Associates Ltd.**
LONDON, ONTARIO, CANADAKEY PLAN
SCALE IN KILOMETRES
0 2 4

LEGEND

- Borehole - Current Investigation
- CPT - Current Investigation
- Borehole - Previous Golder Project 0911320039-1000
- CPT - Previous Golder Project 0911320039-1000
- Borehole - GEOCRETS No. 40J6-27
- CPT - GEOCRETS No. 40J6-27
- Seal
- Standpipe/Vibrating wire
- Standard Penetration Test Value
- Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Measured WL. (May 16, 2016)
- Encountered WL.

No.	ELEV.	CO-ORDINATES (UTM, Nad83, ZONE 17)	
		NORTHING	EASTING
BH15-001	178.81	4 68 2192.2	328 411.5
CPT15-1001	186.52	4 682 135.6	328 420.3
GOLDER REPORT 09-1132-0039			
GBH-167	179.03	4 682 025.1	328 316.1
CPT-167	178.91	4 682 026.8	328 313.4
CPT-169	178.57	4 682 229.5	328 208.8
CPT-171	178.14	4 682 264.8	328 114.3
GBH-172	178.23	4 682 120.1	328 054.0
GBH-193	178.85	4 682 284.0	328 306.8
GEOCRETS 40J6-27			
CPT-165	178.98	4 682 188.2	328 457.7
BH-166/166A	179.00	4 682 168.3	328 349.6
CPT-348	179.15	4 682 160.4	328 512.5
BH-349	179.08	4 682 135.5	328 496.2

NOTES

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

REFERENCE

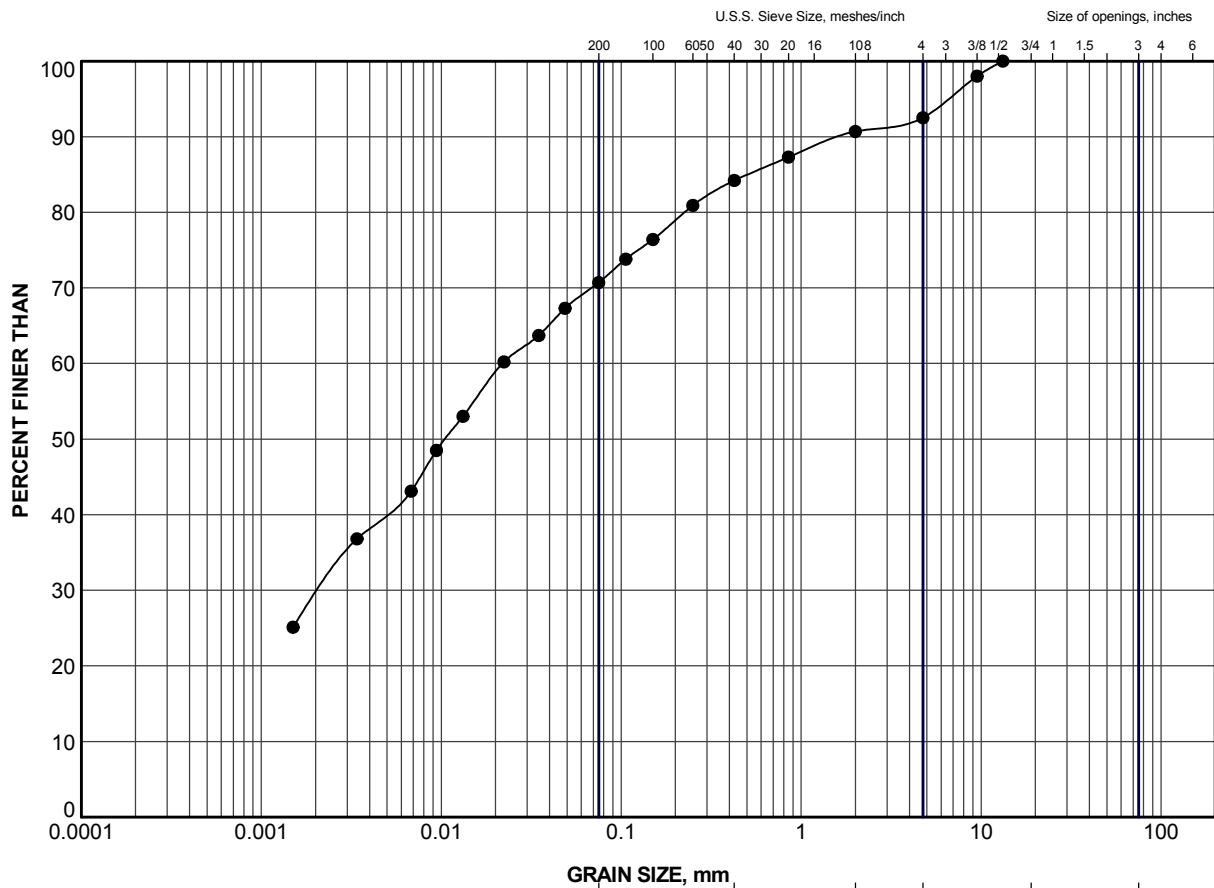
Base plans provided in digital format by AECOM
Received December 10, 2015 and July 7, 2016.

NO.	DATE	BY	REVISION
Geocres No. 40J6-71			
HWY.	401	PROJECT NO. 13-1132-0053	DIST.
SUBM'D.	WH	CHKD. DUP	DATE: June 7/16
DRAWN:	WDF/DCH	CHKD. SJB	APPD. FJH
			DWG. 1



APPENDIX A

Laboratory Test Data - Soil

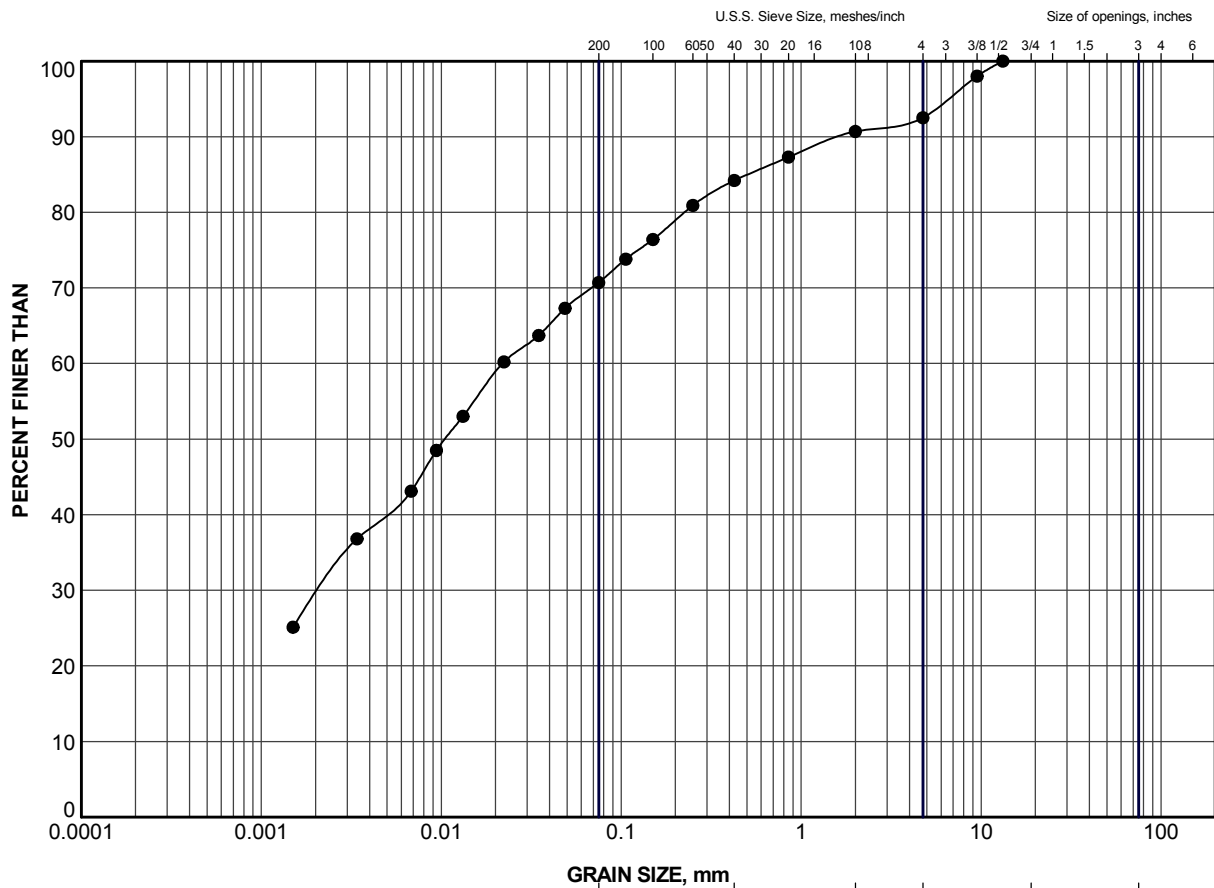


LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH15-001	14	162.4

PROJECT				
OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2 HIGHWAY 401 (RHHGP) GWP 3028-14-00				
TITLE				
GRAIN SIZE DISTRIBUTION CLAYEY SILT				
PROJECT No.		13-1132-0053		FILE No.
				1311320053-R010A1
DRAWN		DCH	May 20/16	SCALE
CHECK				N/A
				REV.
FIGURE A-1				



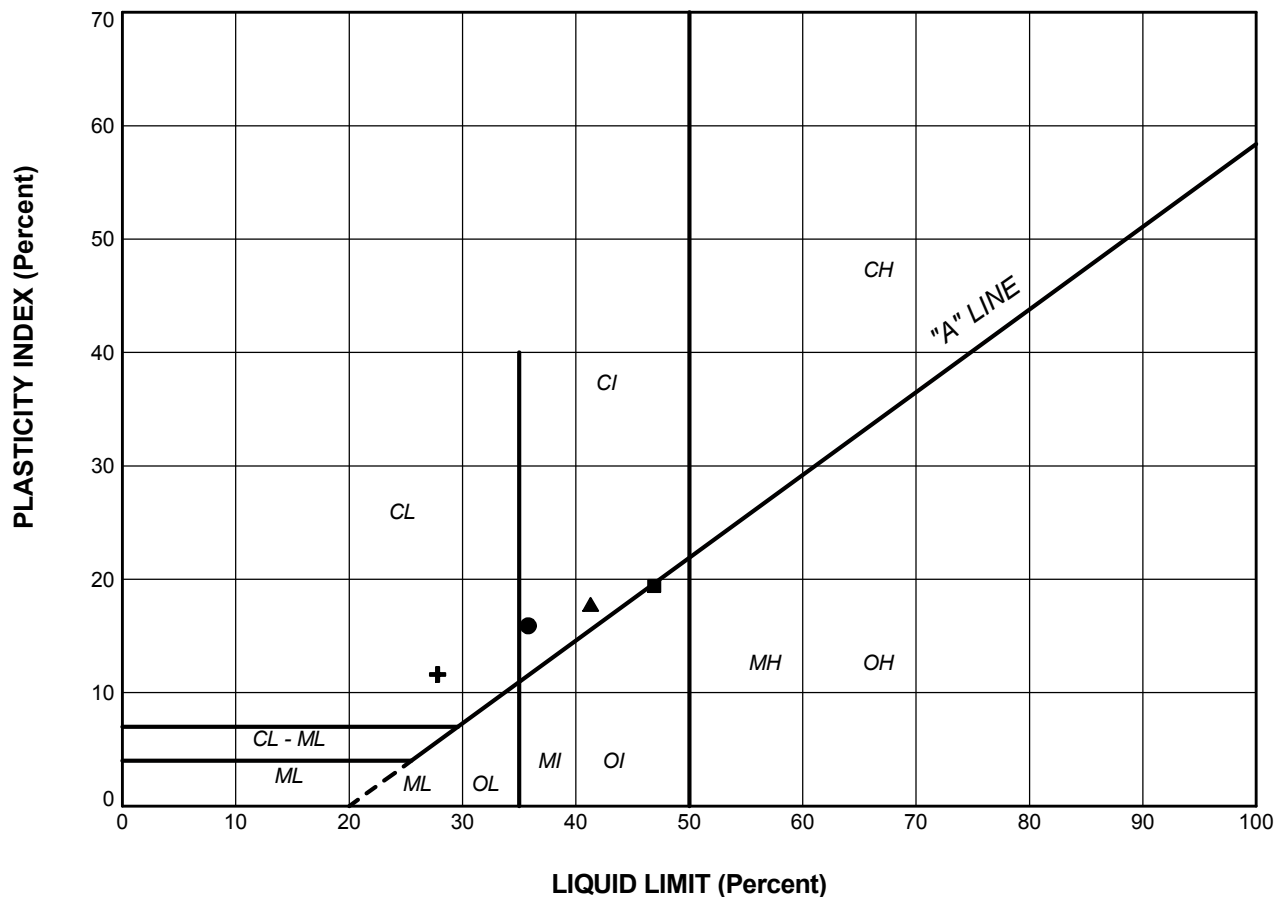


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH15-001	14	162.4

PROJECT OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2 HIGHWAY 401 (RHHGP) GWP 3028-14-00			
TITLE GRAIN SIZE DISTRIBUTION CLAYEY SILT			
	PROJECT No.	13-1132-0053	FILE No. 1311320053-R1002
	DRAWN	DCH	May 20/16
	CHECK		
	SCALE	N/A	REV.
FIGURE A-2			



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
SILTY CLAY					
●	BH15-001	5	35.8	19.9	15.9
■	BH15-001	8	46.9	27.5	19.4
▲	BH15-001	10	41.3	23.5	17.8
CLAYEY SILT					
+	BH15-001	14	27.8	16.2	11.6

PROJECT
 OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2
 HIGHWAY 401 (RHHGP)
 GWP 3028-14-00

TITLE

PLASTICITY CHART



**Golder
Associates**

PROJECT No. 13-1132-0053		FILE No. 1311320053-R010A3	
DRAWN	DCH	May 20/16	SCALE N/A
CHECK			REV.

FIGURE A-3

CONSOLIDATION TEST SUMMARY**ASTM D2435/D2435M****FIGURE A-4A****SAMPLE IDENTIFICATION**

Project Number	13-1132-0053(1000)	Sample Number	8
Borehole Number	BH15-001	Sample Depth, m	7.01-7.47

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	9		
Date Started	11/27/2015		
Date Completed	12/11/2015		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	18.11
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	12.93
Area, cm ²	31.55	Specific Gravity, measured	2.78
Volume, cm ³	60.04	Solids Height, cm	0.903
Water Content, %	40.06	Volume of Solids, cm ³	28.47
Wet Mass, g	110.87	Volume of Voids, cm ³	31.56
Dry Mass, g	79.16	Degree of Saturation, %	100.5

TEST COMPUTATIONS

Stress	Corr. Height	Void	Average Height	t ₉₀	cv.	mv	k
kPa	cm	Ratio	cm	sec	cm ² /s	m ² /kN	cm/s
0.00	1.903	1.108	1.903				
6.51	1.903	1.108	1.903				
11.26	1.906	1.112	1.905				
21.00	1.899	1.104	1.903	317	2.42E-03	4.10E-04	9.73E-08
40.50	1.884	1.087	1.891	470	1.61E-03	4.02E-04	6.35E-08
79.53	1.860	1.060	1.872	591	1.26E-03	3.27E-04	4.03E-08
165.91	1.814	1.009	1.837	577	1.24E-03	2.79E-04	3.39E-08
311.83	1.701	0.885	1.757	1441	4.54E-04	4.06E-04	1.81E-08
622.72	1.573	0.743	1.637	1162	4.89E-04	2.16E-04	1.03E-08
1241.83	1.464	0.622	1.519	960	5.09E-04	9.25E-05	4.62E-09
2483.82	1.361	0.508	1.413	487	8.69E-04	4.35E-05	3.71E-09
1241.83	1.379	0.528	1.370				
311.83	1.446	0.602	1.412				
79.35	1.531	0.696	1.488				
21.23	1.606	0.779	1.568				
6.41	1.670	0.850	1.638				

Note:

Specimen taken 7-13cm from bottom of the tube

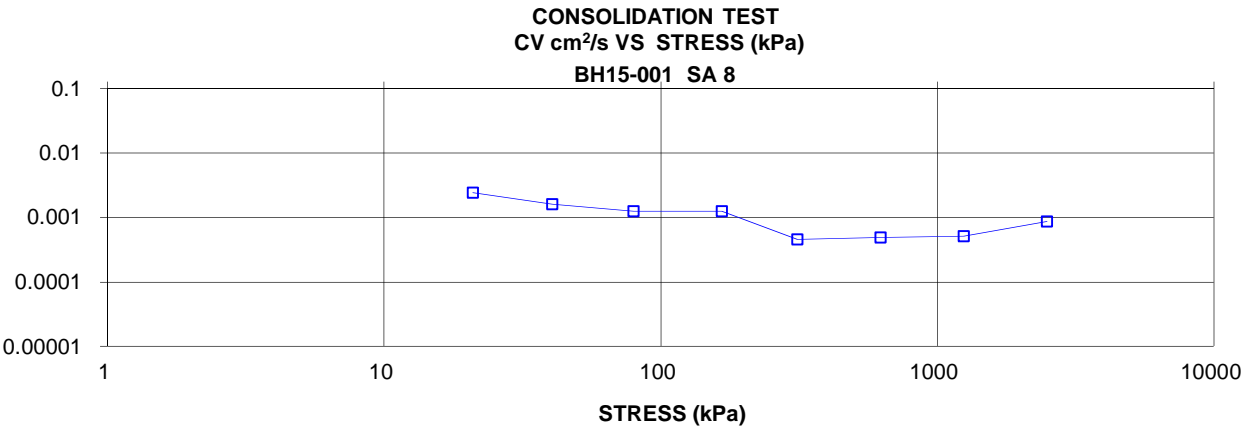
k calculated using cv based on λ_0 values.

Specimen swelled under 11.26 kPa.

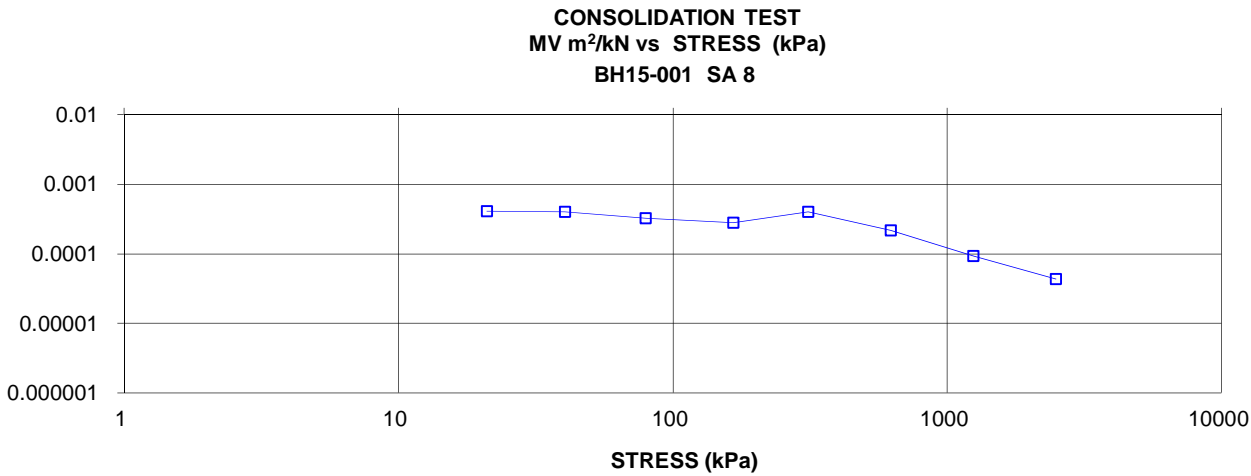
SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.67	Unit Weight, kN/m ³	19.64
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	14.73
Area, cm ²	31.55	Specific Gravity, measured	2.78
Volume, cm ³	52.68	Solids Height, cm	0.903
Water Content, %	33.31	Volume of Solids, cm ³	28.47
Wet Mass, g	105.53	Volume of Voids, cm ³	24.21
Dry Mass, g	79.16		

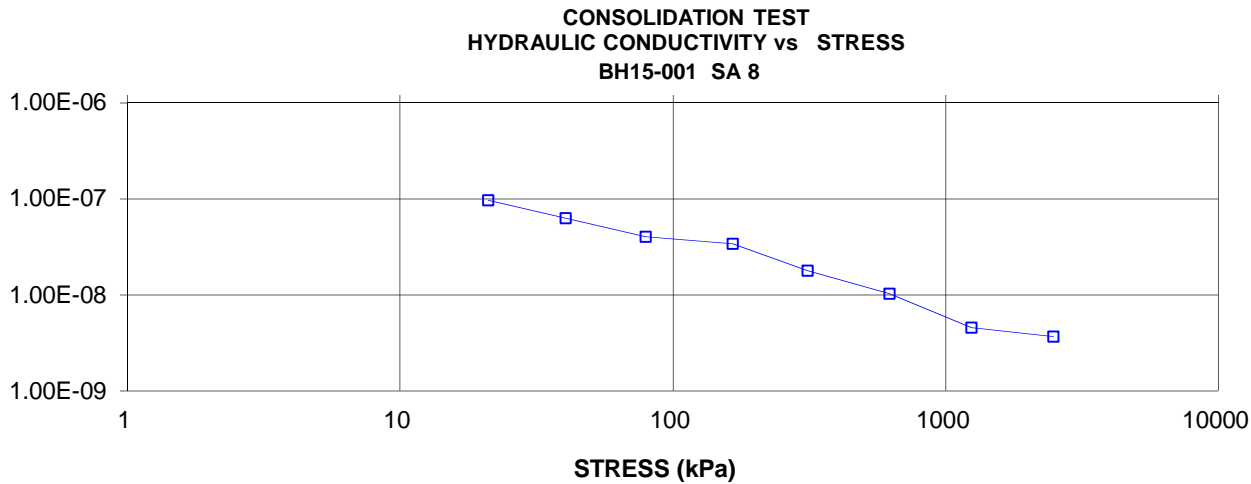
COEFFICIENT OF CONSOLIDATION,
cm²/s

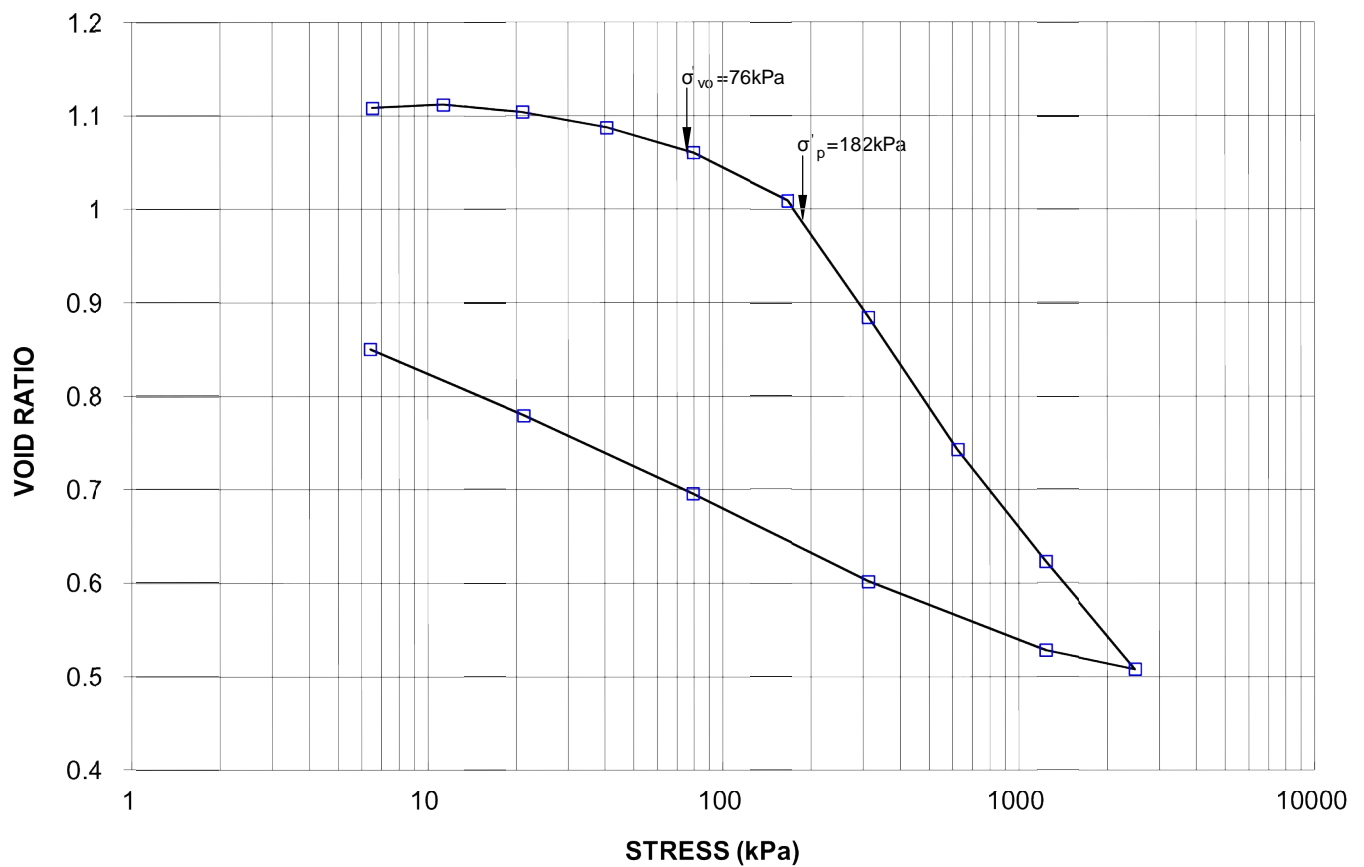


VOLUME COMPRESSIBILITY, m²/kN





HYDRAULIC CONDUCTIVITY,
cm/s

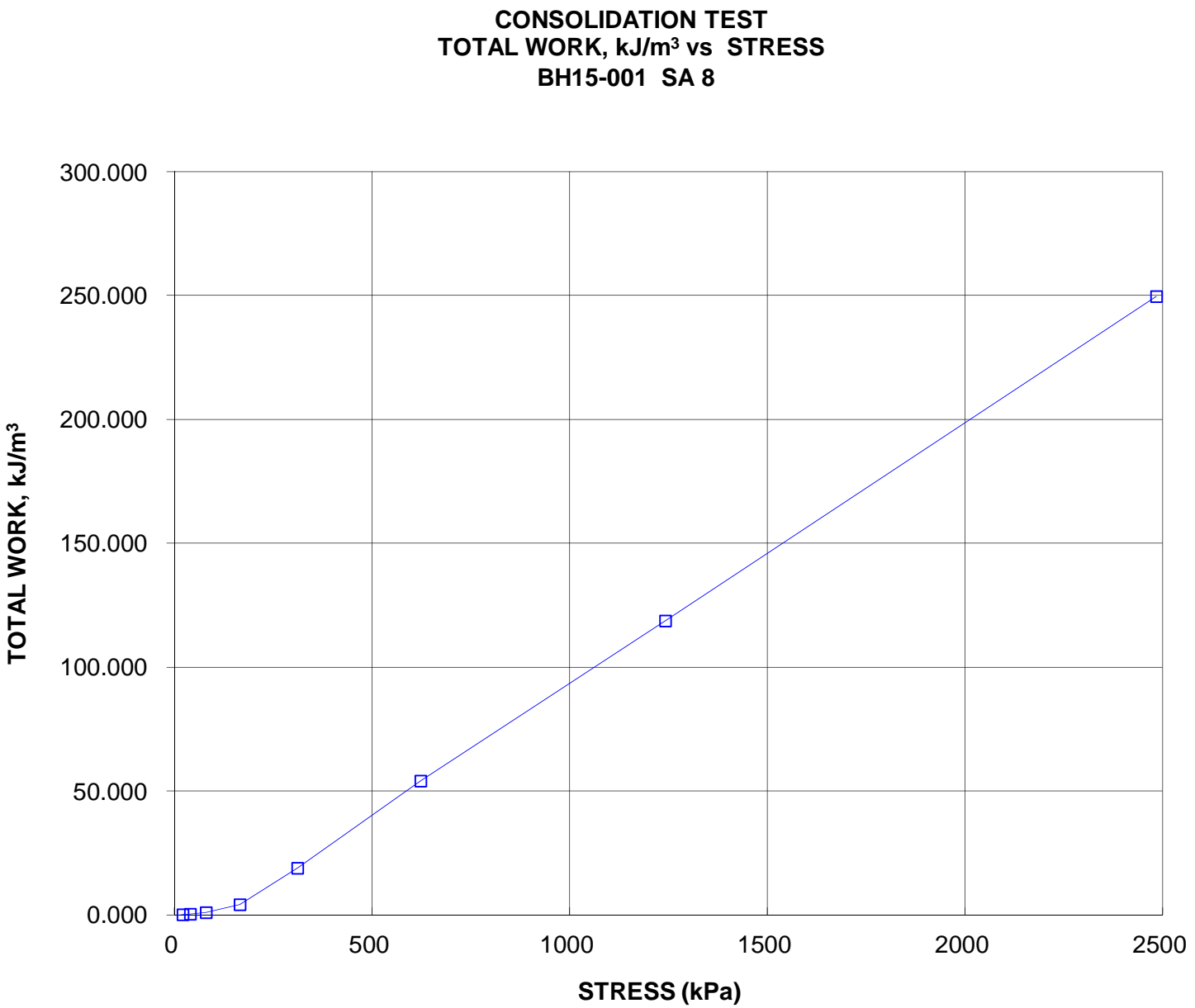




BOREHOLE 15-001 SA 8

PROJECT							
OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2 HIGHWAY 401 (RHHGP) GWP 3028-14-00							
TITLE							
CONSOLIDATION TEST VOID RATIO Vs. LOG PRESSURE							
 Golder Associates	PROJECT No.		13-1132-0053	FILE No. 1311320053-1000-F010A4C			
				SCALE	AS SHOWN	REV.	0
	CADD	DCH	May 20/16	FIGURE A-4C			
	CHECK						





CONSOLIDATION TEST SUMMARY**ASTM D2435/D2435M****FIGURE A-5A****SAMPLE IDENTIFICATION**

Project Number	13-1132-0053(1000)	Sample Number	10
Borehole Number	BH15-001	Sample Depth, m	10.06-10.52

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	11/27/2015		
Date Completed	12/10/2015		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m ³	17.67
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	12.29
Area, cm ²	31.62	Specific Gravity, measured	2.78
Volume, cm ³	59.82	Solids Height, cm	0.853
Water Content, %	43.80	Volume of Solids, cm ³	26.97
Wet Mass, g	107.82	Volume of Voids, cm ³	32.85
Dry Mass, g	74.98	Degree of Saturation, %	100.0

TEST COMPUTATIONS

Stress	Corr. Height	Void	Average Height	t_{90}	cv.	mv	k
kPa	cm	Ratio	cm	sec	cm ² /s	m ² /kN	cm/s
0.00	1.892	1.218	1.892				
5.93	1.884	1.208	1.888				
10.57	1.882	1.206	1.883				
20.53	1.865	1.187	1.873	118	6.30E-03	8.70E-04	5.38E-07
40.04	1.841	1.158	1.853	421	1.73E-03	6.56E-04	1.11E-07
78.72	1.811	1.123	1.826	485	1.46E-03	4.04E-04	5.78E-08
156.26	1.766	1.071	1.789	406	1.67E-03	3.07E-04	5.02E-08
311.09	1.655	0.940	1.711	866	7.16E-04	3.79E-04	2.66E-08
621.11	1.520	0.782	1.587	913	5.85E-04	2.31E-04	1.32E-08
1240.81	1.406	0.649	1.463	360	1.26E-03	9.67E-05	1.19E-08
2479.91	1.298	0.522	1.352	290	1.34E-03	4.61E-05	6.04E-09
1240.81	1.321	0.549	1.310				
311.09	1.375	0.612	1.348				
78.72	1.447	0.696	1.411				
20.41	1.513	0.773	1.480				
5.96	1.563	0.832	1.538				

Note:

Specimen taken 4-10cm from bottom of the tube
k calculated using cv based on t_{90} values.

Specimen swelled under 10.57 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

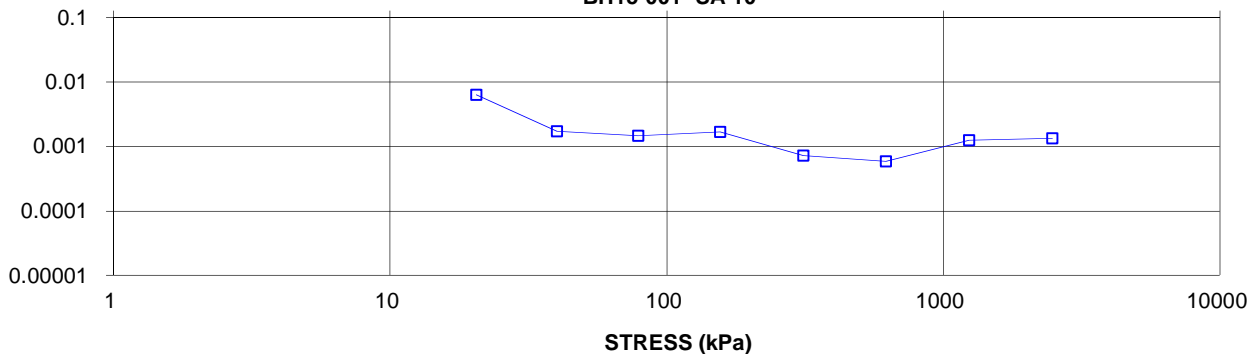
Sample Height, cm	1.56	Unit Weight, kN/m ³	19.87
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m ³	14.88
Area, cm ²	31.62	Specific Gravity, measured	2.78
Volume, cm ³	49.42	Solids Height, cm	0.853
Water Content, %	33.58	Volume of Solids, cm ³	26.97
Wet Mass, g	100.16	Volume of Voids, cm ³	22.45
Dry Mass, g	74.98		

CONSOLIDATION TEST SUMMARY

FIGURE A-5B

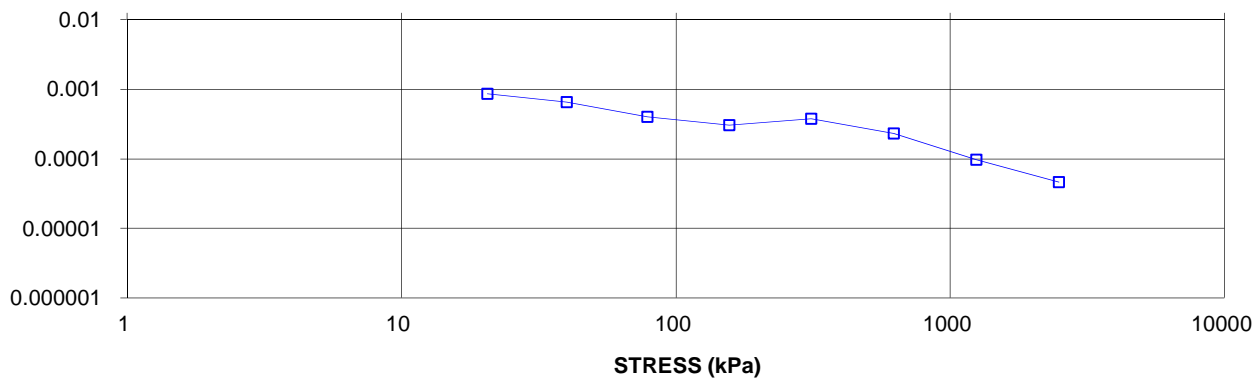
COEFFICIENT OF CONSOLIDATION,
cm²/s

CONSOLIDATION TEST
CV cm²/s VS STRESS (kPa)
BH15-001 SA 10



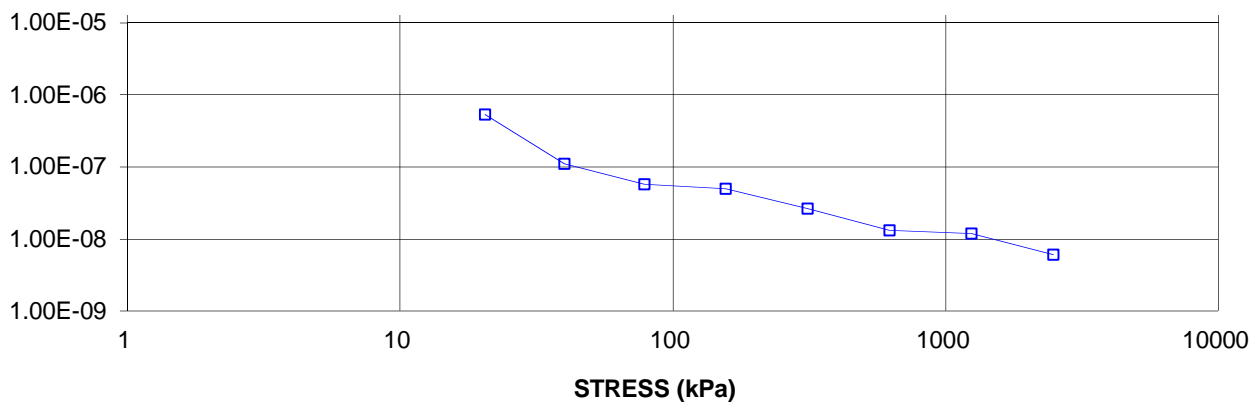
VOLUME COMPRESSIBILITY, m²/kN

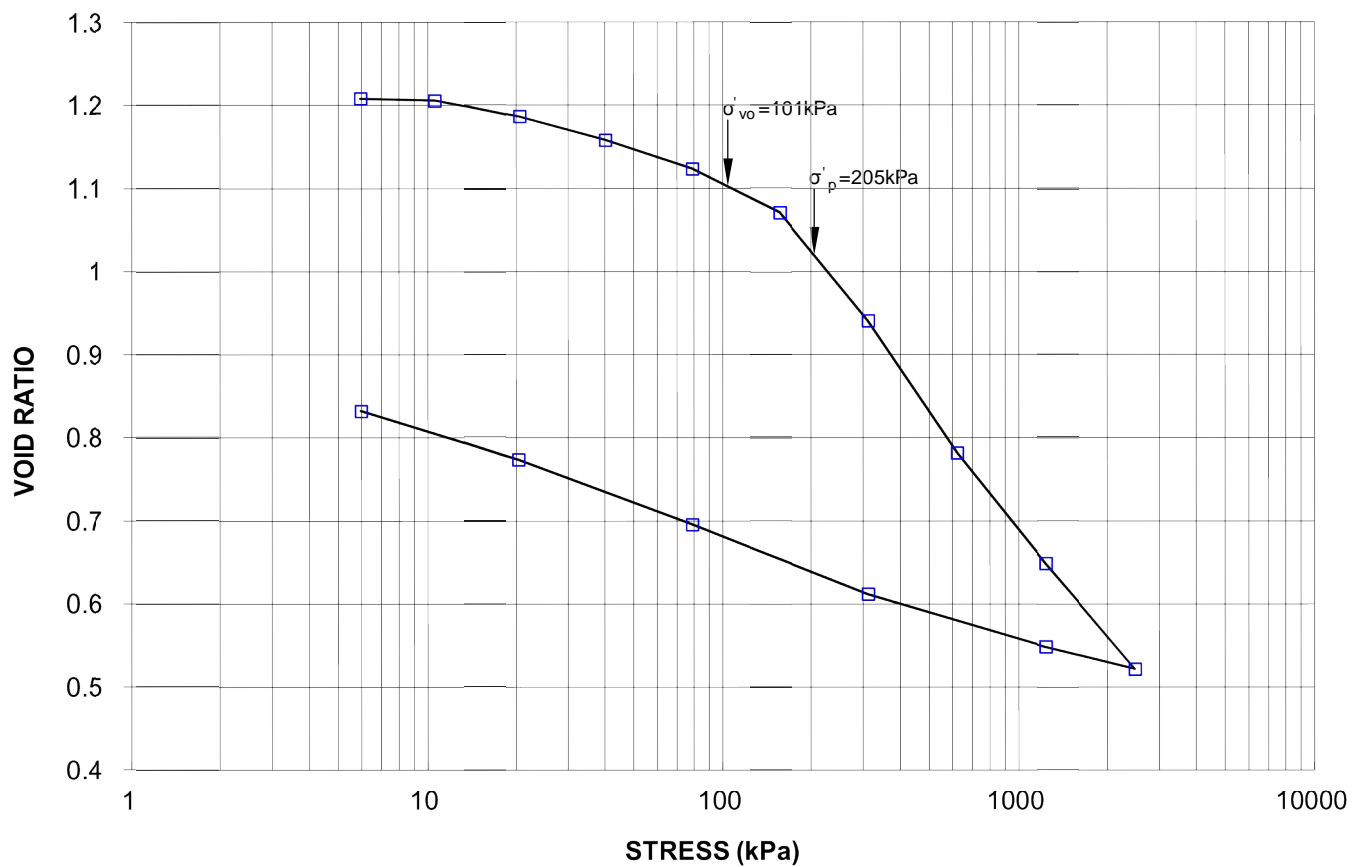
CONSOLIDATION TEST
MV m²/kN vs STRESS (kPa)
BH15-001 SA 10



HYDRAULIC CONDUCTIVITY,
cm/s

CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH15-001 SA 10

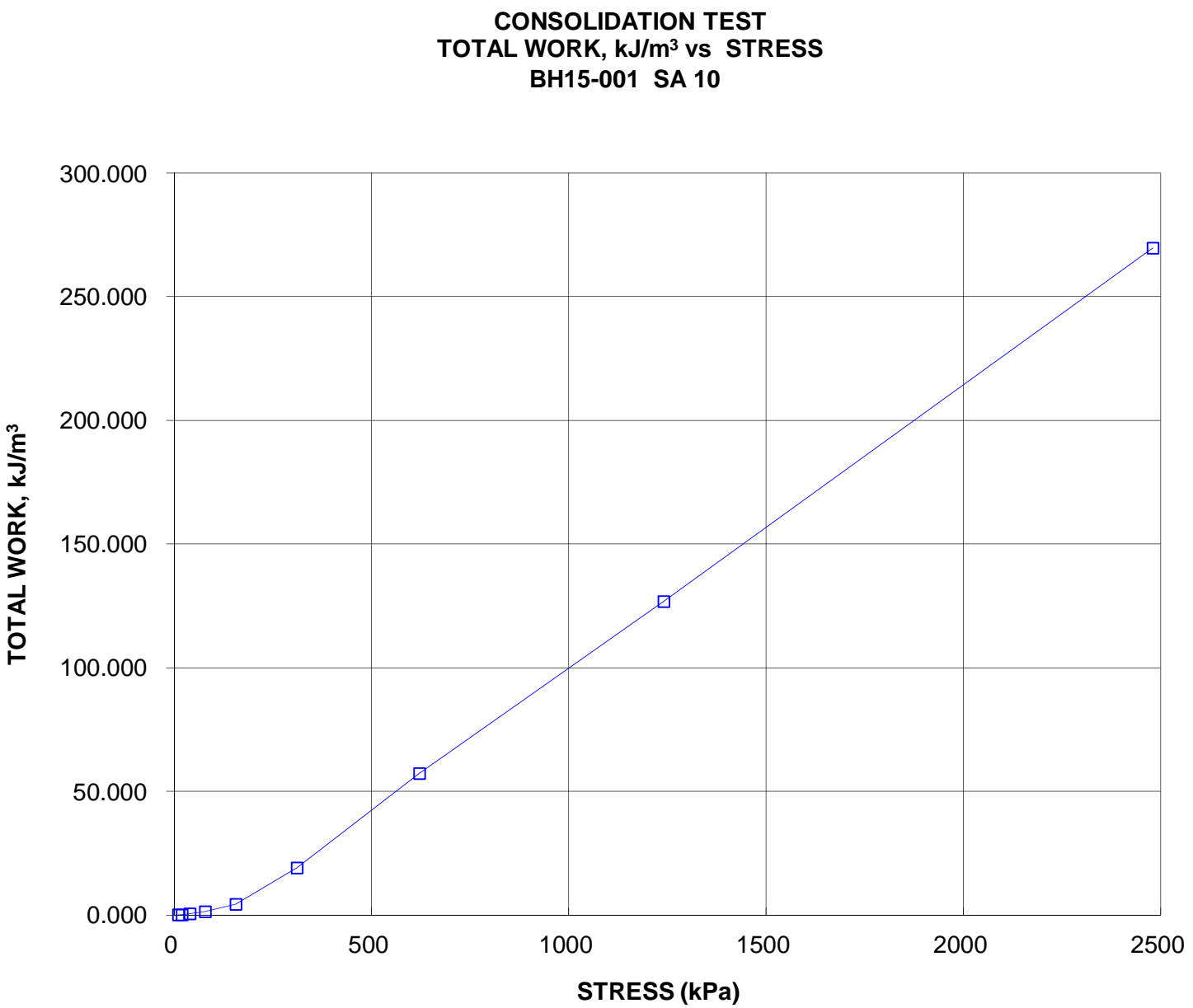




BOREHOLE 15-001 SA 10

PROJECT			
OJIBWAY PARKWAY/ETR OVERPASS, SITES 6-600/1 & 2 HIGHWAY 401 (RHHGP) GWP 3028-14-00			
TITLE			
CONSOLIDATION TEST VOID RATIO Vs. LOG PRESSURE			
PROJECT No.		13-1132-0053	FILE No. 1311320053-1000-F010A5C
CADD	DCH	May 20/16	SCALE AS SHOWN REV. 0
CHECK			FIGURE A-5C







APPENDIX B

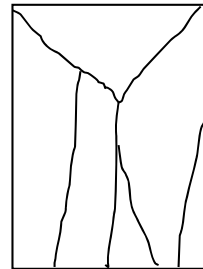
Laboratory Test Data - Rock

FIGURE B-1A**UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS****ASTM D7012**

SAMPLE IDENTIFICATION			
PROJECT NUMBER	13-1132-0052	SAMPLE NUMBER	21
PROJECT NAME		SAMPLE DEPTH, m	26.62-26.74
BOREHOLE NUMBER	BH15-001	DATE:	12/16/2015

TEST CONDITIONS			
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.25

SPECIMEN INFORMATION			
SAMPLE HEIGHT, cm	10.42	WATER CONTENT, (specimen) %	0.14
SAMPLE DIAMETER, cm	4.63	UNIT WEIGHT, kN/m ³	24.36
SAMPLE AREA, cm ²	16.82	DRY UNIT WT., kN/m ³	24.33
SAMPLE VOLUME, cm ³	175.35	SPECIFIC GRAVITY	-
WET WEIGHT, g	435.79	VOID RATIO	-
DRY WEIGHT, g	435.18		

VISUAL INSPECTION**FAILURE SKETCH**

TEST RESULTS			
STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	31.2

REMARKS: -

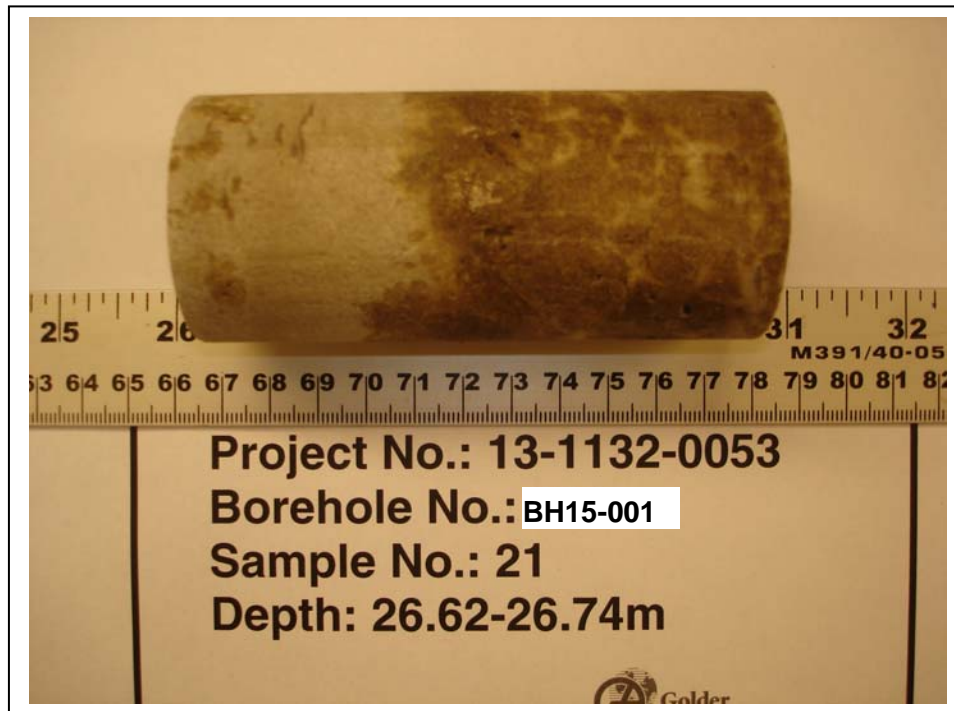
L/D Ratio not in accordance with ASTM Standard

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE B-1B



BEFORE COMPRESSION



AFTER COMPRESSION

Date Dec. 17, 2015
Project 13-1132-0053

Golder Associates

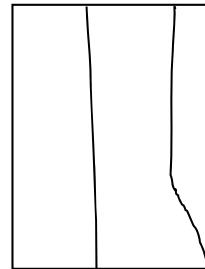
Drawn Frank
Chkd.

FIGURE B-2A**UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS****ASTM D7012**

SAMPLE IDENTIFICATION			
PROJECT NUMBER	13-1132-0052	SAMPLE NUMBER	20
PROJECT NAME		SAMPLE DEPTH, m	25.02-25.15
BOREHOLE NUMBER	BH15-001	DATE:	12/16/2015

TEST CONDITIONS			
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.26

SPECIMEN INFORMATION			
SAMPLE HEIGHT, cm	10.46	WATER CONTENT, (specimen) %	0.09
SAMPLE DIAMETER, cm	4.63	UNIT WEIGHT, kN/m ³	25.21
SAMPLE AREA, cm ²	16.80	DRY UNIT WT., kN/m ³	25.19
SAMPLE VOLUME, cm ³	175.75	SPECIFIC GRAVITY	-
WET WEIGHT, g	451.95	VOID RATIO	-
DRY WEIGHT, g	451.57		

VISUAL INSPECTION**FAILURE SKETCH**

TEST RESULTS			
STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	53.5

REMARKS: -

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE B-2B



BEFORE COMPRESSION



AFTER COMPRESSION

Date Dec. 17, 2015
Project 13-1132-0053

Golder Associates

Drawn Frank
Chkd.



APPENDIX C

Photograph of Rock Core



APPENDIX C

Photograph of Rock Core



[https://golderassociates.sharepoint.com/sites/12992g/ph 1000fdns/2-correspondence/5-rpts/1311320053-1000-r01 \(revised final\) may 24 17 app c rock core photo.docx](https://golderassociates.sharepoint.com/sites/12992g/ph%201000fdns/2-correspondence/5-rpts/1311320053-1000-r01%20(revised%20final)%20may%2024%2017%20app%20c%20rock%20core%20photo.docx)



APPENDIX D

Site Photographs



APPENDIX D

Site Photograph



Photograph 1: Bridge Site B-1 - Construction of east approach embankment.



Photograph 2: Plaza construction area.



APPENDIX E

Record of Previous Boreholes and Laboratory Testing Geocres No. 40J6-27

RECORD OF BOREHOLE No CPT-165

1 OF 1

METRIC

PROJECT 07-1130-207-0

W.P. _____

LOCATION N 4682188.2 : E 328457.7

ORIGINATED BY CC

DIST WEST HWY 401/3

BOREHOLE TYPE POWER AUGER, SOLID STEM

COMPILED BY BRS

DATUM GEODETIC

DATE August 13, 2008

CHECKED BY *SJS*

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						
178.98	GROUND SURFACE													
0.00	FILL, crushed gravel Grey													
0.30	TOPSOIL, sandy Black													
0.46	FILL, silty sand topsoil with silty sand layers, pockets of gravel and wood		1	SS	8						○			
177.91	Loose Black		2	SS	7						○			
177.30	SILTY SAND AND GRAVEL Loose Brown		3	SS	20						○			
176.69	SAND, trace gravel Compact Grey													
2.29	END OF BOREHOLE													
Water level in borehole at about elev. 177.31m during drilling on August 13, 2008.														

PROJECT: 07-1130-207-0

RECORD OF CONE PENETRATION TEST CPT-165

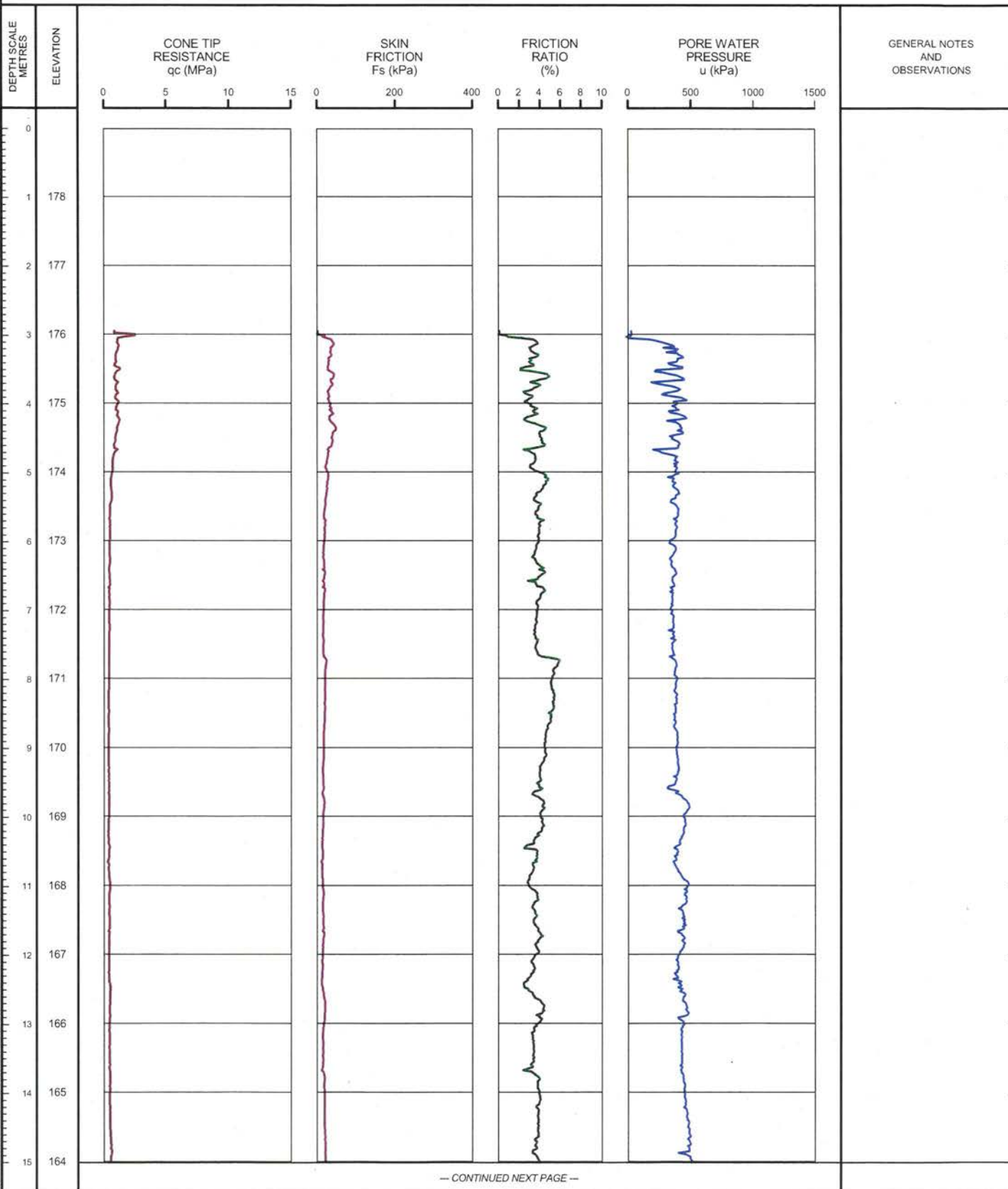
SHEET 1 OF 2

LOCATION: N 4682188.2 E 328457.7

TEST DATE: August 13, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION: PREDRILL DEPTH: 2.95m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: CC

CHECKED: SSS

PROJECT: 07-1130-207-0

RECORD OF CONE PENETRATION TEST CPT-165

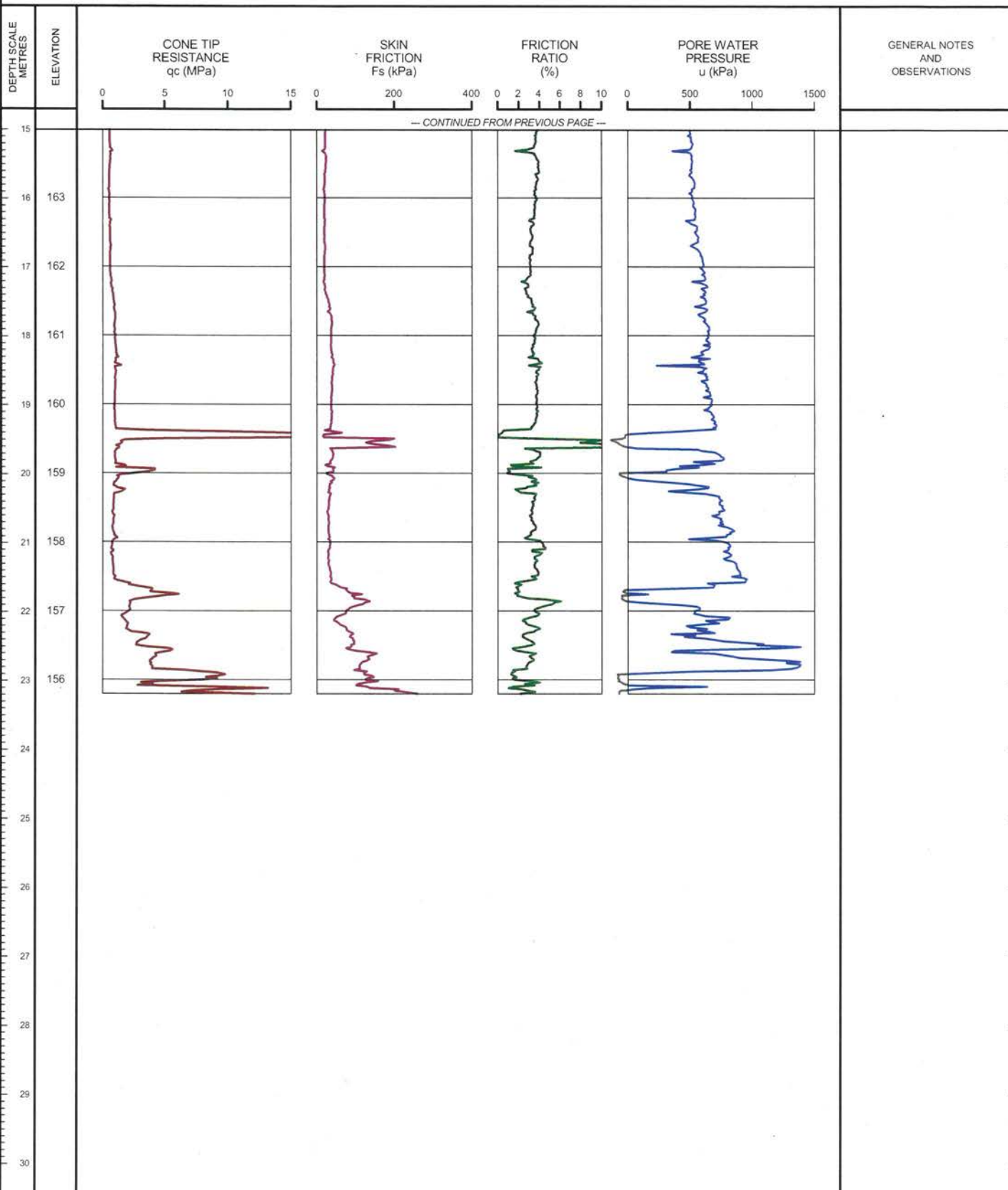
SHEET 2 OF 2

LOCATION: N 4682188.2 ; E 328457.7

TEST DATE: August 13, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION: PREDRILL DEPTH: 2.95m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: CC

CHECKED: SJB

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4682168.3 :E 328349.6

ORIGINATED BY CC

DIST WEST HWY 401/3

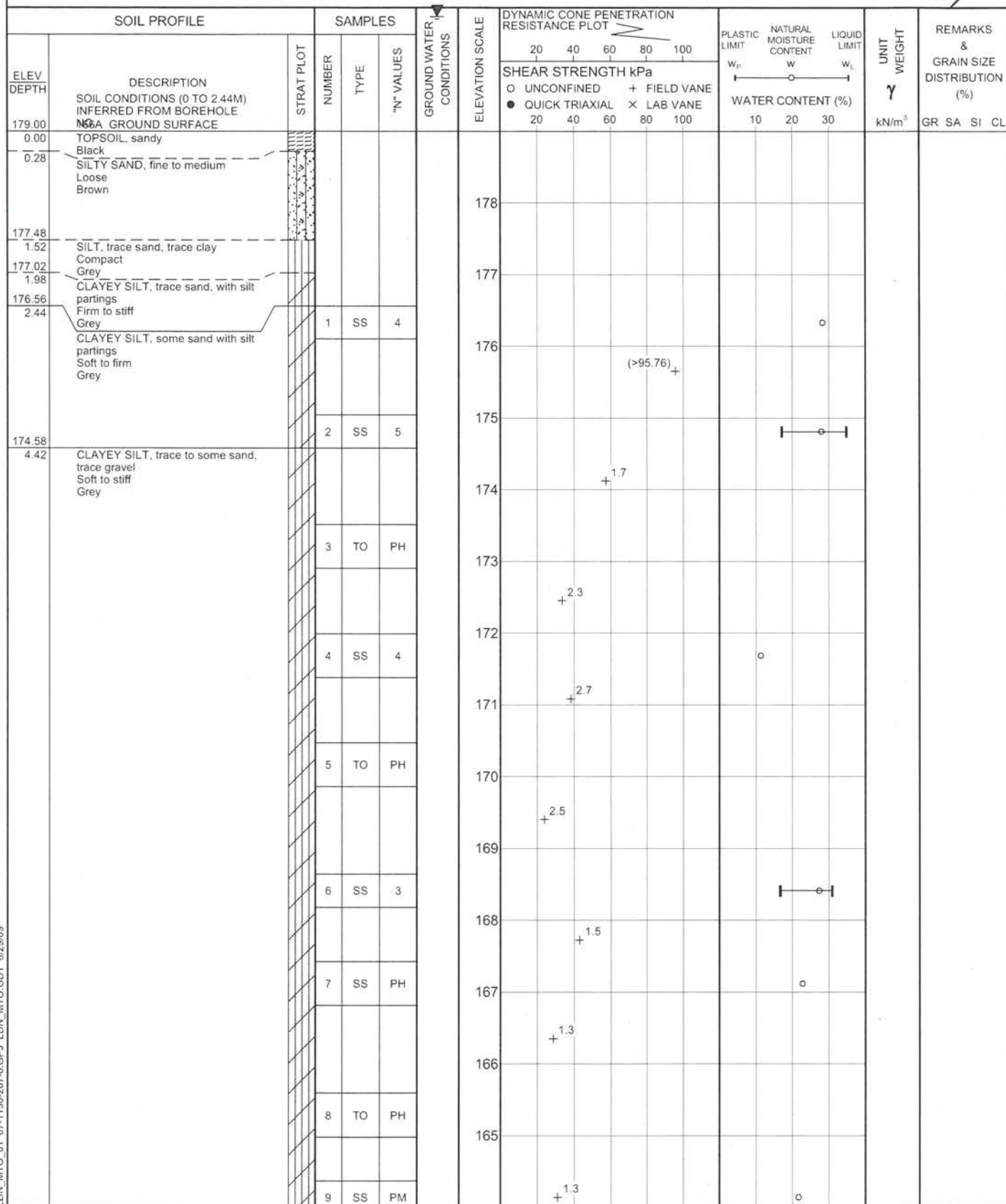
BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC

COMPILED BY LMK

DATUM GEODETIC

DATE September 11, 2008 - September 17, 2008

CHECKED BY SIB



DN_MTO_01 07-1130-207-0.GPJ LDN_MTO.GDT 6/29/09

Continued Next Page

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

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4682168.3 :E 328349.6

ORIGINATED BY CC

DIST WEST HWY 401/3

BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NORC

COMPILED BY LMK

DATUM GEODETIC

DATE September 11, 2008 - September 17, 2008

CHECKED BY **SJR**

[illegible]

DN_MTO_01 07-1130-207-0.GPJ LDN_MTO.GDT 6/30/09

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

PROJECT: 07-1130-207-0

RECORD OF DRILLHOLE: 166

SHEET 3 OF 3

LOCATION: N 4682168.3 ; E 328349.6

DRILLING DATE: September 11, 2008 - September 17, 2008

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: --

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: AARDVARK DRILLING INC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (m/min)	COLOUR FLUSH % RETURN	ELEVATION	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough Br - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				DEPTH (m)					RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION			
									TOTAL CORE %	SOLID CORE %										
																	80 60 40 20	80 60 40 20		
		ROCK SURFACE		155.73																
	MUD ROTARY NO ROCK CORE	LIMESTONE, fresh, medium strong, weakly laminated, fine grained, porous to pitted with occasional vugs, fossiliferous, hydrocarbon staining, mottled brown and grey		23.27				155							JN, PL, Ro CI					
24					1															
		LIMESTONE, fresh, medium strong, weakly laminated, fine grained, faintly porous, hydrocarbon staining, brown, mottled brown and grey zone at 25.3m		154.29				154												
25				24.71	2															
		LIMESTONE, fresh, medium strong, thinly laminated, very fine grained to fine grained, faintly porous, stylolitic, occasional fossils, grey with light grey inclusions		153.63				153							JN, PL, Ro CI					
				25.37											JN, UN, Ro CI					
26					3															
27		END OF DRILLHOLE		152.08																
				26.92																
28																				
29																				
30																				
31																				
32																				
33																				
34																				
35																				
36																				
37																				
38																				

DEPTH SCALE

1 : 75



LOGGED: SG

CHECKED: SJB

RECORD OF BOREHOLE No 166A

1 OF 2

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4682168.3 :E 328349.6

ORIGINATED BY CC

DIST

WEST

HWY 401/3

BOREHOLE TYPE

POWER AUGER, HOLLOW STEM

COMPILED BY LMK

DATUM GEODETIC

DATE

September 17, 2008

CHECKED BY

SS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L
179.00	SOIL CONDITIONS (2.75 TO 15.39M) INFERRED FROM BOREHOLE NO. 166						20	40	60	80	100		
0.00	TOPSOIL, sandy												
0.28	Black SILTY SAND, fine to medium Loose Brown		1	SS	9								
177.48													
1.52	SILT, trace sand, trace clay Compact Grey		2	SS	16								0 3 89 8
177.02													
1.98	CLAYEY SILT, trace sand, with silt partings Firm to stiff Grey		3	SS	8								
176.25													
2.75	CLAYEY SILT, some sand with silt partings Soft to firm Grey												
174.58													
4.42	CLAYEY SILT, trace to some sand, trace gravel Soft to stiff Grey												

RECORD OF BOREHOLE No 166A

2 OF 2

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4682168.3 :E 328349.6

ORIGINATED BY CC

DIST WEST HWY 401/3

BOREHOLE TYPE POWER AUGER, HOLLOW STEM

COMPILED BY LMK

DATUM GEODETIC

DATE

September 17, 2008

CHECKED BY *SB*

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			20	40	60	80	100		
163.61														
15.39	END OF BOREHOLE													
	Water level measured in shallow piezometer at elev. 163.76m on September 19, 2008.													
	Water level measured in shallow piezometer at elev. 165.19m on September 22, 2008.													
	Water level measured in shallow piezometer at elev. 178.43m on January 28, 2009.													

RECORD OF BOREHOLE No CPT-348

1 OF 1

METRIC

PROJECT 09-1132-0080-7000

W.P.

LOCATION

N 4682160.4 :E 328512.5

ORIGINATED BY TA

DIST WEST HWY 401 / 3

BOREHOLE TYPE POWER AUGER, SOLID STEM

COMPILED BY AG

DATUM GEODETIC

DATE April 27, 2010

CHECKED BY SJB

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					
20 40 60 80 100			20 40 60 80 100			10 20 30									
179.15	GROUND SURFACE						179								
0.00	TOPSOIL, sandy Dark brown						178								
0.27	SAND, fine to medium Loose to compact Brown		1	SS	14										
177.32			2	SS	9										
1.83	CLAYEY SILT, some sand, trace gravel Stiff Grey						177								
176.25			3	SS	8										
2.90	END OF BOREHOLE														
	Groundwater encountered at about elev. 177.8m during drilling on April 27, 2010.														

LDN_MTO_01 09-1132-0080-7000.GPJ LDN_MTO.GDT 04/06/10

PROJECT: 09-1132-0080

RECORD OF CONE PENETRATION TEST CPT-348

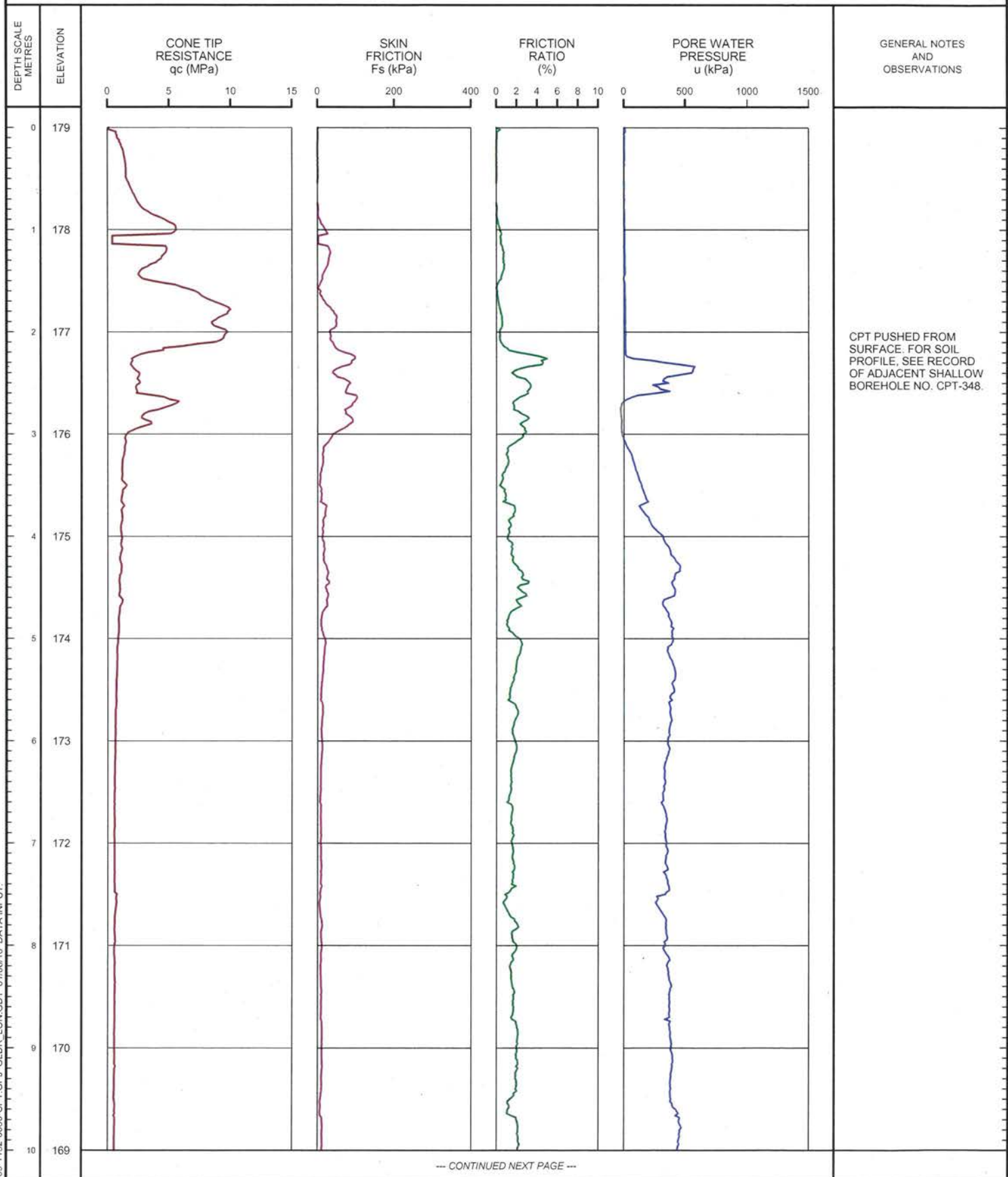
SHEET 1 OF 3

LOCATION: N 4682160.4 ; E 328512.5

TEST DATE: April 26, 2010

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 179.15m PREDRILL DEPTH: 0.00m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



CPT PUSHED FROM
SURFACE. FOR SOIL
PROFILE, SEE RECORD
OF ADJACENT SHALLOW
BOREHOLE NO. CPT-348.

LDN CPT-01 09-1132-0080-CPT.GPJ GLDR_LON.GDT 01/06/10 DATA INPUT:

DEPTH SCALE

1:50



OPERATOR: TA

CHECKED: *503*

PROJECT: 09-1132-0080

RECORD OF CONE PENETRATION TEST CPT-348

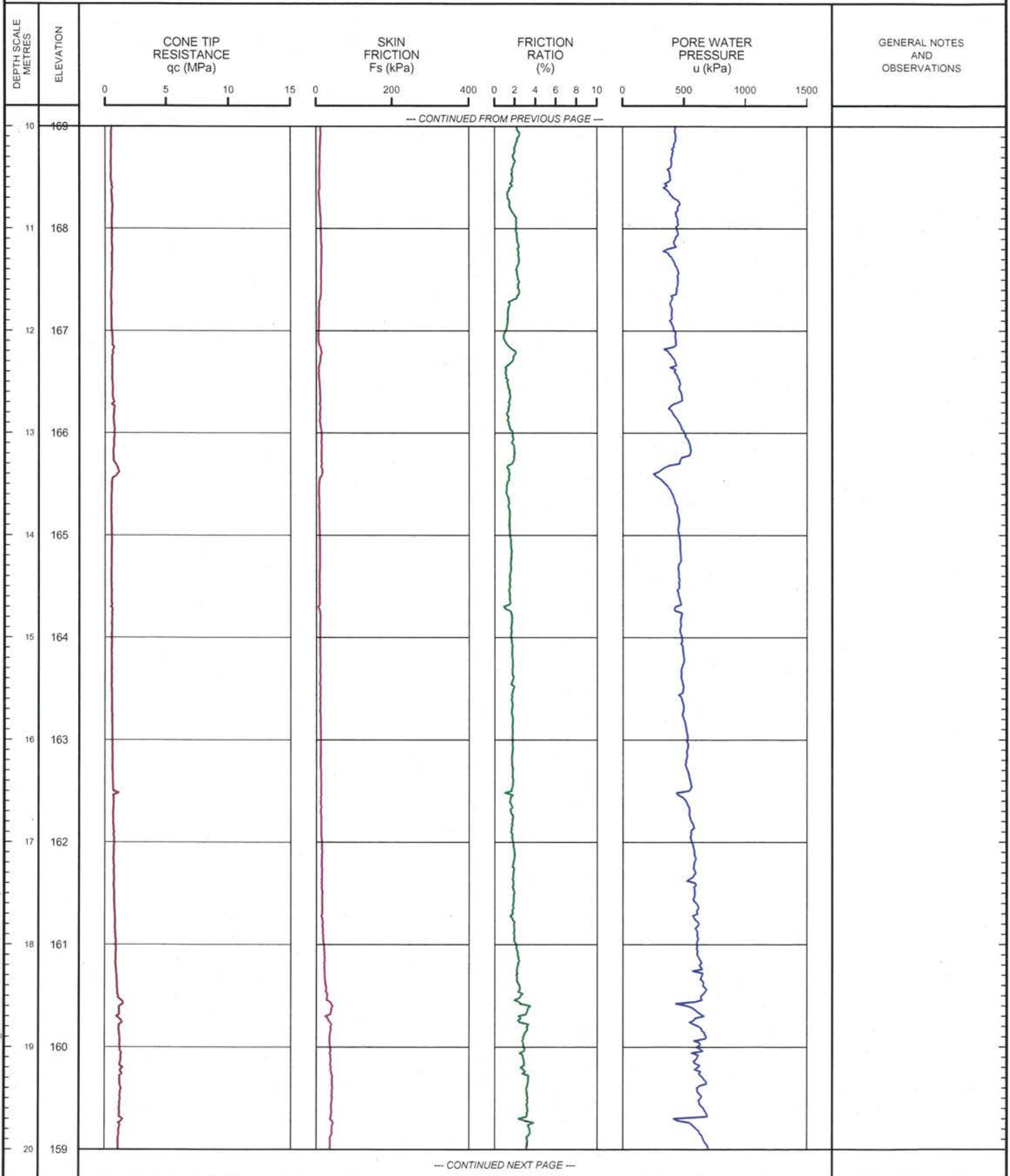
SHEET 2 OF 3

LOCATION: N 4682160.4 ; E 328512.5

TEST DATE: April 26, 2010

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 179.15m PREDRILL DEPTH: 0.00m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



LDN CPT 01 09-1132-0080-CPT GPJ GLDR LON GDT 01/06/10 DATA INPUT

DEPTH SCALE

1 : 50



OPERATOR: TA

CHECKED: SJB

PROJECT: 09-1132-0080

RECORD OF CONE PENETRATION TEST CPT-348

SHEET 3 OF 3

LOCATION: N 4682160.4 ; E 328512.5

TEST DATE: April 26, 2010

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 179.15m PREDRILL DEPTH: 0.00m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



LDN_CPT_01_09-1132-0080-CPT.GPJ GLDR LON GDT 01/06/10 DATA INPUT:

DEPTH SCALE

1 : 50



OPERATOR: TA

CHECKED: *SJS*

RECORD OF BOREHOLE No 349

1 OF 3

METRIC

PROJECT 09-1132-0080-7000

W.P.

LOCATION

N 4682135.5 ; E 328496.2

ORIGINATED BY TA

DIST WEST HWY 401 / 3

BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC

COMPILED BY AG

DATUM GEODETTIC

DATE

April 22, 2010 - April 23, 2010

CHECKED BY *CJB*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p — w — w _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
179.08	GROUND SURFACE						180				
0.00	TOPSOIL, sandy to clayey Dark brown						WL - VWP4				
178.17							179				
0.91	SAND, fine to medium, trace to some silt Loose to compact Brown		1	SS	7		WL - VWP3 WL - VWP2				
176.95							178				
2.13	CLAYEY SILT, trace sand, with silt partings Soft to stiff Grey		2	SS	19		WL - VWP1				
							177				1 94 (5)
			3	SS	11						
			4	SS	6						0 3 74 23
			5	SS	7		176				
			6	SS	3		175				
173.59	SILTY CLAY, trace sand Soft to firm Grey		7	TO	PH		174				0 7 28 65 Oedometer
5.49			8	SS	3		173				
			9	TO	PH		172				
			10	SS	2		171				
169.63	CLAYEY SILT, trace sand Soft to stiff Grey		11	TO	PH		170				2 12 52 34 Oedometer
9.45			12	SS	5		169				
			13	TO	PH		168				
							167				
							166				

Continued Next Page

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

LDN_MTO_06 09-1132-0080-7000.GPJ LDN_MTO.GDT 04/06/10

METRIC

PROJECT 09-1132-0080-7000

W.P.

LOCATION

N 4682135.5 : E 328496.2

ORIGINATED BY TA

DIST WEST HWY 401 / 3

BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC

COMPILED BY AG

DATUM GEODETIC

DATE April 22, 2010 - April 23, 2010

CHECKED BY SJB

[illegible]

DN_MTO_06 09-1132-0080-7000.GPJ LDN_MTO.GDT 04/06/10

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

PROJECT: 09-1132-0080

RECORD OF DRILLHOLE: 349

SHEET 3 OF 3

LOCATION: N 4682135.5 ;E 328496.2

DRILLING DATE: April 22, 2010 - April 23, 2010

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: MOBILE B-57

DRILLING CONTRACTOR: LANTECH DRILLING SERVICES INC.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	PENETRATION RATE (mm/min)	COLOUR % RETURN	FLUSH	ELEVATION	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough Br - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)				NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
				DEPTH (m)	RECOVERY						R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA		DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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LDN ROCK 03 09-1132-0080-7000-ROCK.GPJ GLDR LDN.GDT 01/06/10 DATA INPUT: AG

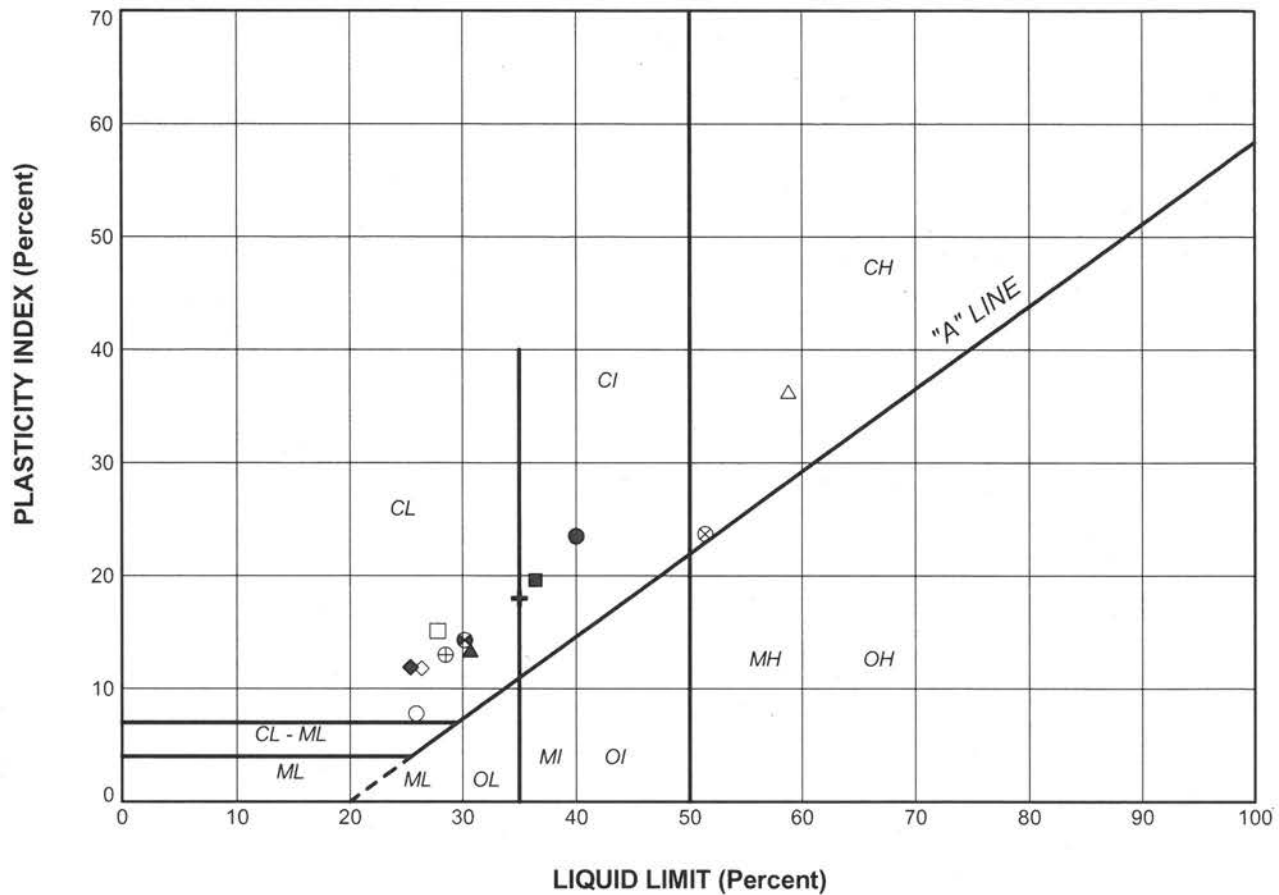
DEPTH SCALE

1:75



LOGGED: TA

CHECKED: *518*

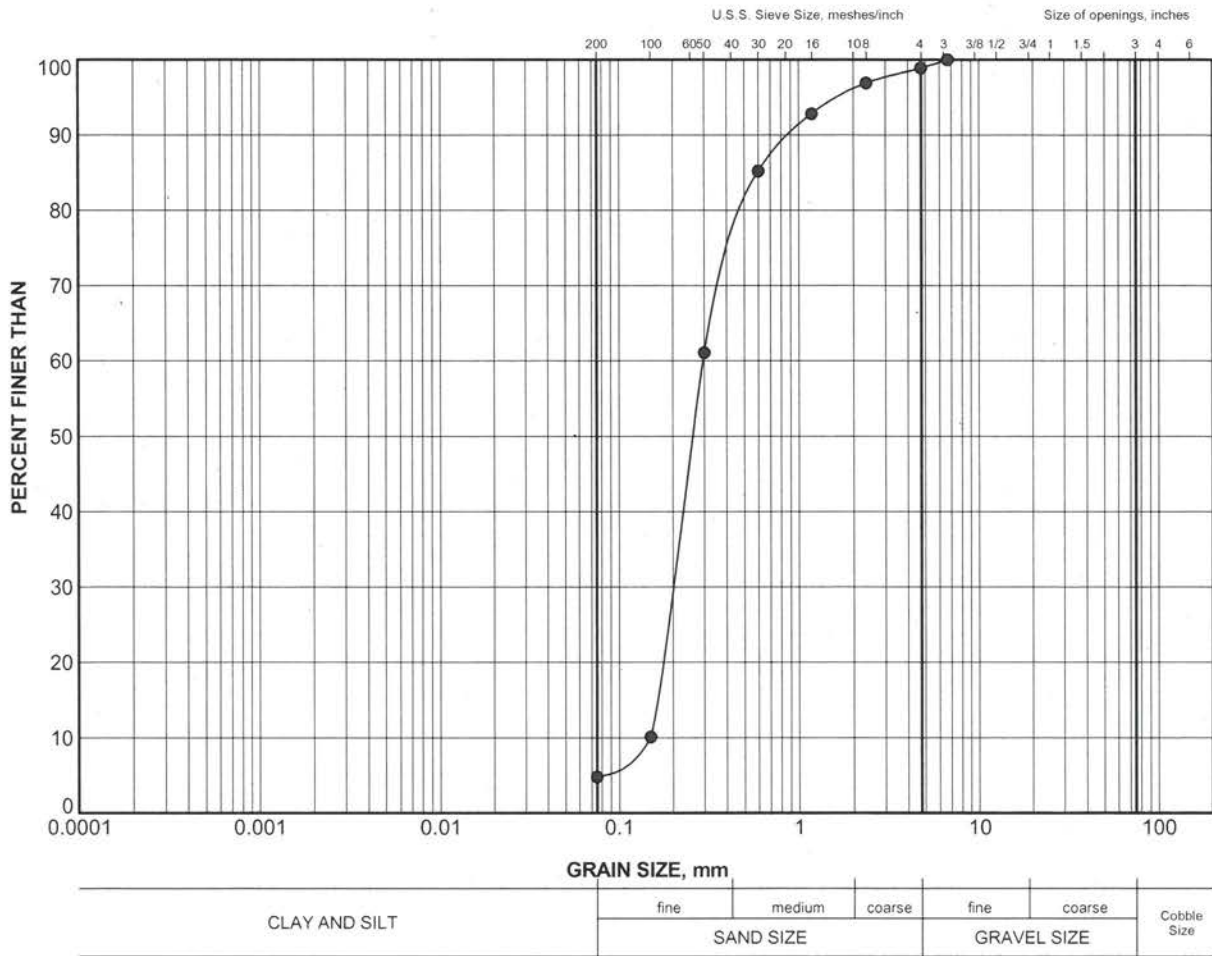


LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	346	5	40.0	16.5	23.5
■	346	9	36.4	16.8	19.6
▲	346	10	30.7	17.3	13.4
⊕	346	11	35.0	17.0	18.0
◆	346	13	25.4	13.5	11.9
◇	346	18	26.4	14.6	11.8
○	349	4	25.9	18.1	7.8
△	349	7	58.8	22.5	36.3
⊗	349	10	51.4	27.7	23.7
⊕	349	11	28.5	15.5	13.0
□	349	14	27.8	12.7	15.1
⊙	349	17	30.2	15.9	14.3

PROJECT			
GEOTECHNICAL DATA REPORT - ADDENDUM NO. 7			
WINDSOR-ESSEX PARKWAY			
WINDSOR, ONTARIO			
TITLE			
PLASTICITY CHART			
PROJECT No. 09-1132-0080		FILE No 0911320080-7000-R020D1	
DRAWN AG	June 8/10	SCALE N/A	REV.
CHECK 5215		FIGURE D-1	

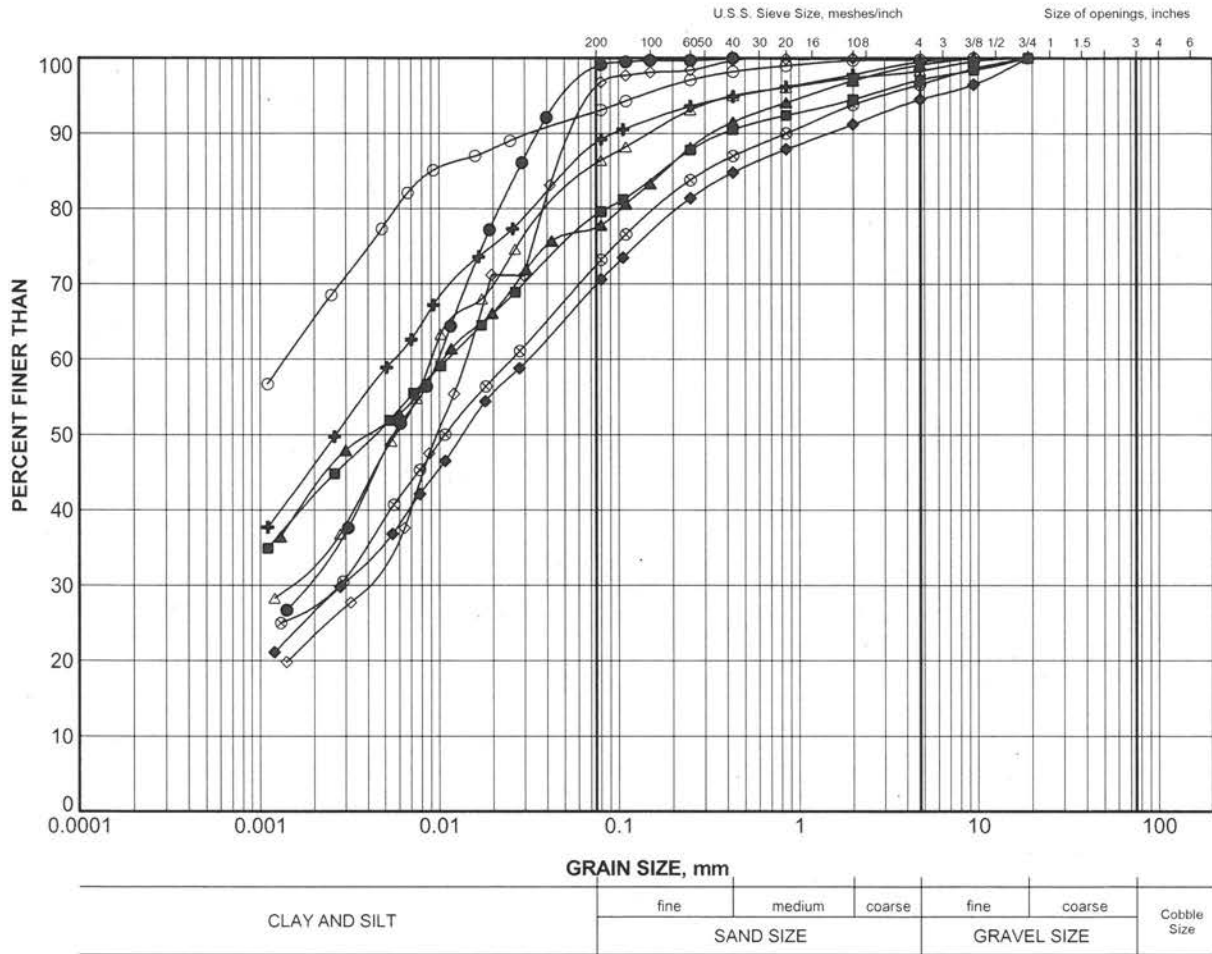




LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	349	2	177.6

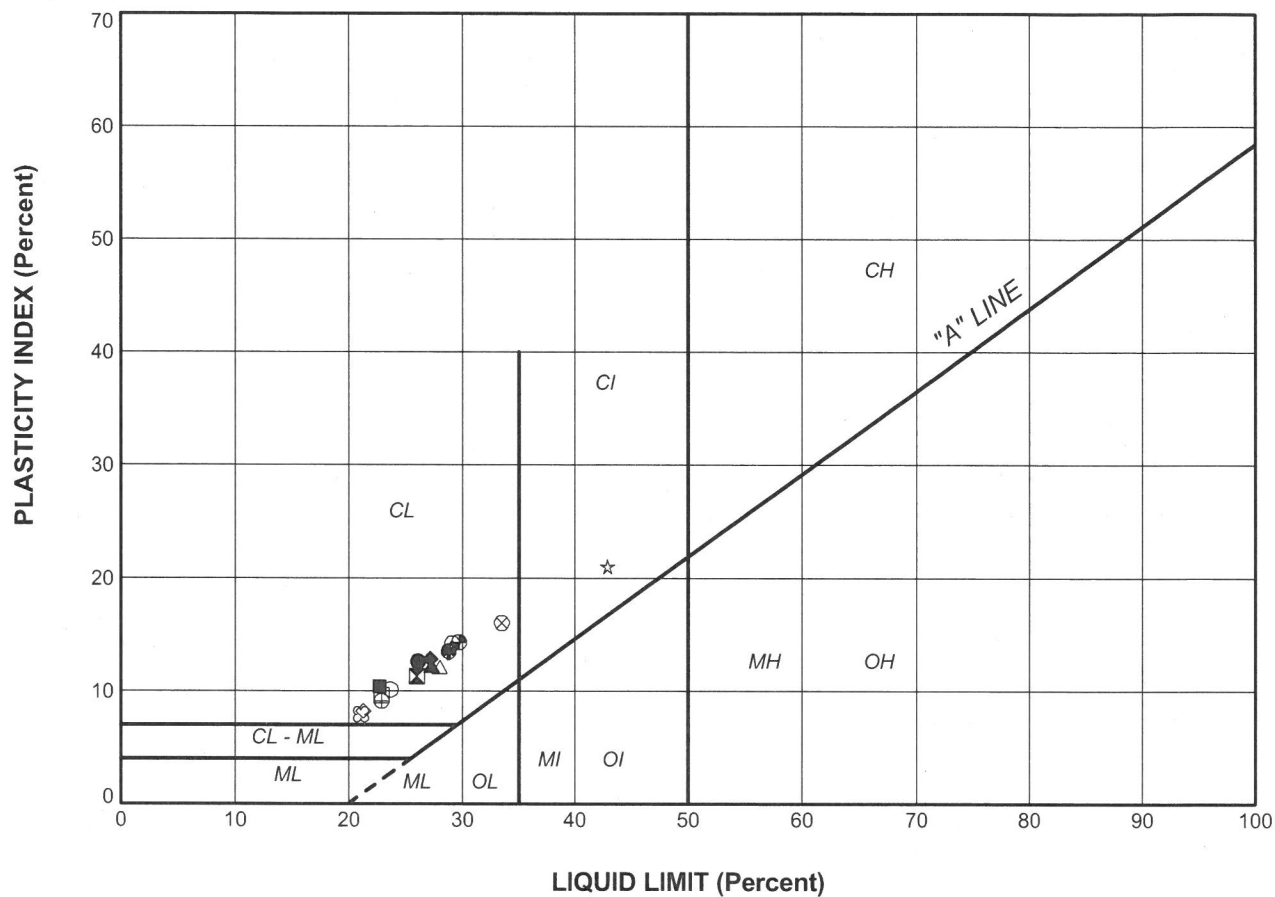
PROJECT			
GEOTECHNICAL DATA REPORT - ADDENDUM NO. 7 WINDSOR-ESSEX PARKWAY WINDSOR, ONTARIO			
TITLE			
GRAIN SIZE DISTRIBUTION UPPER GRANULAR DEPOSITS			
PROJECT No: 09-1132-0080		FILE No 0911320080-7000-R020D2	
DRAWN AG		June 8/10	
CHECK		5/5/2010	
Golder Associates LONDON, ONTARIO		SCALE N/A REV.	



LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	346	5	175.4
■	346	9	171.9
▲	346	10	170.4
✦	346	11	168.9
◆	346	13	165.8
◇	349	4	176.0
○	349	7	173.6
△	349	11	168.7
⊗	349	14	164.1

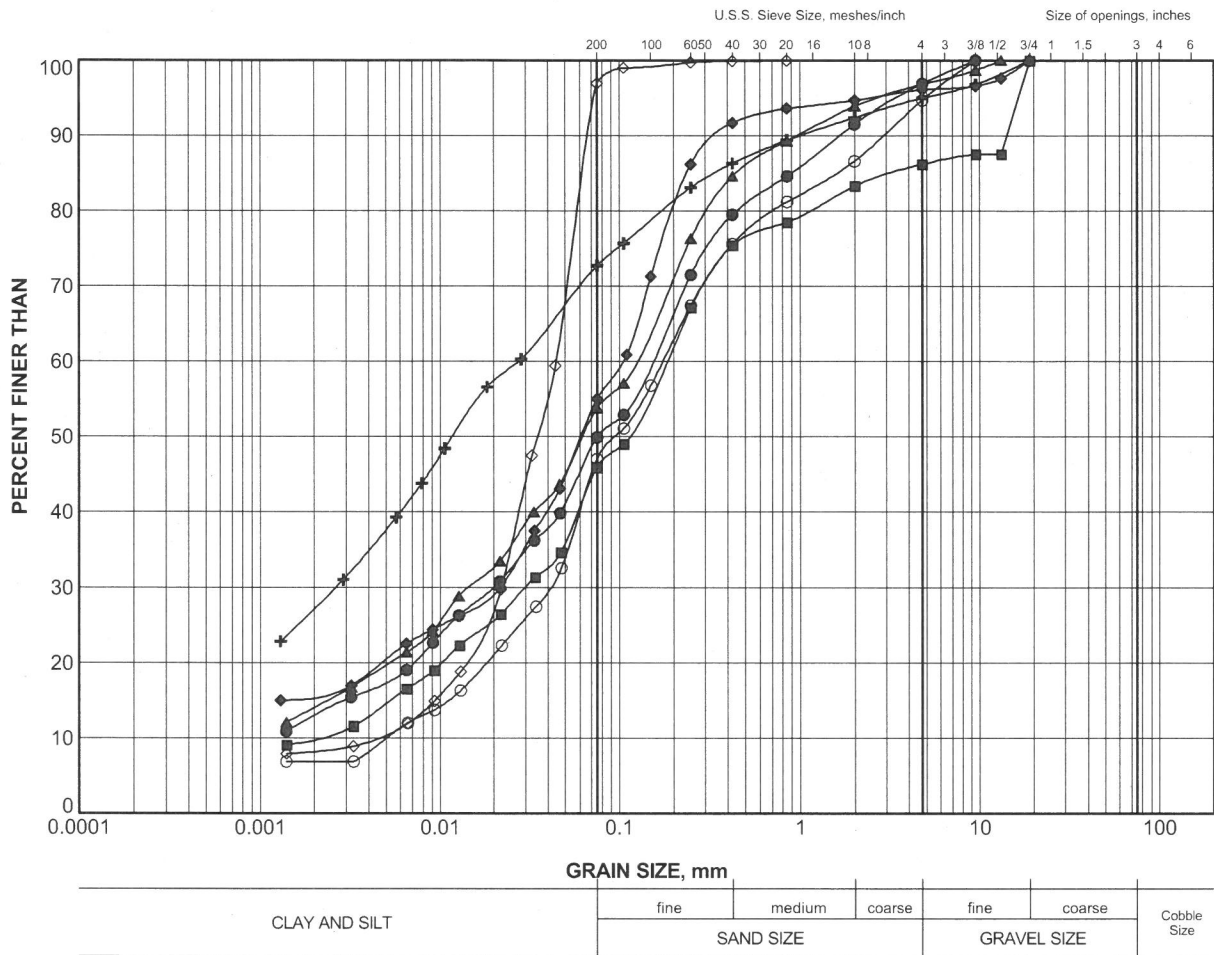
PROJECT			
GEOTECHNICAL DATA REPORT - ADDENDUM NO. 7 WINDSOR-ESSEX PARKWAY WINDSOR, ONTARIO			
TITLE			
GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY DEPOSIT			
PROJECT No. 09-1132-0080		FILE No. 0911320080-7000-R020D3	
DRAWN	AG	June 8/10	SCALE N/A
CHECK	SR	June 8/10	REV.
Golder Associates LONDON, ONTARIO		FIGURE D-3	



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	1	5	26.1	13.5	12.6
■	1	7	22.7	12.3	10.4
▲	1	10	27.3	15.1	12.2
+	1	12	28.8	15.4	13.4
◆	1	14	27.2	14.4	12.8
◇	1	16	21.3	13.1	8.2
○	1	18	23.7	13.6	10.1
△	1	20	28.0	15.9	12.1
⊗	1	23	33.5	17.5	16.0
⊕	7	5	22.9	13.8	9.1
□	7	7	22.9	13.3	9.6
⊗	7	9	28.8	15.3	13.5
⊕	7	11	29.7	15.4	14.3
☆	7	12	42.9	21.9	21.0
⊗	7	15	21.1	13.2	7.9
⊕	7	17	26.0	14.7	11.3
⊗	7	20	29.1	14.9	14.2

PROJECT				GEOTECHNICAL DATA REPORT WINDSOR-ESSEX PARKWAY WINDSOR, ONTARIO			
TITLE							
PLASTICITY CHART							
PROJECT No.		07-1130-207-0		FILE No.		0711302070-R0100F1	
DRAWN		WDF		SCALE		N/A	
CHECK		SSB		REV.			
		May 11/09					
 Golder Associates LONDON, ONTARIO				FIGURE F.1A			



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	104	10	177.5
■	107	13a	172.1
▲	115	10	173.8
+	135	17	162.0
◆	203	10	178.8
◇	166A	2	177.3
○	230N	6	182.5

PROJECT

GEOTECHNICAL DATA REPORT
WINDSOR-ESSEX PARKWAY
WINDSOR, ONTARIO

TITLE

GRAIN SIZE DISTRIBUTION UPPER GRANULAR DEPOSITS



PROJECT No.	07-1130-207-0	FILE No.	0711302070-R0100F2
DRAWN	WDF	SCALE	N/A
CHECK	WDF	REV.	
	May 11/09		

FIGURE F.2

CONSOLIDATION TEST SUMMARY

FIGURE BH 349 SA 7 OED A

SAMPLE IDENTIFICATION

Project Number	09-1132-0080	Sample Number	7
Borehole Number	349	Sample Depth, m	5.5-5.9

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	11		
Date Started	5/4/2010		
Date Completed	5/23/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m ³	17.02
Sample Diameter, cm	6.31	Dry Unit Weight, kN/m ³	11.21
Area, cm ²	31.27	Specific Gravity, measured	2.74
Volume, cm ³	79.43	Solids Height, cm	1.060
Water Content, %	51.77	Volume of Solids, cm ³	33.14
Wet Mass, g	137.82	Volume of Voids, cm ³	46.29
Dry Mass, g	90.81	Degree of Saturation, %	101.6

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	c _v cm ² /s	mv m ² /kN	k cm/s
0.00	2.540	1.397	2.540				
4.89	2.539	1.396	2.539	1	1.37E+00	8.86E-05	1.19E-05
9.57	2.538	1.395	2.538	43	3.18E-02	7.57E-05	2.36E-07
19.52	2.534	1.391	2.536	163	8.36E-03	1.62E-04	1.33E-07
39.17	2.504	1.363	2.519	205	6.56E-03	6.01E-04	3.87E-07
19.50	2.513	1.371	2.508				
9.57	2.519	1.377	2.516				
4.91	2.521	1.379	2.520				
9.57	2.520	1.378	2.521	216	6.24E-03	5.07E-05	3.10E-08
19.74	2.516	1.374	2.518	368	3.65E-03	1.74E-04	6.24E-08
39.38	2.504	1.363	2.510	305	4.38E-03	2.41E-04	1.03E-07
78.38	2.478	1.338	2.491	645	2.04E-03	2.63E-04	5.27E-08
156.54	2.423	1.286	2.450	693	1.84E-03	2.78E-04	5.00E-08
313.17	2.283	1.154	2.353	1135	1.03E-03	3.52E-04	3.56E-08
626.50	2.087	0.969	2.185	1984	5.10E-04	2.46E-04	1.23E-08
1252.53	1.916	0.808	2.001	1185	7.17E-04	1.07E-04	7.55E-09
2506.45	1.759	0.660	1.837	1070	6.69E-04	4.92E-05	3.23E-09
1252.53	1.787	0.686	1.773				
313.17	1.880	0.773	1.833				
78.38	1.993	0.880	1.936				
19.74	2.105	0.986	2.049				
4.89	2.182	1.059	2.144				

Note:

k calculated using cv based on t₉₀ values.

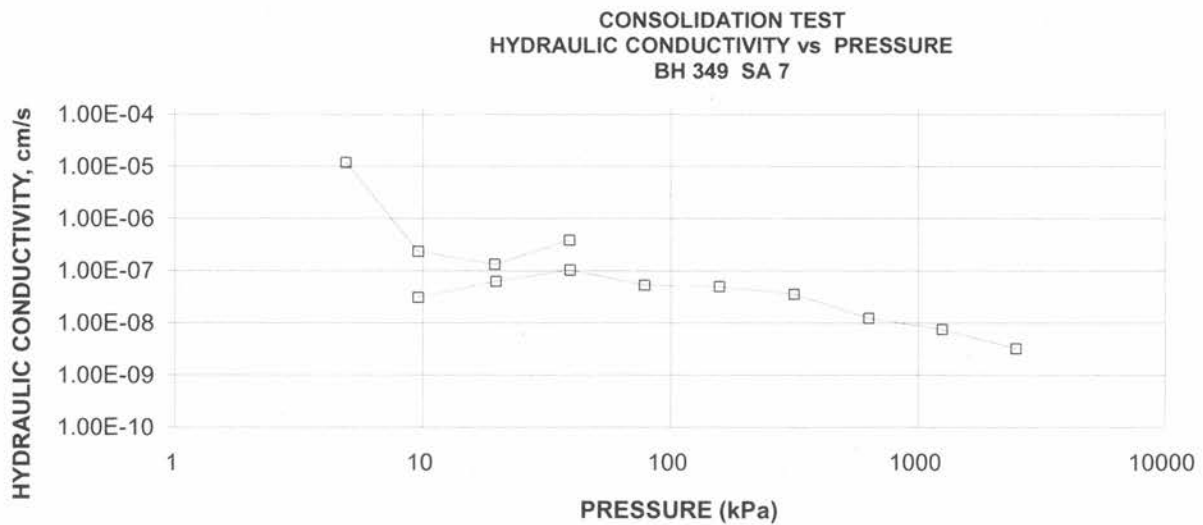
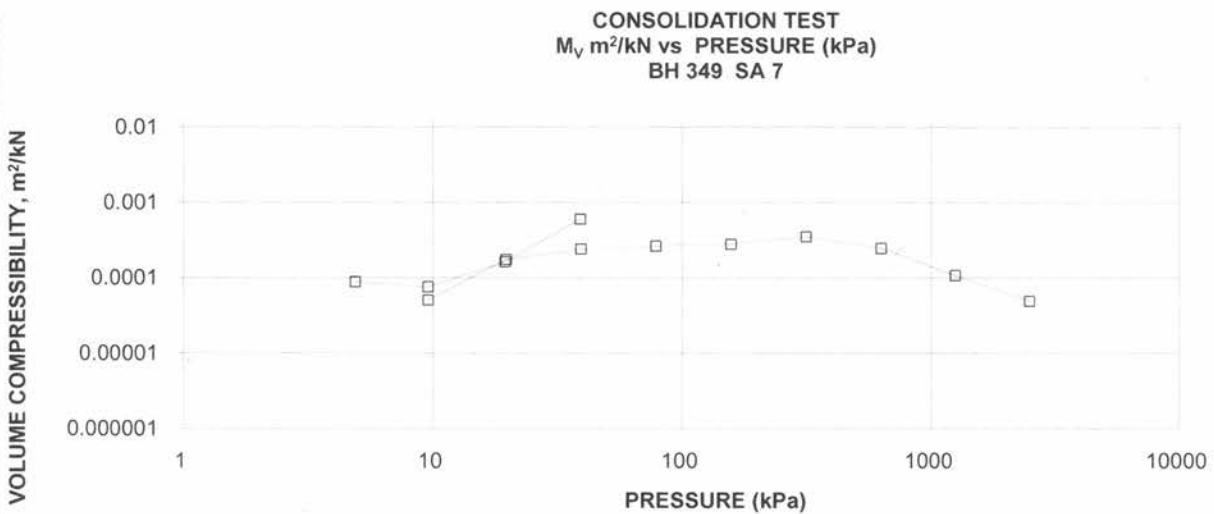
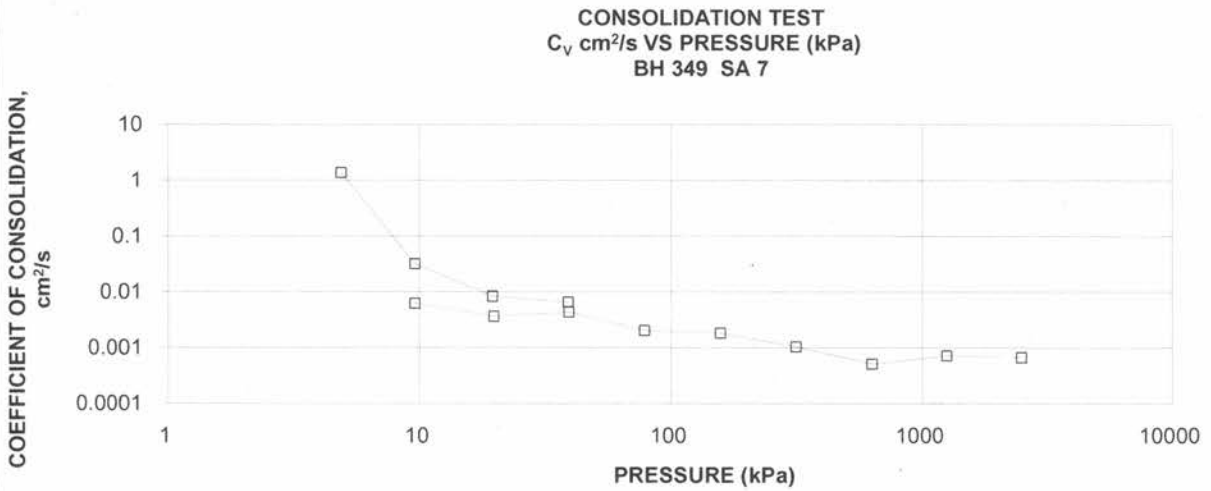
Specimen swelled under 10kPa

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.18	Unit Weight, kN/m ³	18.46
Sample Diameter, cm	6.31	Dry Unit Weight, kN/m ³	13.05
Area, cm ²	31.27	Specific Gravity, measured	2.74
Volume, cm ³	68.23	Solids Height, cm	1.060
Water Content, %	41.45	Volume of Solids, cm ³	33.14
Wet Mass, g	128.45	Volume of Voids, cm ³	35.09
Dry Mass, g	90.81		

CONSOLIDATION TEST SUMMARY

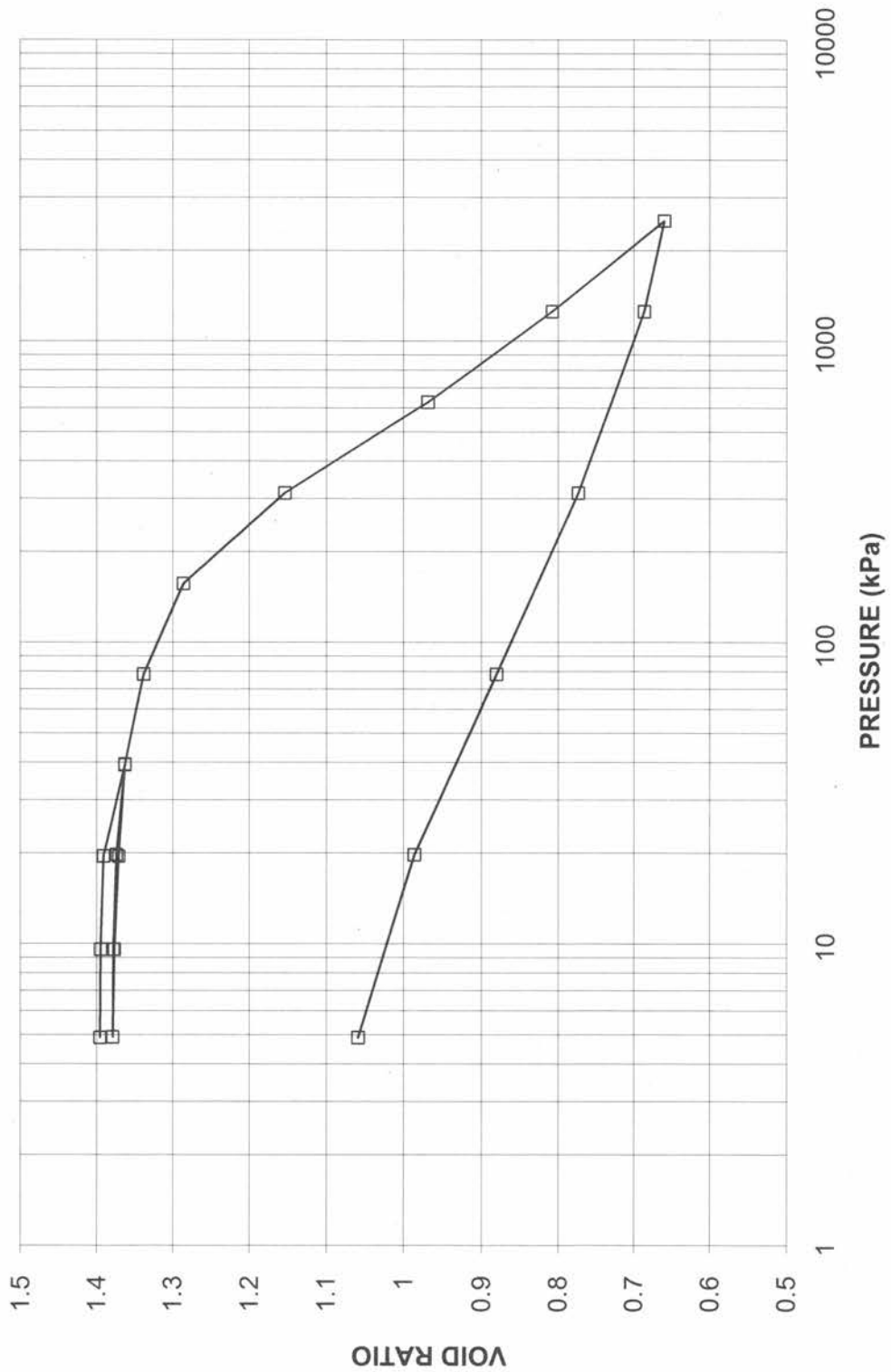
FIGURE BH 349 SA 7 OED B



CONSOLIDATION TEST VOID RATIO VS LOG PRESSURE

FIGURE BH 349 SA 7 OED C

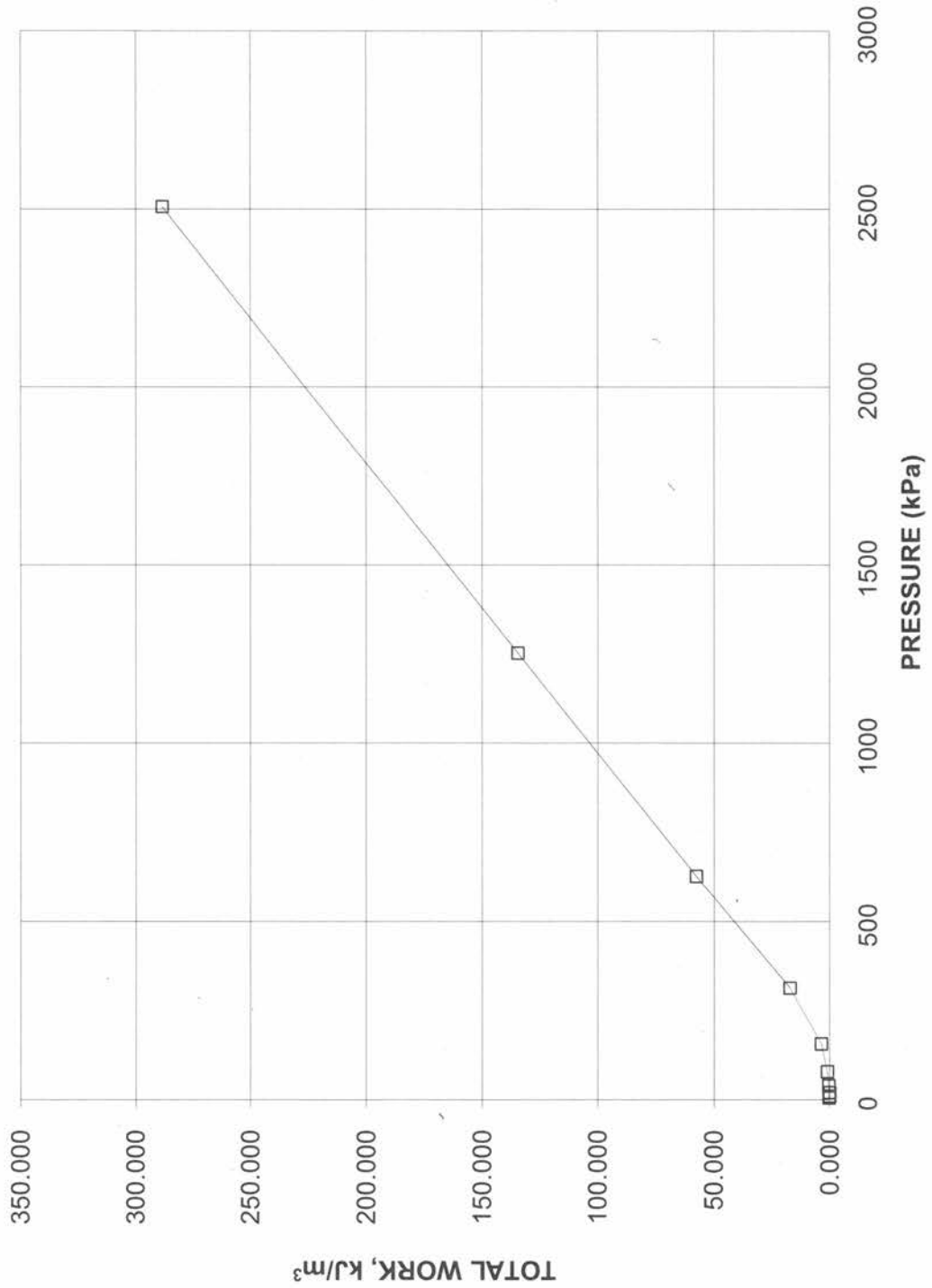
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH 349 SA 7



**CONSOLIDATION TEST
TOTAL WORK VS PRESSURE**

FIGURE BH 349 SA 7 OED D

**CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs PRESSURE
BH 349 SA 7**



CONSOLIDATION TEST SUMMARY

FIGURE BH 349 SA 11 OED A

SAMPLE IDENTIFICATION

Project Number	09-1132-0080	Sample Number	11
Borehole Number	349	Sample Depth, m	10.4-10.8

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	5		
Date Started	5/6/2010		
Date Completed	5/27/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m ³	19.08
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	15.22
Area, cm ²	31.52	Specific Gravity, measured	2.74
Volume, cm ³	59.89	Solids Height, cm	1.076
Water Content, %	25.35	Volume of Solids, cm ³	33.93
Wet Mass, g	116.53	Volume of Voids, cm ³	25.96
Dry Mass, g	92.96	Degree of Saturation, %	90.8

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	c _v cm ² /s	mv m ² /kN	k cm/s
0.00	1.900	0.765	1.900				
4.78	1.880	0.747	1.890	375	2.02E-03	2.21E-03	4.38E-07
9.58	1.869	0.736	1.874	346	2.15E-03	1.21E-03	2.54E-07
19.37	1.853	0.721	1.861	311	2.36E-03	8.66E-04	2.00E-07
38.86	1.831	0.701	1.842	205	3.51E-03	5.94E-04	2.04E-07
77.80	1.803	0.675	1.817	145	4.83E-03	3.80E-04	1.80E-07
38.82	1.806	0.678	1.804				
9.59	1.823	0.693	1.814				
4.78	1.826	0.696	1.824				
9.59	1.824	0.694	1.825	178	3.97E-03	2.19E-04	8.51E-08
19.14	1.820	0.691	1.822	217	3.24E-03	2.26E-04	7.18E-08
38.82	1.811	0.682	1.815	190	3.68E-03	2.41E-04	8.67E-08
77.88	1.799	0.671	1.805	202	3.42E-03	1.63E-04	5.46E-08
155.42	1.759	0.634	1.779	267	2.51E-03	2.71E-04	6.67E-08
310.02	1.689	0.569	1.724	304	2.07E-03	2.39E-04	4.85E-08
620.41	1.616	0.501	1.652	217	2.67E-03	1.24E-04	3.23E-08
1241.70	1.547	0.437	1.581	167	3.17E-03	5.85E-05	1.82E-08
2482.39	1.476	0.371	1.511	135	3.59E-03	3.01E-05	1.06E-08
1241.70	1.489	0.383	1.482				
310.02	1.516	0.408	1.502				
77.88	1.555	0.445	1.536				
19.14	1.598	0.484	1.576				
4.78	1.633	0.517	1.615				

Note:

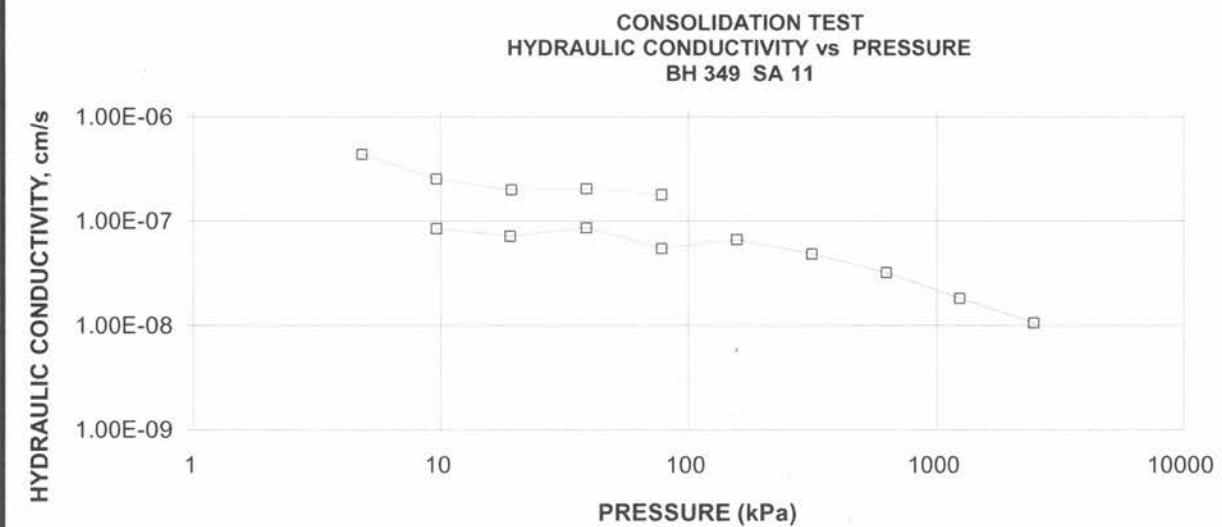
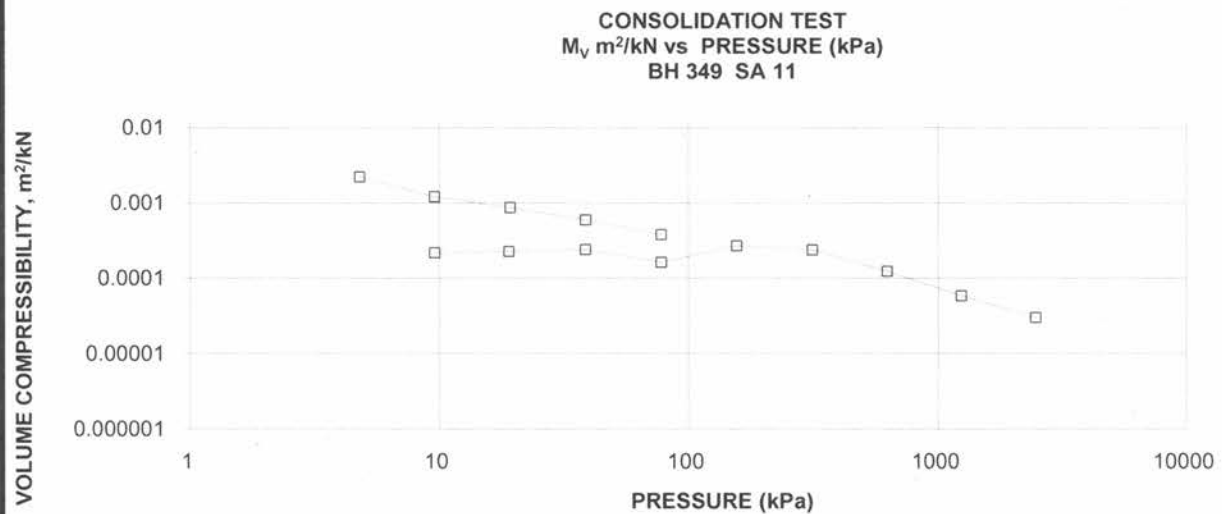
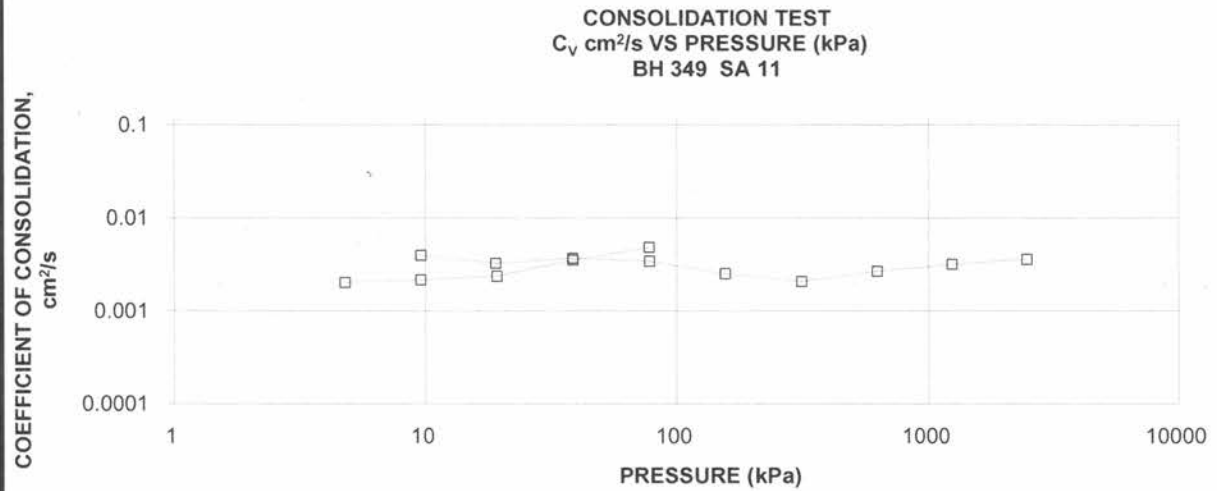
k calculated using cv based on t₉₀ values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.63	Unit Weight, kN/m ³	21.88
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	17.71
Area, cm ²	31.52	Specific Gravity, measured	2.74
Volume, cm ³	51.47	Solids Height, cm	1.076
Water Content, %	23.55	Volume of Solids, cm ³	33.93
Wet Mass, g	114.85	Volume of Voids, cm ³	17.54
Dry Mass, g	92.96		

CONSOLIDATION TEST SUMMARY

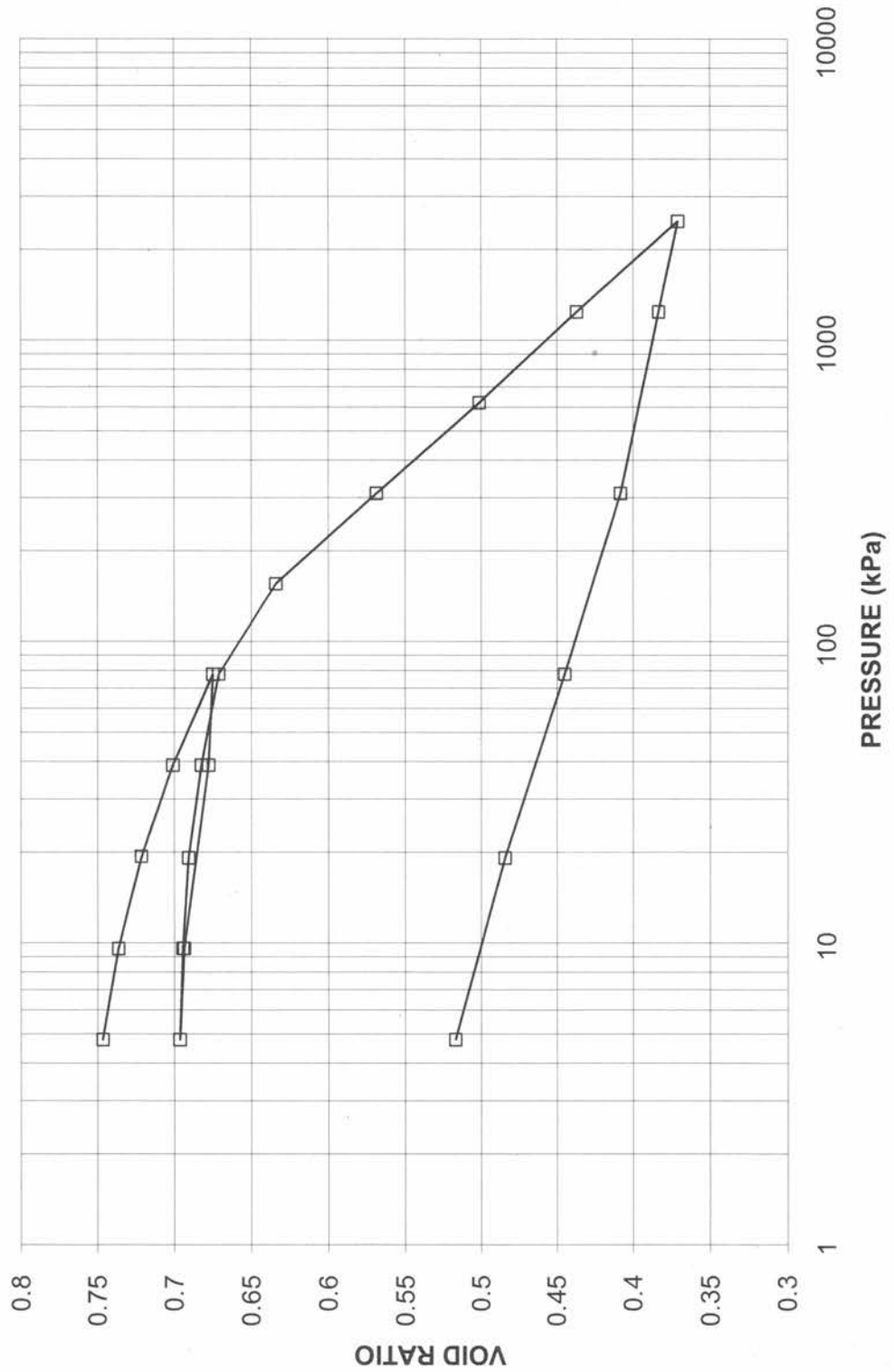
FIGURE BH 349 SA 11 OED B



CONSOLIDATION TEST VOID RATIO VS LOG PRESSURE

FIGURE BH 349 SA 11 OED C

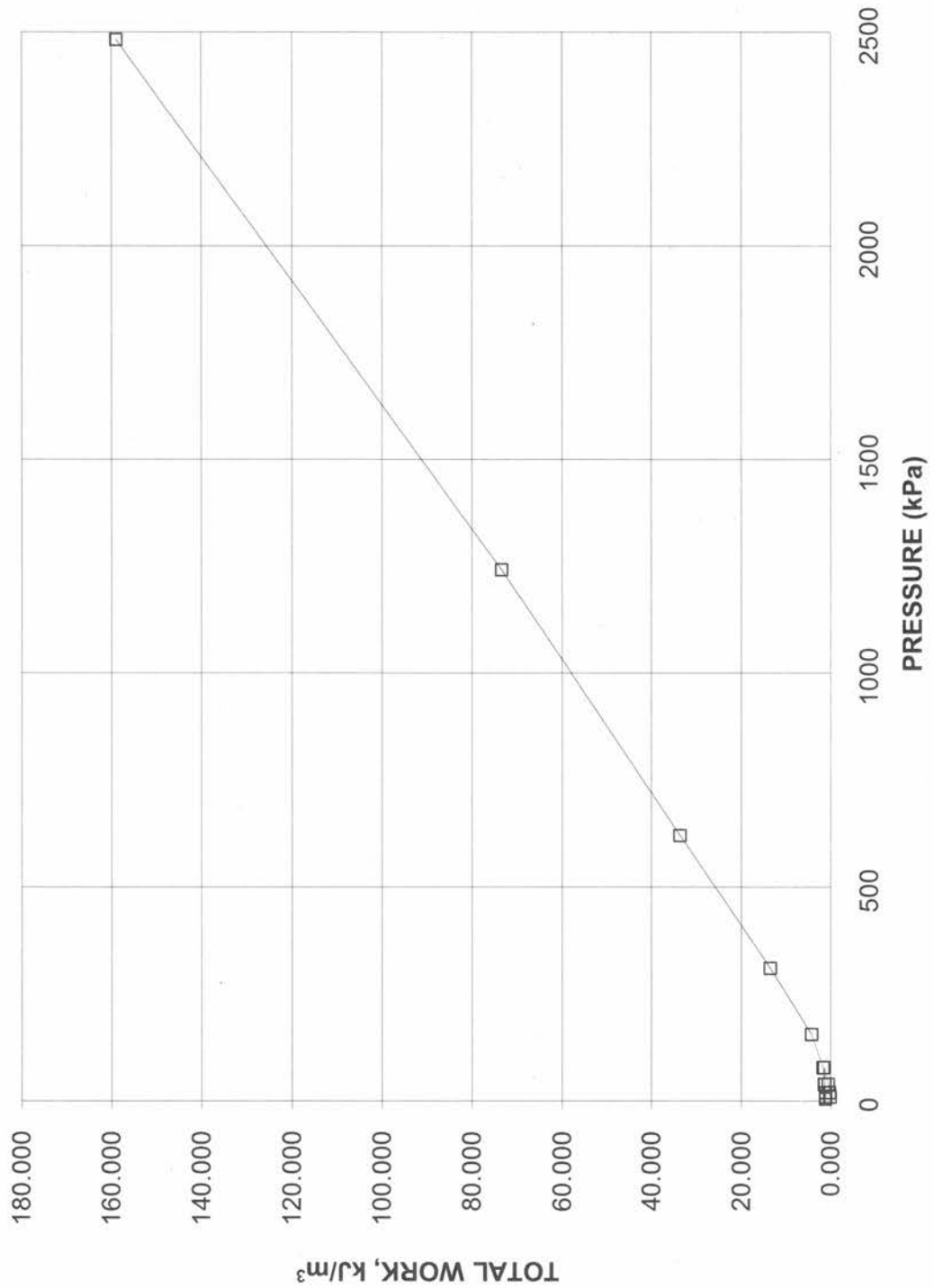
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH 349 SA 11



CONSOLIDATION TEST TOTAL WORK VS PRESSURE

FIGURE BH 349 SA 11 OED D

CONSOLIDATION TEST
TOTAL WORK, kJ/m^3 vs PRESSURE
BH 349 SA 11



Project No. 09-1132-0080

Prepared By: LFG

Golder Associates

Checked By: *SJB*

CONSOLIDATION TEST SUMMARY

FIGURE BH 349 SA 14 OED A

SAMPLE IDENTIFICATION

Project Number	09-1132-0080	Sample Number	14
Borehole Number	349	Sample Depth, m	14.9-15.4

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	4		
Date Started	5/7/2010		
Date Completed	5/27/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m ³	20.50
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	16.95
Area, cm ²	31.57	Specific Gravity, measured	2.73
Volume, cm ³	80.19	Solids Height, cm	1.608
Water Content, %	20.93	Volume of Solids, cm ³	50.77
Wet Mass, g	167.61	Volume of Voids, cm ³	29.42
Dry Mass, g	138.6	Degree of Saturation, %	98.6

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t ₉₀ sec	c _v cm ² /s	mv m ² /kN	k cm/s
0.00	2.540	0.579	2.540				
4.84	2.504	0.557	2.522	1561	8.64E-04	2.94E-03	2.49E-07
9.58	2.494	0.551	2.499	1470	9.01E-04	8.39E-04	7.40E-08
19.47	2.477	0.540	2.485	1135	1.15E-03	6.65E-04	7.52E-08
38.76	2.450	0.524	2.464	1307	9.85E-04	5.45E-04	5.26E-08
77.76	2.418	0.504	2.434	821	1.53E-03	3.28E-04	4.92E-08
155.17	2.369	0.473	2.393	623	1.95E-03	2.49E-04	4.75E-08
77.76	2.376	0.478	2.373				
19.47	2.391	0.487	2.384				
4.77	2.411	0.499	2.401				
9.56	2.405	0.495	2.408	866	1.42E-03	4.68E-04	6.52E-08
19.34	2.400	0.492	2.402	602	2.03E-03	1.89E-04	3.77E-08
38.81	2.391	0.487	2.396	540	2.25E-03	1.76E-04	3.88E-08
77.62	2.380	0.480	2.386	482	2.50E-03	1.17E-04	2.86E-08
155.14	2.360	0.468	2.370	290	4.11E-03	1.01E-04	4.07E-08
310.14	2.309	0.436	2.335	653	1.77E-03	1.29E-04	2.24E-08
621.08	2.245	0.396	2.277	560	1.96E-03	8.13E-05	1.56E-08
1239.69	2.179	0.355	2.212	317	3.27E-03	4.18E-05	1.34E-08
2479.89	2.098	0.305	2.139	581	1.67E-03	2.58E-05	4.22E-09
1239.69	2.108	0.311	2.103				
310.14	2.138	0.330	2.123				
77.62	2.178	0.355	2.158				
19.47	2.218	0.379	2.198				
4.84	2.255	0.402	2.236				

Note:

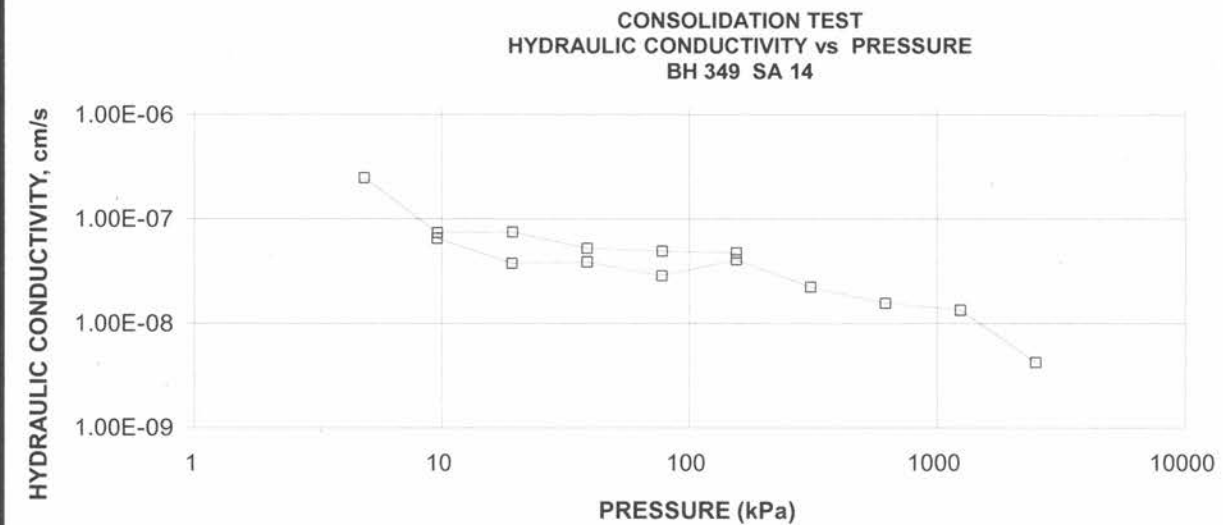
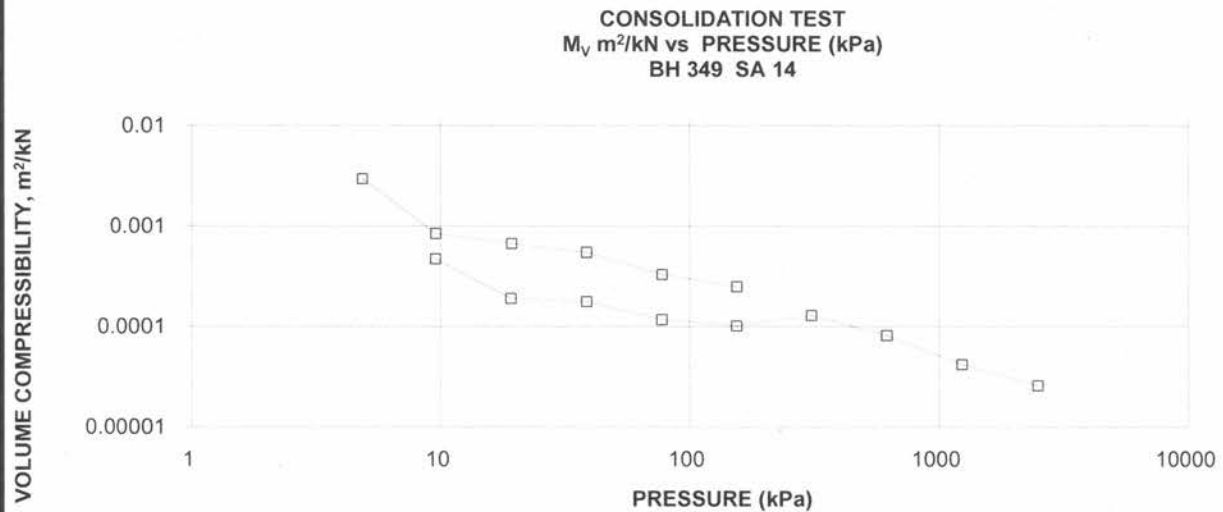
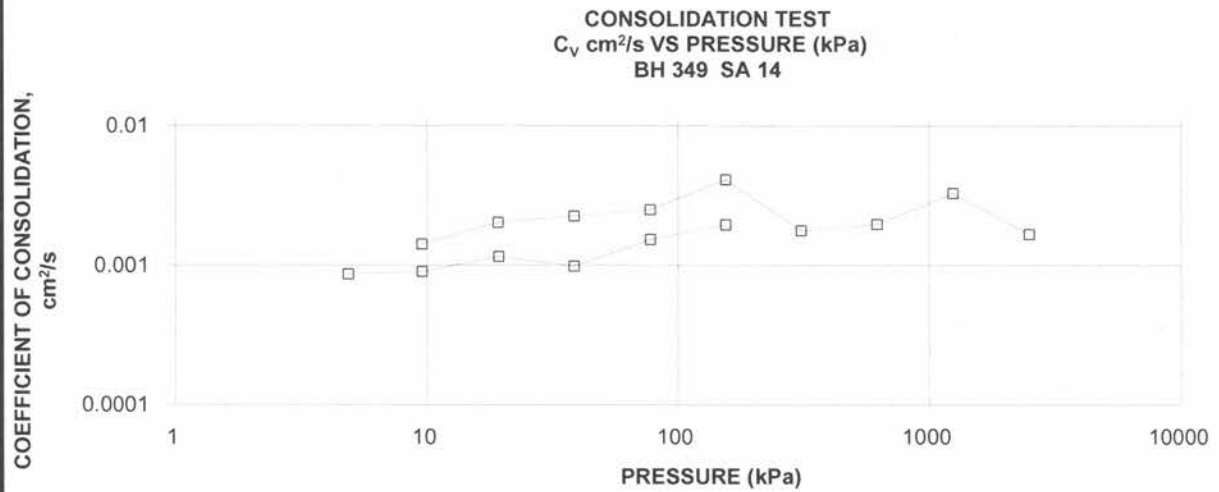
k calculated using c_v based on t₉₀ values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.25	Unit Weight, kN/m ³	22.09
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m ³	19.10
Area, cm ²	31.57	Specific Gravity, measured	2.73
Volume, cm ³	71.17	Solids Height, cm	1.608
Water Content, %	15.66	Volume of Solids, cm ³	50.77
Wet Mass, g	160.30	Volume of Voids, cm ³	20.40
Dry Mass, g	138.6		

CONSOLIDATION TEST SUMMARY

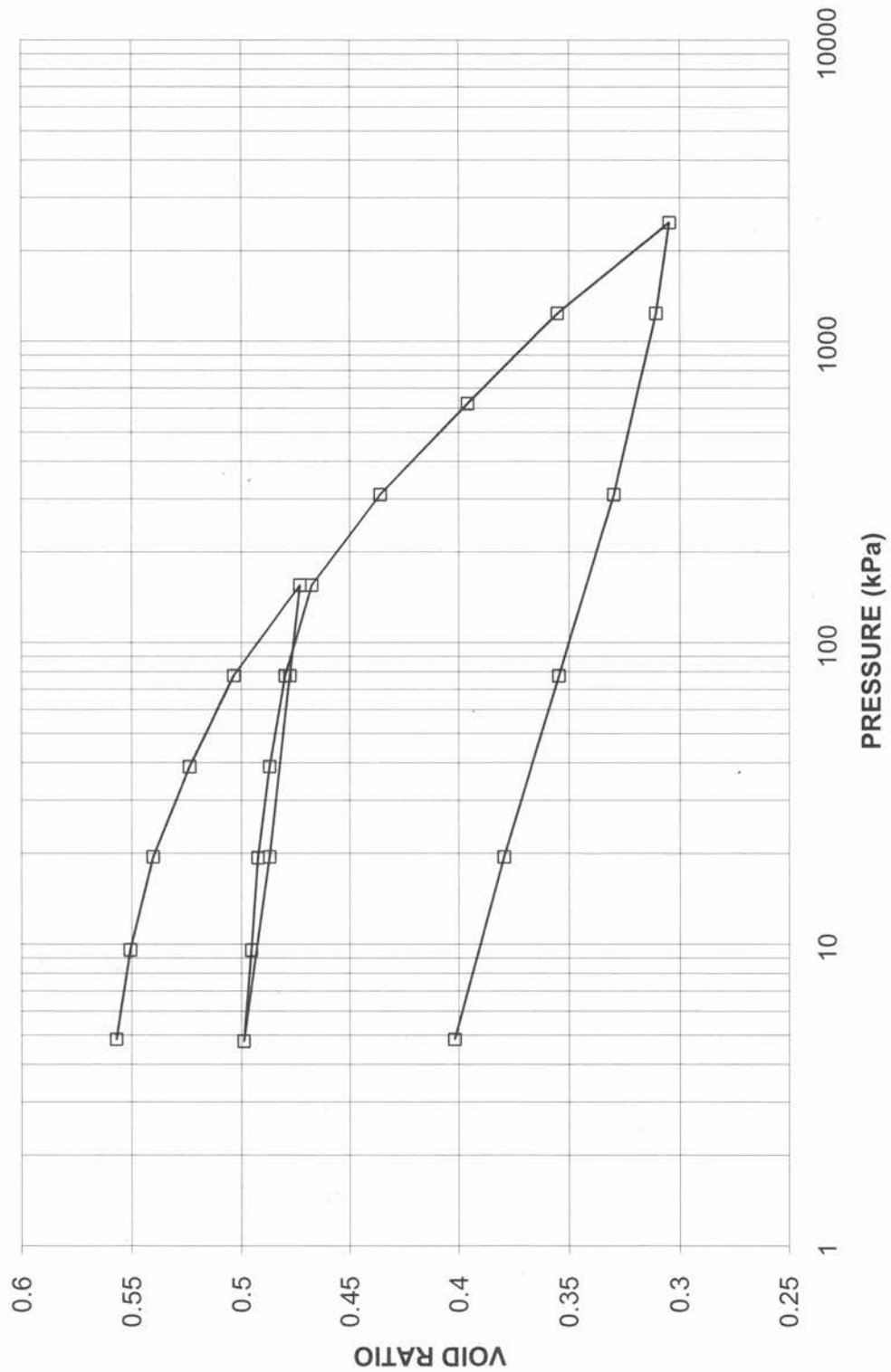
FIGURE BH 349 SA 14 OED B



CONSOLIDATION TEST VOID RATIO VS LOG PRESSURE

FIGURE BH 349 SA 14 OED C

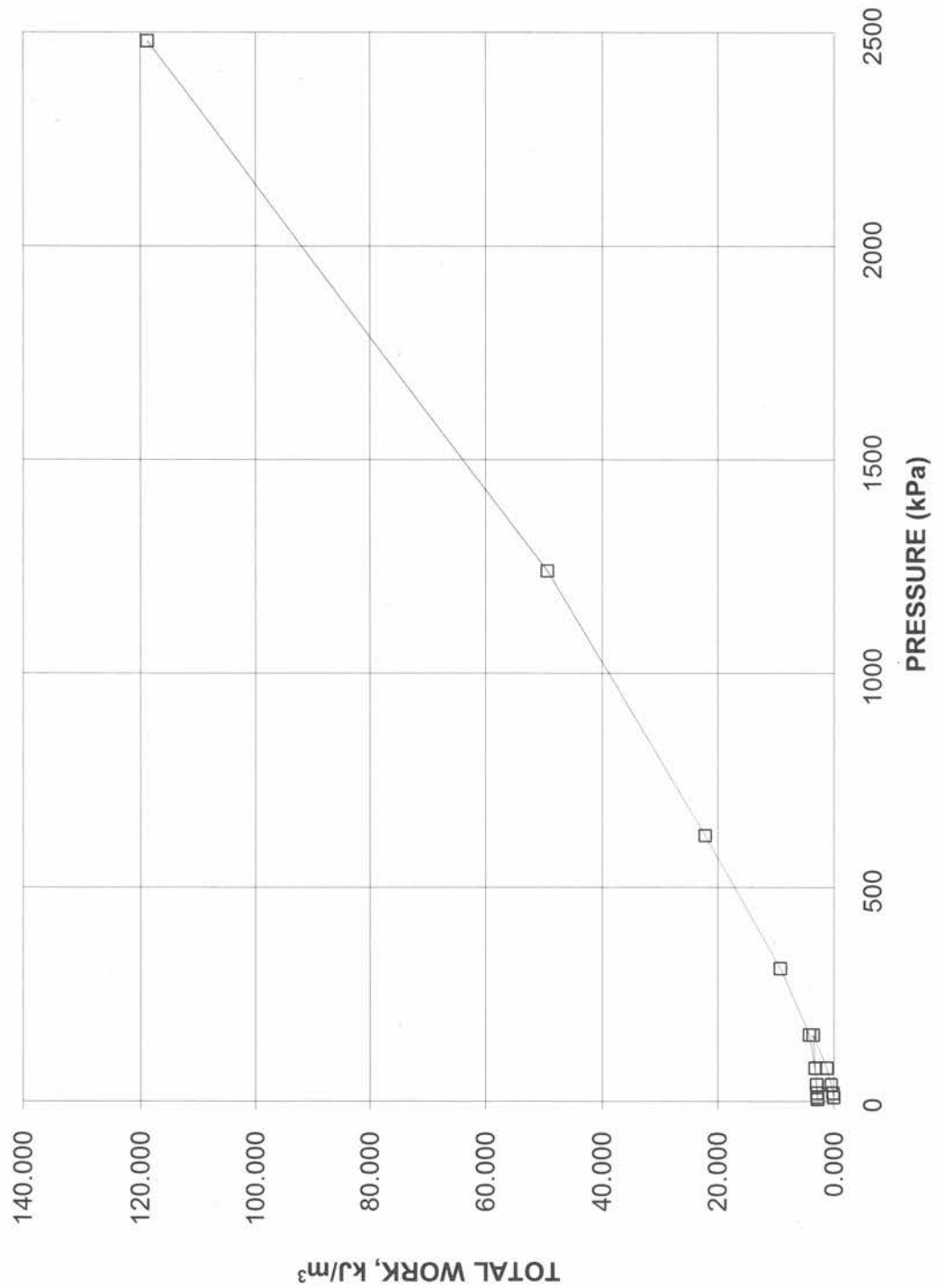
CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH 349 SA 14



CONSOLIDATION TEST TOTAL WORK VS PRESSURE

FIGURE BH 349 SA 14 OED D

CONSOLIDATION TEST
TOTAL WORK, kJ/m^3 vs PRESSURE
BH 349 SA 14





APPENDIX F

**Record of Previous Boreholes and Laboratory Testing
Golder Associates Project No. 09-1132-0039-1000**

PROJECT: 09-1132-0039

RECORD OF DRILLHOLE: **GBH-167**

SHEET 3 OF 3

LOCATION: N 4682025.1 ; E 328316.1

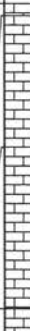
DRILLING DATE: May 25, 2009 - May 28, 2009

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: LANTECH DRILLING SERVICES INC.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	ELEVATION	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough Br - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)		NOTES WATER LEVELS INSTRUMENTATION		
				DEPTH (m)	CORRECTION						RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA		TYPE AND SURFACE DESCRIPTION	CORRECTION	CORRECTION	CORRECTION		CORRECTION				
											TOTAL CORE %	SOLID CORE %			DIP w.r.t. CORE AXIS	CORRECTION							CORRECTION		CORRECTION	CORRECTION
		ROCK SURFACE		154.49																						
25	MUD ROTARY NO ROCK CORE	LIMESTONE, fresh, medium strong, thinly laminated, fine to medium grained, faintly porous, grey - Broken core from 24.54m to 24.66m depth.		24.54 24.66	1					154																
26		LIMESTONE, fresh, medium strong, thinly laminated, very fine to medium grained, faintly porous to porous with pits, mottled dark brown-grey to light grey, fossiliferous		153.06 25.97	2						153															
27		LIMESTONE, fresh, medium strong, thinly laminated, very fine to medium grained, faintly porous to porous with pits, grey, stylolitic, fossiliferous			3						152															
28		LIMESTONE, fresh, medium strong, thinly laminated, fine to medium grained, faintly porous to porous with pits, brown to tannish-grey, fossiliferous END OF DRILLHOLE		151.45 27.58 151.17 27.86																						
29																										
30																										
31																										
32																										
33																										
34																										
35																										
36																										
37																										
38																										
39																										

DEPTH SCALE

1:75


 LOGGED: *ug*
 CHECKED: *SJB*

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 167

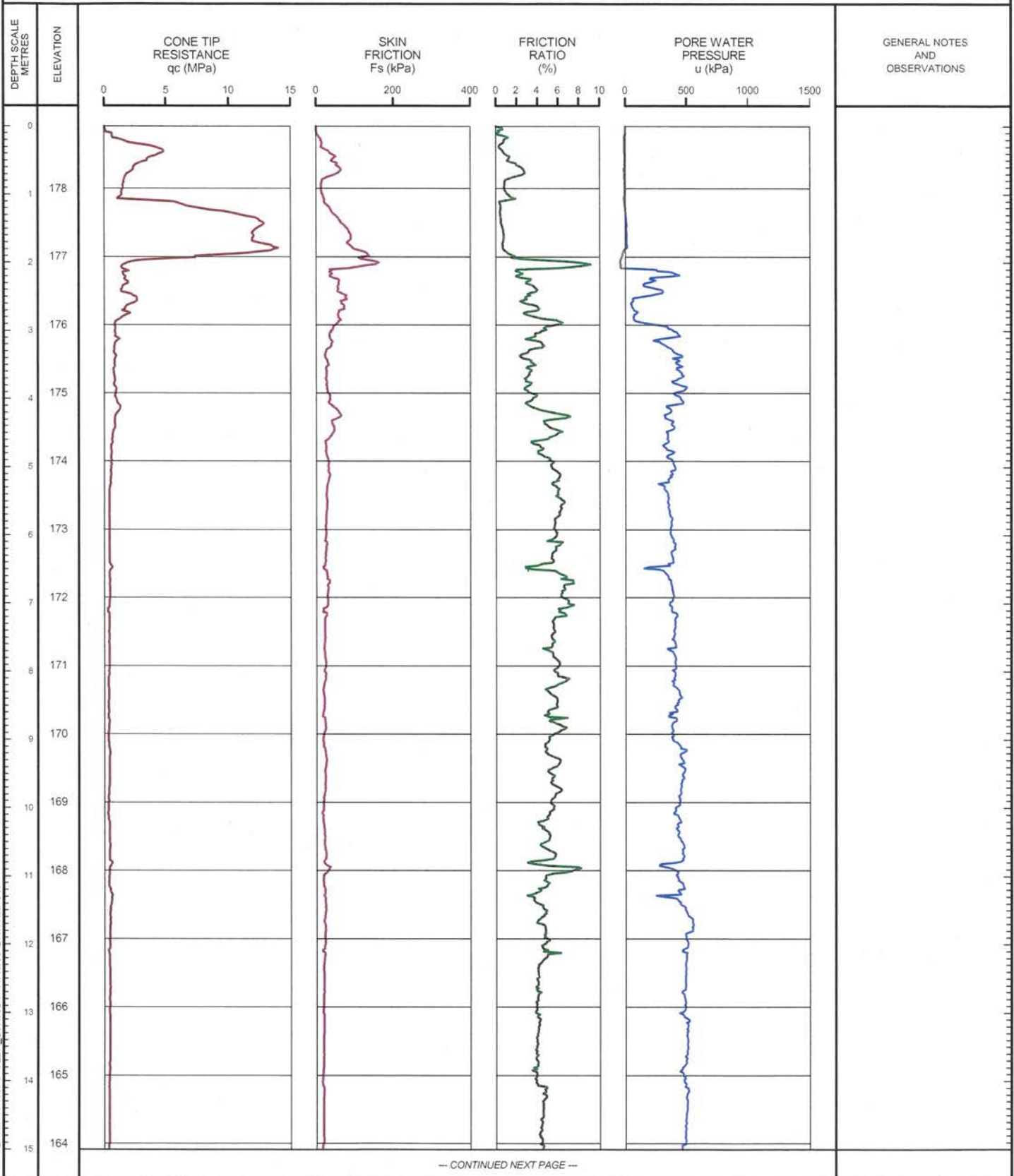
SHEET 1 OF 2

LOCATION: N 4682026.8 ; E 328313.4

TEST DATE: June 3, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.91m PREDRILL DEPTH: 0.00m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



LON_CPT_01 0911320039-CPT.GPJ GLDR_LON.GDT 11/19/09 DATA INPUT:

DEPTH SCALE

1 : 75

OPERATOR: *cu*CHECKED: *SSB*

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 167

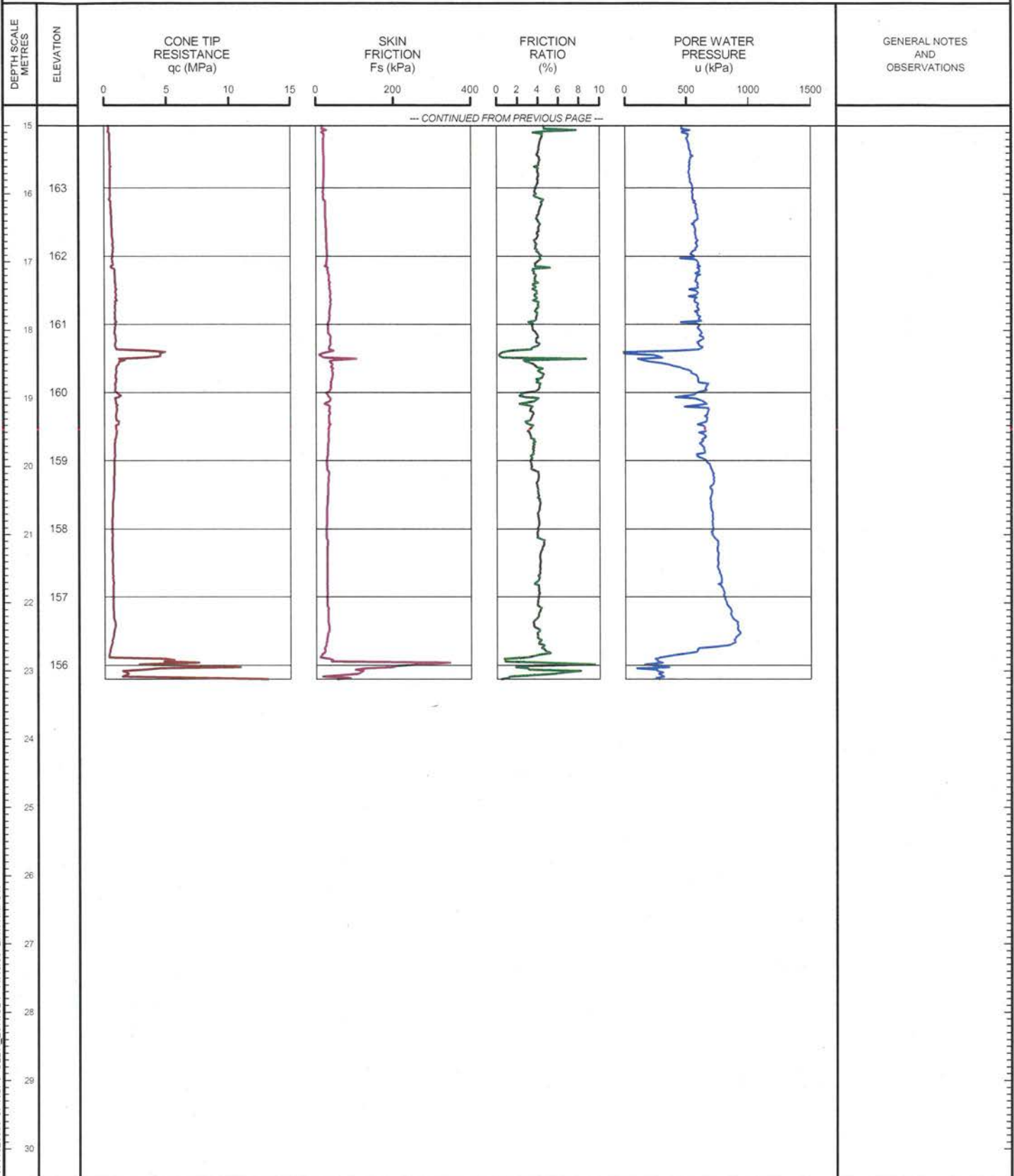
SHEET 2 OF 2

LOCATION: N 4682026.8 ; E 328313.4

TEST DATE: June 3, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.91m PREDRILL DEPTH: 0.00m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



LDN_CPT_01 0911320039-CPT.GPJ GLDR_LON.GDT 11/19/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: CC

CHECKED: SDB

RECORD OF BOREHOLE No CPT-169

1 OF 1

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682229.5 ; E 328208.8

ORIGINATED BY CC

DIST

WEST HWY

BOREHOLE TYPE

POWER AUGER, SOLID STEM

COMPILED BY LMK

DATUM GEODETIC

DATE

June 4, 2009

CHECKED BY *SJB*

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			
178.57	GROUND SURFACE														
0.00	FILL, crushed sand and gravel, Grey														
0.17	FILL, sand and gravel, Brown														
0.46	TOPSOIL, sandy, Black														
0.61	SILTY SAND, trace gravel, trace clay		1	SS	11		178								
177.35	Compact Brown														
1.22	SAND AND GRAVEL		2	SS	19		177								
176.97	Compact, Brown														
1.60	SILT, trace sand														
1.86	Compact, Grey														
	CLAYEY SILT, trace sand, with silt partings		3	SS	11		176								
	Stiff Grey														
175.52	END OF BOREHOLE														
3.05	Groundwater encountered at about elev. 177.37m during drilling on June 4, 2009.														

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 169

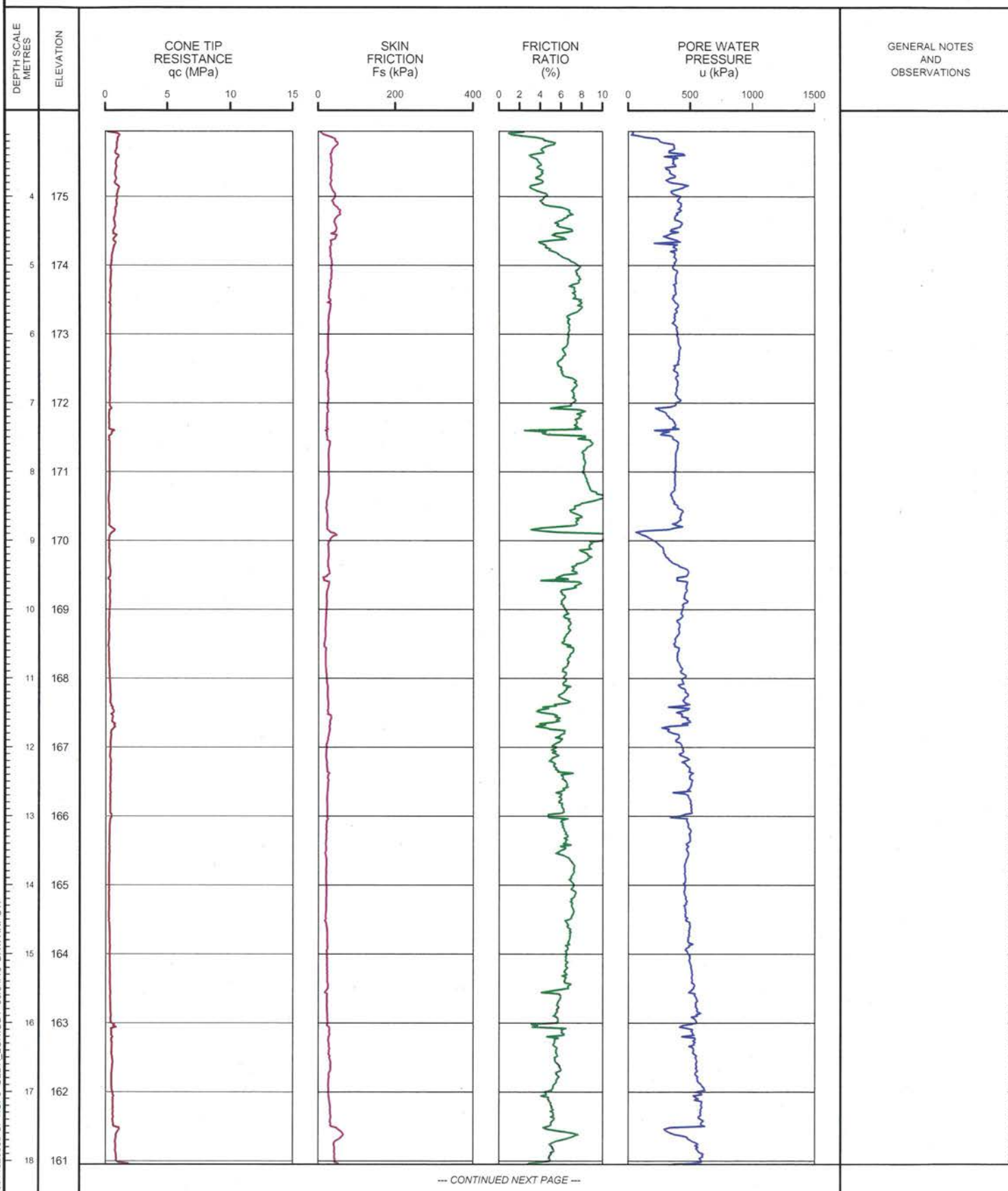
SHEET 1 OF 2

LOCATION: N 4682229.5 ; E 328208.8

TEST DATE: June 4, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.57m PREDRILL DEPTH: 3.05m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



LDN CPT 01 0911320039 CPT GPJ GLDR LON GDT 09/04/10 DATA INPUT

DEPTH SCALE

1 : 75

OPERATOR: *CL*CHECKED: *SJB*

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 169

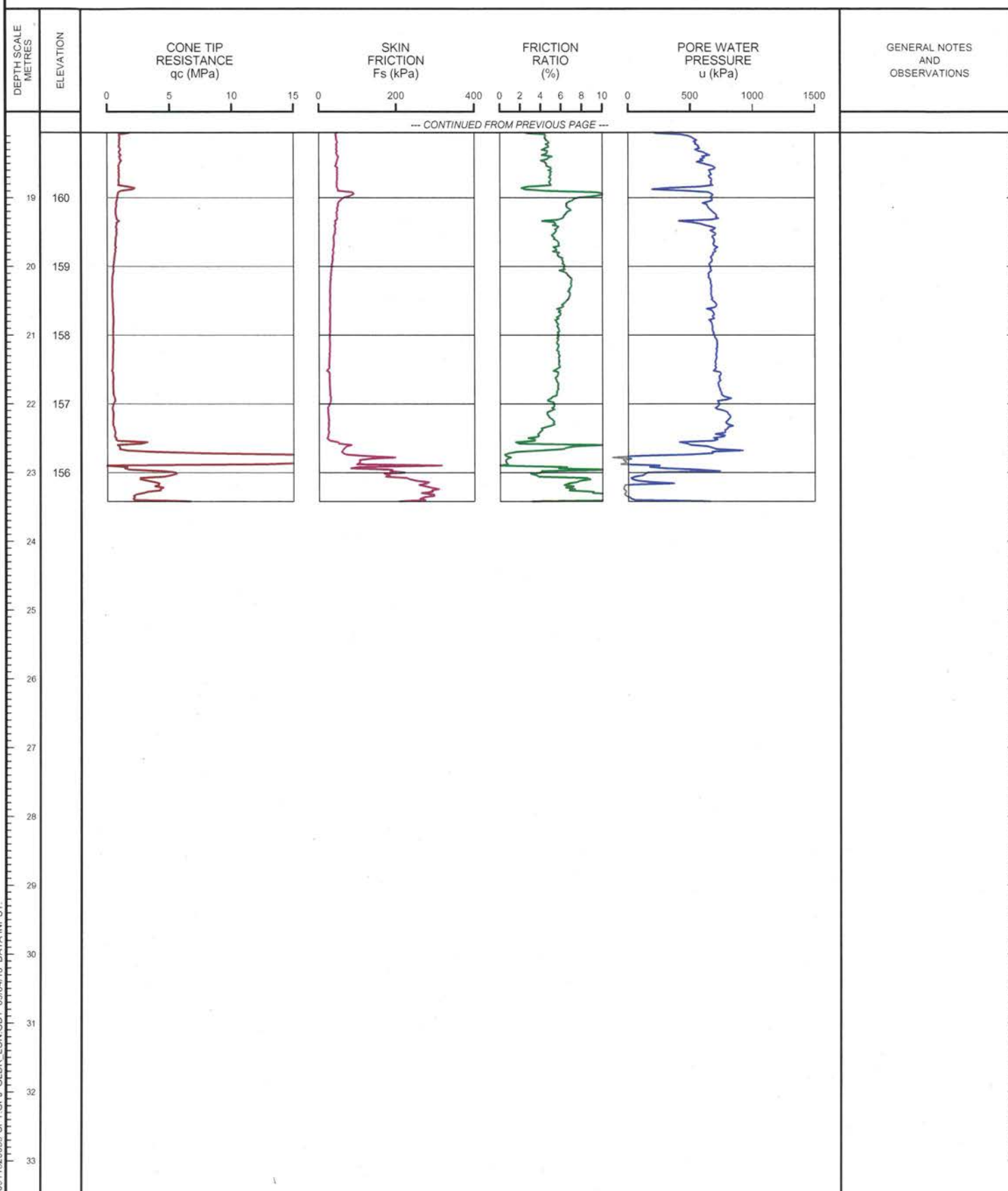
SHEET 2 OF 2

LOCATION: N 4682229.5 ; E 328208.8

TEST DATE: June 4, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.57m PREDRILL DEPTH: 3.05m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



DEPTH SCALE

1: 75

OPERATOR: *CL*
CHECKED: *SSB*

LDN_CPT_01_0911320039-CPT.GPJ GLDR_LON_GDT_090410 DATA INPUT

RECORD OF BOREHOLE No CPT-171

1 OF 1

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682264.8 ; E 328114.3

ORIGINATED BY CC

DIST WEST

HWY

BOREHOLE TYPE

POWER AUGER, SOLID STEM

COMPILED BY LMK

DATUM GEODETIC

DATE

June 4, 2009

CHECKED BY *SB*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
178.14	GROUND SURFACE												
0.00	FILL, recycled aggregate						178						
177.53													
0.61	FILL, concrete												
0.91	FILL, silty sand and gravel, with topsoil and concrete Compact		1	SS	12		177						
176.46	Brown and grey												
1.68	CLAYEY SILT, trace sand, with silt partings Stiff Grey		2	SS	11		176						
			3	SS	9								
175.09													
3.05	END OF BOREHOLE												
	Groundwater encountered at about elev. 175.84m during drilling on June 4, 2009.												

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 171

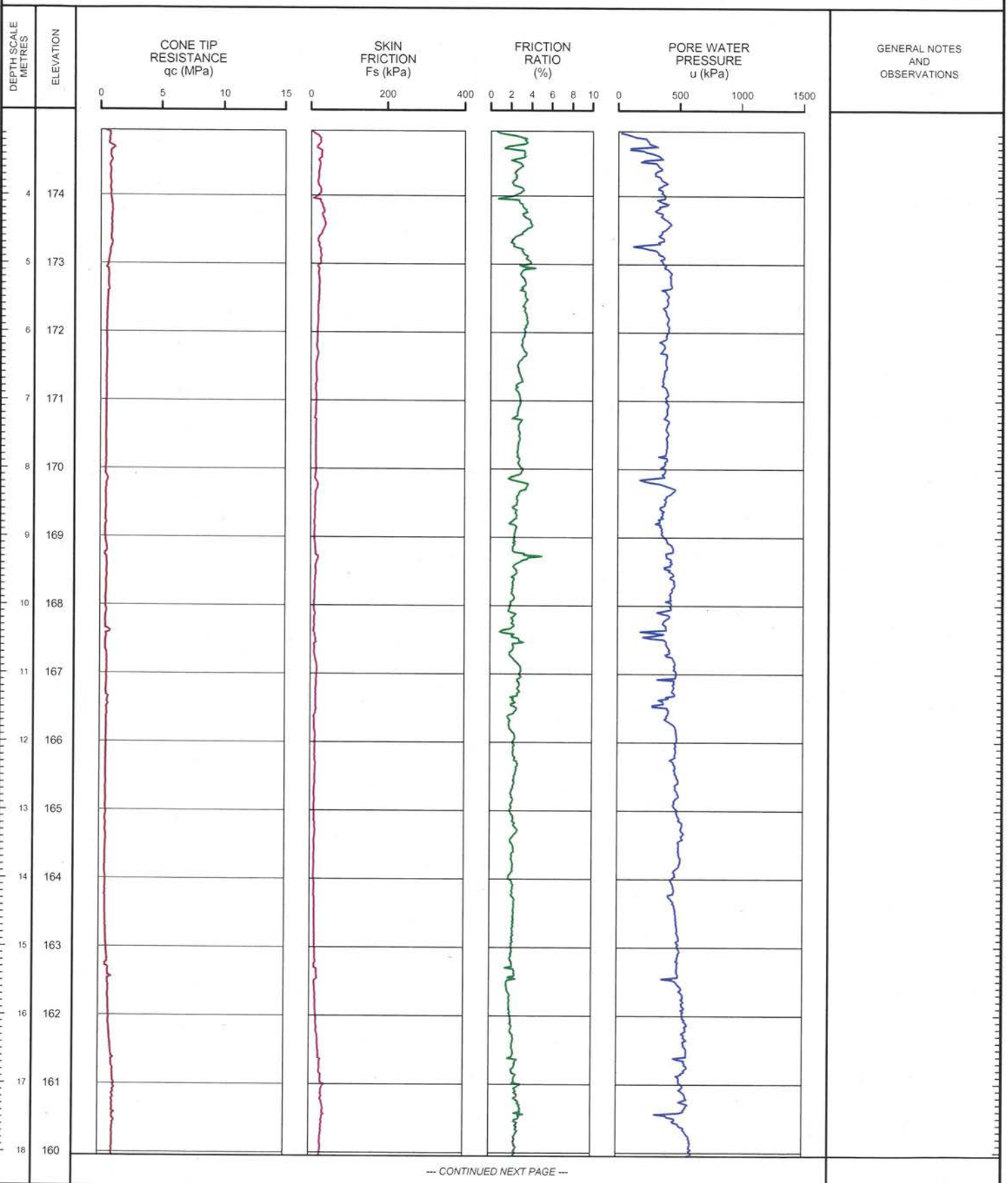
SHEET 1 OF 2

LOCATION: N 4682264.8 ; E 328114.3

TEST DATE: June 4, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.14m PREDRILL DEPTH: 3.05m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



LDN_CPT_01_0911320039-CPT.GPJ GLDR LON GDT 09/04/10 DATA INPUT:

DEPTH SCALE

1 : 75

OPERATOR: *CC*CHECKED: *SJB*

PROJECT: 09-1132-0039

RECORD OF CONE PENETRATION TEST CPT 171

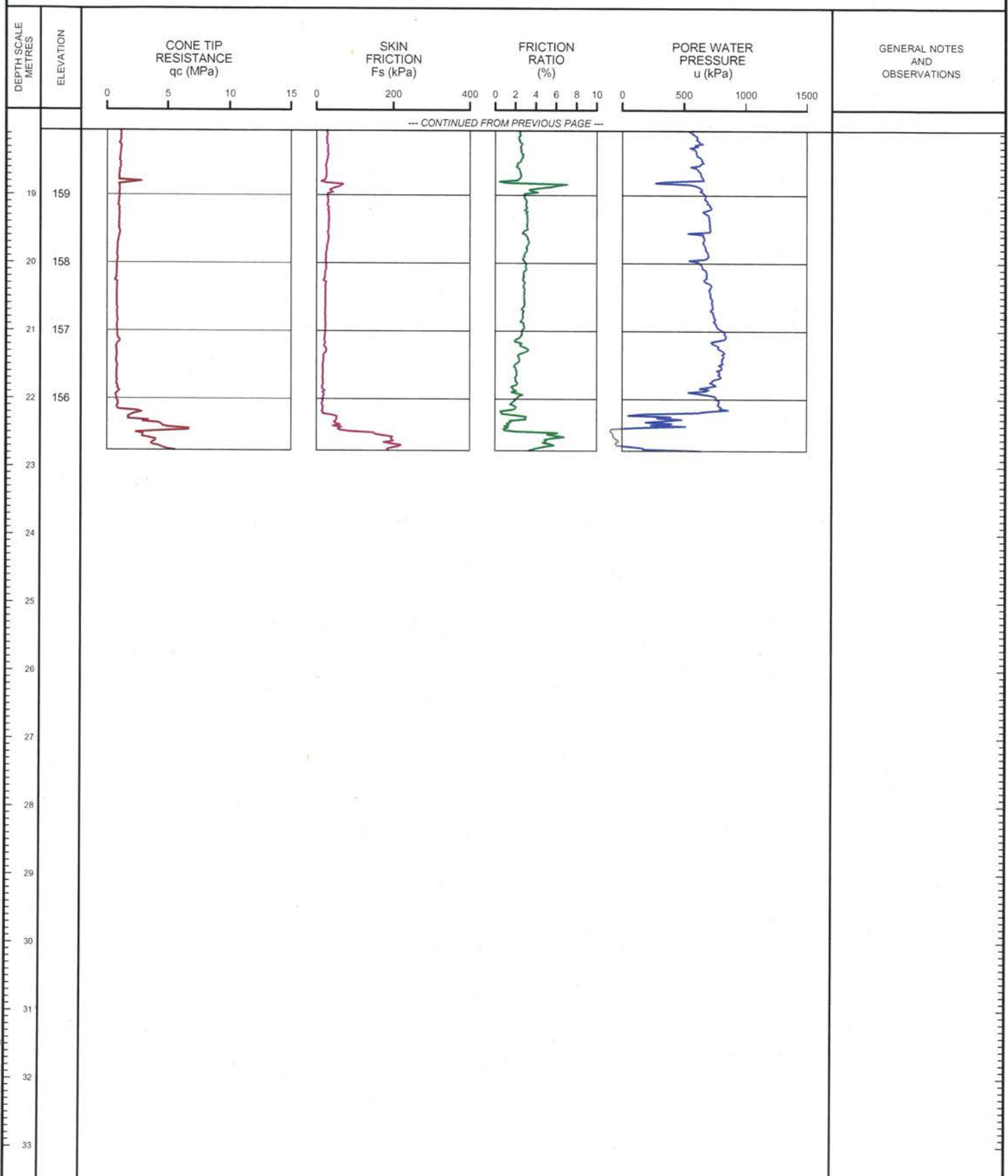
SHEET 2 OF 2

LOCATION: N 4682264.8 ; E 328114.3

TEST DATE: June 4, 2009

DATUM: GEODETIC

GROUND SURFACE ELEVATION: 178.14m PREDRILL DEPTH: 3.05m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012



DEPTH SCALE

1 : 75

OPERATOR: CC
CHECKED: SSB

LDN_CPT_01_0911320039-CPT.GPJ GLDR_LON.GDT 09/04/10 DATA INPUT:

PROJECT 09-1132-0039

RECORD OF BOREHOLE No GBH-172

1 OF 4

METRIC

W.P. LOCATION N 4682120.1 E 328054.0

ORIGINATED BY MR

DIST WEST HWY BOREHOLE TYPE POWER AUGER, HOLLOW STEM, MUD ROTARY WITH NQRC

COMPILED BY DMB

DATUM GEODETTIC DATE May 19, 2009 - May 21, 2009

CHECKED BY **SJS**

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						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								20 40 60 80 100						
178.23	GROUND SURFACE													
0.00	TOPSOIL, silty													
177.83	Black						178							
0.40	FILL, silty sand, some gravel, trace topsoil													
177.16	Very loose, Brown		1	SS	2									
1.07	SAND, some gravel, trace silt						177							
1.37	Very loose, Brown													
176.55	SAND, fine to medium													
1.68	Compact, Grey		2	SS	19									
176.10	SILT, some sand, trace clay													
2.13	Compact, Grey						176							
	CLAYEY SILT, with silt partings		3	SS	6									0 2 76 22
	Firm Grey													
			4	SS	6		175							
174.12														
4.11	SILTY CLAY						174							
	Firm Grey		5	SS	5									
172.90														
5.33	SILTY CLAY TO CLAYEY SILT, some sand, trace gravel						173							
	Soft to stiff Grey		6	SS	3									1 14 33 52
							172							
			7	SS	4									
							171							
			8	SS	3									
							170							
							169							
168.48														
9.75	CLAYEY SILT, some sand, trace gravel						168							
	Firm to stiff Grey		9	SS	4									
							167							
			10	SS	5									
							166							
			11	SS	6		165							4 25 47 27

Continued Next Page

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

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682120.1 :E 328054.0

ORIGINATED BY MR

DIST WEST HWY

BOREHOLE TYPE POWER AUGER, HOLLOW STEM, MUD ROTARY WITH NQRC

COMPILED BY DMB

DATUM GEODETIC

DATE May 19, 2009 - May 21, 2009

CHECKED BY SNB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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 (%)		
							○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			× LAB VANE	W _p	W
							20 40 60 80 100				10 20 30			

	CLAYEY SILT, some sand, trace gravel Firm to stiff Grey						163																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Continued Next Page

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

RECORD OF BOREHOLE No GBH-172

3 OF 4

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682120.1 :E 328054.0

ORIGINATED BY MR

DIST

WEST HWY

BOREHOLE TYPE

POWER AUGER, HOLLOW STEM, MUD ROTARY WITH NQRC

COMPILED BY DMB

DATUM GEODETIC

DATE

May 19, 2009 - May 21, 2009

CHECKED BY *SJB*

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 (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						W _p	W	W _L
							20	40	60	80	100	10	20	30					
							TCR (%)	SCR (%)	RQD (%)										
148.15			20	NQ RC			100	100	100										
30.08	END OF BOREHOLE																		
	Groundwater encountered at about elev. 177.16m during drilling on May 19, 2009.																		
	Artesian water flow and hydrogen sulfide odour encountered during rock coring on May 21, 2009.																		
	Borehole sealed with cement-bentonite grout after coring.																		

PROJECT: 09-1132-0039

RECORD OF DRILLHOLE: **GBH-172**

SHEET 4 OF 4

LOCATION: N 4682120.1 ; E 328054.0

DRILLING DATE: May 19, 2009 - May 21, 2009

DATUM: GEODETIC

INCLINATION: -90°

AZIMUTH: —

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: LANTECH DRILLING SERVICES INC.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm)	FLUSH % RETURN	ELEVATION	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough Br - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
									RECOVERY		R.O.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec					
									TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION							
									50 60 70 80 90 100	50 60 70 80 90 100			50 60 70 80 90 100	50 60 70 80 90 100		10 ⁻⁴ 10 ⁻³ 10 ⁻² 10 ⁻¹				
26	MUD ROTARY NO ROCK CORE	ROCK SURFACE		152.32																
		LIMESTONE, fresh, medium strong, laminated, fine to medium grained, faintly porous, with occasional pits, grey, stylolitic - Broken core from 27.48m to 27.56m depth		25.91				152												
27					1			151												
		LIMESTONE, fresh, medium strong, weakly laminated to laminated, very fine to fine grained, porous, with occasional pits, dark brown to grey, fossiliferous		150.58 27.65				150												
28				2				149												
29																				
30		LIMESTONE, fresh, medium strong, weakly laminated to laminated, fine to medium grained, faintly porous, with occasional pits, grey, occasional fossils, stylolitic		149.06 29.17																
30		END OF DRILLHOLE		148.15 30.08																
31																				
32																				
33																				
34																				
35																				
36																				
37																				
38																				
39																				
40																				

DEPTH SCALE

1 : 75


 LOGGED: *SA/mr*
 CHECKED: *SJB*

LDN_ROCK_03 0911320039-ROCK.GPJ GLDR_LDN.GDT 11/19/09 DATA INPUT: WDF

RECORD OF BOREHOLE No GBH-193

1 OF 3

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682284.0 :E 328306.8

ORIGINATED BY SM

DIST

WEST HWY

BOREHOLE TYPE

POWER AUGER, HOLLOW STEM, MUD ROTARY WITH NQRC

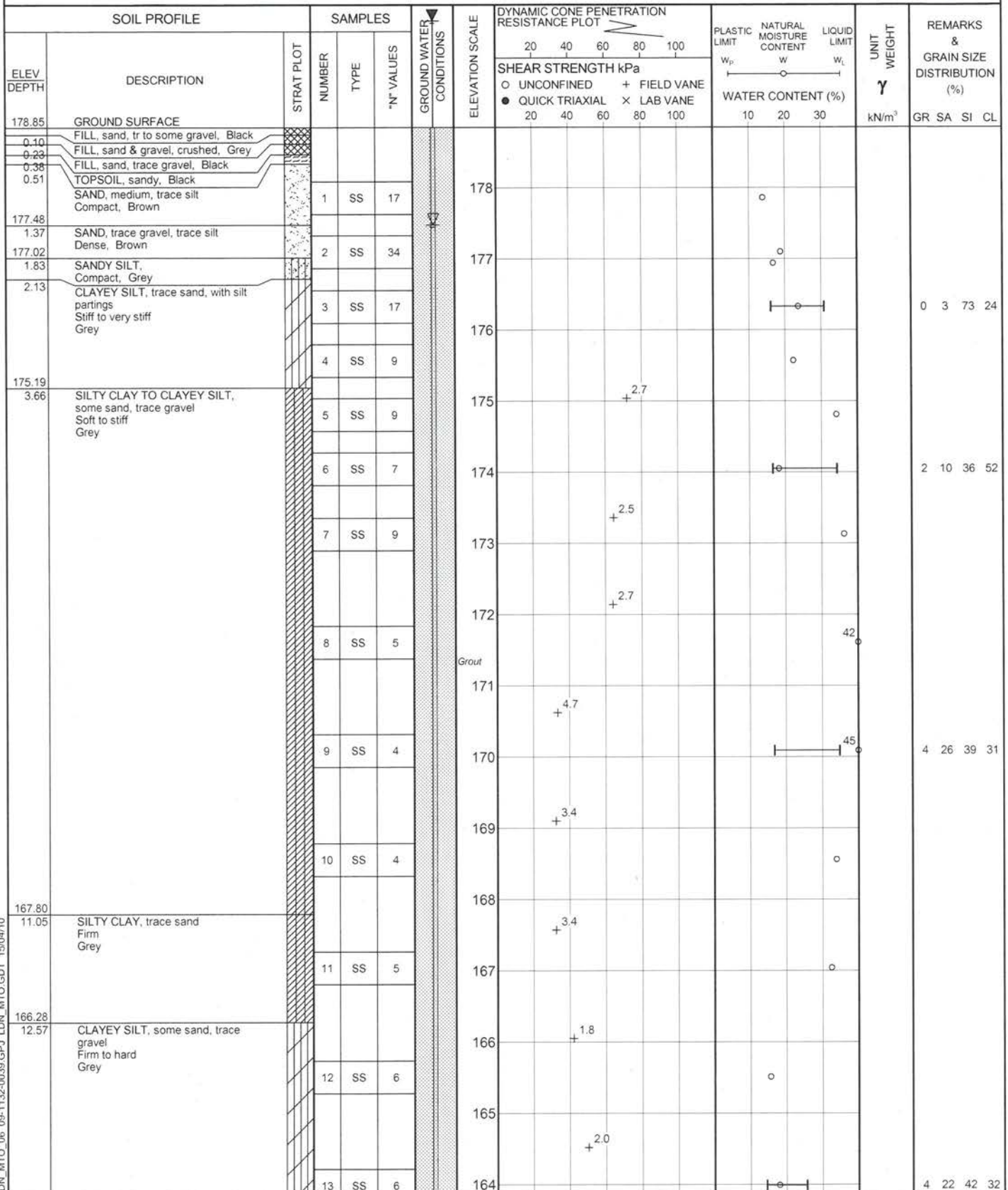
COMPILED BY DMB

DATUM GEODETIC

DATE

June 8, 2009 - June 9, 2009

CHECKED BY



Continued Next Page

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

LDN_MTO_06 09-1132-0039.GPJ LDN_MTO.GDT 15/04/10

METRIC

PROJECT 09-1132-0039

W.P.

LOCATION

N 4682284.0 ;E 328306.8

ORIGINATED BY SM

DIST	WEST	HWY
------	------	-----

BOREHOLE TYPE POWER AUGER, HOLLOW STEM, MUD ROTARY WITH NQRC

COMPILED BY DMB

DATUM GEODETIC

DATE June 8, 2009 - June 9, 2009

CHECKED BY SJB

[illegible]

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

PROJECT: 09-1132-0039

RECORD OF DRILLHOLE: **GBH-193**

SHEET 3 OF 3

LOCATION: N 4682284.0 ;E 328306.8

DRILLING DATE: June 8, 2009 - June 9, 2009

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: LANTECH DRILLING SERVICES INC.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR	% RETURN	ELEVATION	JN - Joint		BD - Bedding		PL - Planar		PO - Polished		Br - Broken Rock		DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION					
											FLT - Fault	SHR - Shear	VN - Vein	CJ - Conjugate	FO - Foliation	CO - Contact	OR - Orthogonal	CL - Cleavage	CU - Curved	UN - Undulating			ST - Stepped	IR - Irregular	K - Slickensided	SM - Smooth	Ro - Rough
											TOTAL CORE %	SOLID CORE %	R.Q.D. %	FRAC INDEX PER 0.3	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec										
		ROCK SURFACE		154.13																							
25	MUD ROTARY NO ROCK CORE	LIMESTONE, slightly weathered, medium strong, thinly laminated, moderately fractured, fine to medium grained, faintly porous, greyish brown, fossiliferous - Broken core from 25.09m to 25.12m, 25.25m to 25.30m, 25.40m to 25.45m and 25.53m to 25.60m depth		24.72						154																	
		153.25		1																							
26		25.60																									
27																											
		LIMESTONE, fresh, medium strong, thinly laminated, moderately fractured, fine to medium grained, faintly porous to vuggy porosity in sections, light tannish grey, fossiliferous		151.47						152																	
28		LIMESTONE, slightly weathered, medium strong, thinly laminated, moderately fractured, fine to medium grained, vuggy porosity, brown-grey, fossiliferous		27.38																							
		END OF DRILLHOLE		150.61						151																	
				28.24																							
29																											
30																											
31																											
32																											
33																											
34																											
35																											
36																											
37																											
38																											
39																											

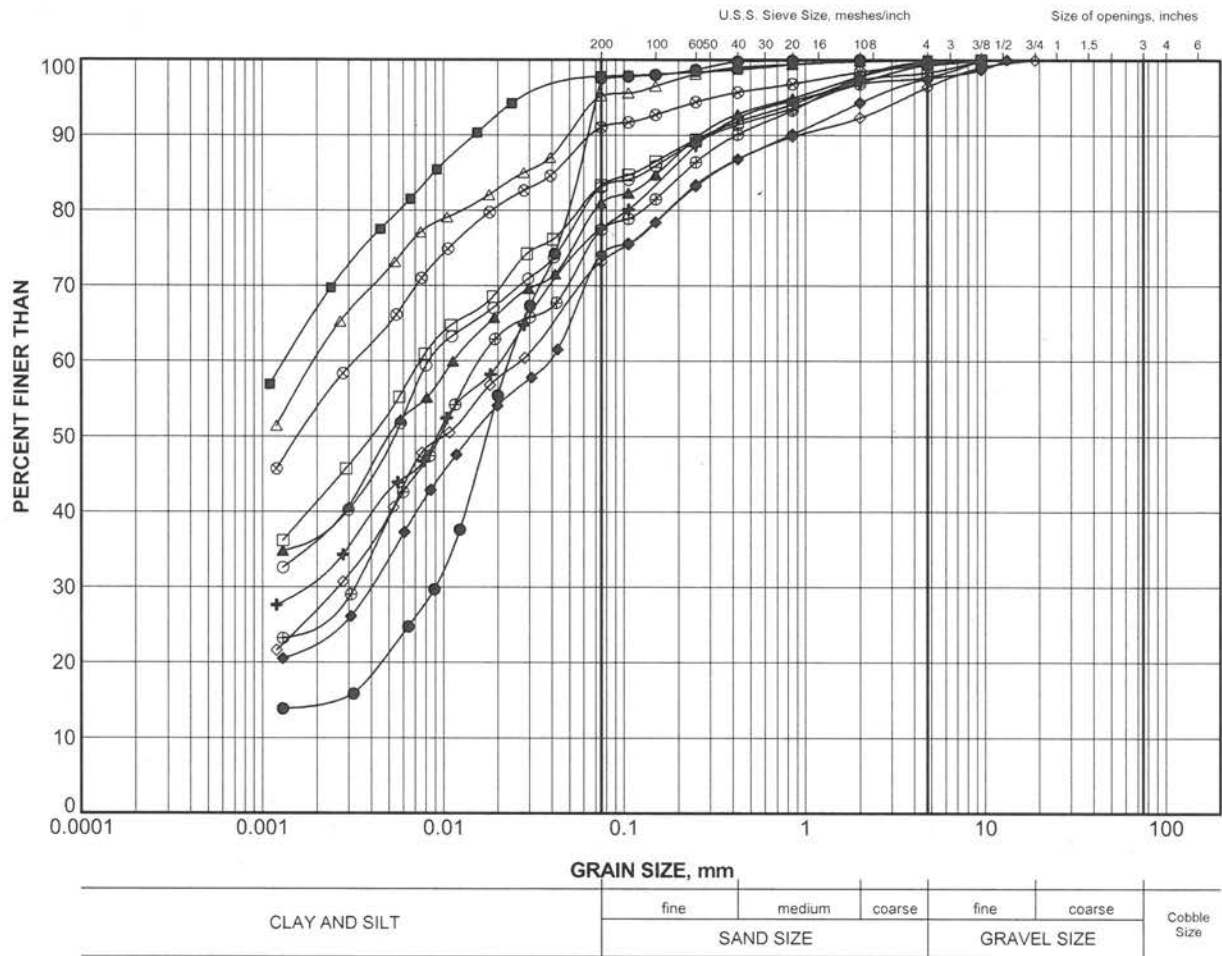
DEPTH SCALE

1 : 75



LOGGED: SM

CHECKED: SJB



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	GBH-167	4	176.7
■	GBH-167	5	174.2
▲	GBH-167	7	171.5
+	GBH-167	9	168.4
◆	GBH-167	11	165.4
◇	GBH-167	12	163.8
○	GBH-167	14	157.7
△	GBH-170	6	172.8
⊗	GBH-170	9	168.3
⊕	GBH-170	12	163.7
□	GBH-170	14	157.6

PROJECT

GEOTECHNICAL DATA REPORT
CANADIAN INSPECTION PLAZA
AND RELATED INFRASTRUCTURE
WINDSOR, ONTARIO

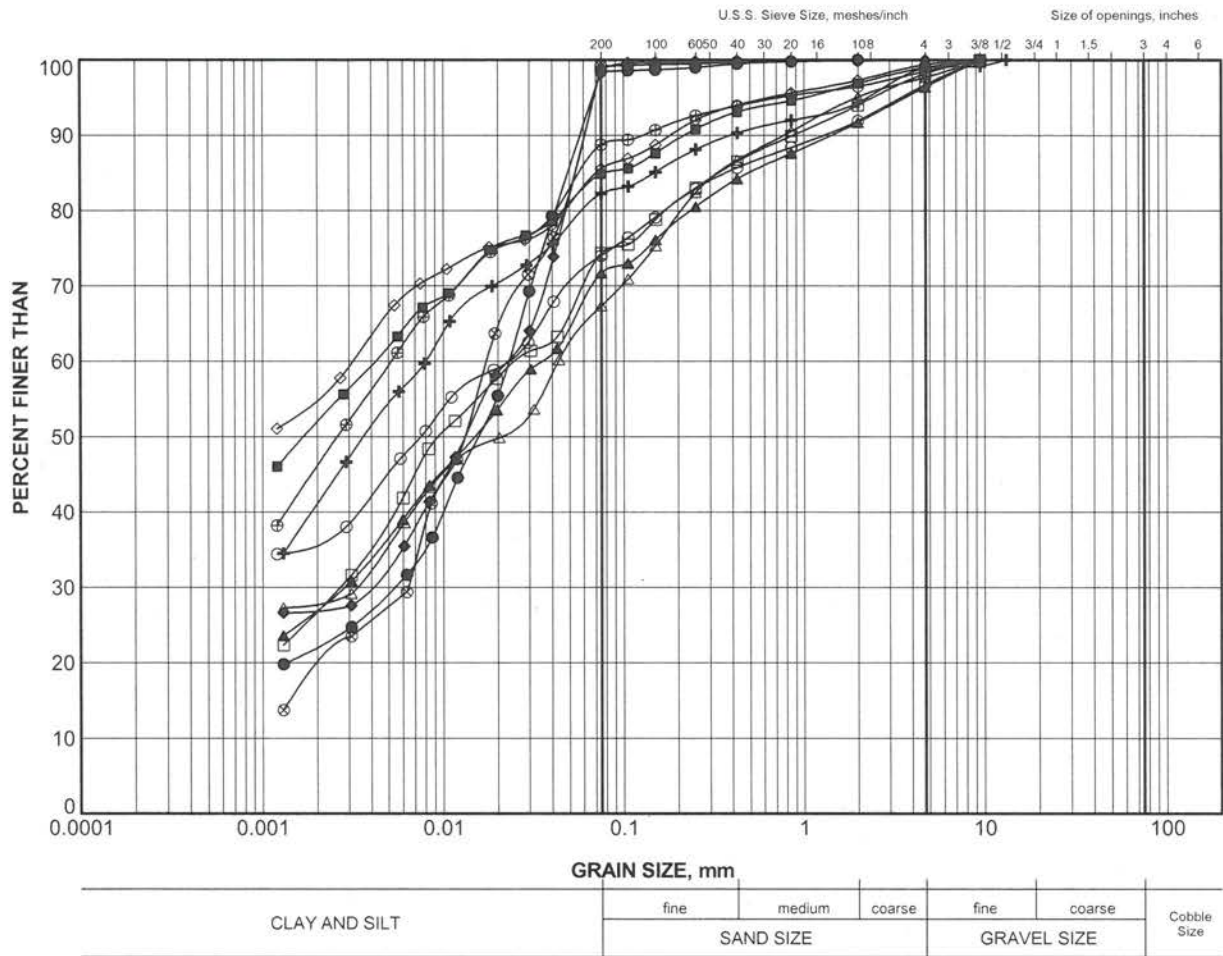
TITLE

GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY



**Golder
Associates**
LONDON, ONTARIO

PROJECT No.	09-1132-0039	FILE No.	0911320039-1000-R020E2
DRAWN	WDF	Apr 9/10	SCALE N/A REV.
CHECK	WDF	Apr 10	FIGURE E-2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	GBH-172	3	175.7
■	GBH-172	6	172.4
▲	GBH-172	11	164.9
+	GBH-172	14	157.3
◆	GBH-176	2	175.6
◇	GBH-176	5	171.4
○	GBH-176	10	163.8
△	GBH-176	13	156.1
⊗	GBH-178	4	175.0
⊕	GBH-178	8	169.4
□	GBH-178	12	163.2

PROJECT

GEOTECHNICAL DATA REPORT
CANADIAN INSPECTION PLAZA
AND RELATED INFRASTRUCTURE
WINDSOR, ONTARIO

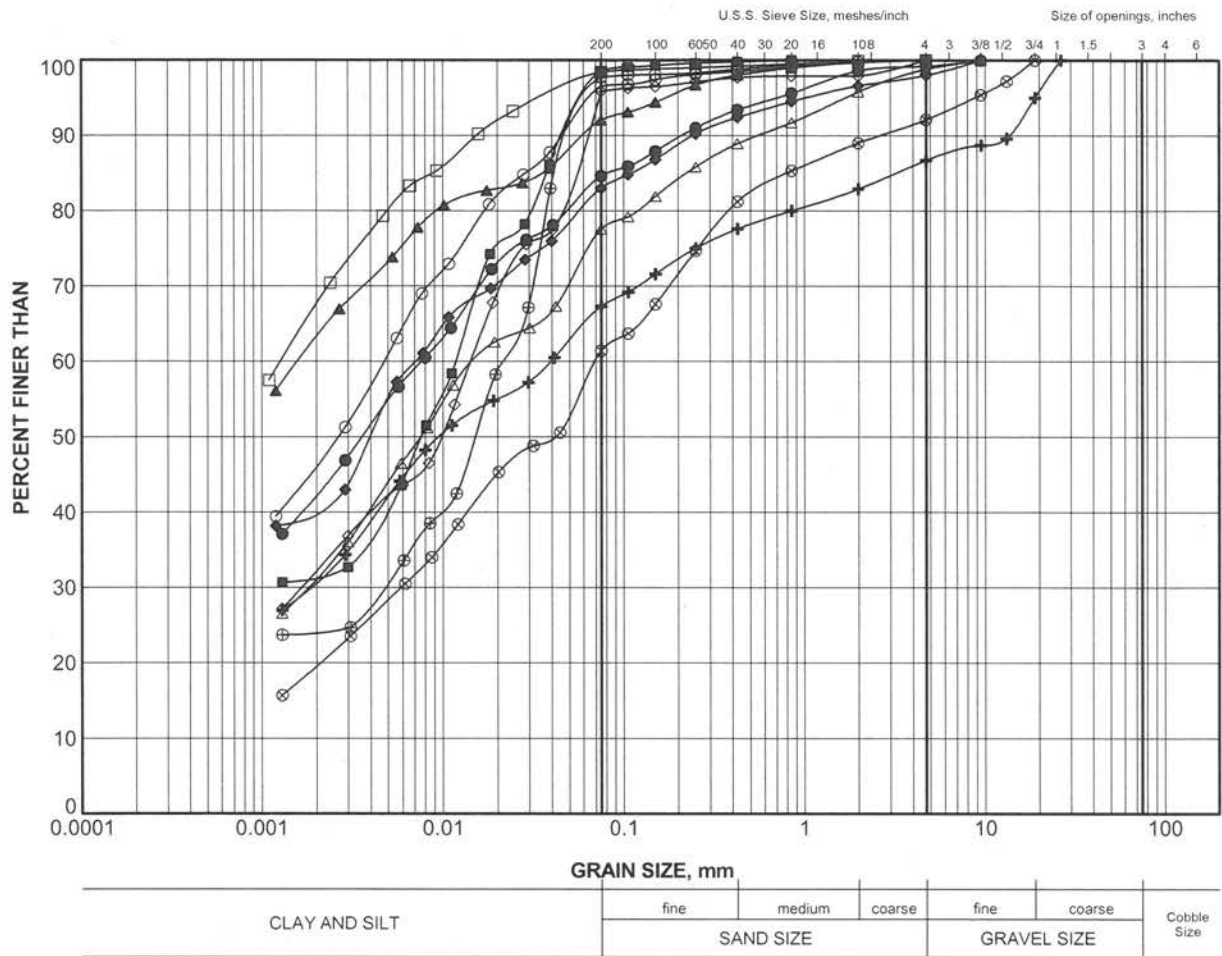
TITLE

GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY



PROJECT No.	09-1132-0039	FILE No.	0911320039-1000-R020E3
DRAWN	WDF	Nov 19/09	SCALE N/A
CHECK	4/13 Apr/10	REV.	

FIGURE E-3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	GBH-178	14	157.2
■	GBH-184	4	174.3
▲	GBH-184	7	170.1
+	GBH-184	11	164.0
◆	GBH-184	14	156.4
◇	GBH-185	3	175.0
○	GBH-185	8	168.6
△	GBH-185	13	159.5
⊗	GBH-185	15	153.4
⊕	GBH-191	3	174.2
□	GBH-191	5	171.9

PROJECT

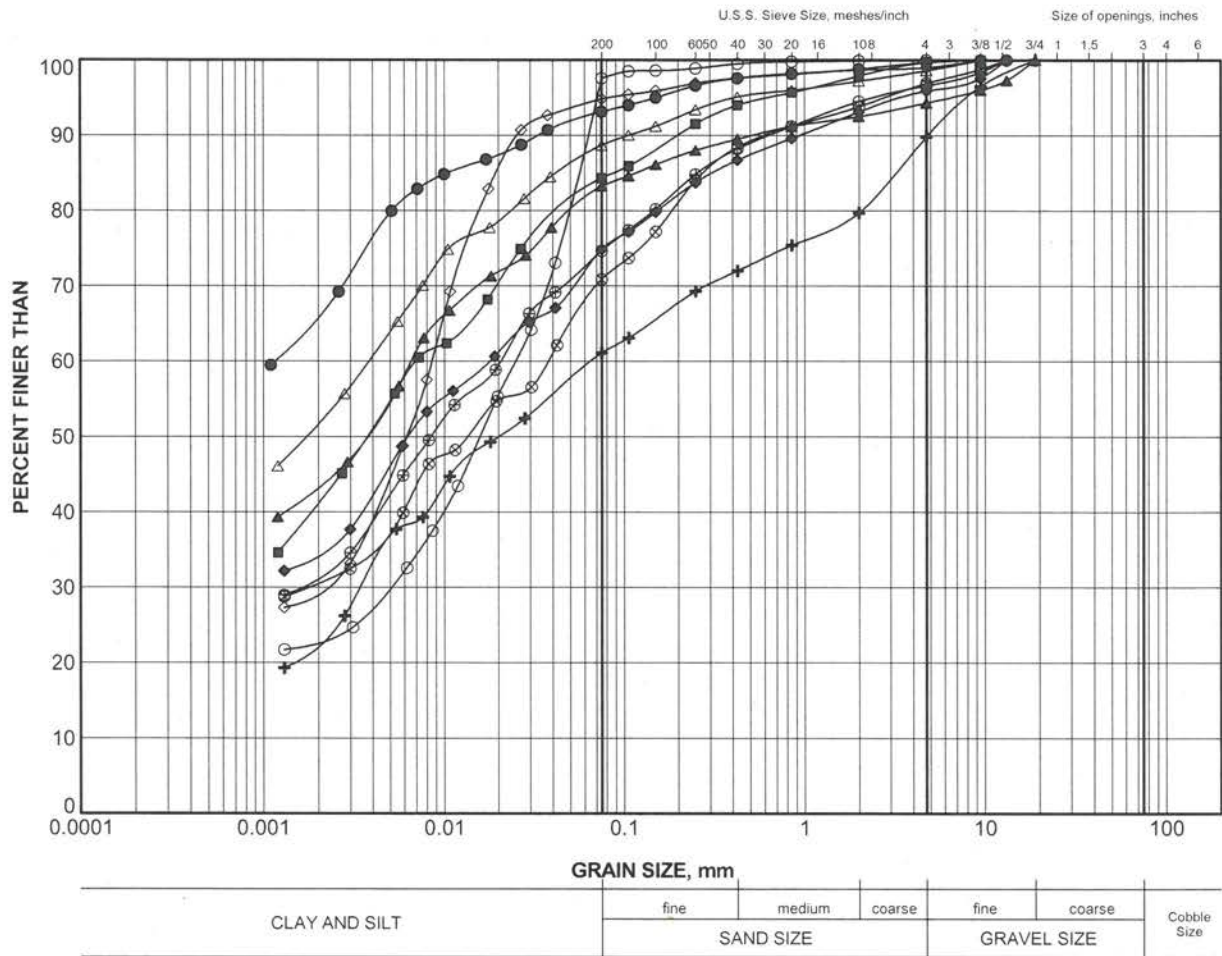
GEOTECHNICAL DATA REPORT
CANADIAN INSPECTION PLAZA
AND RELATED INFRASTRUCTURE
WINDSOR, ONTARIO

TITLE

GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY



PROJECT No.	09-1132-0039	FILE No.	0911320039-1000-R020E4
DRAWN	WDF	Nov 19/09	SCALE N/A REV.
CHECK	SXB	Apr 1/10	FIGURE E-4



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	GBH-191	6	170.9
■	GBH-191	9	166.3
▲	GBH-191	10	164.8
+	GBH-191	12	161.7
◆	GBH-191	13	158.7
◇	GBH-191	15	152.6
○	GBH-193	3	176.3
△	GBH-193	6	174.1
⊗	GBH-193	9	170.1
⊕	GBH-193	13	164.0

PROJECT

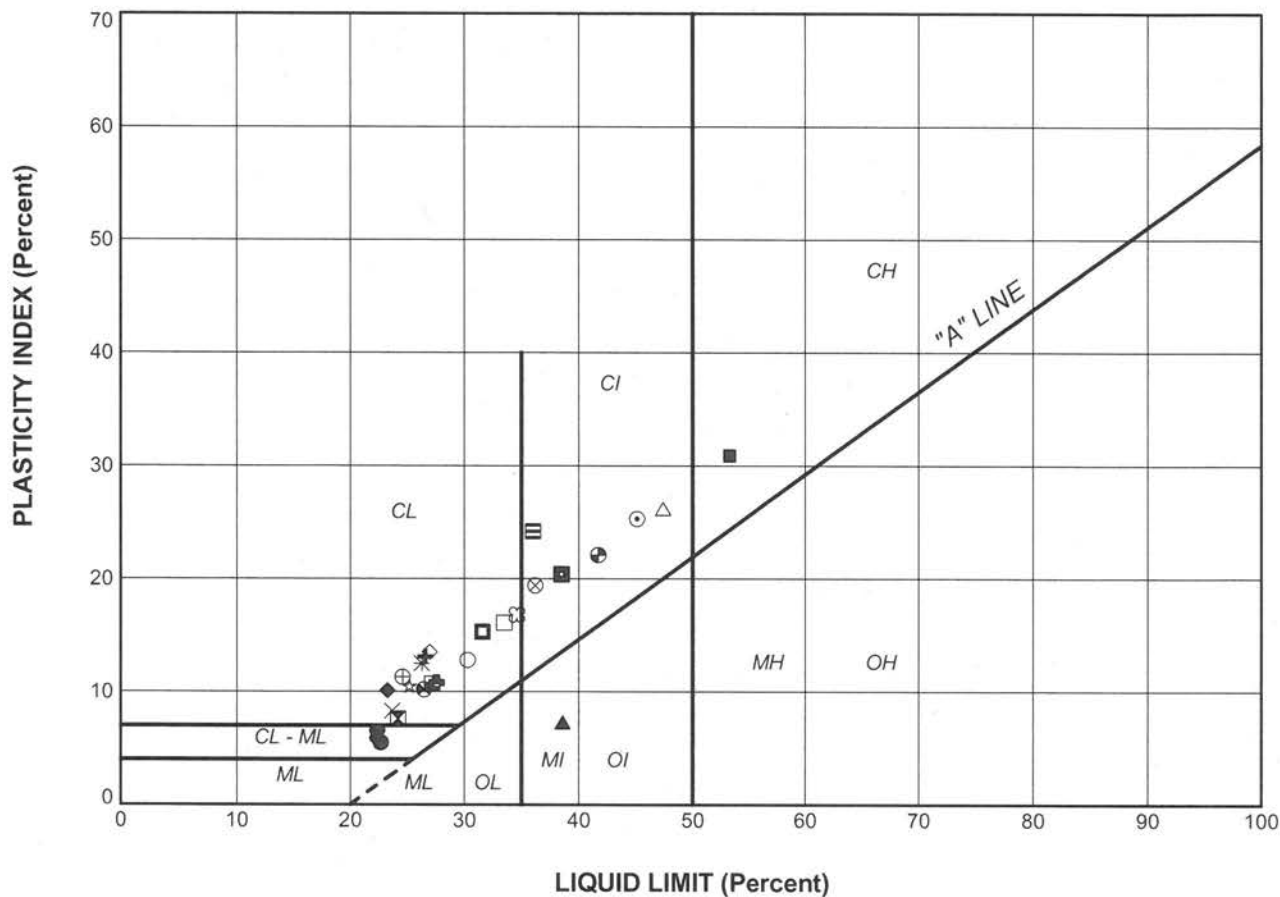
GEOTECHNICAL DATA REPORT
CANADIAN INSPECTION PLAZA
AND RELATED INFRASTRUCTURE
WINDSOR, ONTARIO

TITLE

GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY




PROJECT No.	09-1132-0039	FILE No.	0911320039-1000-R020E5
DRAWN	WDF	Nov 19/09	SCALE N/A REV.
CHECK	SJB	Apr 1/10	FIGURE E-5

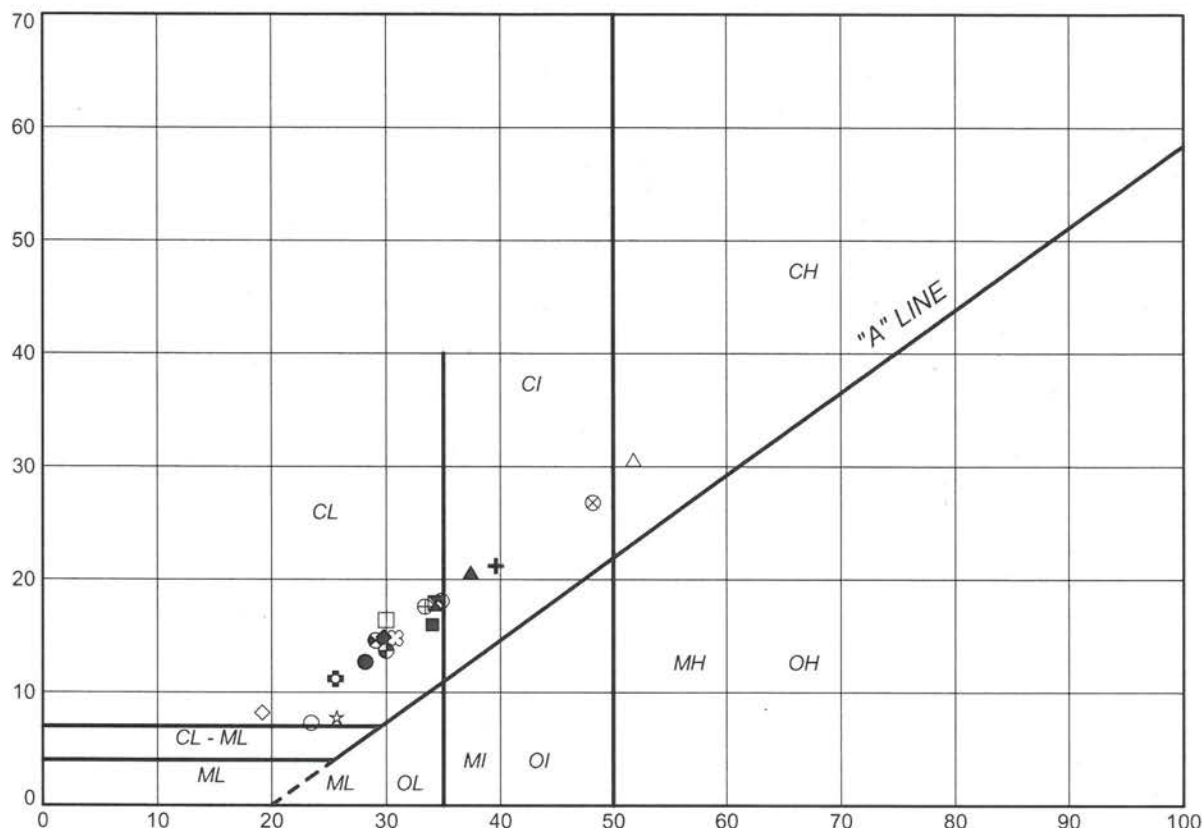


LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	GBH-167	4	22.7	17.2	5.5
■	GBH-167	5	53.3	22.4	30.9
▲	GBH-167	7	38.6	31.3	7.3
+	GBH-167	9	26.6	13.5	13.1
◆	GBH-167	11	23.3	13.2	10.1
◇	GBH-167	12	27.0	13.5	13.5
○	GBH-167	14	30.3	17.5	12.8
△	GBH-170	6	47.4	21.2	26.2
⊗	GBH-170	9	36.2	16.8	19.4
⊕	GBH-170	12	24.6	13.3	11.3
□	GBH-170	14	33.5	17.4	16.1
⊙	GBH-172	3	26.5	16.3	10.2
⊗	GBH-172	6	41.7	19.6	22.1
*	GBH-172	11	25.2	14.7	10.5
⊗	GBH-172	14	34.6	17.8	16.8
⊕	GBH-176	2	24.2	16.6	7.6
⊗	GBH-176	5	45.1	19.8	25.3
⊕	GBH-176	10	27.6	16.8	10.8
×	GBH-176	13	23.7	15.4	8.3
■	GBH-178	4	22.4	16.2	6.2
■	GBH-178	8	38.5	18.1	20.4
*	GBH-178	11	26.3	13.8	12.5
□	GBH-178	14	31.6	16.3	15.3
⊕	GBH-184	4	27.2	16.5	10.7
⊕	GBH-184	7	36.0	11.8	24.2

PROJECT				GEOTECHNICAL DATA REPORT CANADIAN INSPECTION PLAZA AND RELATED INFRASTRUCTURE WINDSOR, ONTARIO			
TITLE				PLASTICITY CHART			
PROJECT No.		09-1132-0039		FILE No.		0911320039-1000-R020E6	
DRAWN		WDF		SCALE		N/A	
CHECK		583		REV.		APR 110	
 Golder Associates LONDON, ONTARIO				FIGURE E-6			

PLASTICITY INDEX (Percent)




LIQUID LIMIT (Percent)

SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	GBH-184	11	28.2	15.5	12.7
■	GBH-184	14	34.0	18.0	16.0
▲	GBH-185	3	37.4	16.8	20.6
+	GBH-185	8	39.6	18.4	21.2
◆	GBH-185	13	29.8	14.9	14.9
◇	GBH-185	15	19.2	11.0	8.2
○	GBH-191	3	23.5	16.2	7.3
△	GBH-191	5	51.8	21.2	30.6
⊗	GBH-191	6	48.2	21.4	26.8
⊕	GBH-191	9	33.4	15.8	17.6
□	GBH-191	10	30.0	13.6	16.4
⊙	GBH-191	12	29.1	14.5	14.6
⊛	GBH-191	13	30.0	16.3	13.7
☆	GBH-191	15	25.7	17.9	7.8
⊞	GBH-193	3	30.8	16.0	14.8
⊟	GBH-193	6	34.3	16.4	17.9
⊠	GBH-193	9	34.8	16.7	18.1
⊡	GBH-193	13	25.6	14.4	11.2

PROJECT				GEOTECHNICAL DATA REPORT CANADIAN INSPECTION PLAZA AND RELATED INFRASTRUCTURE WINDSOR, ONTARIO			
TITLE				PLASTICITY CHART			
PROJECT No.		09-1132-0039		FILE No.		0911320039-1000-R020E7	
DRAWN		WDF		SCALE		N/A	
CHECK		SDB		REV.		REV.	
		Nov 12/09					
		Apr 1/10					
 Golder Associates LONDON, ONTARIO				FIGURE E-7			



APPENDIX G

Results of Analytical Laboratory Testing

Your C.O.C. #: 541628-01-01

Attention:Dirka U. Prout

Golder Associates Ltd
309 Exeter Rd
Unit 1
London, ON
N6L 1C1

Report Date: 2015/12/11

Report #: R3802879

Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5P0837

Received: 2015/12/07, 09:10

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	1	N/A	2015/12/10	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2015/12/10	CAM SOP-00414	OMOE E3138 v2 m
pH CaCl2 EXTRACT	1	2015/12/10	2015/12/10	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	1	2015/12/07	2015/12/10	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	1	N/A	2015/12/10	CAM SOP-00464	EPA 375.4 m
Redox Potential (1)	1	2015/12/08	2015/12/09	SLA SOP-00101	In house

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Sladeview Petrochemical

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Sara Singh, B.Sc, Senior Project Manager

Email: sarasingh@maxxam.ca

Phone# (905)817-5730

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

SOIL CORROSIVITY PACKAGE (SOIL)

Maxxam ID		BMB537	BMB537		
Sampling Date		2015/11/16 14:00	2015/11/16 14:00		
COC Number		541628-01-01	541628-01-01		
	UNITS	BH101-SA6 15-16½'	BH101-SA6 15-16½' Lab-Dup	RDL	QC Batch
Calculated Parameters					
Resistivity	ohm-cm	840			4301801
Inorganics					
Soluble (20:1) Chloride (Cl)	ug/g	81	79	20	4306895
Conductivity	umho/cm	1180		2	4307035
Available (CaCl2) pH	pH	7.75		N/A	4305737
Soluble (20:1) Sulphate (SO4)	ug/g	1100		40	4306896
Subcontracted Analysis					
Redox Potential	mV	+227	+226		4304139
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate					

TEST SUMMARY

Maxxam ID: BMB537
Sample ID: BH101-SA6 15-16½'
Matrix: Soil

Collected: 2015/11/16
Shipped:
Received: 2015/12/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4306895	N/A	2015/12/10	Alina Dobreanu
Conductivity	AT	4307035	N/A	2015/12/10	Lemeneh Addis
pH CaCl2 EXTRACT	AT	4305737	2015/12/10	2015/12/10	Neil Dassanayake
Resistivity of Soil		4301801	2015/12/10	2015/12/10	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4306896	N/A	2015/12/10	Alina Dobreanu
Redox Potential	PH	4304139	2015/12/08	2015/12/09	Grace Sison

Maxxam ID: BMB537 Dup
Sample ID: BH101-SA6 15-16½'
Matrix: Soil

Collected: 2015/11/16
Shipped:
Received: 2015/12/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4306895	N/A	2015/12/10	Alina Dobreanu
Redox Potential	PH	4304139	2015/12/08	2015/12/09	Grace Sison

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.0°C
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Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4304139	Redox Potential	2015/12/09					+104	mV	0.44	20	+244	238 - 248
4305737	Available (CaCl ₂) pH	2015/12/10			99	97 - 103			0.73	N/A		
4306895	Soluble (20:1) Chloride (Cl)	2015/12/10	NC	70 - 130	111	70 - 130	<20	ug/g	NC	35		
4306896	Soluble (20:1) Sulphate (SO ₄)	2015/12/10	NC	70 - 130	102	70 - 130	<20	ug/g	NC	35		
4307035	Conductivity	2015/12/10			100	90 - 110	<2	umho/cm	0.67	10		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services



Grace Sison, B.Sc., C.Chem, Senior Project Manager - Petroleum Division

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