



FOUNDATION INVESTIGATION REPORT

for

**CULVERTS FOR PHASE 3 SECTION
HIGHWAY 69 FOUR-LANING FOR 21.5 KM
FROM 4.5 KM NORTH OF HIGHWAY 64 TO
8.7 KM NORTH OF HIGHWAY 637
G.W.P. 5217-06-00 (PART OF G.W.P. 5379-02-00)
SUDBURY AREA, ONTARIO**

**PHASE 3: STA. 10+000 TO 16+300, TOWNSHIP OF COX
STA. 10+480 TO 10+630, TOWNSHIP OF SERVOS**

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Explanation of Terms Used in Report

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Record of Borehole Sheets

Drawing C1-1 – Borehole Locations and Soil Strata

Culvert at Sta. 10+140 (SBL) (C2), Cox Township

Figure C2-PC-1 – Result of Atterberg Limit Testing

Record of Borehole Sheets

Drawing C2-1 – Borehole Locations and Soil Strata

Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township

Record of Borehole Sheets

Drawing SX-1 – Borehole Locations and Soil Strata

Culvert at Sta. 12+590 (SBL and NBL) (C8/9), Cox Township

Figures C8/9-PC-1 and C8/9-PC-2 – Result of Atterberg Limit Testing

Figure C8/9-GS-1 – Results of Grain Size Distribution Analyses

Record of Borehole Sheets

Drawing C8/9-1 – Borehole Locations and Soil Strata

Culvert at Sta. 12+750 (SBL and NBL) (C10/11), Cox Township

Data from Geotechnical Pavement Investigation (PML Ref.: 06TF054C)

Drawing C10/11 – Borehole Locations and Soil Strata



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Record of Borehole Sheets
Drawing C45-1 – Borehole Locations and Soil Strata

Appendix A - Rock Core Photographs

FOUNDATION INVESTIGATION REPORT

for
Culverts for Phase 3 Section
Highway 69 Four-Laning for 21.5 Km
From 4.5 km North of Highway 64 to 8.7 km North of Highway 637
G.W.P. 5217-06-00 (Part of G.W.P. 5379-02-00)
Sudbury Area, Ontario

*Phase 3: Sta. 10+000 To 16+300, Township of Cox
Sta. 10+480 To 10+630, Township of Servos*

1. INTRODUCTION

Four-Laning of a 21.5 km long section of Highway 69 that extends from 4.5 km north of Highway 64 to 8.7 km north of Highway 637, about 45 km south of Sudbury, is planned. Peto MacCallum Ltd. (PML) prepared this report for AECOM on behalf of the Ministry of Transportation of Ontario (MTO).

The installation of concrete culverts is planned within the Phase 3 Section of the Highway 69 Four-Laning project. Phase 3 of the project extends in part from Sta. 10+000 to 16+300 in the Township of Cox and from Sta. 10+480 to 10+630 in the Township of Servos, new Highway 69 centerline. Eleven culverts have been selected for foundation investigation. For the purpose of this report the culverts were designated by a PML reference number. These reference numbers and locations of the culverts investigated in this report are given in the following table:

PML REF. No.	APPROXIMATE STATION
New Highway 69, Cox Township	
C1	10+100 NBL
C2	10+140 SBL
SX (snowmobile)	10+800 SBL and NBL
C8/9	12+590 SBL and NBL
C10/11	12+750 SBL and NBL
C15	13+206 SBL and NBL
C16	8+240 (Crooked Lake Road South Connection)
C37/38	15+279.1 (skewed) SBL and NBL
C41	15+883 SBL
New Highway 69, Servos Township	
C44	10+523 SBL
C45	10+550 NBL



This report summarizes the results of the field investigation conducted at the locations of the above culverts. The other culvert sites within the Phase 3 section of the alignment in the RFP for geotechnical investigation are provided in the Pavement Design Report under separate cover.

All elevations in the report are expressed in metres.

2. SITE DESCRIPTION AND GEOLOGY

The 21.5 km long section of the existing Highway 69 to be realigned and four-laned is situated about 45 km south of Sudbury in a wooded region with open swampy areas. Land use includes forestry exploration and isolated cottage sites.

The study area is located in the Precambrian Laurentian Peneplane. The topography is irregular in detail and dotted with areas of wet ground separated by steep rock ridges. Pleistocene lacustrine/fluvial deposits and recent swamp sediments have been laid down in depressions and are probably associated with the Nipissing post-glacial stage of the Great Lakes. Soil cover over the rock outcrops is generally sparse.

Metasedimentary rocks of the Huronian Supergroup and gneisses of the Grenville Province underlie the alignment. The area has undergone considerable folding, intrusive activity, regional metamorphism and faulting.

The mineral soil cover is typically less than 1 m and may vary greatly over short distances. Locally, the depth of soil cover may extend to depths of around 20 m within the Murdock River crossing.

3. INVESTIGATION PROCEDURES

The field work for three of the nine culvert sites, C1, SX and C41 included in this study was initiated during June 2009. The initial investigation was limited to the three culvert locations due to ground conditions, as the majority of the culverts are located in open wetland and swampy areas. The second phase of the investigation was carried out from February 9 to 22, 2010. The



field data was supplemented by data from subsurface investigations for the swamp crossings during the period of September, October and November 2007 and February, March, April and October 2008 and from April, May and June 2009.

The recommendations for the original circular culverts C10 and C11 at Sta. 12+750 were previously included within the geotechnical pavement investigation (PML Ref.: 06TF054C). The proposed southbound (C11) and northbound (C10) were increased in size in April 2010. Due to the new width of the culverts, foundational recommendations are required. The geotechnical pavement investigation data collected along the proposed culvert alignment in October and August 2007, February 2008 and September 2009 will be used for foundational recommendations. The data from the previously conducted geotechnical units at centreline and proposed west end of the southbound culvert were confirmed and supplemented in April 2010.

Both corrugated steel pipe and timber crib box culverts were noted under the existing Highway 69 embankment along the same alignment with the proposed northbound culvert C1 and southbound culverts C10 and C41. Corrugated steel pipe or timber crib box culverts were also noted some 10 m south to 20 m north of the proposed northbound culvert SX and the proposed southbound culverts C8/9, C15, C37/38 and C44 locations.

The locations of the boreholes put down along each of the culvert station are shown on the attached Drawings PML Ref. No. C1, C2, SX, C8/9, C10/11, C15, C16, C37/38, C41, C44 and C45. The borehole logs, drawings and figures were identified with the PML reference numbers for the specific culvert stations for ease of cross reference.

The borehole locations were established in accordance with the MTO requirements indicated in the RFP and in general accordance with the requirements of the MTO Northeastern Region Pavement Design Practices and Guidelines (May 20, 1997). Sutcliffe Rody Quesnel Inc. (SRQ) laid out the reference lines of the new highway in the field and these lines in conjunction with staking along the proposed culvert alignments were used by PML. The ground surface elevations at the boreholes were provided by Sutcliffe Rody Quesnel Inc. (SRQ).



The boreholes were advanced using continuous flight hollow and solid stem augers and by using wash boring techniques, powered by a track-mounted D-50 drill rig. The equipment was supplied and operated by a specialist drilling contractor working under the full-time supervision of members of PML engineering staff. The culvert boreholes were taken into competent native soils or where bedrock was encountered, the culvert boreholes were extended into the underlying and surficial bedrock using rotary diamond drilling methods.

Representative soil samples were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. Penetrometer and in-situ vane shear testing (using the MTO 'N' vane) was also performed to further assess the shear strength of the cohesive soils encountered. The penetrometer test results are typically less than the actual values due to sample disturbance. The results of the field tests and observations are reported on the appended Record of Borehole sheets.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open borehole. Upon completion of drilling, all the boreholes were backfilled with a bentonite/cement mixture in accordance with the MTO and MOE Reg. 903 guidelines for borehole abandonment procedures.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. The recovered samples were returned to our laboratory for detailed visual examination and classification. The laboratory testing programme consisted of moisture content determinations, Atterberg plasticity limits tests and grain size distribution analyses. Atterberg plasticity limits were not attempted on samples deemed to be non-plastic by visual and tactile examination.

The results of the laboratory Atterberg plasticity limits and grain size distribution analyses are presented on the appended plasticity charts and grain size distribution figures, which were identified with the respective codes PC and GS.



4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, soil boundary elevations, standard penetration resistance values, in-situ vane shear and penetrometer test data and groundwater observations. The results of laboratory Atterberg plasticity limits tests, grain size distribution analyses and moisture content determinations are also shown on the Record of Borehole sheets.

The borehole locations are shown on Drawings C1, C2, SX, C8/9, C10/11, C15, C16, C37/38, C41, C44 and C45. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

A description of the subsurface stratigraphy at each culvert location is summarised in the following subsections of the report.

4.1 Culvert at Sta. 10+100 (NBL) (C1), Cox Township

Two boreholes designated C1-1 and C1-2 were drilled along the original skewed alignment of culvert C1 at Sta. 10+091.5 in June 2009. The culvert was later increased in size and re-aligned to be perpendicular to northbound lane centreline at Sta. 10+100 in April 2010. The investigation conducted in June 2009 for the original alignment is considered still valid for the current alignment.

The subsurface stratigraphy revealed in the east borehole, C1-1, comprised a surficial peat layer (fill for the initial 0.8 m), underlain by organic clayey silt and silty sand. In the west borehole, C1-2, a thin surficial peat layer was underlain by bedrock. Bedrock was contacted at depths of 6.5 and 0.3 m (elevation 186.9 and 193.5) in boreholes C1-1 and C1-2, respectively. Groundwater was observed at the surface at elevation 193.4 in borehole C1-1.

Reference should be made to the previous boreholes conducted in swamp 601 (boreholes 601-9 to 601-11, including the preliminary investigation borehole N1-2) that are within proximity to the northbound C1 culvert. The boreholes reveal consistent soil conditions with exposed bedrock



and shallow refusal on probable bedrock further west and south of borehole C1-2 in boreholes 9, 9A, 10 and 10A, elevation 192.0 to 197.2 and refusal on probable bedrock at 7.5 to 6.9 m depth to the north and east of boreholes C1-1 and C1-2 at elevation 188.0 and 187.7 in borehole 601-11 and N1-2.

4.1.1 Fill

A localized fill unit was surficially found in borehole C1-1. The fill unit comprised peat with layers of sand with trace silt and was 800 mm thick. The fill unit extended to elevation 192.6.

4.1.2 Peat

Beneath the fill unit in borehole C1-1 at 0.8 m depth (elevation 192.6) and at the surface in borehole C1-2, peat deposits were contacted. The fine fibrous and amorphous peat was 0.3 and 1.9 m thick in borehole C1-2 and C1-1, respectively. Two of the samples obtained from borehole C1-1 were combined to determine the organic content, the test found 30.6% organic content. The moisture content ranged from 35 to 206% in borehole C1-1. The peat deposit extended to bedrock at 0.3 m depth (elevation 193.5) in borehole C1-2 and was penetrated at 2.7 m depth (elevation 190.7) in borehole C1-1.

4.1.3 Organic Clayey Silt

Underlying the peat deposit an organic clayey silt stratum was contacted at 2.7 m depth (elevation 190.7) in borehole C1-1. The organic clayey silt was very soft in consistency and had moisture content of 88%. The organic clayey silt stratum was penetrated at 3.7 m depth (elevation 189.7) in borehole C1-1.

4.1.4 Silty Sand

A silty sand deposit was contacted below the organic clayey silt at 3.7 m depth (elevation 189.7) in borehole C1-1. The compact cohesionless deposit was 2.8 m thick and contained trace amounts of gravel and clay. The "N" values ranged from 10 to 20. The moisture content of the deposit ranged



from 13 to 15%. The silty sand deposit graded to sand with gravel, some silt with depth to the underlying bedrock. The deposit terminated on bedrock at 6.5 m depth (elevation 186.9) in borehole C1-1.

The results of grain size distribution analyses conducted on representative samples of the deposit are presented in Figures C1-GS-1 and C1-GS-2.

4.1.5 Bedrock

Bedrock was contacted at depths of 0.3 and 6.5 m with the bedrock surface elevation decreasing from elevation 193.5 at the west end of the proposed northbound culvert to elevation 186.9 some 20 m south of the east end of the proposed northbound culvert in boreholes C1-2 and C1-1, respectively. Bedrock was proven upon contact by coring 3.0 to 3.1 m into the rock to 3.4 and 9.5 m depth, elevation 190.4 and 183.9, in borehole C1-2 and C1-1.

The bedrock comprised pink and grey/ grey Granitic Gneiss and exhibited high strength in both of the borehole locations. A detailed description of the rock cores retrieved from borehole C1-1 and C1-2 is given in Table A, appended.

The measured core recovery ranged from 97 to 100%. The RQD determined from the rock cores was in a range of 79 to 93%, thus indicating good to excellent quality rock. Locally in borehole C1-2, from elevation 193.5 to 192.0, the initial 1.5 m of Granitic Gneiss bedrock was of poor quality, as characterized by RQD values of 40%.

4.1.6 Groundwater

In June 2009, groundwater was observed in borehole C1-1 during the course of the field work at the ground surface (elevation 193.4) some 20 m south of the proposed east end of the northbound culvert. No perched water was observed within the thin peat layer at borehole C1-2. Upon completion of drilling, groundwater levels were not established due to the introduced drill water used for rock coring.



The groundwater level observed during the investigation in September and November 2007, and March and October 2008 for swamp 601 and during the preliminary investigation in February 2004 found water levels ranging from the surface to 0.9 m depth, elevation 193.3 to 194.4.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.2 Culvert at Sta. 10+140 (SBL) (C2), Cox Township

Three boreholes designated C2-1 to C2-3 were drilled along the original skewed alignment of the culvert C2 at Sta. 10+140 in February 2010. The culvert was later increased in size and realigned to be perpendicular to southbound lane centreline in April 2010. The investigation conducted in February 2010 for the original skewed alignment is considered still valid for the current alignment.

The subsurface stratigraphy revealed in the east and centreline boreholes, C2-1 and C2-2, comprised peat and organic clayey silt layers underlain by a thin deposit of clayey silt in borehole C2-1 and a thin deposit of silt and sand in borehole C2-2. The west borehole, C2-3, contacted a thin layer of surficial peat over bedrock. Bedrock was contacted at depths of 3.8 and 0.9 m (elevation 190.5 and 193.4) in boreholes C2-1 and C2-3, respectively. Probable bedrock was contacted at 3.0 m depth (elevation 191.3) in borehole C2-2. Groundwater was observed at the surface at elevation 194.3 in all of the boreholes.

Reference should be made to the previous boreholes conducted in swamp 601 (boreholes 601-12 to 601-16) that are within proximity to the southbound C2 culvert. Boreholes 601-13 and 601-14 located 8 m south and 1.5 to 10.5 m east of borehole C2-1, revealed consistent soil conditions with refusal on probable bedrock at 2.7 and 4.3 m depth, elevation 191.1 and 190.1. Borehole 601-16 located 10 m north of borehole C2-2 revealed similar soil conditions but refusal on probable bedrock is some 3.4 m deeper at 5.9 m depth (elevation 187.9) compared to refusal in borehole C2-2. Borehole 601-12 located 15 m south of the proposed culvert alignment and 25 m south of borehole C2-3, encountered refusal on probable bedrock at 0.1 m depth (elevation 197.1), some 3.7 m higher as compared to the bedrock depth (elevation 193.4) in borehole C2-3.



4.2.1 Peat

Beneath the ice and water at 0.6 m depth (elevation 193.7) peat deposits were contacted in all of the boreholes. The fine to course fibrous peat was 0.3, 1.1 and 1.6 m thick in boreholes C2-3, C2-2 and C2-1, respectively. The moisture content ranged from 155 to 734% in the boreholes. The peat deposit extended to bedrock at 0.9 m depth (elevation 193.4) in borehole C2-3 and was penetrated at 2.2 and 1.7 m depth (elevation 192.1 and 192.6) in boreholes C2-1 and C2-2, respectively.

4.2.2 Organic Clayey Silt

Underlying the peat deposits in boreholes C2-1 and C2-2, an organic clayey silt stratum was contacted at 2.2 and 1.7 m depth (elevation 192.1 and 192.6). The organic clayey silt was very soft in consistency. The split spoon sampler penetrated the deposits with the weight of hammer and the drilling rods. Three samples obtained from the deposit were tested to determine the organic content, two of the samples were combined due to their size, the tests found 13.9 and 18.8% organic content. The organic clayey silt stratum was penetrated at 3.5 and 2.6 m depth (elevation 190.8 and 191.7) in boreholes C2-1 and C2-2, respectively.

The results of Atterberg plasticity limits testing conducted on the two combined samples of the organic clayey silt from culvert C2 is presented on Figure C2-PC-1.

The liquid limit and plastic limit of the organic clayey silt was 103 and 64, respectively, with a plasticity index value 39. The moisture content of representative samples of the organic clayey silt ranged from 164 to 227%.

4.2.3 Clayey Silt

Underlying the organic clayey silt at 3.5 m depth (elevation 190.8) in borehole C2-1 was a 0.3 m thick clayey silt deposit. The consistency of the clayey silt was very soft. An "N" value of 1 was found. The clayey silt deposit extended to the underlying bedrock at 3.8 m depth (elevation 190.5). A moisture content of clayey silt was 46%.



4.2.4 Silt and Sand

A silt and sand deposit was contacted below the organic clayey silt at 2.6 m depth (elevation 191.7) in borehole C2-2. The very loose cohesionless deposit was 0.4 m thick and contained trace amounts of clay. An "N" value of 3 was found. The moisture content of the deposit was 27%. The silt and sand deposit extended to probable bedrock at 3.0 m depth (elevation 191.3).

4.2.5 Bedrock

Bedrock and probable bedrock was contacted at depths of 0.9 to 3.8 m with the bedrock surface elevation decreasing from elevation 193.4, some 10 m north of the west end of the proposed southbound culvert (borehole C2-3) to elevation 190.5, some 7 m south of the east end of the proposed southbound culvert (borehole C2-1). Bedrock was proven upon contact by coring 3.1 to 3.3 m into the rock to 6.9 and 4.2 m depth, elevation 187.4 and 190.1, in boreholes C2-1 and C2-3.

The bedrock comprised pink to red and light grey to pink Syenite and exhibited high strength in both of the borehole locations. A dark grey to black Gabbro bedrock layer was contacted below the Syenite bedrock in borehole C2-1. The Gabbro bedrock also exhibited high strength. A detailed description of the rock cores retrieved from borehole C2-1 and C2-3 is given in Table A, appended.

The measured core recovery ranged from 77 to 100%. The RQD determined from the rock cores was in a range of 50 to 80%, thus indicating fair to good quality rock. Locally in borehole C2-3, from elevation 193.4 to 190.9, the initial 2.5 m of Syenite bedrock was of poor quality, as characterized by RQD values of 33 and 39%. Numerous vertical fissures were observed within the first and second rock core samples retrieved from borehole C2-3.



4.2.6 Groundwater

In February 2010, groundwater was observed at the ground surface (elevation 194.3) in all of the boreholes during the investigation and upon completion of drilling.

The groundwater level observed during the investigation in September and November 2007, and March and October 2008 for swamp 601 found water levels ranging from the surface to 0.9 m depth, elevation 193.3 to 194.4.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.3 Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township

Three boreholes designated SX-1 to SX-3 were drilled along the alignment of the proposed snowmobile culverts at Sta. 10+800 (SBL and NBL) (SX) in June 2009. The subsurface stratigraphy revealed in the boreholes comprised surficial peat or topsoil underlain by bedrock. Cobbles and boulders were encountered within the topsoil deposit at the centreline borehole SX-2 and a thin layer of sand was contacted underlying the peat in borehole SX-3. Bedrock was contacted at depths of 0.7 to 1.2 m (elevation 203.6 to 205.6). Groundwater was observed at the surface, elevation 206.4 and 204.3 in borehole SX-1 and SX-3.

4.3.1 Peat

Peat deposits were contacted in borehole SX-1 and SX-3 and measured 800 and 600 mm in thickness. The deposits were underlain by bedrock at elevation 205.6 in borehole SX-1 and a thin sand deposit at elevation 203.7 in borehole SX-3.

4.3.2 Topsoil

A 1.2 m thick surficial silty sand topsoil deposit was contacted in borehole SX-2. The topsoil included cobbles and boulders and extended to bedrock at 1.2 m depth (elevation 204.7).



4.3.3 Bedrock

Bedrock was contacted at depths of 0.7 to 1.2 m with the bedrock surface elevation decreasing from elevation 205.6 at the west end of the proposed southbound culvert to elevation 203.6 at the east end of the proposed northbound culvert. Bedrock was proven upon contact by coring 3.0 to 3.3 m into the rock to 3.8 to 4.5 m depth, elevation 202.6 to 200.5, in boreholes SX-1 to SX-3.

The bedrock comprised pink and grey/ pink Granitic Gneiss and exhibited high strength in all of the borehole locations. A detailed description of the rock cores retrieved from boreholes SX-1 to SX-3 is given in Table A, appended.

The measured core recovery ranged from 76 to 100%. The RQD determined from the rock cores was in a range of 73 to 99%, thus indicating fair to excellent quality rock. Locally in borehole SX-2, from elevation 204.7 to 204.4, the initial 0.3 m of Granitic Gneiss bedrock was of very poor quality, as characterized by an RQD value of 24%. Also in borehole SX-3, from elevation 203.6 to 202.2, the initial 1.4 m of Granitic Gneiss bedrock was of poor quality, as characterized by an RQD value of 38%. Vertical fractures were observed within the first rock core samples retrieved from borehole SX-2 and SX-3.

4.3.4 Groundwater

In June 2009, groundwater was observed during drilling at the ground surface, elevation 206.4 and 204.3 in borehole SX-1 and SX-3. Upon completion of drilling, groundwater levels were not established due to the introduced drill water used for rock coring.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



4.4 Culvert at Sta. 12+590 (SBL and NBL) (C8/9), Cox Township

Four boreholes designated C8/9-1 to C8/9-4 were drilled along the alignment of the culvert at Sta. 12+590 (SBL and NBL) (C8/9) in February 2010. The subsurface stratigraphy revealed in the boreholes typically comprised peat and organic silty clay underlain by deposits of silty clay and cohesionless sand deposits with varying amounts of gravel. In boreholes C8/9-1 and C8/9-4, the peat and organic silty clay were underlain only by cohesionless deposits. Bedrock was contacted at depths of 2.4 and 7.2 m (elevation 195.6 and 189.7) near the west end of the proposed southbound culvert C9 and the east end of the proposed northbound culvert C8 in boreholes C8/9-1 and C8/9-4, respectively. Probable bedrock was contacted at 7.3 and 11.7 m depth (elevation 190.6 and 185.7) in boreholes C8/9-2 and C8/9-3, along and close to the proposed highway centreline. Groundwater was observed from the surface down to 1.0 m depth in all of the boreholes (elevation 196.9 to 197.3) during the investigation.

Reference should be made to the previous boreholes conducted in swamp 603 (boreholes 603-16 to 603-22) that are within proximity to the southbound culvert C9 and northbound culvert C8. The penetration test (603-18) conducted near the west end of the proposed southbound culvert terminated at 1.7 m depth, elevation 196.8. Boreholes 603-16 and 603-21 along the proposed southbound highway centreline terminated in road platform fill. Borehole 603-19, some 5 m south of borehole C8/9-2, revealed consistent soil conditions with refusal on probable bedrock at 9.4 m depth, elevation 188.1, which is 2.5 m deeper than borehole C8/9-2. Boreholes 603-17 and 603-22 along the proposed northbound highway centreline revealed similar soil conditions with refusal on probable bedrock at 5.8 and 5.7 m depth, elevation 191.3 and 191.4. Borehole 603-20 located 2.5 m south and 1 m west of borehole C8/9-4, refused some 2.4 m higher at elevation 192.1, compared to the depth of bedrock encountered in borehole C8/9-4.



4.4.1 Peat

Surficial peat was contacted in boreholes C8/9-1, C8/9-2 and C8/9-3 and beneath the ice at 0.1 m depth (elevation 196.8) in borehole C8/9-4. The fine fibrous to amorphous peat layer was 1.4 to 3.6 m thick and locally contained organic silty clay inclusions and decayed wood fragments in boreholes C8/9-1 and C8/9-4. The moisture content of the deposit ranged from 132 to 877%. The peat deposit was penetrated at 1.4 to 3.6 m depths (elevation 196.6 and 193.3), from the west end of the proposed southbound culvert to the east end of the proposed northbound culvert.

4.4.2 Organic Silty Clay

Underlying the peat deposits in all the boreholes, except borehole C8/9-1, an organic silty clay stratum was contacted at 3.0 to 3.6 m depth (elevation 194.9 to 193.3). The organic silty clay was very soft in consistency. The split spoon sampler penetrated the deposit with the weight of hammer and the drilling rods. In-situ vane testing conducted at 4.0 m depth in borehole C8/9-3 indicated a shear strength of 10 kPa. One representative sample obtained from the deposit was tested to determine the organic content, the test found 19.6% organic content. The organic silty clay stratum was penetrated at 4.2 to 4.4 m depth (elevation 193.7 to 192.5).

The results of Atterberg plasticity limits testing conducted on one representative sample of the organic silty clay from culvert C8/9 is presented on Figure C8/9-PC-1.

The liquid limit and plastic limit of the organic silty clay was 112 and 75, respectively, with a plasticity index value 37. The moisture content of representative samples of the organic silty clay ranged from 179 to 292%.

4.4.3 Silty Clay

Underlying the organic silty clay at 4.2 m depth (elevation 193.7 and 193.2) in boreholes C8/9-2 and C8/9-3, a 1.7 and 0.6 m thick silty clay deposit was contacted. The consistency of the deposit was very soft to soft. The split spoon sampler penetrated the deposit with the weight of hammer and the drilling rods. In-situ vane testing conducted at 5.5 m depth in borehole C8/9-2 indicated a



shear strength of 22 kPa. The silty clay deposit was penetrated at 5.9 and 4.8 m depth (elevation 192.0 and 192.6) in boreholes C8/9-2 and C8/9-3, respectively. The moisture content of a representative sample of the silty clay was 46%.

4.4.4 Silt with Sand

Underlying the silty clay deposit at 4.8 m depth (elevation 192.6) in borehole C8/9-3, was a 0.9 m thick silt with sand deposit. The deposit comprised some clay and trace gravel. Slight plasticity (plasticity index of 4) was noted due to the clay content. The silt with sand deposit was very loose in density. The split spoon sampler penetrated the deposit with the weight of hammer and the drilling rods. The silt with sand was penetrated at 5.7 m depth (elevation 191.7).

The results of grain size distribution analyses conducted on a sample of the deposit is presented on Figure C8/9-GS-1.

The results of Atterberg plasticity limits testing conducted on a representative sample of the silt with sand from culvert C8/9 is presented on Figure C8/9-PC-2.

The liquid limit and plastic limit of the silt with sand was 20 and 16, respectively, with a plasticity index value 4. The moisture content of silt with sand was 30%.

4.4.5 Sand

Gravelly sand and sand deposits were encountered at depths of 1.4, 5.9, 5.7 and 4.4 m (elevation 196.6, 192.0, 191.7 and 192.5), underlying the peat, silty clay, silt with sand and organic silty clay in boreholes C8/9-1, C8/9-2, C8/9-3 and C8/9-4, respectively. The deposit ranged in thickness from 1.0 m in borehole C8/9-1 to 6.0 m in borehole C8/9-3. The sand deposit was gravelly in borehole C8/9-1 and contained some gravel within the other boreholes. Cobbles were also contacted within the deposit in boreholes C8/9-1 and C8/9-4. The density of the cohesionless deposit was typically compact, locally, very loose in borehole C8/9-2 and within the upper portion of the deposit in borehole C8/9-3 and became very dense within the lower portion of the deposit in borehole C8/9-3. The "N" values for the deposit ranged from 1 to 103, typically around 20. The



moisture content for the sand deposits ranged from 7 to 15%. The gravelly sand and sand deposits extended to bedrock and probable bedrock at depths of 2.4, 7.3, 11.7 and 7.2 m (elevation 195.6, 190.6, 185.7 and 189.7) in borehole C8/9-1, C8/9-2, C8/9-3 and C8/9-4, respectively.

The results of grain size distribution analyses conducted on a sample of the gravelly sand deposit from borehole C8/9-1 is presented on Figure C8/9-GS-1.

4.4.6 Bedrock

Bedrock and probable bedrock was contacted at depths of 2.4 to 11.7 m with the bedrock surface elevation decreasing from elevation 195.6 at the west end of the proposed southbound culvert (borehole C8/9-1) to elevation 190.6, 185.7 and 189.7 in boreholes C8/9-2, C8/9-3 and C8/9-4, towards the east end of the proposed northbound culvert. Bedrock was proven upon contact by coring 2.8 to 3.0 m into the rock, to 5.2 and 10.2 m depth, elevation 192.8 and 186.7, in boreholes C8/9-1 and C8/9-4, respectively.

The bedrock comprised pink and light grey Granitic Gneiss and exhibited high and medium strengths in boreholes C8/9-1 and C8/9-4. A detailed description of the rock cores retrieved from boreholes C8/9-1 to C8/9-4 is given in Table A, appended.

The measured core recovery was 100%. The RQD determined from the rock cores was in a range of 53 to 100%, thus indicating fair to excellent quality rock. Locally in borehole C8/9-4, from elevation 189.7 to 188.9, the initial 0.8 m of Granitic Gneiss bedrock was of poor quality, as characterized by an RQD value of 30%. Vertical fissures were observed within the first rock core sample retrieved from borehole C8/9-1.

4.4.7 Groundwater

In February 2010, groundwater was observed in all of the boreholes during the course of the field work. Water was observed at the surface (elevation 196.9) in borehole C8/9-4 at the proposed east end of the northbound culvert and was contacted at 0.3 to 1.0 m depth (elevation 197.0 to



197.3) within the other boreholes during the investigation. Upon completion of drilling, groundwater levels remained the same. In borehole C8/9-1 the water level after drilling was not observed due to the introduced drill water used for rock coring.

The groundwater level observed during the investigation in October 2007 and February 2008 for boreholes 603-16 to 603-22 within swamp 603, found water levels ranging from the surface to 0.3 m depth, elevation 197.1 to 197.2.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.5 Culvert at Sta. 12+750 (SBL and NBL) (C10/11), Cox Township

The recommendations for the original circular culverts C10 and C11 at Sta. 12+750 were previously included within the geotechnical pavement investigation (PML Ref.: 06TF054C). The proposed southbound (C11) and northbound (C10) culverts were increased in size in April 2010. Due to the new width of the culverts, foundational recommendations are required. The geotechnical pavement investigation data collected along the proposed culvert alignment in October and August 2007, February 2008 and September 2009 will be used for foundational recommendations. The data from the previously conducted geotechnical units at centreline and proposed west end of the southbound culvert were confirmed and supplemented in April 2010.

The geotechnical units conducted along the proposed alignment of culvert C10/11 at Sta. 12+750 ranged in distance from 34.0 m left to 47.0 m right of the new highway centreline and were some 1.5 to 1.7 m lower than the centreline datum. Utilizing the provided culvert cross sectional drawing from April 2010, the existing grade at the new highway centreline is interpreted to be near elevation 198.0. To establish the depth and elevation to probable bedrock from the geotechnical data the existing grade elevation at 198.0 will be applied as the datum for geotechnical units along the culvert alignment.

The subsurface stratigraphy revealed in the geotechnical units typically comprised 1.0 to 3.8 m thick peat deposits overlying probable bedrock at 1.0 to 4.5 m depth (near elevation 197.0 to 191.8). Locally, the peat deposits were underlain by 0.2 m thick silty sand and 0.5 m thick silty



clay layers at 34.0 m Lt. and 47.0 m Rt. of the proposed highway centreline. The previously encountered refusal on boulders at 0.5 m depth within the sand and gravel fill at the proposed highway centreline in August 2007 was penetrated to reveal an underlying 0.5 m thick peat deposit over probable bedrock at 1.0 m depth in April 2010.

4.5.1 Fill

A 0.5 m thick layer of fill was contacted surficially at the proposed highway centreline. The fill comprised sand and gravel and contained boulders. During the investigation in August 2007 the geotechnical unit refused on boulders within the fill. In April 2010 the fill layer was penetrated to reveal underlying peat at 0.5 m depth (near elevation 197.5).

4.5.2 Peat

Peat was contacted at 0.1 to 0.2 m depth below the water and/ or ice within the geotechnical units at 34.0 m Lt., 19.0 m Rt. and 47.0 m Rt. of the proposed highway centreline. A deposit of peat was also contacted at 0.5 m depth below the sand and gravel fill at the proposed highway centreline in April 2010. The fine fibrous peat was 0.5 to 3.8 m thick in the geotechnical units. The peat deposit was penetrated at 1.5 and 4.0 m depth (near elevation 195.0 and 192.3), at the west end of the proposed southbound culvert to the east end of the proposed northbound culvert. The peat deposit was underlain by probable bedrock at 1.0 and 1.2 m depth (near elevation 197.0 and 195.1), at the proposed highway centerline and at 19.0 m Rt. of the proposed highway centreline.

4.5.3 Silty Sand

Underlying the peat deposit at 1.5 m depth (near elevation 195.0) in the geotechnical unit at 34.0 m Lt. of the proposed highway centreline, a 0.2 m thick silty sand layer was contacted. The silty sand layer was underlain by probable bedrock at 1.7 m depth (near elevation 194.8).



4.5.4 Silty Clay

Underlying the peat deposit at 4.0 m depth (near elevation 192.3) in the geotechnical unit at 47.0 m Rt. of the proposed highway centreline, a 0.5 m thick silty clay layer was contacted. The silty clay layer was underlain by probable bedrock at 4.5 m depth (near elevation 191.8).

4.5.5 Bedrock

Probable bedrock was contacted at depths of 1.0 to 1.7 m below existing grade (near elevation 197.0 to 194.8) from the proposed east to west end of the southbound culvert, and at depths of 1.0 to 4.5 m (near elevation 197.0 to 191.8) from the proposed west to east end of the northbound culvert.

4.5.6 Groundwater

Groundwater at the time of the geotechnical pavement field investigation in October and August 2007, February 2008 and September 2009 was observed from the surface down to 0.2 m depth, near elevation 196.1 to 196.5.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.6 Culvert at Sta. 13+206 (SBL and NBL) (C15), Cox Township

Three boreholes designated C15-1 to C15-3 were drilled along the alignment of the culvert at Sta. 13+206 (SBL and NBL) (C15) in February 2010. The subsurface stratigraphy revealed in the boreholes comprised surficial peat, over organic silt, underlain by cohesionless gravelly sand or sand with silt deposits. Bedrock was contacted below the gravelly sand and sand with silt deposits at a depth of 5.5 m (elevation 185.8 and 186.6) in boreholes C15-1 and C15-3. Probable bedrock was contacted below the gravelly sand at 5.9 m depth (elevation 186.2) in borehole C15-2. Groundwater was measured from the surface to 1.2 m depth, elevation 190.1 to 192.1.



Reference should be made to the previous boreholes conducted in swamp 604 (boreholes 604-9 to 604-13 and the preliminary borehole N5-2) that are within proximity to culvert C15. The boreholes reveal consistent soil conditions with refusal on probable bedrock at 7.3 m depth, elevation 184.7, in borehole 604-10, some 1.5 and 1.9 m deeper than boreholes C15-2 and C15-3. The penetration test 604-12, located 6.5 m north of the proposed culvert along the new highway centreline extended to 7.0 m depth (elevation 185.0) without refusal, some 1.2 m lower than borehole C15-2. Borehole 604-13 refused on probable bedrock at 2.8 m depth (elevation 189.2), 2.6 m higher than borehole C15-3. Borehole 604-9 and the preliminary borehole N5-2, conducted within the existing road platform and at the toe of slope, terminated on boulders at depths of 3.8 and 2.3 m, elevation 192.6 and 189.6, respectively.

4.6.1 Peat

A peat deposit was contacted in all of the boreholes, surficially (elevation 191.3) in borehole C15-1 and beneath the ice and water at depths of 0.6 and 0.7 m, elevation 191.3 and 191.5, in boreholes C15-2 and C15-3. The fine fibrous to amorphous peat was 2.2 to 2.6 m in thickness. The moisture content of the peat deposit ranged from 433 to 703%. The deposit was penetrated at depths of 2.6, 3.2 and 2.9 m (elevation 188.7 to 189.2) in boreholes C15-1, C15-2 and C15-3, respectively.

4.6.2 Organic Silt

Underlying the peat in all of the boreholes at depths of 2.6 to 3.2 m (elevation 188.7 to 189.2) was an organic silt deposit. The organic silt was very loose in density and measured 0.9 to 1.7 m in thickness. The split spoon sampler penetrated the deposits with the weight of hammer and the drilling rods. Two samples obtained from the deposit were combined due to their size and tested to determine the organic content, the test found 12.3% organic content. The organic silt deposit was penetrated at depths of 3.5, 4.9 and 3.8 m (elevation 187.2 to 188.3) in boreholes C15-1, C15-2 and C15-3, respectively.



The results of Atterberg plasticity limits testing conducted on the two combined samples of the organic silt from culvert C15 is presented on Figure C15-PC-1.

The liquid limit and plastic limit of the organic silt was 81 and 52, respectively, with a plasticity index value 29. The moisture content of representative samples of the organic silt ranged from 151 to 252%.

4.6.3 Sand

Gravelly sand and sand with silt deposits were encountered at depths of 3.5, 4.9 and 3.8 m underlying the organic silt in boreholes in boreholes C15-1, C15-2 and C15-3, respectively. The deposits ranged in thickness from 1.0 to 2.0 m within the boreholes. The sand deposit was gravelly in boreholes C15-1 and C15-2 and contained some silt with cobbles and boulders (measuring 0.6 m in thickness during coring) in borehole C15-1. A sand with silt deposit was encountered in borehole C15-3, comprising some gravel and trace clay. The cohesionless deposits were typically compact in density, locally loose in borehole C15-3, within the upper portion of the deposit and very dense within the lower portion of the deposit in borehole C15-1. The "N" values for the deposits ranged from 9 to 71 blows for 15 cm sample penetration (with the sampler bouncing on an underlying cobble or boulder in borehole C15-1). The moisture content for the sand deposits ranged from 11 to 14%. The gravelly sand and sand with silt deposits mantled bedrock and probable bedrock at depths of 5.5, 5.9 and 5.5 m (elevation 185.8, 186.2 and 186.6) in borehole C15-1, C15-2 and C15-3, respectively.

The results of grain size distribution analyses conducted on a sample of the sand with silt deposit from borehole C15-3 is presented on Figure C15-GS-1.

4.6.4 Bedrock

Bedrock and probable bedrock was contacted at depths of 5.5 to 5.9 m with the bedrock surface elevation decreasing from elevation 186.6 at the east end of the proposed culvert (borehole C15-3) to elevation 185.8 at the west end of the proposed culvert (borehole C15-1).



Bedrock was proven upon contact by coring 2.8 to 3.0 m into the rock to 8.3 and 8.5 m depth, elevation 183.0 and 183.6, in boreholes C15-1 and C15-3.

The bedrock comprised dark grey Migmatite and pink to light grey Granitic Gneiss and exhibited high strength in boreholes C15-1 and C15-3, respectively. A detailed description of the rock cores retrieved from boreholes C15-1 and C15-3 is given in Table A, appended.

The measured core recovery ranged from 83 to 100%. The RQD determined from the rock cores was in a range of 79 to 100%, thus indicating good to excellent quality rock.

4.6.5 Groundwater

In February 2010, groundwater was observed in all of the boreholes during the course of the field work. Water was observed at the surface (elevation 192.1) in boreholes C15-2 and C15-3 and was contacted at 1.2 m depth (elevation 190.1) within borehole C15-1 during the investigation. Upon completion of drilling the groundwater levels remained the same. In borehole C15-1 the water level after drilling was not observed due to the introduced drill water used for rock coring.

The groundwater level observed during the investigation in October 2007 and March and April 2008 for swamp 604, found water levels ranging from the surface to 0.6 m depth, elevation 190.9 to 192.0.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.7 Culvert at Sta. 8+240 (Crooked Lake Road South Connection) (C16), Cox Township

Two boreholes designated C16-1 and C16-2 were drilled along the alignment of the proposed culvert at Sta. 8+240 (Crooked Lake Road South Connection) (C16) in February 2010. The subsurface stratigraphy revealed in the boreholes comprised surficial peat, over organic silt, underlain by bedrock at the west end and gravelly sand at the east end of the proposed culvert. Bedrock and probable bedrock was contacted at depths of 2.3 and 4.3 m (elevation 188.8 and



186.7) in boreholes C16-1 and C16-2. Groundwater was measured at depths of 0.6 and 0.9 m, elevation 190.2 and 190.4.

For additional subsurface data reference is made to the geotechnical pavement investigation conducted 10 m north of this alignment at Sta. 8+250 (PML Ref.: 06TF054C). Probable bedrock was contacted at 2.3 m depth at 14.0 m left of and at the centreline median, the same depth that bedrock was contacted in borehole C16-1. The investigation conducted at 14.0 m right of the centreline median revealed similar subsurface conditions to borehole C16-2 with the sand deposit contacted at 3.4 m depth.

4.7.1 Peat

A peat deposit was contacted underlying the ice at 0.2 m depth, elevation 190.9 and 190.8 in boreholes C16-1 and C16-2. The fine fibrous peat was 1.2 and 2.2 m thick with moisture contents ranging from 352 to 543%. A representative sample obtained from the deposit was tested to determine the organic content, the test found 32.6% organic content. The peat deposit was penetrated at depths of 1.4 and 2.4 m, elevation 189.7 and 188.6, in boreholes C16-1 and C16-2.

4.7.2 Organic Silt

Overlain by peat in both of the boreholes at 1.4 and 2.4 m depth (elevation 189.7 to 188.6) was a deposit of organic silt. The organic silt was very loose in density and was 0.9 m thick in both boreholes. The split spoon sampler penetrated the deposits with the weight of hammer and the drilling rods. The moisture content of representative samples of the organic silt ranged from 170 to 337%. A representative sample obtained from the deposit was tested to determine the organic content, the test found 12.3% organic content. The deposit mantled bedrock at 2.3 m depth, elevation 188.8, in borehole C16-1 and was penetrated at 3.3 m depth, elevation 187.7, in borehole C16-2.



4.7.3 Gravelly Sand

A Gravelly sand deposit was encountered at 3.3 m depth (elevation 187.7) underlying the organic silt in borehole C16-2. The 1.0 m thick deposit was compact in density and contained cobbles and boulders. The "N" value obtained within the deposit was 11. The gravelly sand deposit was underlain by probable bedrock at 4.3 m depth, elevation 186.7.

4.7.4 Bedrock

Bedrock and probable bedrock was contacted at depths of 2.3 and 4.3 m, with the bedrock surface elevation decreasing from elevation 188.8 at the west end of the proposed culvert (borehole C16-1) to elevation 186.7 at the east end of the proposed culvert (borehole C16-2). Reference is also made to borehole C15-1 for the proposed culvert C15. Borehole C15-1 is located along the same alignment, 14.0 m east of borehole C16-2, and contacted bedrock at 5.5 m depth, elevation 185.8, indicating the bedrock elevation continues to decrease in an easterly direction.

The bedrock comprised dark grey Migmatite and exhibited high strength in boreholes C16-1 and C15-1. A detailed description of the rock cores retrieved from boreholes C16-1 and C15-1 is given in Table A, appended.

The measured core recovery ranged from 83 to 100%. The RQD determined from the rock cores was in a range of 83 to 100%, thus indicating good to excellent quality rock.

4.7.5 Groundwater

In February 2010, groundwater was measured at 0.9 and 0.6 m depth, elevation 190.2 and 190.4, in boreholes C16-1 and C16-2 during the investigation. Upon completion of drilling the groundwater level remained the same in borehole C16-2. In borehole C16-1 the water level after drilling was not observed due to the introduced drill water used for rock coring.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



4.8 Culvert at Sta. 15+279.1 (SBL and NBL) (C37/38), Cox Township

Three boreholes designated C37/38-1 to C37/38-3 were drilled along the original alignment of the culvert at Sta. 15+284.5 (SBL and NBL) (C37/38) in February 2010. The proposed culvert was later rotated about the west end to station 15+279.1 in April 2010. The investigation conducted in February 2010 for the original alignment is still considered valid for the current alignment.

The subsurface stratigraphy generally revealed in the boreholes comprised sand and gravel deposits. Locally, surficial fill was contacted in borehole C37/38-1 and cohesionless deposits of sand with silt/ silt and sand were encountered beyond 3.4 m depth in borehole C37/38-2. Bedrock was contacted below the sand and gravel deposit at 4.1 m depth, elevation 194.8, in borehole C37/38-3 and was not contacted within the 6.7 to 9.1 m depth of exploration below elevation 191.8 and 188.7 in boreholes C37/38-2 and C37/38-1, respectively. Groundwater was measured from the surface to 1.2 m depth, elevation 198.9 to 196.6, in boreholes C37/38-3 to C37/38-1, respectively.

Reference should be made to the previous boreholes conducted in swamp 605 (boreholes 605-7 to 605-16) that are within proximity to culvert C37/38. The boreholes reveal consistent soil conditions with refusal on probable boulders at 0.4 to 4.3 m depth, elevation 195.2 to 204.9. Exposed bedrock was noted at boreholes 605-7, 605-9 and 605-11, some 6 to 22 m south of the skewed culvert C37/38 at elevation 201.1 to 203.0.

4.8.1 Fill

A thin surficial layer of fill was contacted in borehole C37/38-1. The loose 300 mm thick fill layer comprised silty sand with organics. The "N" value obtained within the layer was 7. The fill deposit was penetrated at 0.3 m depth, elevation 197.3.



4.8.2 Sand and Gravel

A sand and gravel deposit was encountered underlying the fill at 0.3 m depth (elevation 197.3) in borehole C37/38-1, at the surface (elevation 198.5) in borehole C37/38-2 and below the ice and water at 0.5 m depth (elevation 198.4) in borehole C37/38-3. The 3.4 to 8.8 m thick deposit was compact to very dense in density and contained some silt with cobbles and boulders (measuring 0.6 m in thickness during coring). Locally, within borehole C37/38-2, the deposit graded to a gravelly sand around 1.5 m depth, elevation 197.0. The sand and gravel deposit was compact to very dense. The "N" values obtained within the deposit ranged from 7 to 50 blows for 0 cm sample penetration (with the sampler bouncing on underlying cobbles or boulders at various depths in borehole C37/38-1 and C37/38-3). The lower "N" value of 7 obtained at 3.7 m depth in borehole C37/38-1 was due to hydrostatic disturbance during sampling. A representative moisture content of 18% was obtained from within the deposit. The 8.8 m thick deposit was not penetrated at the 9.1 m depth of exploration (to elevation 188.7) in borehole C37/38-1, was penetrated at 3.4 m depth (elevation 195.1) in borehole C37/38-2, and mantled bedrock at 4.1 m depth (elevation 194.8) in borehole C37-38-3.

The results of grain size distribution analyses conducted on a sample of the gravelly sand deposit from borehole C37/38-2 is presented on Figure C37/38-GS-1.

4.8.3 Sand with Silt/ Silt and Sand

A deposit of sand with silt/ silt and sand was contacted underlying the sand and gravel at 3.4 m depth, elevation 195.1, in borehole C37/38-2. The 3.3 m thick cohesionless sand/ silt deposit was loose to compact in density. The "N" values obtained within the deposit ranged from 4 to 15. The deposit extended to the 6.7 m depth of exploration borehole C37/38-2, to elevation 191.8.

The results of grain size distribution analyses conducted on two representative samples of the deposit from borehole C37/38-2 is presented on Figure C37/38-GS-2.



4.8.4 Bedrock

Bedrock was contacted at 4.1 m depth, elevation 194.8, in borehole C37/38-3 at the west end of the proposed culvert and proved upon contact by coring 3.1 m into the rock to 7.2 m depth, elevation 191.7. Bedrock was not contacted at the median or east end of the culvert (boreholes C37/38-2 and C37/38-1) within the 6.7 and 9.1 m depth of exploration, to elevation 191.8 and 188.7, respectively.

The bedrock comprised dark grey Migmatite and exhibited medium strength in boreholes C37/38-3. A detailed description of the rock cores retrieved from boreholes C37/38-3 is given in Table A, appended.

The measured core recovery was 100%. The RQD determined from the rock cores was in a range of 81 to 100%, thus indicating good to excellent quality rock.

4.8.5 Groundwater

In February 2010, groundwater was measured during the investigation from the surface to 1.2 m depth, elevation 198.9 to 196.6, in boreholes C37/38-3 to C37/38-1, respectively. Upon completion of drilling the water level was not observed due to the introduced drill water used for wash boring.

The groundwater level observed during the investigation in October 2007, March and April 2008 and April to June 2009 for swamp 605, found water levels ranging from the 0.1 to 1.8 m depth, elevation 197.7 to 199.7.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.9 Culvert at Sta. 15+883 (SBL) (C41), Cox Township

Three boreholes designated C41-1 to C41-3 were drilled along the alignment of the culvert at Sta. 15+883 (SBL) (C41) in June 2009. Borehole C41-3 was conducted after borehole C41-1 and



C41-2 and was an unsampled probe to refusal. The subsurface stratigraphy revealed in the boreholes generally comprised surficial peat, locally topsoil, overlying clay/ silty clay deposits. Locally in borehole C41-2, near the west end of the proposed culvert, cohesive deposits were not encountered. A deposit of silty sand was contacted underlying the peat at borehole C41-2 and below the silty clay at borehole C41-3. Bedrock was contacted below the silty clay and silty sand deposits at depths of 5.8 and 2.4 m (elevation 199.9 and 203.6) in borehole C41-1 and C41-2. Groundwater was measured from the surface to 2.1 m depth, elevation 206.0 to 203.6, in boreholes C41-2 to C41-1, respectively.

Reference should be made to the previous boreholes conducted in swamp 606 (boreholes 606-1, 606-3, 606-4 and 606-6) that are within proximity to the southbound C41 culvert. The boreholes reveal consistent soil conditions with probable bedrock contacted at 2.4 m depth, elevation 205.3, near the west end of the proposed culvert (borehole 606-3) at 4.4 and 8.2 m depth, elevation 201.6 and 198.2, some 13 m south and 17 m north of the centreline of the proposed culvert (boreholes 606-1 and 606-6) and at 5.2 m depth, elevation 200.7, near the east end of the proposed culvert (borehole 606-4).

4.9.1 Topsoil

The surficial topsoil layer contacted in borehole C41-1 was 300 mm thick and was penetrated at elevation 205.4.

4.9.2 Peat

A peat deposit was contacted in borehole C41-2 and C41-3. The fine fibrous and amorphous peat was 1.8 and 1.4 m thick in borehole C41-2 and C41-3, respectively. Two of the samples obtained from borehole C41-2 were combined to determine the organic content, the test found 70.7% organic content. The moisture content ranged from 270 to 319% in borehole C41-2. The peat deposit was penetrated at depths of 1.8 and 1.4 m (elevation 204.2 and 204.5) in borehole C41-2 and C41-3, on the underlying silty sand and silty clay deposits.



4.9.3 Clay/ Silty Clay

Underlying the topsoil at 0.3 m depth in borehole C41-1 was a 2.0 m thick clay deposit. The consistency of the clay was stiff becoming firm with depth. The “N” values ranged from 2 to 7. Penetrometer testing on samples of the clay deposit indicated a range of shear strength from 38 to 75 kPa. The clay deposit was penetrated at 2.3 m depth (elevation 203.4).

Overlain by clay at 2.3 m depth and peat at 1.4 m depth in boreholes C41-1 and C41-3, a deposit of silty clay was contacted. The silty clay deposit was 3.5 and 5.8 m thick and was firm to soft in consistency. The “N” values ranged from 1 to 3 in the sampled borehole C41-1. In-situ vane testing conducted at 3.8 and 5.3 m depth in borehole C41-1 indicated a shear strength from 22 to 28 kPa. The deposit extended to the underlying bedrock at 5.8 m depth (elevation 199.9) in borehole C41-1 and was penetrated at 7.2 m depth (elevation 198.7) in borehole C41-3.

The results of Atterberg plasticity limits testing and grain size distribution analysis conducted on samples of the clay and silty clay from culvert C41 are presented in respective Figures C41-PC-1 and C41-GS-1.

The liquid limit and plastic limit of the clay was 51 and 25, respectively, with a plasticity index value 26. The moisture content of representative samples of the clay ranged from 34 to 45%.

The liquid limit and plastic limit of the silty clay was 41 and 23, respectively, with a plasticity index value 18. The moisture content of representative samples of the silty clay ranged from 51 to 53%.

4.9.4 Silty Sand

Beneath the peat at 1.8 depth (elevation 204.2) in borehole C41-2, a silty sand deposit was contacted. The silty sand deposit was 0.6 m thick and comprised some gravel with cobbles. The relative density of the silty sand was loose. The “N” values of the silty sand were 6 and 8 blow for 15 cm sample penetration. The “N” value reflects the sampler bouncing at 2.4 m depth (elevation 203.6) on the underlying bedrock after 15 cm of penetration.



Silty sand was also contacted in the unsampled borehole C41-3, underlying the silty clay at 7.2 m depth (elevation 198.7). The unsampled borehole terminated within the silty sand deposit on a probable boulder at 7.3 m depth (elevation 198.6).

4.9.5 Bedrock

Bedrock was contacted at depths of 2.4 and 5.8 m with the bedrock surface elevation decreasing from elevation 203.6 at the west end of the proposed southbound culvert to elevation 199.9 at the east end of the proposed northbound culvert in borehole C41-2 and C41-1, respectively. Bedrock was proven upon contact by coring 3.2 m into the rock to 5.6 and 9.0 m depth, elevation 200.4 and 196.7, in boreholes C41-2 and C41-1.

The bedrock comprised dark grey to black, medium strength Biotite Gneiss and pink and grey, high strength Granitic Gneiss in borehole C41-2 and C41-1. A detailed description of the rock cores retrieved from borehole C41-1 and C41-2 is given in Table A, appended.

The measured core recovery ranged from 97 to 100%. The RQD determined from the rock cores was in a range of 94 to 100%, thus indicating excellent quality rock.

4.9.6 Groundwater

In June 2009, groundwater was observed during drilling at the surface in borehole C41-2 (elevation 206.0) and at 2.1 m depth in boreholes C41-1 and C41-3 (elevation 203.6 and 203.8). Upon completion of drilling, groundwater levels could only be established in borehole C41-3 due to the introduced drill water used for rock coring in boreholes C41-1 and C41-2. The groundwater level after drilling was at 4.6 m depth (elevation 201.3) in borehole C41-3.

The groundwater level observed during the investigation in November 2007 and February 2008 for swamp 606 (boreholes 606-1, 606-4 and 606-6) that are within proximity to the southbound C41 culvert found water levels ranging from elevation 205.3 to 206.1, at ground surface to 0.7 m depth.



The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

4.10 Culvert at Sta. 10+523 (SBL) (C44), Servos Township

Three boreholes designated C44/45-1 to C44/45-3 were drilled along the original southbound and northbound alignment of the proposed culverts C44 and C45 at Sta. 10+523 in February 2010. The northbound culvert was later shifted some 27.0 m further north to Sta. 10+550 due to constructability issues. The investigation conducted in February 2010 for the original alignment is considered still valid for the current southbound alignment.

The subsurface stratigraphy revealed in the boreholes comprised surficial fill and/ or peat, underlain by deposits of cohesionless sand/ silt, cohesive clay/ silty clay and sand/ sand and gravel deposits. Locally, in borehole C44/45-1 an organic silty clay layer was contacted below the peat. Probable bedrock was contacted below the sand/ sand and gravel deposits at 9.3 and 6.6 m depth, elevation 195.5 and 198.1, in boreholes C44/45-1 and C44/45-2. Bedrock was contacted below the silty clay deposit at 6.6 m depth, elevation 198.1, in borehole C44/45-3. Groundwater was measured from 0.3 to 0.6 m depth, elevation 204.2 to 204.4.

Reference should be made to the previous boreholes conducted in swamp 607 (boreholes 607-8 to 607-16 and the preliminary borehole N10-2) that are within proximity to culvert C44, specifically boreholes 607-11 that was drilled 2 m north of the culvert alignment. The boreholes generally reveal consistent soil conditions however, refusal on probable bedrock varies. For the proposed southbound culvert, the penetration test 607-8 and boreholes 607-11, 607-13 and N10-2, refused on probable bedrock at depths of 0.9 to 7.5 m, elevation 198.7 to 203.9, some 0.6 to 8.4 m higher than the depth that refusal was encountered in boreholes C44/45-1 and C44/45-2. As indicated above, borehole 607-11 was drilled in close proximity to the proposed southbound culvert and the variation in depth to probable bedrock in borehole 607-11 was 1.4 and 4.0 m higher than the depths encountered in boreholes C44/45-1 and C44/45-2.



4.10.1 Fill

A 900 mm thick silty sand fill layer was contacted surficially in borehole C44/45-1. The loose fill layer was penetrated at 0.9 m depth, elevation 203.9.

4.10.2 Peat

Peat was contacted below the fill at 0.9 m depth (elevation 203.9) in borehole C44/45-1 and at the surface in boreholes C44/45-2 and C44/45-3. The fine fibrous peat was 200 to 500 mm thick and was penetrated at depths of 0.2 to 1.2 m (elevation 203.6 to 204.5) in the boreholes.

4.10.3 Organic Silty Clay

Underlying the peat deposit in borehole C44/45-1, an organic silty clay stratum was contacted at 1.2 m depth, elevation 203.6. The 0.4 m thick layer of organic silty clay was soft to firm in consistency. An "N" value of 4 was obtained within the deposit. The organic silty clay was penetrated at 1.6 m depth, elevation 203.2.

4.10.4 Sand/ Silt

Underlying the organic silty clay or peat at depths of 1.6 and 0.5 m (elevation 203.2 and 204.2) in boreholes C44/45-1 and C44/45-2, a sand deposit was contacted. The 0.8 and 0.9 m thick deposit comprised trace to some silt and clay and trace gravel. The density of the sand deposit was loose. An "N" value of 9 was obtained within the deposit in each borehole. The sand layer was penetrated at depths of 2.4 and 1.4 m (elevation 202.4 and 203.3) in boreholes C44/45-1 and C44/45-2. The moisture content of the sand ranged from 21 to 23%.

Underlying the peat at 0.2 m depth (elevation 204.5) in borehole C44/45-3, a sandy silt deposit was contacted. The 0.5 m thick deposit comprised trace clay and was loose in density. An "N" value of 6 was obtained within the deposit. The sandy silt layer was penetrated at 0.7 m depth (elevation 204.0) in borehole C44/45-3. The moisture content of the sandy silt was 16%.



The results of grain size distribution analyses conducted on a sample of the sand deposit from borehole C44/45-2 is presented on Figure C44/45-GS-1.

4.10.5 Clayey Silt/ Clay/ Silty Clay

A 700 mm thick deposit of clayey silt was contacted below the sandy silt at 0.7 m depth (elevation 204.0) in borehole C44/45-3. The deposit was firm in consistency. An "N" value of 4 was obtained within the deposit. The clayey silt deposit was penetrated on the underlying silty clay at 1.4 m depth (elevation 203.3). The moisture content of the clayey silt was 34%.

Overlain by sand at depths of 2.4 and 1.4 m (elevation 202.4 and 203.3) in boreholes C44/45-1 and C44/45-2, a deposit of clay was contacted. The clay deposit was 3.1 m thick in both boreholes and was soft to firm in consistency. The initial "N" values of 1 were recorded upon contact with the deposit, beyond this point, the split spoon sampler penetrated the deposit under the weight of the hammer and drilling rods. In-situ vane testing conducted in both boreholes indicated a range in shear strength from 18 to 50 kPa. The deposit extended to the underlying silty clay at 5.5 and 4.5 m depth (elevation 199.3 and 200.2) in boreholes C44/45-1 and C44/45-2, respectively.

A silty clay deposit was contacted below the clay deposit at 5.5 and 4.5 m depth (elevation 199.3 and 200.2) in boreholes C44/45-1 and C44/45-2, and below the clayey silt at 1.4 m depth (elevation 203.3) in borehole C44/45-3. The silty clay comprised trace sand and ranged from 1.7 to 5.2 m in thickness. Locally, within the deposit in borehole C44/45-3, layers of clay and layer of sand were noted. The silty clay was firm in consistency. An initial "N" value of 2 was recorded upon contact with the deposit in borehole C44/45-3. The split spoon sampler penetrated the deposit under the weight of the hammer and drilling rods at further depth in borehole C44/45-3 and within the other boreholes. In-situ vane testing conducted in the boreholes indicated a range in shear strength from 32 to 36 kPa. The deposit extended to the underlying sand and gravel and sand deposits at 7.5 and 6.2 m depth (elevation 197.3 and 198.5) in boreholes C44/45-1 and C44/45-2, respectively. In borehole C44/45-3, the deposit extended to bedrock at 6.6 m depth, elevation 198.1.



The results of Atterberg plasticity limits testing and grain size distribution analysis conducted on samples of the clay from culvert C44/45 are presented in respective Figures C44/45-PC-1 and C44/45-GS-2.

The results of Atterberg plasticity limits testing and grain size distribution analysis conducted on samples of the silty clay from culvert C44/45 are presented in respective Figures C44/45-PC-1 and C44/45-GS-3.

The liquid limit and plastic limit of representative samples of the clay ranged from 65 to 69, and from 24 to 25, respectively, resulting in plasticity index values of 41 to 44. The water content of representative samples of the clay ranged from 58 to 95%.

The liquid limit and plastic limit of representative samples of the silty clay ranged from 45 to 50, and from 22 to 23, respectively, resulting in plasticity index values of 22 to 28. The water content of representative samples of the silty clay ranged from 26 to 64%, reflecting the influence on water content from the sand and clay layers that were contacted in borehole C44/45-3.

4.10.6 Sand and Gravel/ Sand

Sand and gravel and sand deposits were encountered at depths of 7.5 and 6.2 m (elevation 197.3 and 198.5) underlying the silty clay in boreholes C44/45-1 and C44/45-2, respectively. The deposits ranged in thickness of 0.4 to 1.8 m in the boreholes. The sand and gravel deposit contained trace silt and the sand deposit contained some silt and gravel. The sand and gravel deposit was compact in density and the sand deposit was very loose in density. The "N" values for the sand and gravel and sand deposits were 15 and 2, respectively. The moisture content for the cohesionless deposits ranged from 13 to 23%. The deposits extended to probable bedrock at 9.3 and 6.6 m depth (elevation 195.5 and 198.1) in borehole C44/45-1 and C44/45-2, respectively.



4.10.7 Bedrock

Bedrock and probable bedrock was contacted at depths of 6.6 to 9.3 m with the bedrock surface elevation decreasing from elevation 198.1 east of the proposed southbound culvert (borehole C44/45-3) to elevation 195.5 at the west end of the proposed southbound culvert (borehole C44/45-1). Bedrock was proven upon contact by coring 3.2 m into the rock to 9.8 m depth, elevation 194.9, in borehole C44/45-3.

The bedrock comprised pink, high strength Syenite in borehole C44/45-3. A detailed description of the rock cores retrieved from borehole C44/45-3 is given in Table A, appended.

The measured core recovery was 100%. The RQD determined from the rock cores was in a range of 83 to 100%, thus indicating excellent quality rock. In borehole C44/45-3, from elevation 195.4 to 194.9, the final 0.5 m of Syenite bedrock obtained was of poor quality, as characterized by an RQD value of 41%.

4.10.8 Groundwater

In February 2010, groundwater was observed in all of the boreholes during the course of the field work. Water was contacted at 0.3 to 0.6 m depth (elevation 204.2 to 204.4) within the boreholes during the investigation. Upon completion of drilling the groundwater levels remained the same. In borehole C44/45-3, the water level after drilling was not observed due to the introduced drill water used for rock coring.

The groundwater level observed during the investigation in March and February 2008 for boreholes 607-9 to 607-16 and in March 2004 for the preliminary borehole N10-2 within swamp 607, found water levels ranging from the surface to 1.0 m depth, elevation 204.4 to 205.0.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



4.11 Culvert at Sta. 10+550 (NBL) (C45), Servos Township

Three boreholes designated C44/45-1 to C44/45-3 were drilled along the original southbound and northbound alignment of the proposed culverts C44 and C45 at Sta. 10+523 in February 2010. The northbound culvert was later shifted some 27.0 m further north to Sta. 10+550 due to constructability issues. Due to the northbound culvert re-alignment the data obtained during the investigation for swamp 607 will be utilized. An additional manual borehole (borehole C44/45-4) was conducted in April 2010 to supplement the previous swamp 607 investigation data.

Borehole C44/45-4 was conducted at Sta. 10+550 on the new highway centerline close the proposed west end of the culvert and found exposed bedrock at elevation 205.5.

Reference is made to the previous boreholes conducted in swamp 607 that are within proximity to northbound culvert C45 (boreholes 607-14 to 607-21 and the preliminary investigation borehole N10-3). Borehole 607-18 was drilled near the east end of the proposed northbound culvert and comprised surficial peat over silty clay underlain by probable bedrock at 1.5 m depth (elevation 203.2). Borehole 607-16 conducted 12.5 m south of the eastern end of the culvert, comprised surficial peat over a 1.2 m thick layer of organic clay, over 5.6 m thick layer of clay underlain by probable bedrock at 7.3 m depth (elevation 197.3).

4.11.1 Peat

A 0.5 m thick surficial peat deposit was contacted in borehole 607-18. The coarse fibrous peat was penetrated at 0.5 m depth (elevation 204.2).

4.11.2 Silty Clay

Underlying the peat deposit in borehole 607-18, a silty clay deposit was contacted at 0.5 m depth, elevation 204.2. The 1.0 m thick layer of silty clay was stiff in consistency. An "N" value of 7 was obtained within the deposit. A penetrometer test taken on a sample of the silty clay deposit found a shear strength of 88 kPa. The silty clay deposit was underlain by probable bedrock at 1.5 m depth (elevation 203.2).



The liquid limit and plastic limit of the silty clay was 37 and 20, respectively, with a plasticity index value 17. The moisture content of the representative sample of the silty clay was 26%.

4.11.3 Bedrock

Exposed bedrock and probable bedrock at 1.5 m depth was found decreasing from elevation 205.5 near the west end of the proposed northbound culvert (borehole C44/45-4) to elevation 203.2 near the east end of the proposed northbound culvert (borehole 607-18).

Refusal on probable bedrock was contacted at 0.3 and 0.1 m depth (elevation 205.3 and 204.9) in boreholes 607-17 and 607-20, located west and north of the western end of the culvert, respectively. In the penetration tests N10-3 and 607-21 conducted 8.0 and 12.5 m north of the eastern portion of the culvert, probable bedrock was contacted at 2.3 and 5.2 m depth (elevation 202.6 and 199.7). Refusal on probable bedrock was contacted at some 3.8 to 7.4 m lower (elevation 201.7 and 195.8) than boreholes C44/45-4 and 607-18, respectively, in the penetration tests 607-14 and 607-15 conducted 12.5 m further south.

4.11.4 Groundwater

In February 2010, groundwater was observed in all of the boreholes during the course of the field work for original culvert alignment at Sta. 10+523. Water was contacted at 0.3 to 0.6 m depth (elevation 204.2 to 204.4) within the boreholes during the investigation. Upon completion of drilling the groundwater levels remained the same. In borehole C44/45-3, the water level after drilling was not observed due to the introduced drill water used for rock coring. These water levels are 0.3 to 0.7 m above the anticipated subgrade levels of the proposed culvert alignment.

The groundwater level observed during the investigation in March and February 2008 for boreholes 607-9 to 607-23 and in March 2004 for the preliminary borehole N10-2 within swamp 607, found water levels ranging from the surface to 1.0 m depth, elevation 204.4 to 205.0.

The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.



5. MISCELLANEOUS

The field work was carried out under the supervision of Mr. F. Portela and Mr. M. Rapsey and the direction of Mr. M.J. Narduzzi, BEng. Walker Drilling Ltd. supplied the drilling equipment. The laboratory work was carried out in the PML laboratory in Toronto.

This report was prepared by Mr. C.M.P. Nascimento, P.Eng., with the assistance of Mr. M.J. Narduzzi, BEng., and was independently reviewed by Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact.

Yours very truly

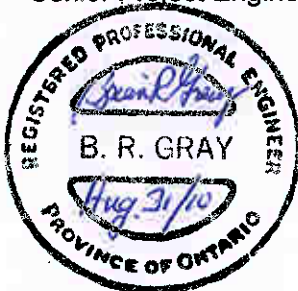
Peto MacCallum Ltd.

A handwritten signature in blue ink, appearing to read "Mark Narduzzi", is written over the typed name.

Mark Narduzzi, BEng.
Engineer-in-Training



Carlos M. P. Nascimento, P.Eng.
Senior Project Engineer



Brian R. Gray, MEng, P.Eng.
MTO Designated Principal Contact
CN/BRG:mn-lnr-mi



TABLE A
ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C1-1 (Sta.10+080 36 m Rt.)	10	6.5 – 8.0	98	83	6.5 – 9.5	GRANITIC GNEISS: Grey, fine to medium crystalline, with occasional dark grey to black bands, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar, tight to slightly altered with red oxidation and/or scale on partings, good to excellent quality.
	11	8.0 – 9.5	97	93		
C1-2 (Sta.10+098 3 m Rt.)	2	0.3 – 1.3	100	40	0.3 – 3.4	GRANITIC GNEISS: Pink and grey, fine to medium crystalline, high strength, slightly weathered, very close to close becoming close to moderate spaced flat to dipping cross joints, rough planar, tight to slightly altered with red oxidation and/or scale on partings, poor to good quality.
	3	1.3 – 1.8	100	40		
	4	1.8 – 3.4	97	79		
C2-1 (Sta.10+133 6 m Lt.)	5	3.8 – 5.3	77	50	3.8 – 5.8	SYENITE: Pink to red, fine to medium crystalline, occasional steeply dipping bands of white feldspar and dark mafic material, high strength, slightly weathered, close to moderate spaced flat to dipping cross joints, rough planar, with green to dark green secondary mineralization and/or scale on partings, fair quality.
	6	5.3 – 6.9	93	52	5.8 – 6.9	
						GABBRO: Dark grey to black, medium crystalline, high strength, slightly weathered, close spaced flat to dipping cross joints, rough planar, with scale and/or silt on partings, fair quality.

Originated: FP
 Compiled: JW
 Checked: MN/ CN



TABLE A
ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C2-3 (Sta.10+148 35 m Lt.)	2	0.9 – 2.0	100	33	0.9 – 3.4	SYENITE: Light grey to pink, fine to medium crystalline, high strength, slightly weathered, very close to moderate spaced flat to dipping cross joints, multiple sets, rough planar, tight to slightly oxidized, numerous vertical fissures, with orange oxidation on surface, poor quality, over steeply dipping composite layer (2 mm thick black mafic breccia over 25 mm thick red, fine crystalline material).
	3	2.0 – 3.5	100	39		
	4	3.5 – 4.2	100	80		
					3.4 – 4.2	SYENITE: Pink to red, fine crystalline, with occasional irregular porous seams, high strength, slightly weathered, close (locally very close) spaced flat cross joints, rough planar, with green secondary mineralization and/or scale on partings, good quality.
SX-1 (Sta.10+800 31 m Lt.)	1	0.8 – 2.3	100	86	0.8 – 3.8	GRANITIC GNEISS: Pink and grey, fine to medium crystalline, with pegmatitic layer, high strength, slightly weathered, close to moderate (locally very close) spaced flat to dipping cross joints, rough planar, slightly altered with red oxidation and/or silt on partings, good to excellent quality.
	2	2.3 – 3.8	100	99		
SX-2 (Sta.10+800 CL)	1	1.2 – 2.0	76	24	1.2 – 4.5	GRANITIC GNEISS: Pink, fine to medium crystalline, high strength, slightly weathered, close to wide (locally very close) spaced flat to dipping cross joints, rough planar, slightly altered with red oxidation stains on partings, multiple vertical fractures in upper 330 mm, very poor becoming excellent quality.
	2	2.0 – 3.4	100	90		
	3	3.4 – 4.5	98	98		
SX-3 (Sta.10+798)	1	0.7 – 2.1	100	38	0.7 – 3.8	GRANITIC GNEISS: Pink and grey, fine to medium crystalline, high strength, slightly weathered, close to moderate spaced flat to dipping
	2	2.1 – 3.5	100	93		

Originated: FP
 Compiled: JW
 Checked: MN/ CN



TABLE A
ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
30 m Rt.)	3	3.5 – 3.8	100	73		cross joints, rough planar, slightly altered with dark red oxidation and/or scale on partings, poor to excellent quality.
C8/9-1 (Sta.12+590 38 m Lt.)	5	2.4 – 3.2	100	53	2.4 – 5.2	GRANITIC GNEISS: Pink to light grey, slight near vertical banding, fine to medium crystalline, with near vertical irregular pink vein, high strength, slightly weathered to unweathered, close to moderate becoming wide spaced dipping cross joints, rough planar, tight to slightly altered with dark red oxidations stains and/or scale on partings, some vertical fissures in upper 0.7 m, locally open to 0.5 mm, with dark mineralization on parting, fair, becoming excellent quality.
	6	3.2 – 4.8	100	93		
	7	4.8 – 5.2	100	100		
C8/9-4 (Sta.12+590 36 m Rt.)	9	7.2 – 8.0	100	30	7.2 – 10.2	GRANITIC GNEISS: Pink, fine crystalline, no banding, with veinlets throughout rock mass, medium strength, slightly weathered to unweathered, very close to close (locally moderate) spaced dipping cross joints (multiple sets), rough planar, tight to occasionally slightly altered with silt on partings, poor to fair quality.
	10	8.0 – 9.5	100	74		
	11	9.5 – 10.2	100	68		
C15-1 (Sta.13+206 48 m Lt.)	8	5.5 – 6.5	100	93	5.5 – 8.3	MIGMATITE: Dark grey, fine to medium crystalline, with near vertical banding, high strength, slightly weathered to unweathered, moderate to wide (locally close) spaced flat cross joints, rough planar, tight to slightly altered with red oxidation stains on partings, good to excellent quality.
	9	6.5 – 8.0	98	98		
	10	8.0 – 8.3	83	83		

Originated: FP
 Compiled: JW
 Checked: MN/ CN



TABLE A
ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C15-3 (Sta.13+206 39.5 m Rt.)	6	5.5 – 5.7	100	100	5.5 – 8.5	GRANITIC GNEISS: Pink to light grey, medium crystalline, no banding, high strength, slightly weathered to unweathered, moderate to wide (locally close) spaced flat to dipping cross joints, rough planar, tight to slightly altered with dark oxidation stains and/or silt on partings, possible 50 mm void at 7.3 m depth, good to excellent quality.
	7	5.7 – 6.4	92	92		
	8	6.4 – 7.9	97	79		
	9	7.9 – 8.5	100	100		
C16-1 (Sta.8+240 CLRSC 13 m Lt.)	4	2.3 – 3.5	100	100	2.3 – 5.4	MIGMATITE: Light grey, fine to medium crystalline, with near vertical dark grey to black distorted banding, occasional metallic mineralization, high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough planar, with silt and/or scale on partings, good to excellent quality.
	5	3.5 – 5.0	100	88		
	6	5.0 – 5.4	100	100		
C-37/38-3 (Sta.15+310 47 m Lt.)	4	4.1 – 5.1	100	100	4.1 – 7.2	MIGMATITE: Dark grey, medium to coarse crystalline, biotite rich with occasional bands of white to pink feldspar, medium strength, slightly weathered with occasional highly weathered layers, close to moderate spaced flat to dipping cross joints, rough planar, slightly altered with oxidation and/or silt on partings, vertical fissures, smooth planar (locally polished appearance) with oxidized friable infilling up to 20 mm wide, good to excellent quality.
	5	5.1 – 6.5	100	81		
	6	6.5 – 7.2	100	100		

Originated: FP
 Compiled: JW
 Checked: MN/ CN



TABLE A
ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
C41-1 (Sta.15+885 5 m Lt.)	7	5.8 – 6.6	100	100	5.8 – 8.9	GRANITIC GNEISS: Pink and grey, medium crystalline, high strength, slightly weathered, close to wide spaced flat to dipping cross joints, rough planar, slightly altered with oxidation and/or scale on partings, excellent quality.
	8	6.6 – 8.1	100	100		
	9	8.1 – 8.9	100	100		
C41-2 (Sta.15+888 46 m Lt.)	5	2.4 – 3.7	100	94	2.4 – 5.6	BIOTITE GNEISS: Dark grey to black, fine to medium crystalline, medium strength, slightly weathered, close to moderate spaced flat to dipping cross joints, rough planar, slightly altered with oxidation and/or scale on partings, excellent quality.
	6	3.7 – 5.1	100	100		
	7	5.1 – 5.6	97	97		
C-44/45-3 (Sta.10+523 37 m Rt.)	7	6.6 – 6.8	100	100	6.6 – 9.8	SYENITE: Pink, fine crystalline, high strength, slightly weathered, close to moderate spaced flat to dipping cross joints, rough planar, slightly altered with silt and/or scale on partings, occasional vertical fissure, rough planar, oxidized, good to excellent, becoming poor quality.
	8	6.8 – 7.8	100	88		
	9	7.8 – 9.3	100	83		
	10	9.3 – 9.8	100	41		

NOTE: RQD = Rock Quality Designation

Originated: FP
 Compiled: JW
 Checked: MN/ CN

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

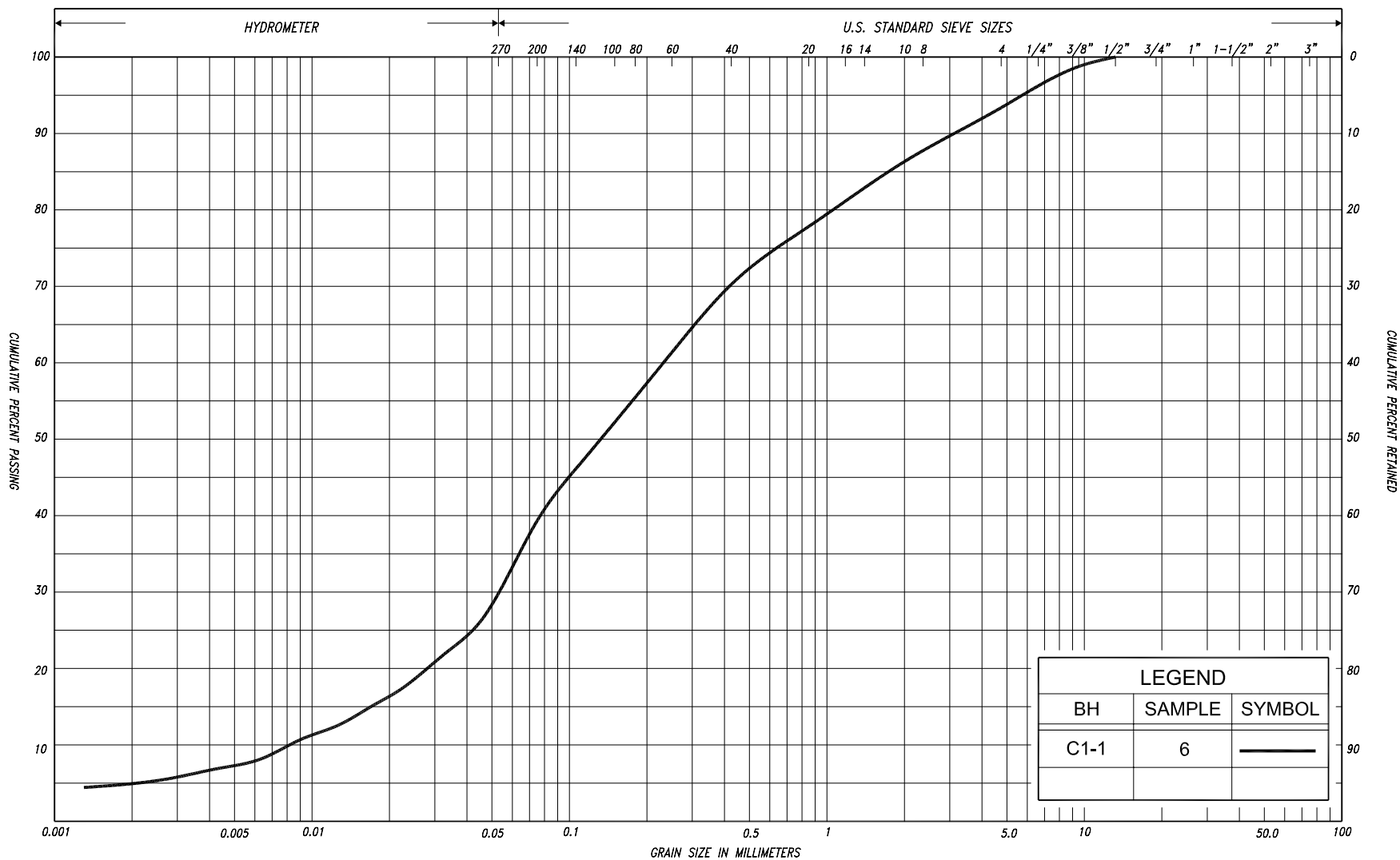
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

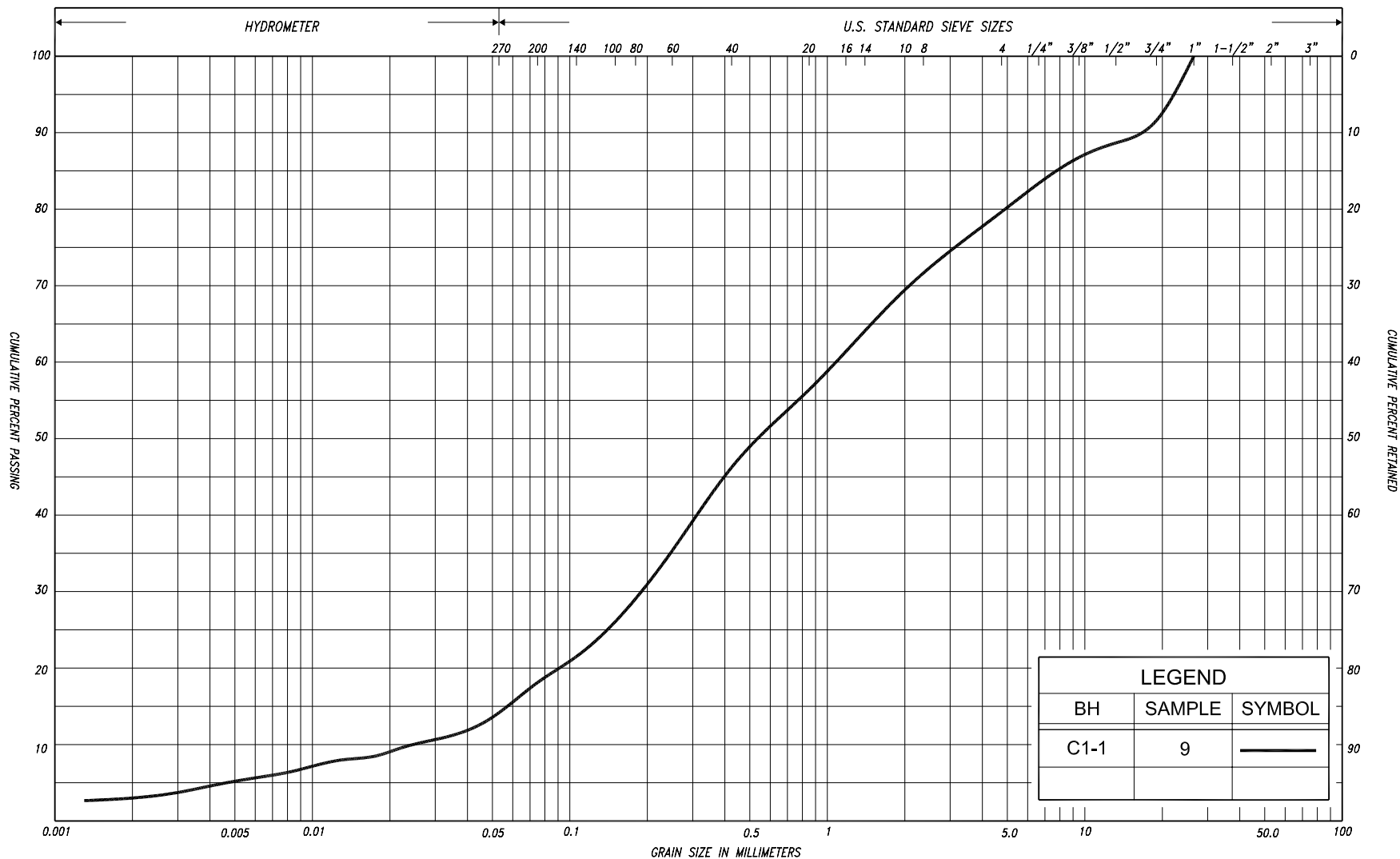
ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m^3	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m^3/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kN/m^3	SEEPAGE FORCE
e	1, %	VOID RATIO						

Culvert at Sta. 10+100 (NBL) (C1), Cox Township

Figures C1-GS-1 to C1-GS-2 – Results of Grain Size Distribution Analyses
Record of Borehole Sheets
Drawing C1-1 – Borehole Locations and Soil Strata



SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED	
					SAND										
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT														
CLAY		SILT			V. FINE	FINE	MED.	COARSE	GRAVEL						U.S. BUREAU
					SAND										



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT				V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
CLAY		SILT		SAND				GRAVEL				

METRIC

G.W.P. <u>5217-06-00</u>		LOCATION <u>Co-ords: 5 111 256.9 N ; 328 470.7 E Hwy 69, Sta. 10+080, o/s 36m Rt.</u>	ORIGINATED BY <u>F.P.</u>
DIST <u>54</u>	HWY <u>69</u>	BOREHOLE TYPE <u>C.F.S.S.A. and Rotary Diamond Coring</u>	COMPILED BY <u>M.N.</u>
DATUM <u>Geodetic</u>		DATE <u>June 22 & 23, 2009</u>	CHECKED BY <u>C.N.</u>

[illegible]

RECORD OF BOREHOLE No C1-2										1 of 1		METRIC					
G.W.P. 5217-06-00			LOCATION Co-ords: 5 111 254.0 N ; 328 433.1 E Hwy 69, Sta. 10+098, o/s 3m Rt.			ORIGINATED BY F.P.											
DIST 54 HWY 69			BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring			COMPILED BY M.N.											
DATUM Geodetic			DATE June 22, 2009			CHECKED BY C.N.											
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									
193.8	Ground surface																
0.0 193.5 0.3	Peat, fine fibrous Dark brown Granitic Gneiss bedrock Slightly weathered High strength Poor to good quality		1	SS	1												
			2	RC NQ	REC 100%		193										RQD 40%
			3	RC NQ	REC 100%		192										RQD 40%
			4	RC NQ	REC 97%		191										RQD 79%
190.4 3.4	End of borehole Sample 1: Sampler bouncing * Borehole charged with drilling water C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																

RECORD OF BOREHOLE No 601-8

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+075, o/s 30.5m Lt. CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY G.D.
 DATUM Geodetic DATE November 07, 2007 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					w _p	w	w _L	WATER CONTENT (%)	GR	SA		SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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RECORD OF PENETRATION TEST No 601-9

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+075 CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE March 08, 2008 CHECKED BY C.N.

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						
194.4	Top of Ice													
0.0	Probable ice													
	Probable peat													
	Probable clayey silt													
	Firm													
192.0	End of dynamic cone penetration test													
2.4	Refusal on probable bedrock													

RECORD OF BOREHOLE No 601-9A

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+080, o/s 8.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY G.D.
 DATUM Geodetic DATE October 09, 2008 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)							GR	SA	SI	CL			
						○ UNCONFINED			● QUICK TRIAXIAL	+	×	FIELD VANE	LAB VANE											
195.7	Ground Surface																							
0.0	Bedrock at surface																							
	* Borehole dry																							

RECORD OF BOREHOLE No 601-10

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+100, o/s 18.8m Lt. CL Med. ORIGINATED BY K.H.
DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY G.D.
DATUM Geodetic DATE November 07, 2007 CHECKED BY C.N.

SOIL PROFILE				SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							GR	SA	SI	CL
197.2	Ground Surface																				
0.0	Bedrock at surface																				
	* Borehole dry																				

RECORD OF BOREHOLE No 601-10A 1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+100, o/s 6.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY G.D.
 DATUM Geodetic DATE October 09, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE					LAB VANE							
195.6	Ground Surface					*																		
0.0	Bedrock at surface																							
	* Borehole dry																							

RECORD OF BOREHOLE No 601-11

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+100, o/s 12.0m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE September 26, 2007 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
195.5	Ground Surface						20	40	60	80	100						
0.0	Sand some gravel, trace silt Compact Brown Moist		1	SS	30												
	cobbles and boulders		2	SS	10												15 78 (7)
	Loose (FILL)																
			3	SS	7												
			4	SS	9												
			5	SS	6/10cm												
			6	RC NQ	**												**
191.1	Clayey silt, some sand organic inclusions Firm Grey Moist		7	SS	9												0 12 75 13
4.4				FV													
189.7																	
5.8	Sand some gravel, some silt Compact Grey Wet		8	SS	28												20 62 (18)
188.8																	
6.7	End of borehole Probable sand																
188.0	Compact																
7.5	End of dynamic cone penetration test Refusal on probable bedrock Sample 5: Sampler bouncing * Borehole dry on completion of drilling ** Blast rock coring C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers																

RECORD OF BOREHOLE No 601-12

1 of 1

METRIC

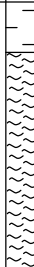
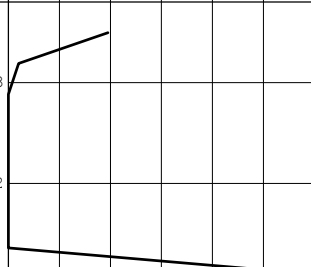
G.W.P.	5217-06-00	LOCATION	Hwy 69 (New), Sta. 10+125, o/s 34.5m Lt. CL Med.	ORIGINATED BY	K.H.
DIST	54	HWY	69	BOREHOLE TYPE	Manual Sampling
				COMPILED BY	G.D.
DATUM	Geodetic	DATE	March 09, 2008	CHECKED BY	C.N.

[illegible]

RECORD OF PENETRATION TEST No 601-13

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 4.5m Lt. CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE March 08, 2008 CHECKED BY C.N.

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						
193.8 0.0	Top of Ice Probable ice Probable peat						193 192							
191.1 2.7	End of dynamic cone penetration test Refusal on probable bedrock							120/20cm						

METRIC

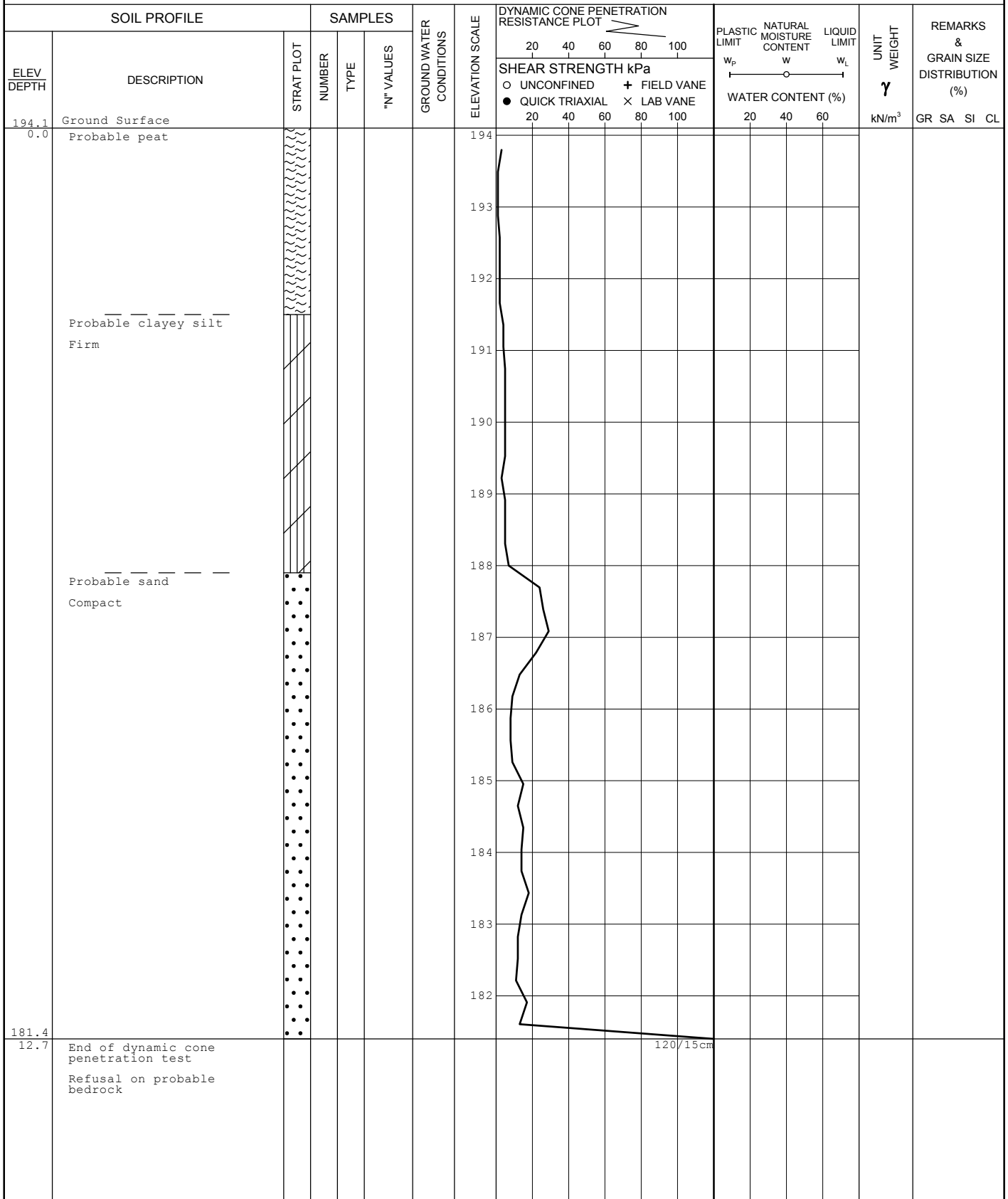
+⁷, ×⁵: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

RECORD OF PENETRATION TEST No 601-15

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 38.0m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE March 30, 2008 CHECKED BY C.N.



RECORD OF BOREHOLE No N1-2

1 of 1

METRIC

G.W.P. 5218-06-00

LOCATION

Hwy. 69 (New), Sta. 10+082, o/s 45.2m Rt.
Co-ords. 5 111 264 N; 328 477 E

ORIGINATED BY R.M.

DIST 54

HWY 69

BOREHOLE TYPE

Continuous Flight Hollow Stem Augers

COMPILED BY R.M.

DATUM Geodetic

DATE

February 28, 2004

CHECKED BY C.N.

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								○		
194.6	Ground Surface						20	40	60	80	100									
0.0	Peat		1	SS	33															
	Dark brown																			
			2	SS	4										126					
192.3	Silty clay																			
2.3	Soft Grey Wet		3	SS	2										91					
190.8	Sand, with to some silt some gravel, trace clay																			
3.8	Compact Brown Moist		4	SS	24															
			5	SS	15															
187.7	End of borehole																			
6.9	Refusal on probable bedrock																			
	* 2004 02 28																			
	Water level measured after drilling																			

CONT No

GWP No 5217-06-00

GWP No 5379-02-00

CULVERT AT STA. 10+100 (NBL) (C1)

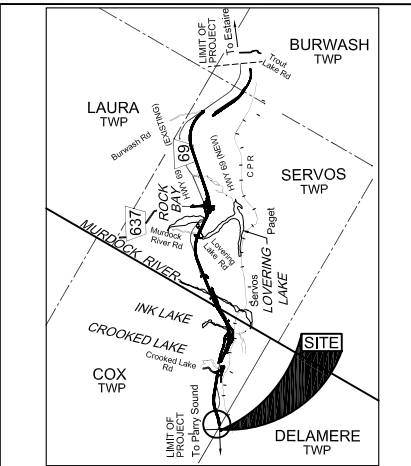
HIGHWAY 69 FOUR-LANING - COX TWP

BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



KEY PLAN
SCALE
0 2 4 6 km

LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)
- * Water level not established
- W L at time of investigation June 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

(Legend Continued)

BH No	ELEVATION	STA COX TWP	o/s CL MED
601-8	197.4	10+075	30.5m Lt.
601-9	194.4	10+075	CL
601-9A	195.7	10+080	8.0m Lt.
601-10	197.2	10+100	18.8m Lt.
601-10A	195.6	10+100	6.0m Lt.
601-11	195.5	10+100	12.0m Rt.
601-12	197.2	10+125	34.5m Lt.
601-13	193.8	10+125	4.5m Lt.
601-14	194.4	10+125	4.5m Rt.
601-15	194.1	10+125	38.0m Rt.
N1-2	194.6	10+082	45.2m Rt.

(Legend Continues)

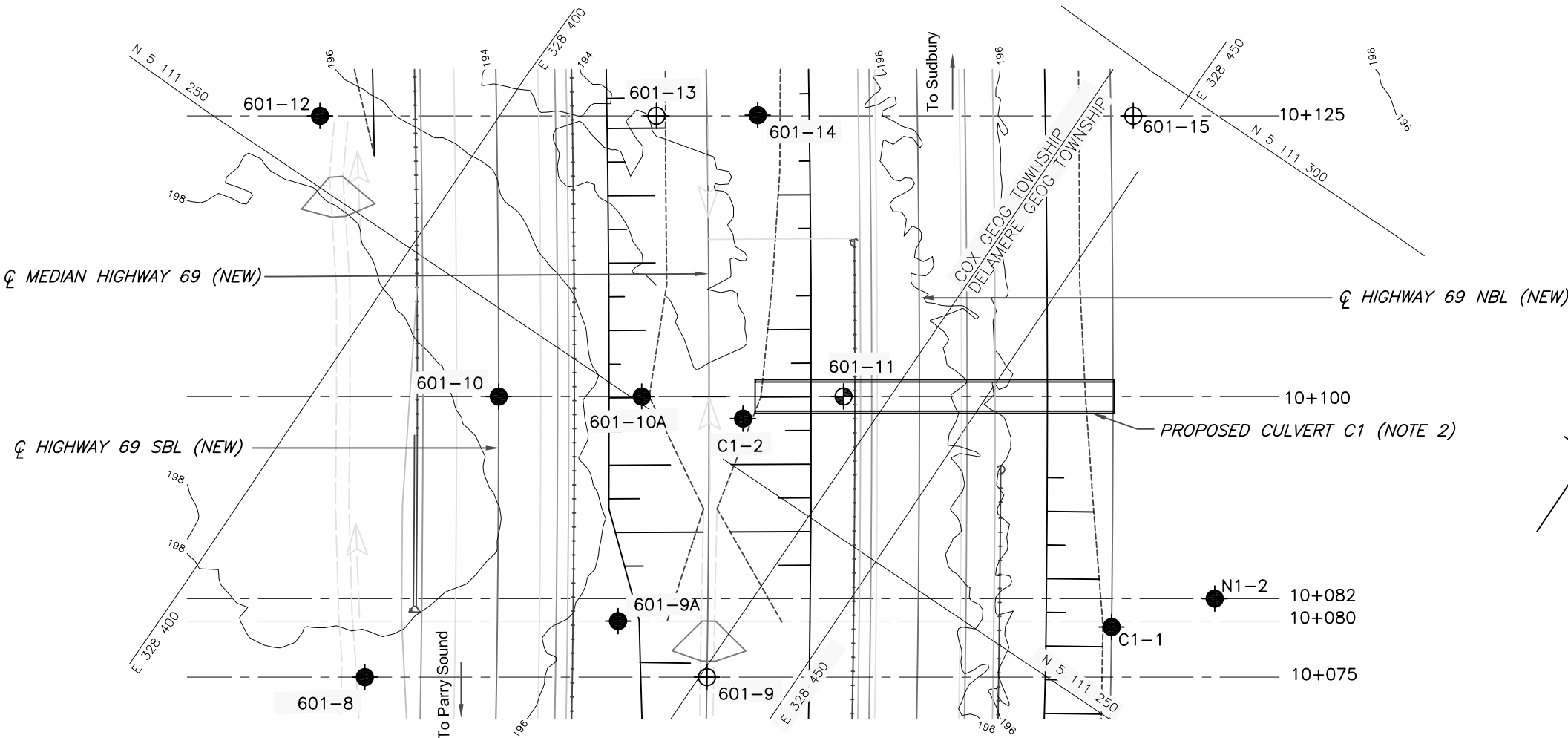
- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

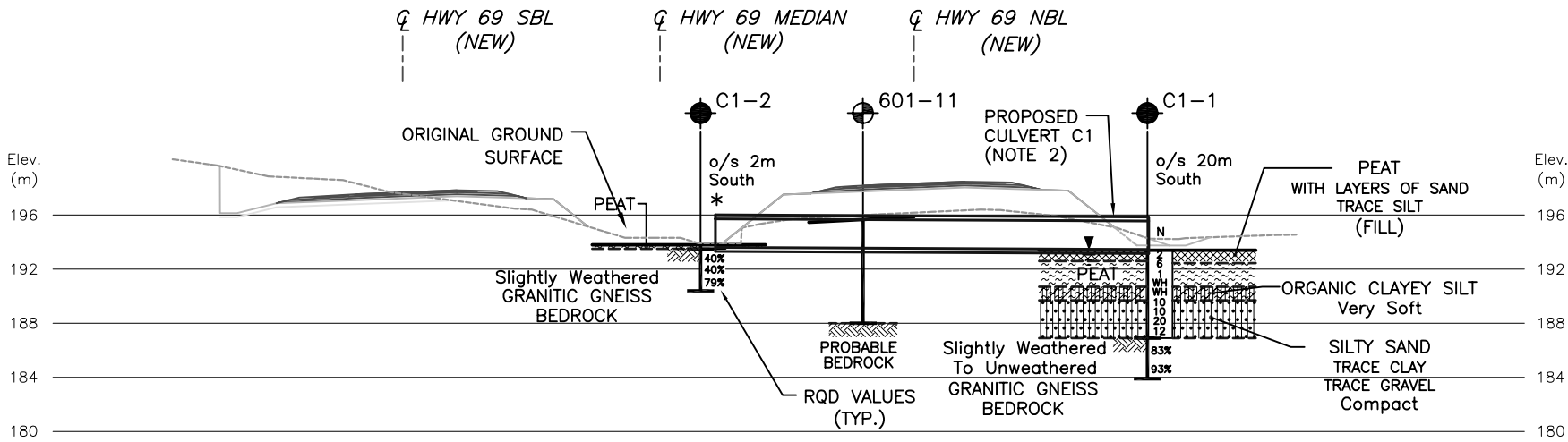
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262

HWY No	69	DIST	Sudbury Area
SUBM'D	MN	CHECKED	MN
DATE	AUG. 30, 2010	SITE	
DRAWN	NA	CHECKED	CN
APPROVED	BRG	DWG	C1-1



PLAN
SCALE
0 5 10m



PROFILE Q CULVERT STA. 10+100 (NBL) (C1)

SCALE
0 5 10m

NOTES:

- DRAWING C1-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- CULVERT AT STA. 10+100 WAS DESIGNATED AS CULVERT C1 FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

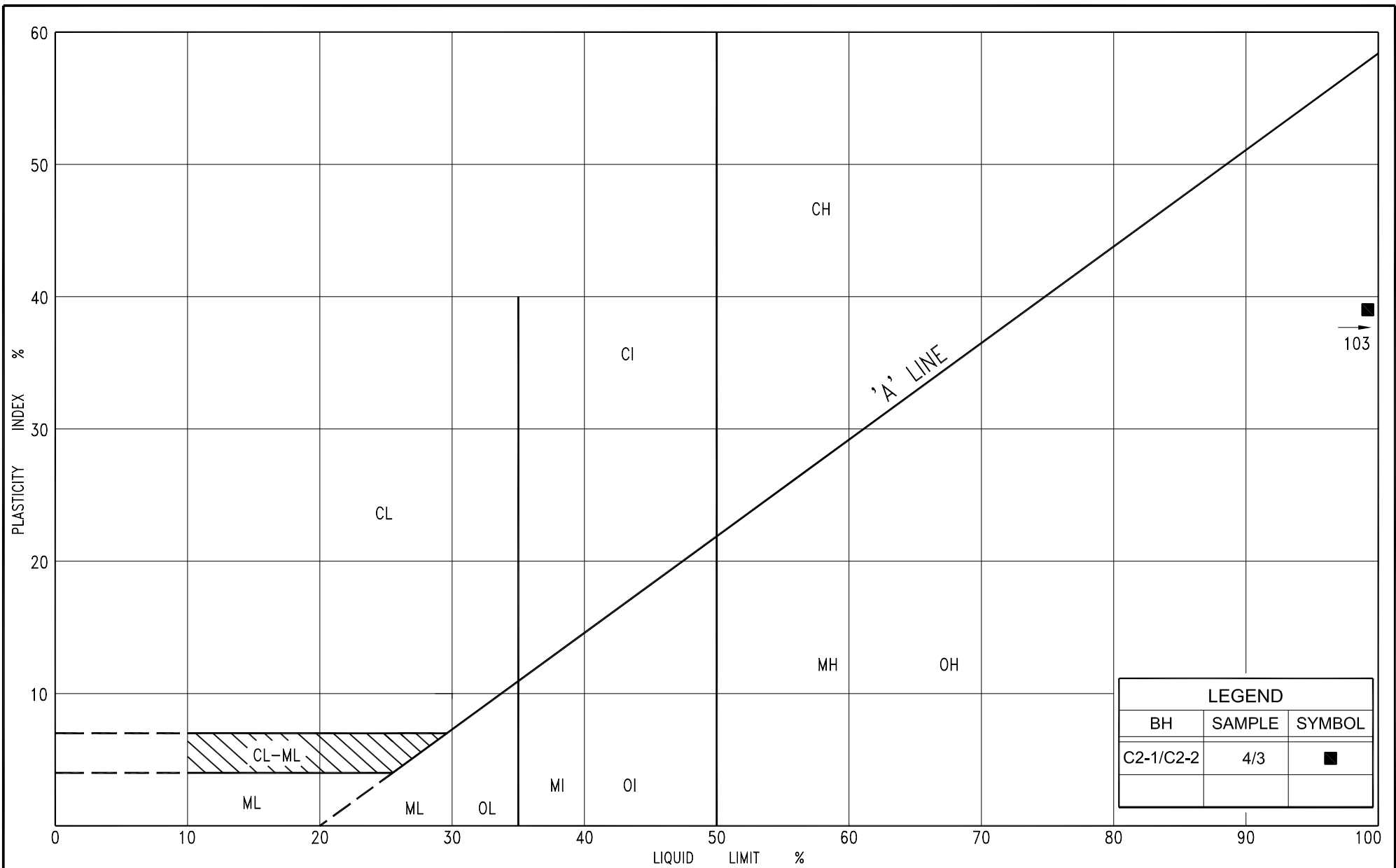
REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010; Hwy 69
Servos - Cont 3 -Structural -PC Conc Box Culv
Prof 10+100 10+140 12+750 13+206 CLRSC
8+240.dwg, dated April 23, 2010 and
C3-Lidar-ctrs.dwg, dated May 14, 2008.



Culvert at Sta. 10+140 (SBL) (C2), Cox Township

Figure C2-PC-1 – Result of Atterberg Limit Testing
Record of Borehole Sheets

Drawing C2-1 – Borehole Locations and Soil Strata



LEGEND		
BH	SAMPLE	SYMBOL
C2-1/C2-2	4/3	■

RECORD OF BOREHOLE No C2-1										1 of 1		METRIC				
G.W.P. 5217-06-00			LOCATION Co-ords: 5 111 277.4 N ; 328 405.9 E Hwy 69, Sta. 10+133, o/s 6m Lt.			ORIGINATED BY M.R.										
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring			COMPILED BY M.N.										
DATUM Geodetic			DATE February 22, 2010			CHECKED BY C.N.										
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p	w	W _L	γ	GR	SA	SI	CL
194.3	Ground surface					▽*										
0.0	Ice						194									
193.7	Water															
0.6	Peat, fine fibrous															
	Dark brown		1	SS	WH**							734				
							193					287				
			2	SS	WH											
192.1	Organic clayey silt						192					227				
2.2	Very soft Dark brown/ green Wet		3	SS	WH											
							191					103				
190.8	Clayey silt, some sand		4	SS	1											
3.5	Very soft Grey Wet															
190.5	Syenite bedrock						190									
3.8	Slightly weathered		5	RC NQ	REC 77%											
	High strength						189									
	Fair quality															
188.5	Gabbro bedrock															
5.8	Slightly weathered		6	RC NQ	REC 93%		188									
	High strength															
	Fair quality															
187.4	End of borehole															
6.9																
<p>* 2010 02 22</p> <p>▽ Water level observed during drilling</p> <p>▽* Water level measured after drilling</p> <p>WH** Denotes penetration due to weight of rods and hammer</p> <p>C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers</p> <p>Sample 4 was combined with sample 3 from borehole C2-2 for testing</p>																

RECORD OF BOREHOLE No C2-2 1 of 1 METRIC												
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 111 276.0 N ; 328 391.5 E Hwy 69, Sta. 10+140, o/s 19m Lt.				ORIGINATED BY M.R.				
DIST 54 HWY 69		BOREHOLE TYPE		Continuous Flight Hollow Stem Augers				COMPILED BY M.N.				
DATUM Geodetic		DATE		February 22, 2010				CHECKED BY C.N.				
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L			
194.3	Ground surface											
0.0	Ice											
193.7	Water											
0.6	Peat, fine fibrous											
	Dark brown		1	SS	WH**						155	
192.6	Organic clayey silt											
1.7	Very soft Dark brown/ green		2	SS	WH							Org. 18.8%
191.7	Silt and sand, trace clay											
2.6	Very loose Grey		3	SS	WH						103	Org. 13.9%
191.3	End of borehole										164	
3.0	Refusal on probable bedrock											
<p>* 2010 02 22</p> <p>▽ Water level observed during drilling</p> <p>▼ Water level measured after drilling</p> <p>WH** Denotes penetration due to weight of rods and hammer</p> <p>Sample 3 was combined with sample 4 from borehole C2-1 for testing</p>												

METRIC

G.W.P.	5217-06-00	LOCATION	Hwy 69, Sta. 10+148, o/s 35m Lt.	ORIGINATED BY	M.R.
DIST	54	HWY	69	BOREHOLE TYPE	C.F.H.S.A. and Rotary Diamond Coring
DATUM	Geodetic	DATE	February 22, 2010	COMPILED BY	M.N.
				CHECKED BY	C.N.

+⁷, ×⁵: Numbers refer to Sensitivity

20
15 — ○ — 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 601-12

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 34.5m Lt. CL Med. ORIGINATED BY K.H.

DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY G.D.

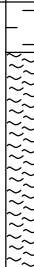
DATUM Geodetic DATE March 09, 2008 CHECKED BY C.N.

[illegible]

RECORD OF PENETRATION TEST No 601-13

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 4.5m Lt. CL Med. ORIGINATED BY K.H.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE March 08, 2008 CHECKED BY C.N.

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						
193.8 0.0	Top of Ice Probable ice Probable peat						193 							

RECORD OF BOREHOLE No 601-14

1 of 1

METRIC

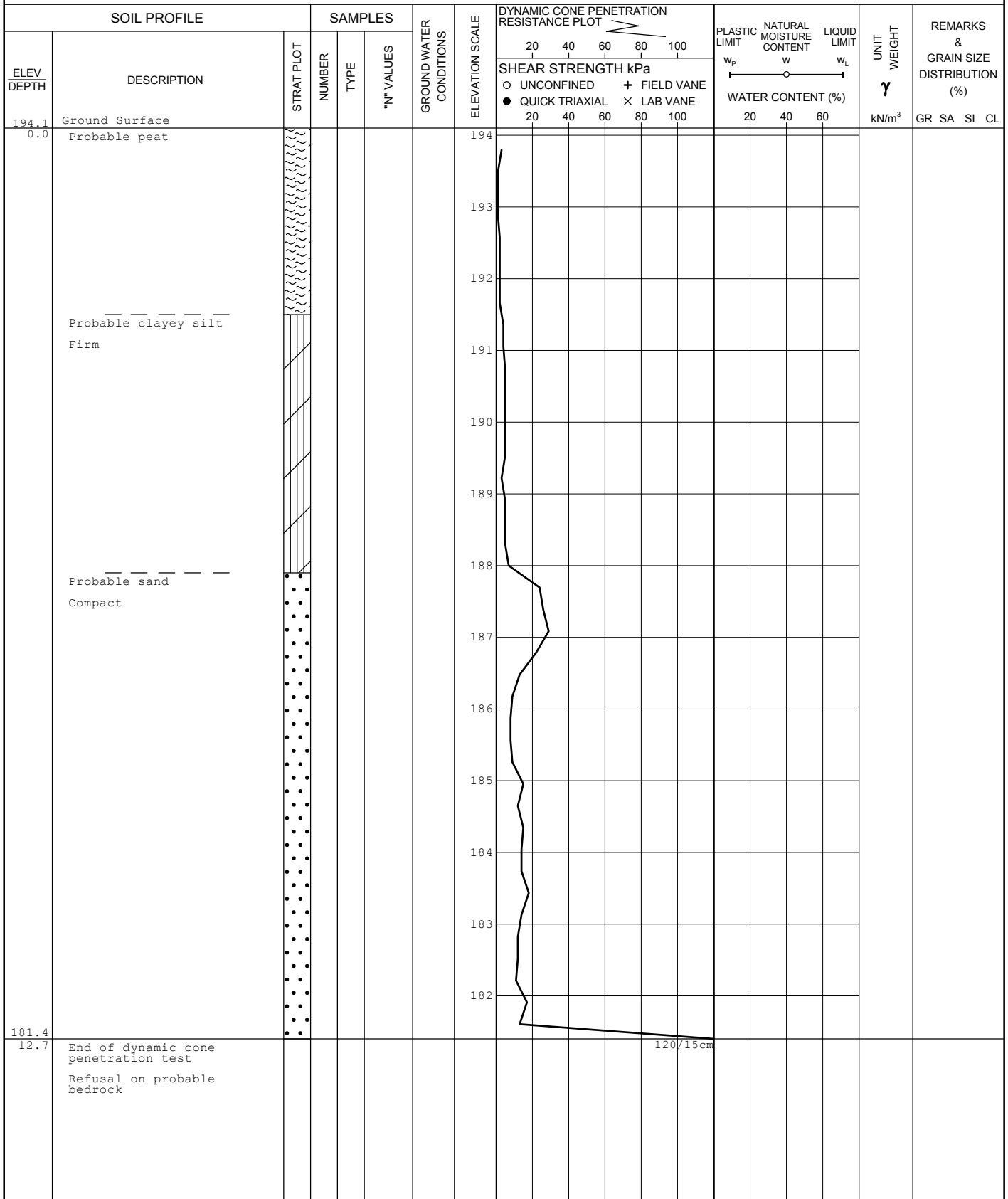
G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 4.5m Rt. CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE March 06, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE						○							
						● QUICK TRIAXIAL × LAB VANE															
194.4 0.0	Top of Ice Ice		1	SS	10	▼	194										452 Org. 37.1%	GR SA SI CL			
193.9 0.5	Peat, fine fibrous Dark brown		2	SS	1		193														
			3	SS	1		192														
			4	SS	1		191														
191.0 3.4	Clayey silt, trace sand Soft Light Wet grey		5	SS	2																
190.1 4.3	End of borehole Refusal on probable bedrock			FV																	
* 2008 03 06																					
▽ Water level observed during drilling																					
▼ Water level measured after drilling																					

RECORD OF PENETRATION TEST No 601-15

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+125, o/s 38.0m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE March 30, 2008 CHECKED BY C.N.



RECORD OF BOREHOLE No 601-16

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+150, o/s 19.0m Lt. CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE March 07, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _P	W	W _L					
193.8	Top of Ice					▼*		20	40	60	80	100								
0.0	Ice					19*	193													
	Water																			
192.5																				
1.3	Peat, fine fibrous		1	SS	WH**		192										173		Org. 25.7%	
	Dark brown																227			
			2	SS	WH		191													
190.8																				
3.0	Clayey silt, trace sand		3	SS	2		190													
	Soft to Grey Wet			FV																
	sand seams		4	SS	3		189													
188.5																				
5.3	Sand, trace gravel																			
187.9	Grey Wet					188														
5.9	End of borehole																			
	Refusal on probable bedrock																			

* 2008 03 07

▽ Water level observed
during drilling

▽ Water level measured
after drilling

WH** Denotes penetration due
to weight of rods and
hammer

RECORD OF BOREHOLE No 601-17

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+150, o/s 26.0m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + NW Casing COMPILED BY G.D.
 DATUM Geodetic DATE September 26, 2007 CHECKED BY C.N.

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								
196.1	Ground Surface						20	40	60	80	100						
0.0	Sand, some gravel		1	SS	28												
	Compact Brown Moist																
			2	SS	29												
	cobbles and boulders																
	(FILL)																
193.8																	
2.3	Sand, some to trace gravel		3	SS	16												
	trace silt																
	Compact Grey Wet																
	to loose		4	SS	8							○				1 93 (6)	
191.7																	
4.4	End of borehole																
	Refusal on probable bedrock																
	* Borehole dry on completion of drilling																
	C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																

RECORD OF BOREHOLE No 601-17A

1 of 2

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+165, o/s 6.0m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE October 09, 2008 CHECKED BY C.N.

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								○		
196.2	Ground Surface						20	40	60	80	100									
0.0	Sand and gravel		1	SS	5															
	Loose Brown																			
	(FILL)		2	SS	7															
	cobbles and boulders		3	SS	4															
	(ROCKFILL)		4	SS	11/15cm															
			5	SS	25/15cm															
			6	SS	21/15cm															
			7	SS	30/8cm															
191.2	Silty clay, trace sand organics to 5.9m depth																			
5.0	Firm Grey Wet		8	SS	1															
	layers of clayey sil			FV																
	layers of sand trace silt, trace gravel		9	SS	4															
	cobbles			FV																
			10	SS	47															
			11	SS	2															
184.6	Sand trace silt, trace gravel																			
11.6	Compact Grey Wet		12	SS	15															
	some silt, trace clay																			
			13	SS	15															
181.7	End of borehole																			
14.5	Refusal on probable bedrock																			

RECORD OF BOREHOLE No 601-17A

2 of 2

METRIC

G.W.P. 5217-06-00	LOCATION	Hwy 69 (New), Sta. 10+165, o/s 6.0m Rt. CL Med.	ORIGINATED BY	F.P.
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DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.

DATUM Geodetic DATE October 09, 2008 CHECKED BY C.N.

[illegible]

CONT No
GWP No 5217-06-00
GWP No 5379-02-00

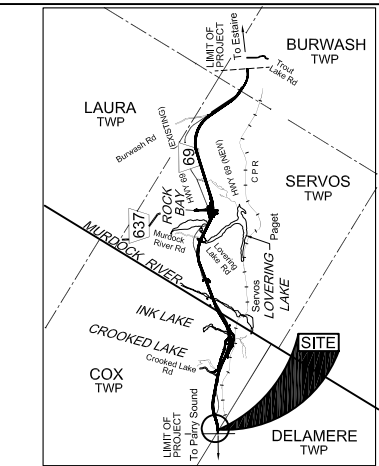


CULVERT AT STA. 10+140 (SBL) (C2)

SHEET

HIGHWAY 69 FOUR-LANING - COX TWP

BOREHOLE LOCATIONS AND SOIL STRATA



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WH Penetration due to weight of hammer and rods
- W L at time of investigation February, 2010
- Head
- ARTESIAN WATER
- Encountered
- PIEZOMETER

(Legend Continued)

BH No	ELEVATION	STA COX TWP	o/s CL MED
601-12	197.2	10+125	34.5m Lt.
601-13	193.8	10+125	4.5m Lt.
601-14	194.4	10+125	4.5m Rt.
601-15	194.1	10+125	38.0m Rt.
601-16	193.8	10+150	19.0m Lt.
601-17	196.1	10+150	26.0m Rt.
601-17A	196.2	10+165	6.0m Rt.

BH No	ELEVATION	NORTHINGS	EASTINGS
C2-1	194.3	5 111 277.4	328 405.9
C2-2	194.3	5 111 276.0	328 391.5
C2-3	194.3	5 111 274.3	328 373.1

(Legend Continues)

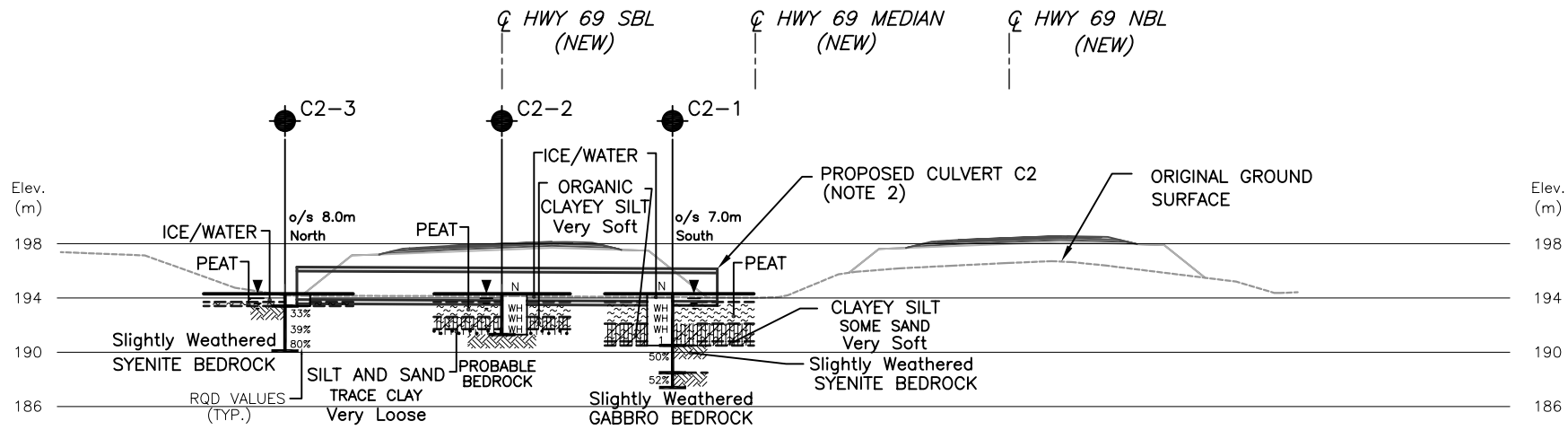
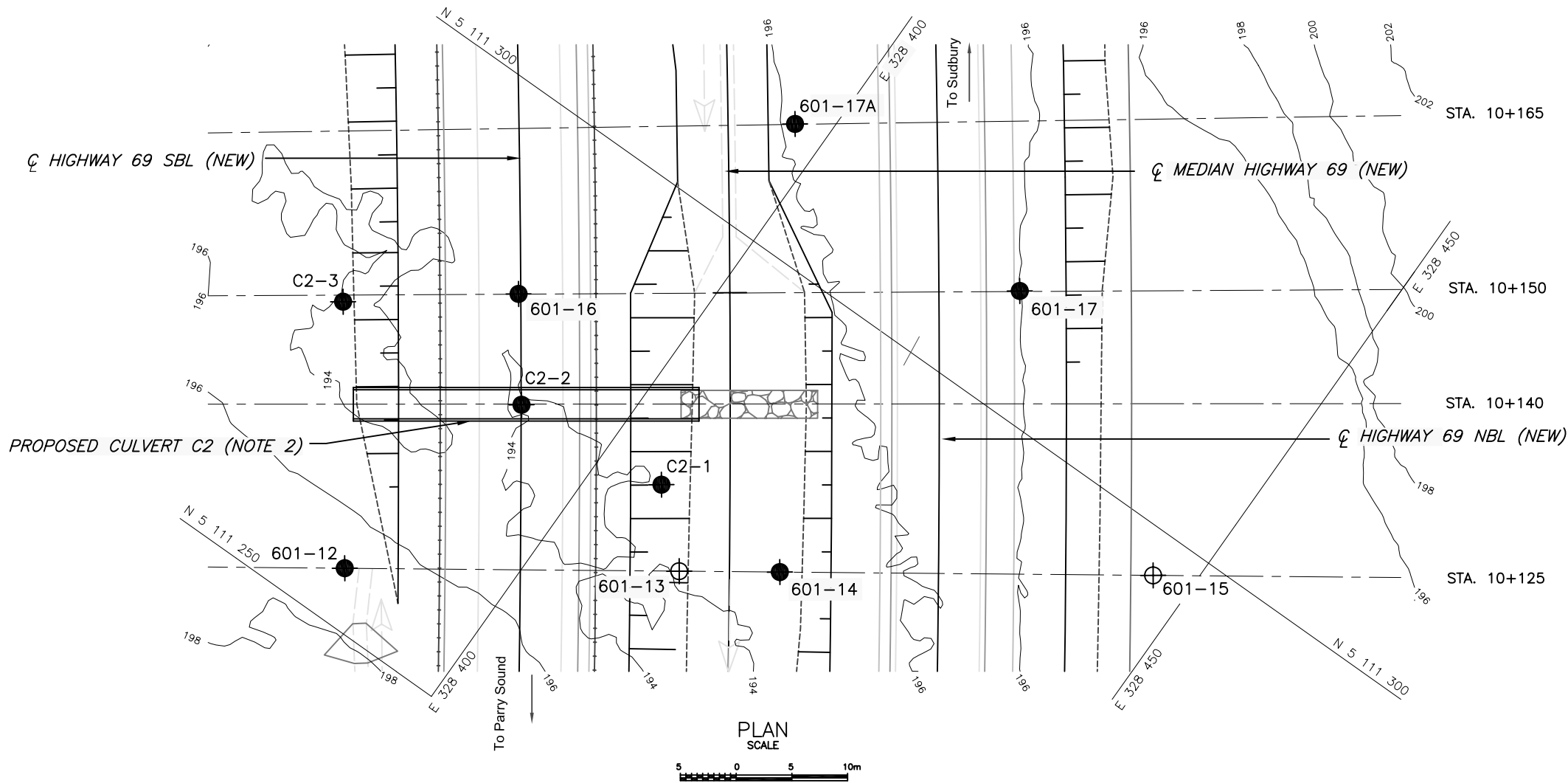
- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262

HWY No 69				DIST Sudbury Area	
SUBM'D	MN	CHECKED	MN	DATE AUG. 30, 2010	SITE ----
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG C2-1



PROFILE & CULVERT STA. 10+140 (SBL) (C2)



NOTES:

- DRAWING C2-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THE CULVERT AT STA. 10+140 WAS DESIGNATED AS CULVERT C2 FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.




REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010;
Hwy 69 Servos - Cont 3 -Structural -PC Conc
Box Culv Prof 10+100 10+140 12+750 13+206
CLRSC 8+240.dwg, dated April 23, 2010 and
C3-Lidar-ctrs.dwg, dated May 14, 2008.



Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township

Record of Borehole Sheets

Drawing SX-1 – Borehole Locations and Soil Strata

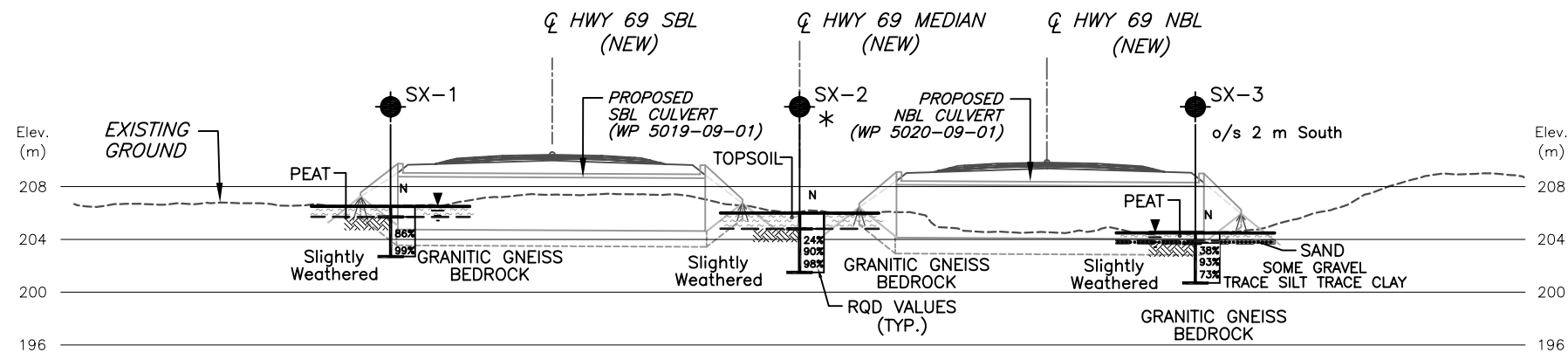
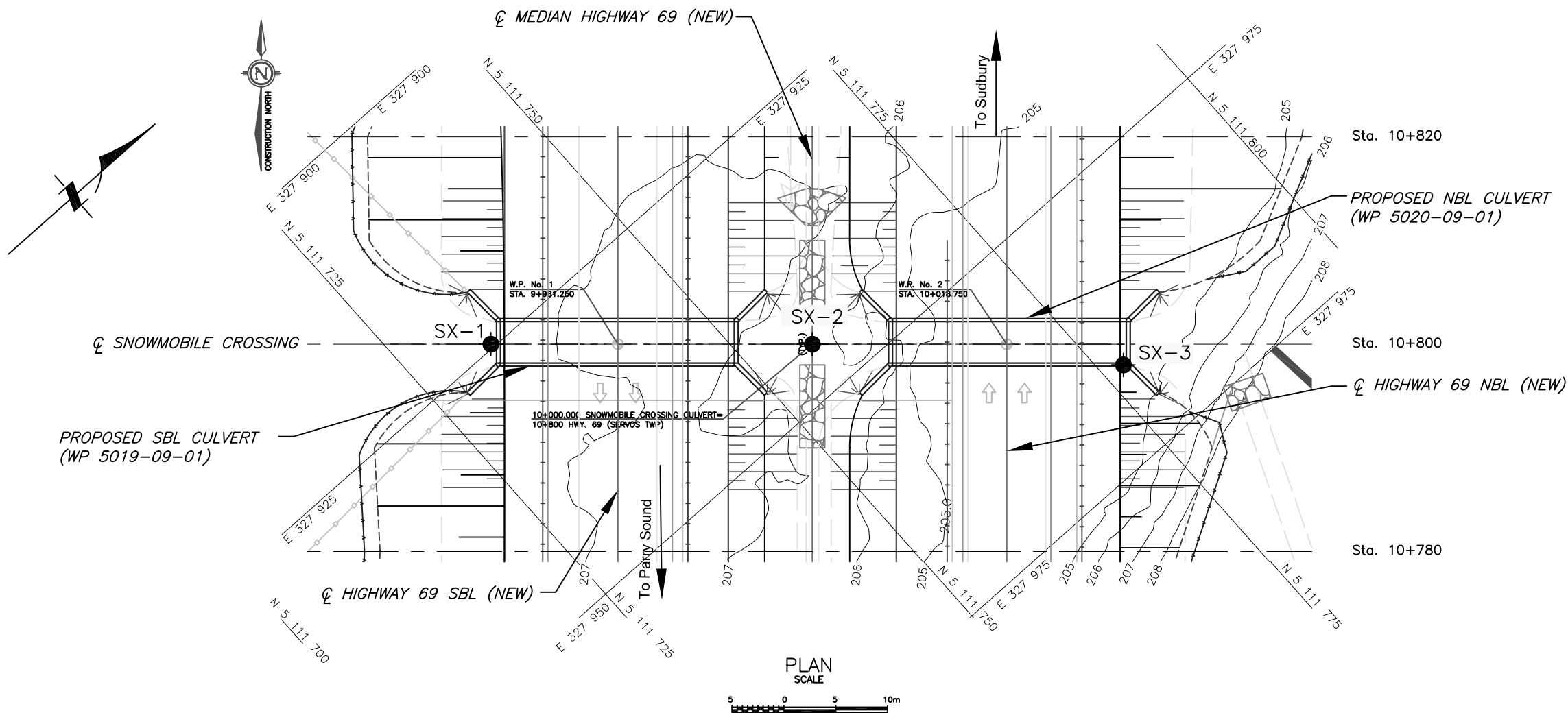
RECORD OF BOREHOLE No SX-1 1 of 1 METRIC																
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 111 732.9 N ; 327 924.5 E Hwy 69, Sta. 10+800, o/s 31m Lt.				ORIGINATED BY F.P.								
DIST 54 HWY 69		BOREHOLE TYPE		C.F.S.S.A. and Rotary Diamond Coring				COMPILED BY M.N.								
DATUM Geodetic		DATE		June 18, 2009				CHECKED BY C.N.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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		ELEVATION SCALE	SHEAR STRENGTH kPa								
206.4	Ground surface						20	40	60	80	100					
0.0	Peat, fine fibrous					206										
	Dark brown															
205.6	Granitic Gneiss bedrock		1	RC NQ	REC 100%	205										RQD 86%
0.8	Slightly weathered															
	High strength															
	Good to excellent quality		2	RC NQ	REC 100%	204										RQD 99%
						203										
202.6	End of borehole															
3.8																
<div style="margin-top: 10px;"> * 2009 06 18  Water level observed during drilling C.F.S.S.A. denotes Continuous Flight Solid Stem Augers </div>																

RECORD OF BOREHOLE No SX-2										1 of 1		METRIC					
G.W.P. 5217-06-00			LOCATION Co-ords: 5 111 756.1 N ; 327 945.1 E Hwy 69, Sta. 10+800, CL.			ORIGINATED BY F.P.											
DIST 54 HWY 69			BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring			COMPILED BY M.N.											
DATUM Geodetic			DATE June 18, 2009			CHECKED BY C.N.											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	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										
205.9	Ground surface						20	40	60	80	100						
0.0	Topsoil cobbles and boulders																
204.7	Granitic Gneiss bedrock Slightly weathered High strength Very poor** to excellent quality		1	RC NQ	REC 76%												RQD 24%
1.2			2	RC NQ	REC 100%												RQD 90%
			3	RC NQ	REC 98%												RQD 98%
201.4	End of borehole																
4.5	<p>* Borehole charged with drilling water</p> <p>** From 1.2 to 1.5m depth multiple vertical fractures resulting in lower recovery and a low RQD value.</p> <p>C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</p>																

METRIC

G.W.P.	5217-06-00	LOCATION	Hwy 69, Sta. 10+798, o/s 30m Rt.	ORIGINATED BY	F.P.
DIST	54	HWY	69	BOREHOLE TYPE	C.F.S.S.A. and Rotary Diamond Coring
DATUM	Geodetic	DATE	June 19, 2009	CHECKED BY	C.N.

$+^7, \times^5$: Numbers refer to Sensitivity




PROFILE \varnothing CULVERTS AT STA. 10+800 (SBL & NBL) (SX)

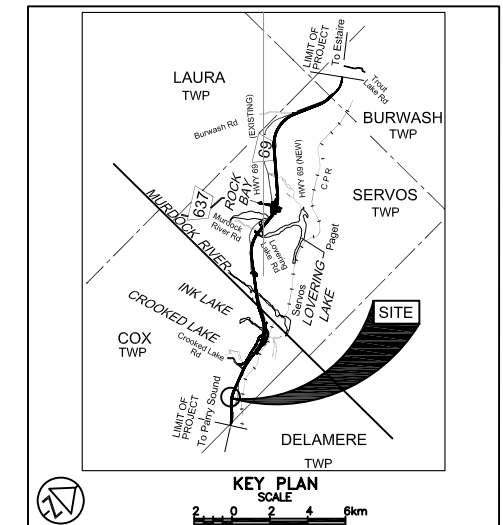
NOTES:

1. DRAWING SX-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND THE RECORD OF BOREHOLE LOGS.
2. CULVERTS AT STA. 10+800 WERE DESIGNATED AS CULVERT SX FOR THE INVESTIGATION.
3. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
4. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



REF AECOM DRAWINGS:
42-91088-SNOWMOBILE CROSSING-1-t350-GA.dwg dated
January 26, 2010 AND C3-Lidar-ctrs.dwg, dated May 14, 2008

CONT No		
GWP No 5217-06-00		
GWP No 5379-02-00		
<u>CULVERT AT STA. 10+800 (SBL & NBL) (SX)</u>		SHEET
HIGHWAY 69 FOUR-LANING - COX TWP.		
BOREHOLE LOCATIONS & SOIL STRATA		



LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J / blow)		
CONE	Blows/0.3m (60° Cone, 475 J / blow)		
*	Water level not established		
W L	W L at time of investigation June 2009		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		
BH No	ELEVATION	NORTHINGS	EASTINGS
SX-1	206.4	5 111 732.9	327 924.5
SX-2	205.9	5 111 756.1	327 945.1
SX-3	204.3	5 111 777.1	327 966.6

(Legend Continues)

NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262

HWY No 69	CHECKED CN	DATE AUG. 30, 2010	DIST 54
SUBM'D MN	CHECKED CN	APPROVED BRG	SITE 46-543/1&2
DRAWN NA	CHECKED CN	APPROVED BRG	DWG SX-1

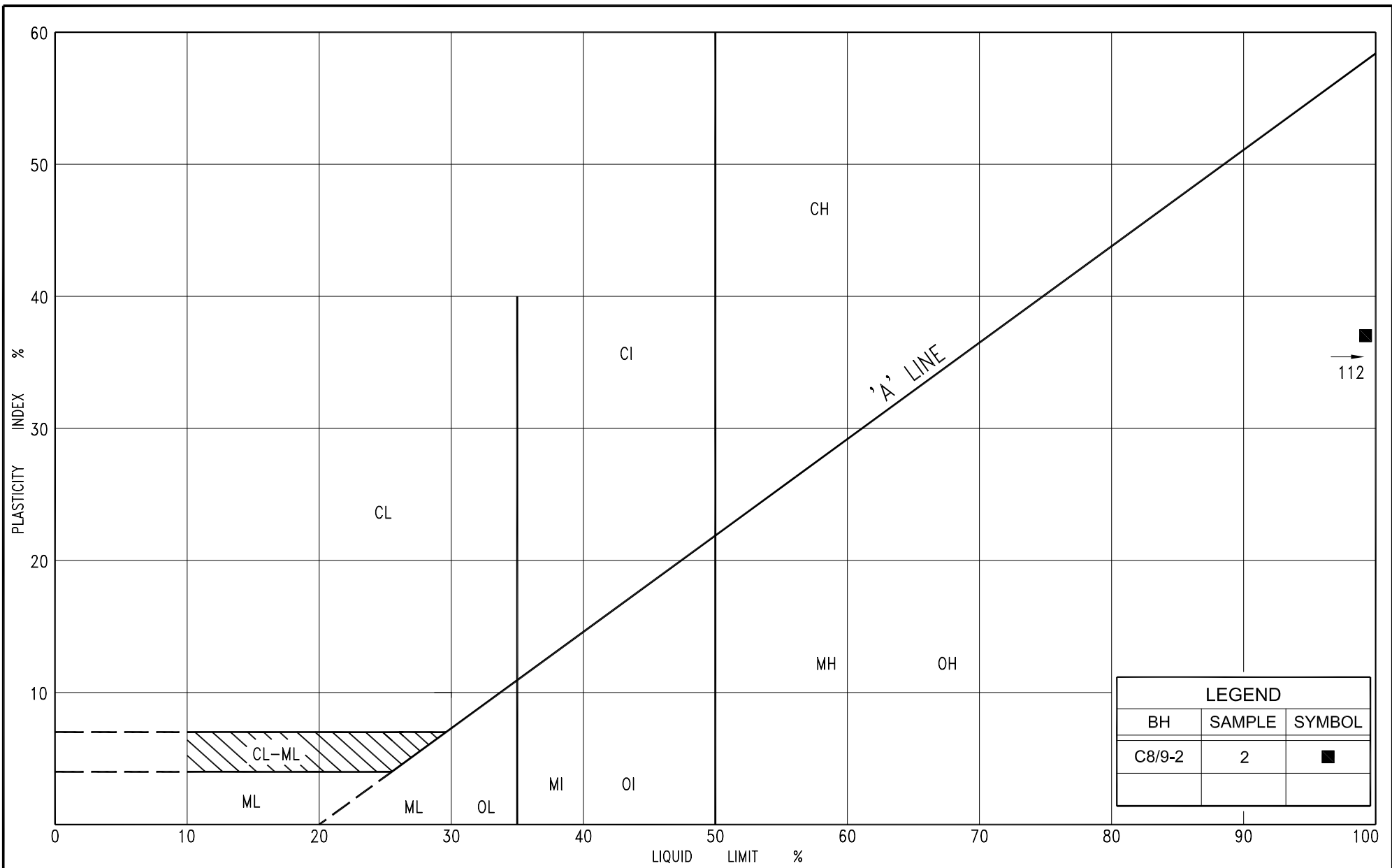
Culvert at Sta. 12+590 (SBL and NBL) (C8/9), Cox Township

Figures C8/9-PC-1 and C8/9-PC-2 – Result of Atterberg Limit Testing

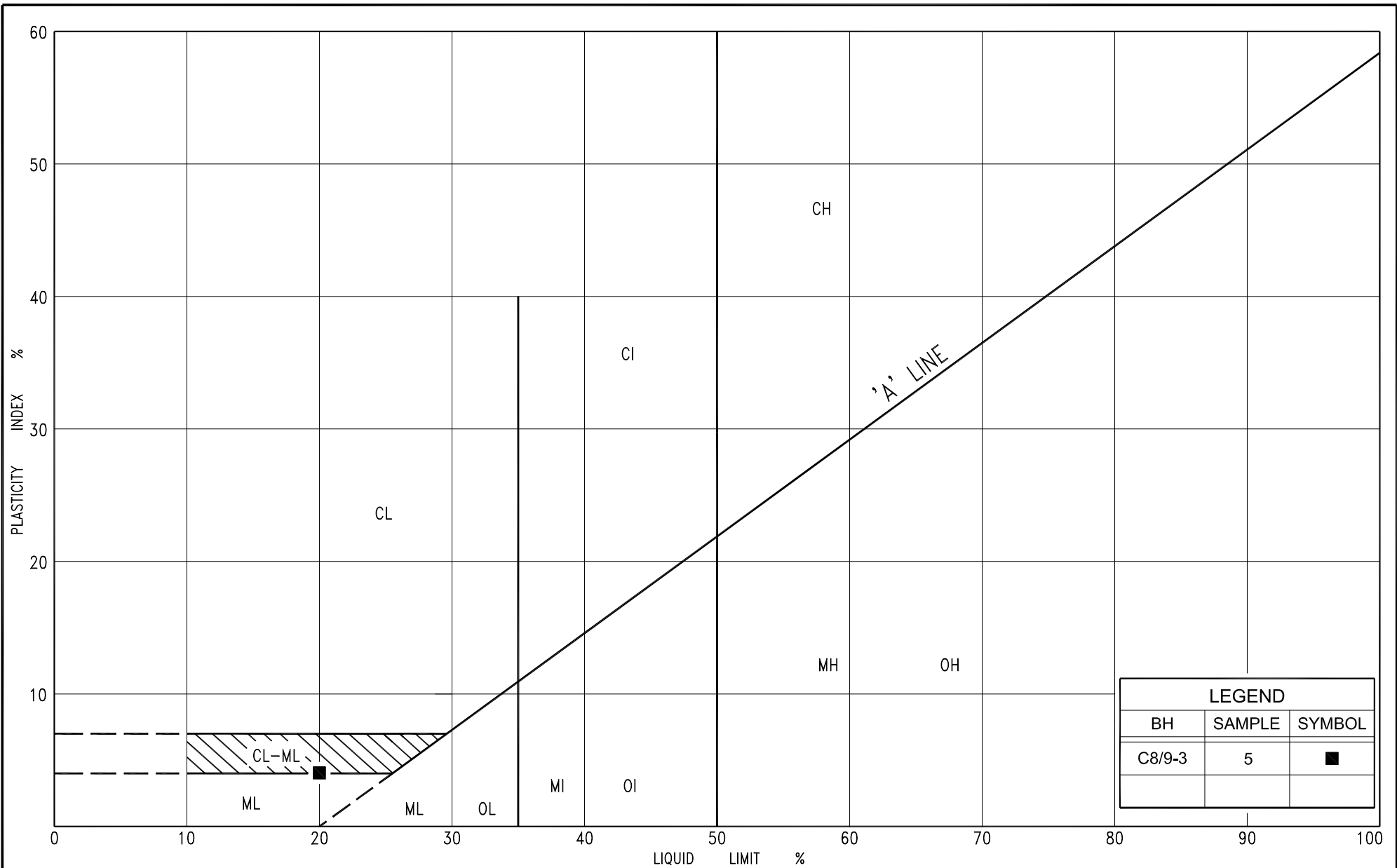
Figure C8/9-GS-1 – Results of Grain Size Distribution Analyses

Record of Borehole Sheets

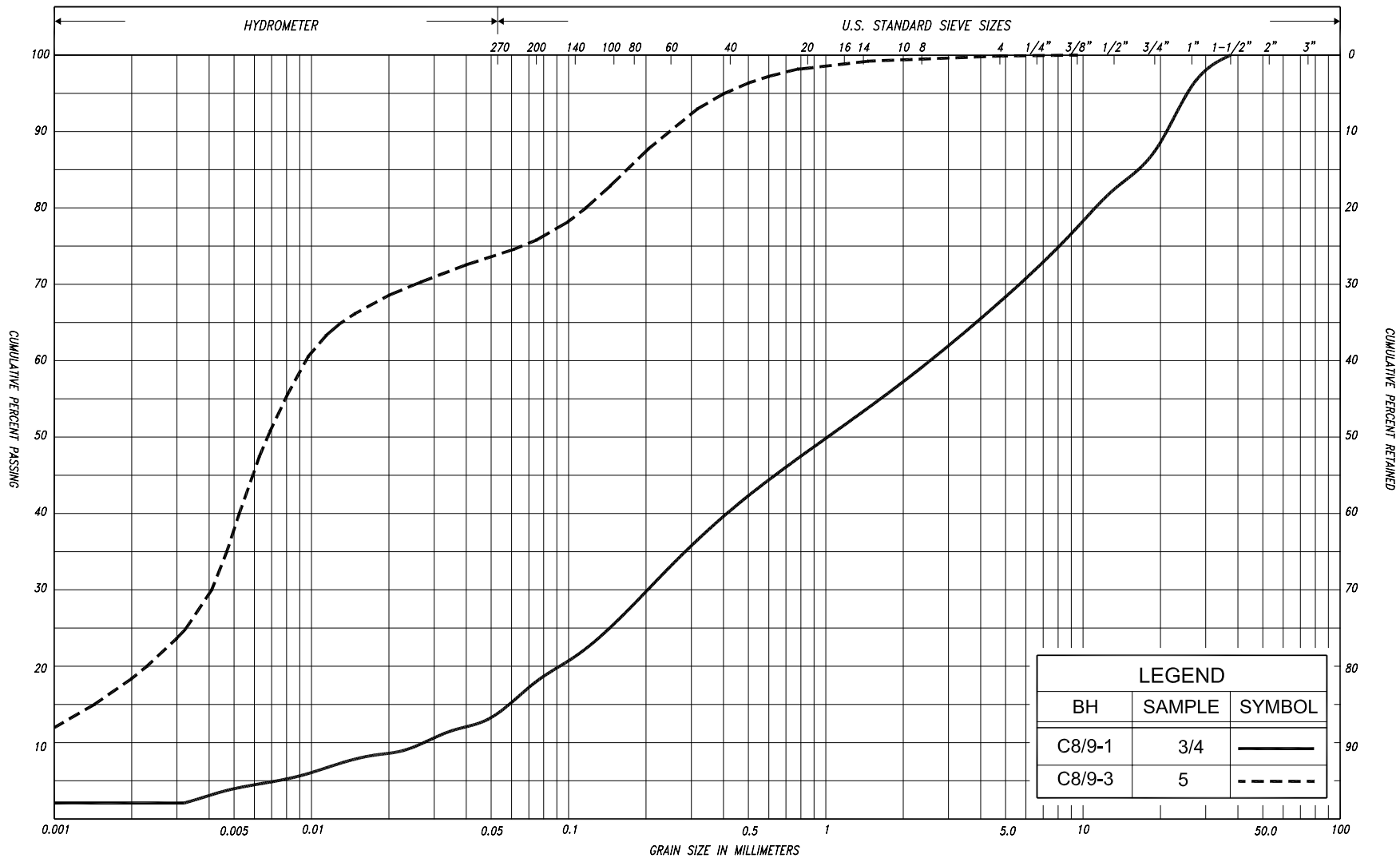
Drawing C8/9-1 – Borehole Locations and Soil Strata



LEGEND		
BH	SAMPLE	SYMBOL
C8/9-2	2	■



LEGEND		
BH	SAMPLE	SYMBOL
C8/9-3	5	■



SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED		
CLAY	FINE		MEDIUM		COARSE	FINE		MEDIUM		COARSE	GRAVEL			COBBLES	M.I.T.	
	SILT					FINE		SAND		COARSE		GRAVEL			COBBLES	U.S. BUREAU
CLAY			SILT			V. FINE	FINE	MED.	COARSE	GRAVEL					COBBLES	U.S. BUREAU

RECORD OF BOREHOLE No C8/9-1										1 of 1		METRIC					
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 113 303.4 N ; 327 088.7 E Hwy 69, Sta. 12+590, o/s 38m Lt.						ORIGINATED BY M.R.							
DIST 54 HWY 69		BOREHOLE TYPE		C.F.H.S.A. and Rotary Diamond Coring						COMPILED BY M.N.							
DATUM Geodetic		DATE		February 19, 2010						CHECKED BY C.N.							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
198.0	Ground surface																
0.0	Peat, fine fibrous Dark brown		1	SS	1										132		
	organic silty clay inclusions		2	SS	WH**										268		
196.6	Gravelly sand some silt, trace clay Cobbles		3	SS	23												
1.4	Compact Grey Wet		4	SS	50/10cm												
195.6	Granitic Gneiss bedrock		5	RC NQ	REC 100%												
2.4	Slightly weathered to unweathered High strength Fair*** to excellent quality		6	RC NQ	REC 100%												
			7	RC NQ	REC 100%												
192.8	End of borehole																
5.2	Sample 4: Sampler bouncing																
	* 2010 02 19																
	▽ Water level observed during drilling																
	WH** Denotes penetration due to weight of rods and hammer																
	*** From 2.4 to 3.1m depth vertical fissures resulted in a lower RQD value.																
	C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers																
	Sample 3 and 4 were combined for testing																

RECORD OF BOREHOLE No C8/9-2 1 of 1 METRIC																
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 113 318.7 N ; 327 123.7 E Hwy 69, Sta. 12+592.5, CL.				ORIGINATED BY M.R.								
DIST 54 HWY 69		BOREHOLE TYPE		Continuous Flight Hollow Stem Augers				COMPILED BY M.N.								
DATUM Geodetic		DATE		February 21, 2010				CHECKED BY C.N.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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									
197.9	Ground surface						20	40	60	80	100					
0.0	Peat, fine fibrous Dark brown					▼* ▼*										
			1	SS	1											
194.9	Organic silty clay Very soft Dark Wet brown brown		2	SS	WH**										112 179	Org. 19.6%
193.7	Silty clay Very soft Grey Wet to soft		3	SS	WH											
				FV												
192.0	Sand some gravel, some silt Very loose Grey Wet		4	SS	2											
190.6	End of borehole Refusal on probable bedrock															
7.3																

RECORD OF BOREHOLE No C8/9-3

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 113 319.4 N ; 327 133.1 E
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers ORIGINATED BY M.R.
DATUM Geodetic DATE February 20 & 21, 2010 COMPILED BY M.N.
CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P	W	W _L		WATER CONTENT (%)				
197.4	Ground surface							20	40	60	80	100									
0.0	Peat, fine fibrous Dark brown					▽* ▽*	197														
			1	SS	WH**		196														
			2	SS	WH		195														
	amorphous		3	SS	WH		194														
193.8	Organic silty clay		4	SS	WH		193														
3.6	Very soft Dark brown Wet			FV			192														
193.2	Silty clay						191														
4.2	Very soft Grey Wet						190														
192.6	Silt with sand some clay, trace gravel		5	SS	WH		189														
4.8	Very loose Grey Wet						188														
191.7	Sand some silt, some gravel						187														
5.7	Very loose Grey Wet to compact		6	SS	1		186														
			7	SS	25																
	very dense																				
			8	SS	103																
185.7	End of borehole																				
11.7	Refusal on probable bedrock																				
	* 2010 02 20 & 21																				
	▽ Water level observed during drilling																				
	▽ Water level measured after drilling																				
	WH** Denotes penetration due to weight of rods and hammer																				

RECORD OF BOREHOLE No C8/9-4

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 113 328.6 N ; 327 158.5 E
Hwy 69, Sta. 12+590, o/s 36m Rt. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring COMPILED BY M.N.
DATUM Geodetic DATE February 20, 2010 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
196.9 0.0	Ground surface							20	40	60	80	100								
196.8 0.1	Ice																			
	Peat, fine fibrous		1	SS	WH**															
	Dark brown																			
	decayed wood		2	SS	6		196													
			3	SS	WR***		195													
			4	SS	WH		194													
			5	FV	WH												543			
193.3 3.6	Organic silty clay																			
	Very soft Dark brown Wet		6	SS	WH		193										292			
192.5 4.4	Sand some silt, some gravel cobbles																			
	Compact Grey Wet		7	SS	10		192													
			8	SS	19		191													
							190													
189.7 7.2	Granitic Gneiss bedrock																			
	Slightly weathered to unweathered		9	RC NQ	REC 100%		189												RQD 30%	
	Medium strength																			
	Poor to fair quality		10	RC NQ	REC 100%		188												RQD 74%	
			11	RC NQ	REC 100%		187												RQD 68%	
186.7 10.2	End of borehole																			
	* 2010 02 20																			
	▽ Water level observed during drilling																			
	▼ Water level measured after drilling																			
	WH** Denotes penetration due to weight of rods and hammer																			
	WR*** Denotes penetration due to weight of rods only																			
	C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers																			

RECORD OF BOREHOLE No 603-16

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+575, o/s 25.2m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Power Auger COMPILED BY G.D.
 DATUM Geodetic DATE October 04, 2007 CHECKED BY C.N.

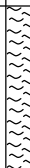
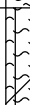

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
201.5	Ground Surface					*											
0.0	Gravelly sand, trace silt _____ Brown _____ Moist _____ some gravel, some silt (FILL)						201										
200.5	End of borehole Refusal on probable bedrock																
1.0																	
	* Borehole dry																

RECORD OF BOREHOLE No 603-17

1 of 1

METRIC

G.W.P.	5217-06-00	LOCATION	Hwy 69 (New), Sta. 12+575.0, o/s 19.0m Rt. CL Med	ORIGINATED BY	M.R.
DIST	54	HWY	69	BOREHOLE TYPE	Continuous Flight Solid Stem Augers
				COMPILED BY	G.D.
DATUM	Geodetic	DATE	February 21, 2008	CHECKED BY	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w _p	w	w _L		GR	SA	SI	CL
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							
197.1 0.0	Ground Surface Peat, fine fibrous Dark brown					▽*	197													
			1	CS			196													
							195													
			2	CS			194													
193.5 3.6	Organic silty clay Stiff Brown Moist						193													
192.3 4.8	Sand and gravel, trace silt Compact Brown Wet		3	SS	11	192														
191.3 5.8	End of borehole Refusal on probable bedrock																			
* 2008 02 20																				
▽ Water level observed during drilling																				

1 of 1 **METRIC**

$+^7, \times^5$: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 603-19

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+587.5, o/s CL Med. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 20, 2008 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
							20 40 60 80 100					20 40 60						
197.5	Ground Surface																	
0.0	Peat, fine fibrous Dark brown																	
194.6	Organic silty clay Dark brown		1	SS	WH													
193.9	Silty clay Very soft Grey Wet			FV														
3.6			2	SS	1													
				FV														
191.7	Clayey silt, trace sand Very loose Grey Wet		3	SS	1													
5.8																		
190.3	Sand, some silt Compact Brown/ Wet grey																	
7.2																		
188.1	End of borehole Refusal on probable bedrock																	
9.4																		
	* 2008 02 20																	
	▽ Water level observed during drilling																	
	WH** Denote penetration due to weight of rods and hammer																	
	*** C.F.S.S.A. Denotes Continuous Flight Solid Stem Augers																	

RECORD OF BOREHOLE No 603-20

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+587.5, o/s 35.0m Rt. CL Med. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Manual Probe COMPILED BY G.D.
DATUM Geodetic DATE February 21, 2008 CHECKED BY C.N.

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									
197.0 0.0	Top of Ice							20	40	60	80	100					
196.9 0.1	Ice																
	Peat, fine fibrous																
	Dark brown																
193.9 3.1	Silty clay, trace sand																
	Brown Moist																
192.2 4.8	End of borehole																
	Refusal on probable bedrock																
	Note: Insufficient ice thickness to conduct using a drill rig at the time of investigation																
	* 2008 02 21																
	▽ Water level observed during drilling																

RECORD OF BOREHOLE No 603-21

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+590, o/s 11.1m Lt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE May 26, 2009 CHECKED BY C.N.

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							
201.5	Ground Surface						20	40	60	80	100							
0.0	70mm asphalt over sand and gravel, trace silt																	
	Brown/ Moist grey (FILL)																	
	Rockfill																	
199.2	End of borehole																	
2.3	Refusal on probable boulder																	
	* Borehole dry																	

RECORD OF BOREHOLE No 603-22

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+600.0, o/s 19.0m Rt. CL Med. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 21, 2008 CHECKED BY

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							
197.1	Ground Surface						197								
0.0	Peat, fine fibrous Dark brown						196								
195.0							195								
2.1	Sand, some silt Loose Brown/ Wet grey		1	SS	6		194								
			2	SS	5		193								
							192								
191.4															
5.7	End of borehole and dynamic cone penetration test Refusal on probable bedrock														
	* Borehole dry														
	** C.F.S.S.A. Denotes Continuous Flight Solid Stem Augers														

RECORD OF BOREHOLE No 603-23

1 of 1

METRIC

G.W.P. 5217-06-00	LOCATION	Hwy 69 (New), Sta. 12+610.0, o/s 36.0m Lt. CL Med.	ORIGINATED BY	M.R.
-------------------	----------	--	---------------	------

DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.

DATUM Geodetic DATE February 25, 2008 CHECKED BY _____

[illegible]

RECORD OF PENETRATION TEST No 603-24

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+610 CL Med. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 21, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
198.4 0.0	Ground Surface													
	Probable peat													
	Probable silty clay													
196.3 2.1	End of dynamic cone penetration test													
	Refusal on probable bedrock													

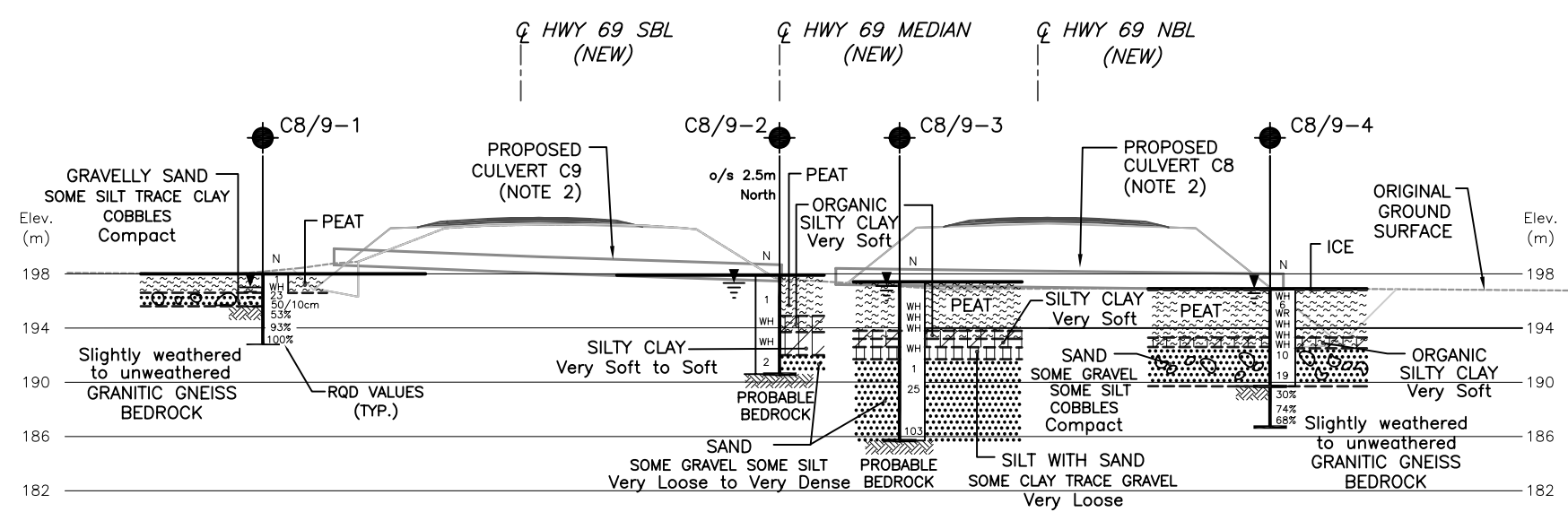
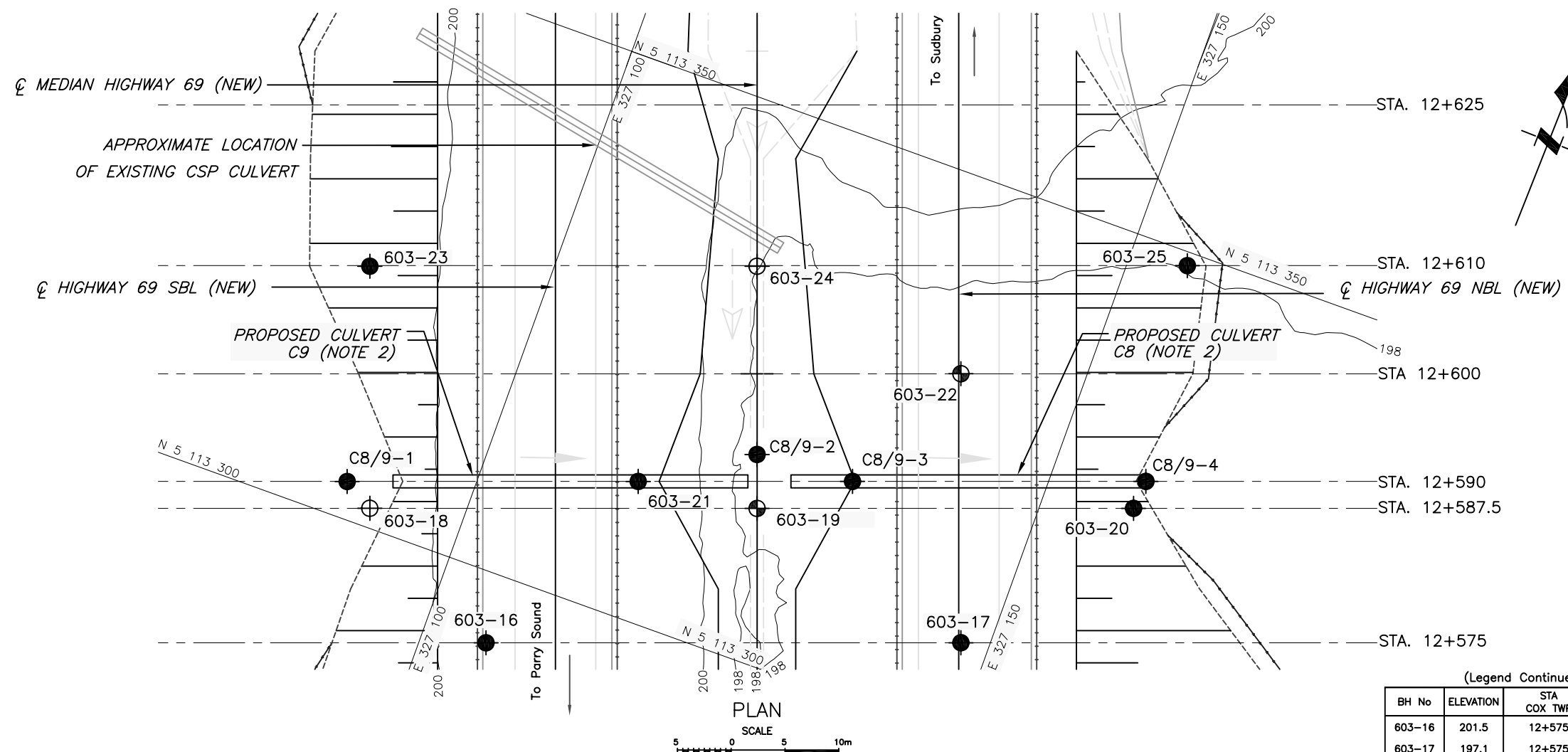
RECORD OF BOREHOLE No 603-25

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 12+610, o/s 40.0m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 21, 2008 CHECKED BY C.N.

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									
198.4	Ground Surface					▽*	198	<div><div></div><div></div><div></div><div></div><div></div></div>									GR SA SI CL
0.0 198.1	Peat, fine fibrous Dark brown	<div><div></div><div></div><div></div><div></div><div></div></div>															
0.3	Sand with silt, trace gravel	<div><div></div><div></div><div></div><div></div><div></div></div>															
197.5 0.9	Brown Wet	<div><div></div><div></div><div></div><div></div><div></div></div>															
	End of borehole Refusal on probable bedrock																
	* 2008 02 21																
	▽ Water level observed during drilling																

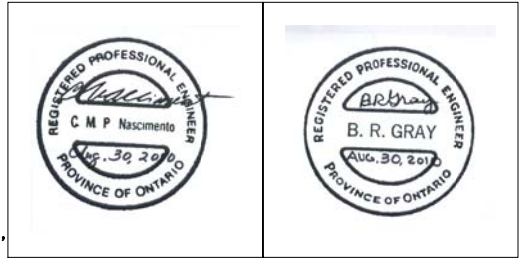


PROFILE \varnothing CULVERTS STA. 12+590 (SBL AND NBL) (C8/9)

NOTES:

- DRAWING C8/9-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THE CULVERTS AT STA. 12+590 WERE DESIGNATED AS CULVERT C8/9 FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

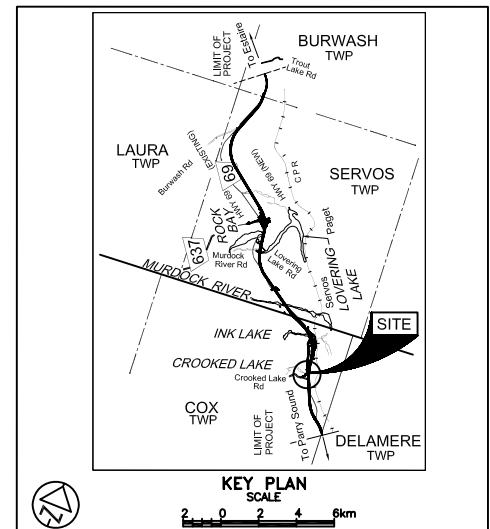
REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-HWY69-Des.dwg dated April 15, 2010;
Hwy69 Servos-Cont3-Culvert Profiles.dwg,
dated Jan. 21 2010 and C3-Lidar-ctrs.dwg,
dated May 14, 2008



CONT No
GWP No 5217-06-00
GWP No 5379-06-00

CULVERTS AT STA. 12+590
(SBL AND NBL) (C8/9)
HIGHWAY 69 FOUR-LANING - COX TWP
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
WH	Penetration due to weight of hammer and rods		
WR	Penetration due to weight of rods only		
	WL at time of investigation February 2010		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	NORTHINGS	EASTINGS
C8/9-1	198.0	5 113 303.4	327 088.7
C8/9-2	197.9	5 113 318.7	327 123.7
C8/9-3	197.4	5 113 319.4	327 133.1
C8/9-4	196.9	5 113 328.6	327 158.5

(Legend Continues)

- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
	DATE	BY	DESCRIPTION

Geocres No. 411-262

HWY No 69		DIST Sudbury Area	
SUBM'D MN	CHECKED MN	DATE AUG. 30, 2010	SITE ---
DRAWN NA	CHECKED CN	APPROVED BRG	DWG C8/9-1

Culvert at Sta. 12+750 (SBL and NBL) (C10/11), Cox Township

Data from Geotechnical Pavement Investigation (PML Ref.: 06TF054C)
Drawing C10/11 – Borehole Locations and Soil Strata



Proposed Hwy 69, Cox Twp, Culverts
DATUM: Proposed Centrlne Median

12+750.0	34.0	Lt C/L	D-1.5	HA	14+580.0	35.0	Rt C/L	D-1.2	HA
0 - 100		Fr Wat			0 - 100		Br/Dk Br Sa(y) Si Tps W Roots Moist		
100 - 1.5		Blk F Fib Peat Sat			100 - 400		Br Sa(y) Si Moist		
1.5 - 1.7		Gry Si(y) Sa Sat			400 - 2.0		Br Si(y) Cl Tr Sa Firm Moist-Wet		
1.7		NFP BR			2.0 - 4.1		Br/Gry Si(y) Cl Soft Sat		
		Fr Wat @ 0			4.1 - 4.4		Gry Sa Some Si Sat		
					4.4		NFP BR		
12+896.0	33.0	Lt C/L	D-0.5	HA			Fr Wat @ 1.8		
0 - 100		Fr Wat			14+883.0	45.0	Lt C/L	D-0.2	HA
100 - 400		Gry Sa Some Si Tr Gr Wet			Toe of Slope				
400		NFP BR			0 - 050		Dk Br/Blk Si Tps Moist		
		Fr Wat @ 0			050 - 500		Gry Cl(y) Si Some Sa Wet-Sat		
14+580.0		C/L	D	HD	500		NFP BR		
0 - 400		Dk Br/Blk Amor Peat Tr Sa Wet-Sat					Fr Wat @ 200		
400 - 1.2		Br/Gry Si(y) Cl Some Gr Some Si Sat			14+883.0	35.0	Rt C/L	D-3.2	HA
1.2 - 3.6		Br/Gry Cl(y) Si Tr Sa Mott Firm Moist-Sat			0 - 200		Dk Br/Blk Si Tps W Roots Moist		
3.6 - 5.5		Gry Cl(y) Si Soft Sat			200 - 1.7		Br Si(y) Cl Tr Sa Firm Wet		
5.5 - 5.8		Gry Sa Some Si Sat			1.7 - 2.8		Br Si(y) Cl Tr Sa Soft Wet		
		Fr Wat @ 100			2.8 - 3.1		Br Sa Some Gr Some Si Wet		
14+580.0	19.0	Lt C/L	D+0.6	HA					
0 - 200		Br/Dk Br Sa(y) Si Tps W Roots Moist			16+318.0		C/L	D	HA
200 - 1.7		Br Si(y) Cl Tr Sa Firm Moist			0 - 200		Blk Sa(y) Si Tps Moist		
1.7 - 2.2		Br Si(y) Cl Soft Sat			200 - 800		Gry/Br Si(y) Cl Mott Moist		
2.2 - 2.4		Br Sa Some Si Sat			800		NFP BR		
2.4		NFP BR			16+321.0	33.0	Rt C/L	D+0.9	HA
		Fr Wat @ 1.7			0 - 200		Blk Si Tps Moist		
14+580.0	35.0	Lt C/L	D+0.7	HA	200 - 500		Br Sa(y) Si Moist		
0 - 300		Dk Br/Blk Amor Peat Tr Sa Wet			500		NFP BR		
300 - 900		Br Si(y) Cl Tr Sa Firm Sat							
900		NFP BR							
		Fr Wat @ 100							
14+580.0	19.0	Rt C/L	D-0.7	HA					
0 - 100		Dk Br/Blk Amor Peat Tr Sa Wet							
100 - 2.5		Br/Gry Si(y) Cl Occ Co Sa Seams Firm Moist-Sat							
2.5 - 3.4		Br Si(y) Cl Tr Sa Soft Sat							
3.4 - 3.7		Gry Sa Some Si Sat							
3.7		NFP BR							
		Fr Wat @ 1.4							



Proposed Hwy 69, Cox Twp, Sta 12+001 to 13+000

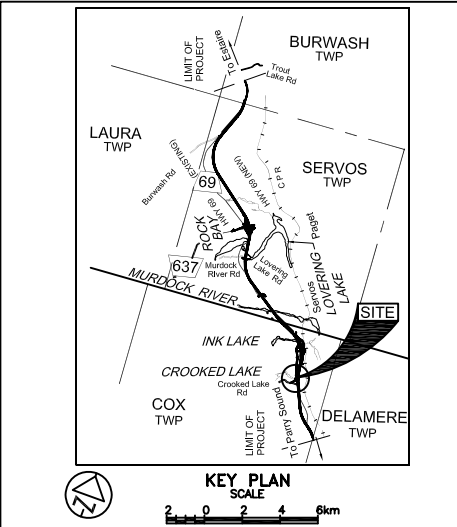
DATUM: Proposed Centreline Median

12+650.	11.2	Lt C/L	D-0.8	EP	12+700.	21.9	Lt C/L	D-0.1	EP
0 - 230		Asph			0 - 225		Asph		
230 - 320		Br Cr Sa W Gr Tr Si Moist			225 - 420		Lt Br Cr Sa Some Gr Tr Si Moist		
320 - 900		Lt Br Sa Some Gr Some Si Num Cob Moist			420 - 700		Br/Lt Br Sa Some Gr Some Si Moist		
900		NFP RF			700		NFP RF		
12+660.	7.0	Rt C/L	D+0.6	HA	12+700.	24.6	Lt C/L	D-0.1	SHR
0		NFP BR			0 - 310		Br/Dk Br Cr Gr(y) Sa Tr Si Moist		
12+660.	19.0	Rt C/L	D+0.8	HA	310 - 600		Lt Br Sa Some Gr Some Si Moist		
0 - 025		Dk Br Si Tps W Roots Moist			600 - 1.1		Br Gr(y) Sa Tr Si Occ Cob Moist		
025		NFP BR			1.1		NFP BR		
12+660.	33.0	Rt C/L	D-0.3	HA	12+700.	7.0	Rt C/L	D-0.1	HA
0 - 050		Dk Br Si Tps W Roots Moist			0 - 050		Dk Br Si Tps W Roots Moist		
050		NFP BR			050		NFP BR		
12+670.	6.0	Rt C/L	D+/-0	HA	12+700.	19.0	Rt C/L	D+0.8	HA
0 - 200		Dk Br/Blk Si Tps W Roots Moist			0 - 200		Dk Br Si Tps W Roots Num Bld Moist		
200		NFP Weath BR			200		NFP BR		
12+670.	19.0	Rt C/L	D-0.5	PA	12+700.	33.0	Rt C/L	D+0.5	HA
0 - 400		Dk Br/Blk Sa(y) Si Tps W Roots Moist			0		NFP BR		
400		NFP Weath BR			12+720.	7.0	Rt C/L	D+0.1	HA
12+670.	33.0	Rt C/L	D-1.4	HA	0		NFP BR		
0 - 300		Dk Br/Blk Si Tps W Roots Moist			12+720.	19.0	Rt C/L	D+/-0	HA
300		NFP Weath BR			0		NFP BR		
12+680.	7.0	Rt C/L	D-0.1	HA	12+720.	33.0	Rt C/L	D+0.7	HA
0 - 300		Dk Br Si Tps W Roots Moist			0 - 050		Dk Br Si Tps W Roots Moist		
300		NFP BR			050		NFP BR		
12+680.	19.0	Rt C/L	D+0.3	HA	12+730.	19.0	Rt C/L	D+0.7	HA
0		NFP BR			0		NFP BR		
12+680.	33.0	Rt C/L	D-1.7	HA	12+745.	10.1	Lt C/L	D+2.2	MSH
0 - 250		Dk Br Si Tps Num Cob Num Bld W Roots Moist			0 - 050		Asph		
250		NFP BR			050 - 200		Dk Br Cr Gr(y) Sa Tr Si Moist		
					200 - 1.1		Br/Lt Br Sa Some Si Tr Gr Occ Cob Moist		
					1.1		NFP RF		



Proposed Hwy 69, Cox Twp, Sta 12+001 to 13+000
DATUM: Proposed Centreline Median

12+745.	11.5	Lt C/L	D+2.2	EP	12+800.	23.2	Lt C/L	D+1.8	MSH
0 - 190		Asph			0 - 040		Asph		
190 - 240		Br Cr Sa Some Gr Tr Si Moist			040 - 340		Lt Br Cr Sa Some Gr Tr Si Moist		
240 - 800		Lt Br Sa Some Si Tr Gr Moist			340 - 650		Br/Lt Br Sa Some Gr Some Si Moist		
800		NFP BR			650		NFP BR		
12+750.		C/L	D	PA	12+800.	19.0	Rt C/L	D-2.3	HD
0 - 500		Br/Gry Sa And Gr Tr Si Moist			0 - 100		Ice		
500		NFP Bld			100 - 1.2		Dk Br F Fib Peat Sat		
12+750.	19.0	Rt C/L	D-1.7	HD	1.2 - 1.6		Dk Br Si(y) Cl W Org Very Soft Sat		
0 - 200		Ice			1.6		NFP BR		
200 - 1.2		Dk Br F Fib Peat Sat					Fr Wat @ 100		
1.2		NFP BR			12+800.	47.0	Rt C/L	D-2.3	HD
		Fr Wat @ 200			0 - 200		Ice		
12+750.	47.0	Rt C/L	D-1.7	HD	200 - 2.0		Dk Br F Fib Peat Sat		
0 - 200		Ice			2.0 - 3.2		Dk Br Amor Peat Sat		
200 - 4.0		Dk Br F Fib Peat Sat			3.2 - 4.0		Dk Br Si(y) Cl W Org Very Soft Sat		
4.0 - 4.5		Dk Br Si(y) Cl W Org Sat			4.0 - 4.5		Gry Si(y) F Sa Very L Sat		
4.5		NFP BR			4.5		NFP BR		
12+775.	19.0	Rt C/L	D-1.8	HD			Fr Wat @ 200		
0 - 200		Ice			12+825.		C/L	D	HA
200 - 600		Dk Br F Fib Peat Sat			0 - 300		Br Gr Some Sa Tr Si W Org Moist		
600		NFP BR			300		NFP BR		
		Fr Wat @ 200			12+825.	19.0	Rt C/L	D-1.2	HA
12+800.		C/L	D	PA	0 - 050		Dk Br Si Tps W Roots Moist		
0 - 400		Br Sa And Gr Tr Si Moist			050		NFP BR		
400		NFP BR			12+825.	45.0	Rt C/L	D-1.8	HD
12+800.	21.9	Lt C/L	D+1.8	EP	0 - 100		Ice		
0 - 240		Asph			100 - 2.5		Dk Br F Fib Peat Sat		
240 - 340		Lt Br Cr Sa Some Gr Tr Si Moist			2.5 - 2.9		Dk Br Si(y) Cl W Org Very Soft Sat		
340 - 700		Br Sa Some Gr Some Si Moist			2.9		NFP BR		
700		NFP BR					Fr Wat @ 100		
					12+850.		C/L	D	HA
					0 - 300		Br Sa Tr Si Tr Gr Moist		
					300		NFP Bld		



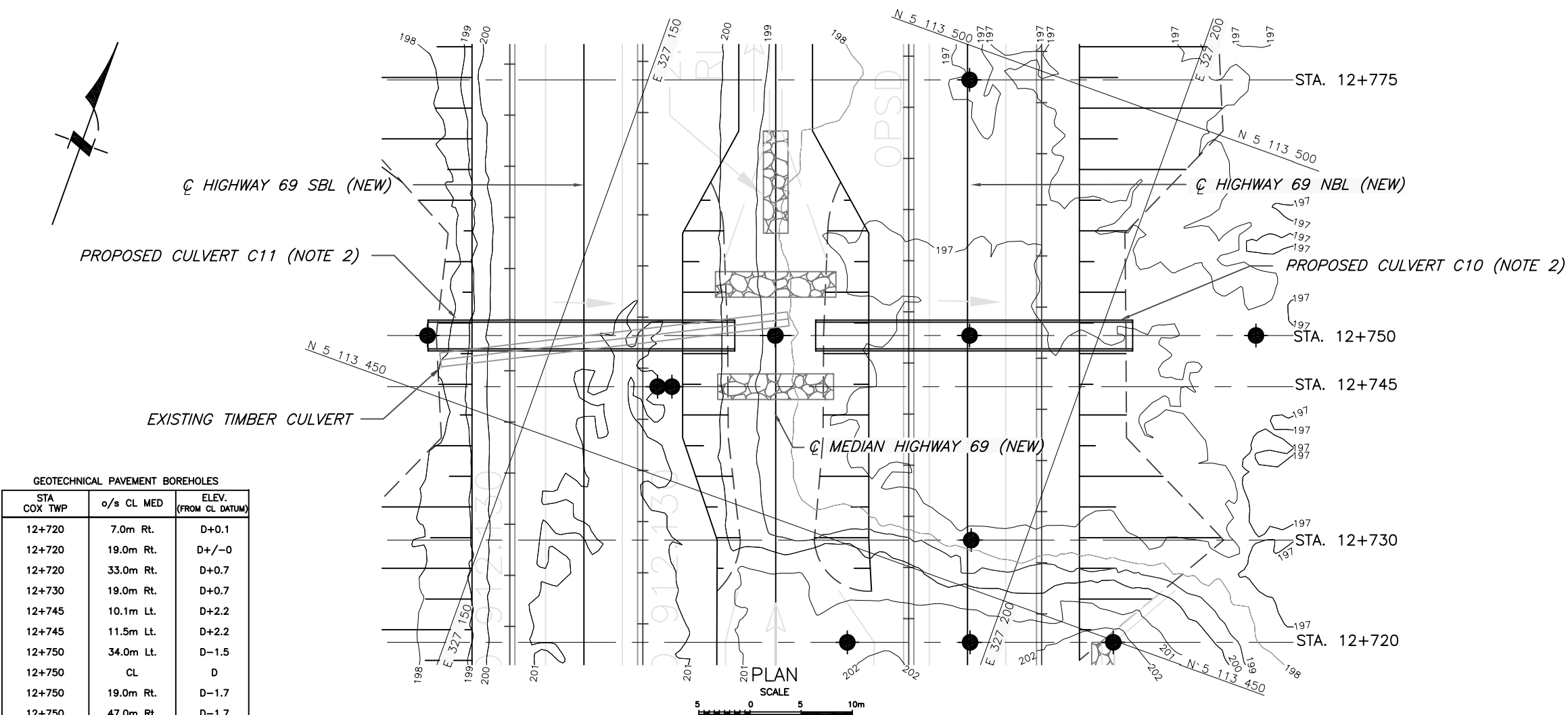
LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
WH	Penetration due to weight of hammer and rods		
	WL at time of investigation February 2008 to September 2009		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	NORTHINGS	EASTINGS

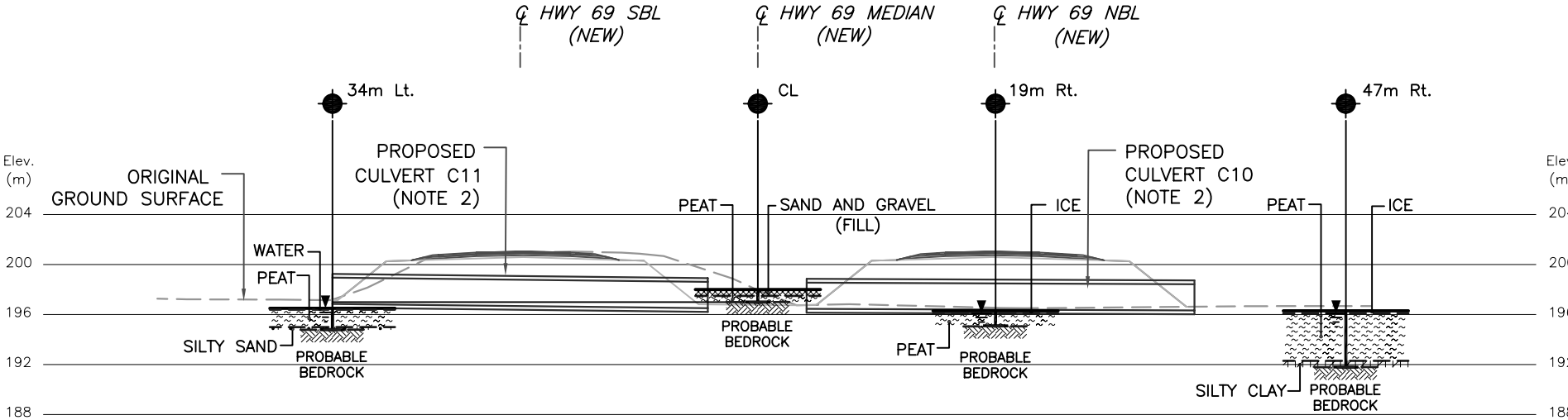
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262			
HWY No	69	DIST Sudbury Area	
SUBM'D	MN	CHECKED MN	DATE AUG. 30, 2010 SITE ---
DRAWN	NA	CHECKED CN	APPROVED BRG DWG C10/11-1



GEOTECHNICAL PAVEMENT BOREHOLES		
STA COX TWP	o/s CL MED	ELEV. (FROM CL DATUM)
12+720	7.0m Rt.	D+0.1
12+720	19.0m Rt.	D+/-0
12+720	33.0m Rt.	D+0.7
12+730	19.0m Rt.	D+0.7
12+745	10.1m Lt.	D+2.2
12+745	11.5m Lt.	D+2.2
12+750	34.0m Lt.	D-1.5
12+750	CL	D
12+750	19.0m Rt.	D-1.7
12+750	47.0m Rt.	D-1.7
12+775	19.0m Rt.	D-1.8



PROFILE - CULVERTS AT STA. 12+750 (SBL AND NBL) (C10/11) - COX TWP

- NOTES:
- DRAWING C10/11-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND THE GEOTECHNICAL PAVEMENT DATA.
 - THE CULVERTS AT STA. 12+750 WERE DESIGNATED AS CULVERT C10/11 FOR THE INVESTIGATION.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REF AECOM Drawings:
C3-Hwy69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010; Hwy 69 Servos - Cont 3 -Structural -PC Conc Box Culv Prof 10+100 10+140 12+750 13+206 CLRSC 8+240.dwg, dated April 23, 2010 and C3-Lidar-ctrs.dwg, dated May 14, 2008.



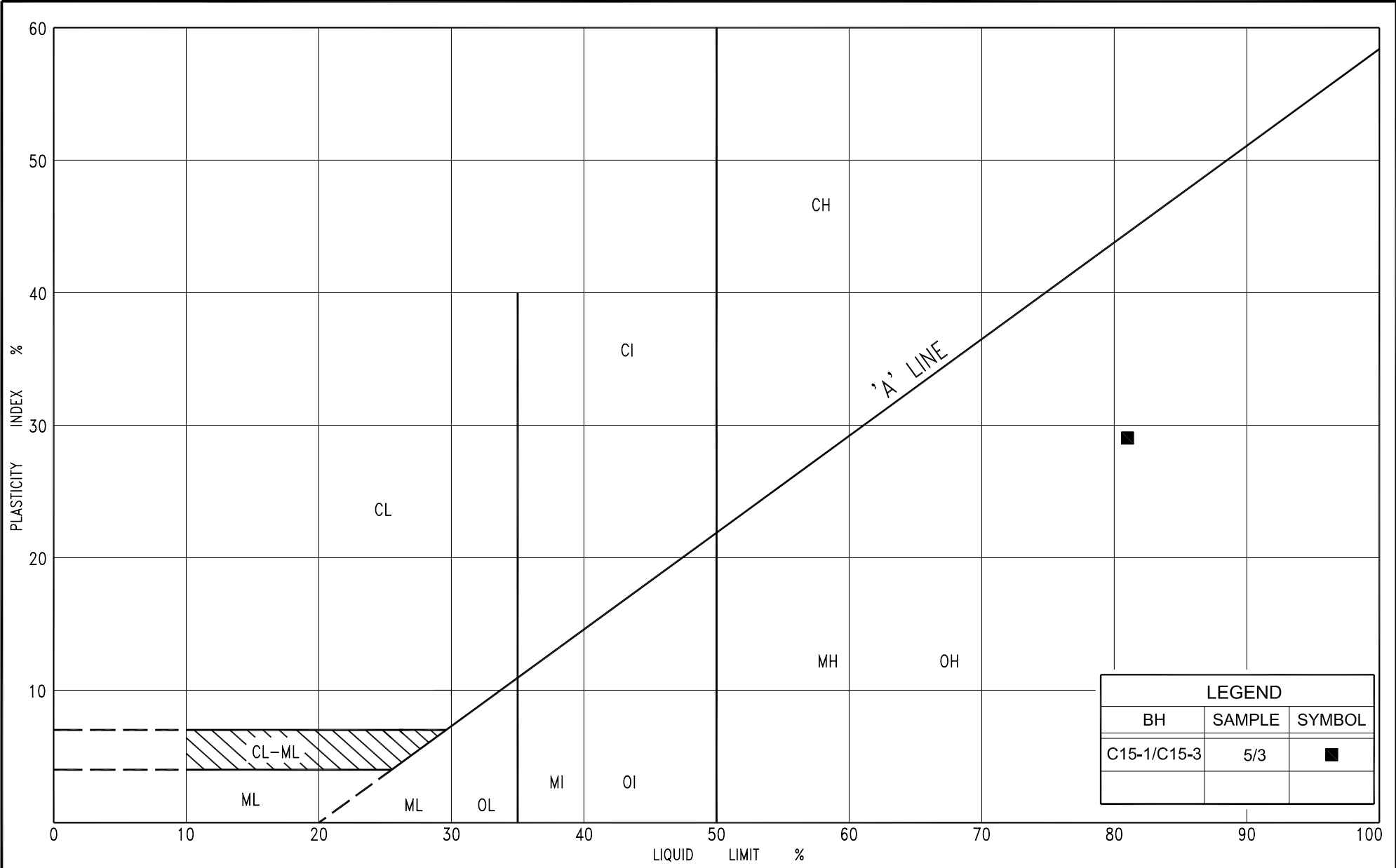
Culvert at Sta. 13+206 (SBL and NBL) (C15), Cox Township

Figure C15-PC-1 – Result of Atterberg Limit Testing

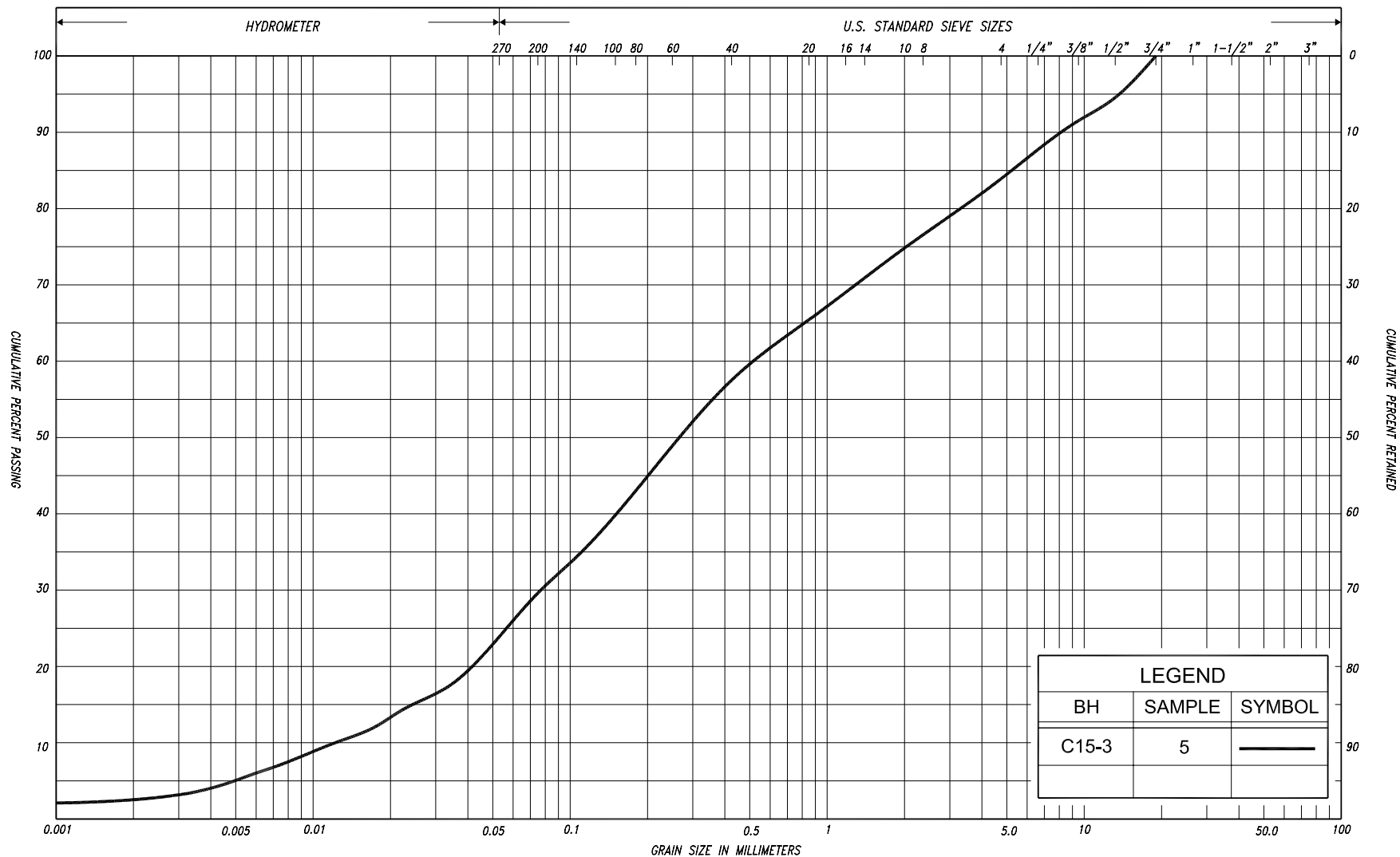
Figure C15-GS-1 – Results of Grain Size Distribution Analyses

Record of Borehole Sheets

Drawing C15-1 – Borehole Locations and Soil Strata



LEGEND		
BH	SAMPLE	SYMBOL
C15-1/C15-3	5/3	■



LEGEND		
BH	SAMPLE	SYMBOL
C15-3	5	

SILT & CLAY				FINE SAND			MEDIUM SAND		COARSE SAND	GRAVEL			COBBLES	UNIFIED
														M.I.T.
CLAY	FINE	MEDIUM SILT	COARSE	FINE	MEDIUM SAND	COARSE							COBBLES	
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU			

RECORD OF BOREHOLE No C15-1										1 of 1		METRIC				
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 113 886.9 N ; 326 877.1 E Hwy 69, Sta. 13+206, o/s 48m Lt.						ORIGINATED BY M.R.						
DIST 54 HWY 69		BOREHOLE TYPE		C.F.H.S.A. and Rotary Diamond Coring						COMPILED BY M.N.						
DATUM Geodetic		DATE		February 17, 2010						CHECKED BY C.N.						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
191.3 0.0	Ground surface Peat, fine fibrous Dark brown		1	SS	1		191								443 490 81 252 Org. 12.3%	
			2	SS	1		190									
			3	SS	WH**		189									
188.7 2.6	Organic silt Very loose Dark Wet brown		4	SS	WH		188									
187.8 3.5	Gravelly sand, some silt cobbles and boulders Compact to Grey Wet very dense	5	SS	WH	187											
		6	SS	71/15cm	186											
		7	RC NQ	-	185											
185.8 5.5	Migmatite bedrock Slightly weathered to unweathered High strength Good to excellent quality	8	RC NQ	REC 100%	184											
		9	RC NQ	REC 98%	183											
183.0 8.3	End of borehole Sample 6: Sampler bouncing * 2010 02 17 Water level observed during drilling WH** Denotes penetration due to weight of rods and hammer C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers Sample 5 was combined with sample 3 from borehole C15-2 for testing	10	RC NQ	REC 83%												

RECORD OF BOREHOLE No C15-2

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 113 898.6 N ; 326 924.1 E
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers ORIGINATED BY M.R.
 DATUM Geodetic DATE February 18, 2010 COMPILED BY M.N.
 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
192.1	Ground surface																GR SA SI CL
0.0	Ice							20 40 60 80 100	20 40 60								
191.5	Water																
0.6	Peat, amorphous		1	SS	WR**												
	Dark brown		2	SS	WR												
			3	SS	WH***					703							
188.9	Organic silt		4	SS	WH												
3.2	Very loose Dark Wet																
	brown		5	SS	10					151							
187.2	Gravelly sand, some silt																
4.9	Compact Grey Wet																
186.2	End of borehole																
5.9	Refusal on probable bedrock																
	<div>* 2010 02 18</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div> <div>WR** Denotes penetration due to weight of rods only</div> <div>WH*** Denotes penetration due to weight of rods and hammer</div>																

RECORD OF BOREHOLE No C15-3										1 of 1		METRIC	
G.W.P. 5217-06-00			LOCATION Co-ords: 5 113 908.1 N ; 326 962.4 E Hwy 69, Sta. 13+206, o/s 39.5m Rt.			ORIGINATED BY M.R.							
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring			COMPILED BY M.N.							
DATUM Geodetic			DATE February 18, 2010			CHECKED BY C.N.							
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L				
192.1	Ground surface												
0.0	Ice												
191.4	Water												
0.7	Peat, amorphous												
	Dark brown												
			1	SS	WR**								
	fine fibrous		2	SS	WR					466			
189.2	Organic silt												
2.9	Very loose Dark brown Wet		3	SS	WR					81			
										185	Org. 12.3%		
188.3	Sand with silt some gravel, trace clay		4	SS	9								
3.8	Loose to Grey Wet compact		5	SS	13								
											16 54 27 3		
186.6	Granitic Gneiss bedrock		6	RC	REC100%						RQD 100%		
5.5	Slightly weathered to unweathered		7	RC NQ	REC 92%						RQD 92%		
	High strength		8	RC NQ	REC 97%						RQD 79%		
	Good to excellent quality		9	RC NQ	REC 100%						RQD 100%		
183.6	End of borehole												
8.5													
<p>* 2010 02 18</p> <p>▽ Water level observed during drilling</p> <p>▼ Water level measured after drilling</p> <p>WR** Denotes penetration due to weight of rods only</p> <p>C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers</p> <p>Sample 3 was combined with sample 5 from borehole C15-1 for testing</p>													

RECORD OF BOREHOLE No 604-6

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 13+187.5, o/s 45m Lt. CL Med. ORIGINATED BY A.D.
 DIST 54 HWY 69 BOREHOLE TYPE Power Auger COMPILED BY G.D.
 DATUM Geodetic DATE April 11, 2008 CHECKED BY C.N.

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	● QUICK TRIAXIAL	✚ FIELD VANE	✕ LAB VANE								
191.1 0.0	Top of Ice Ice					▼*										GR	SA	SI	CL
190.9 0.2	Peat, fine fibrous					▽*													
190.3 0.8	Black																		
190.2 0.9	Gravelly sand, some silt cobbles and boulders Grey Wet End of borehole Refusal on probable boulder																		
	* 2008 04 11																		
	▽ Water level observed during drilling																		
	▼ Water level measured after drilling																		

1 of 1

METRIC

Foundation Design

SOIL PROFILE	SAMPLES	3	DYNAMIC CONE PENETRATION		
--------------	---------	---	--------------------------	--	--

ON MOT VER3 604.GPJ ON MOT.GDT 7/10/2009 11:27:21 AM

$+$ ⁷, \times ⁵: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

1 of 1 **METRIC**[illegible]

RECORD OF BOREHOLE No 604-9

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 13+209, o/s 20m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. + NW Casing COMPILED BY G.D.
 DATUM Geodetic DATE May 26, 2009 CHECKED BY C.N.

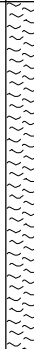
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
196.4	Ground Surface						20	40	60	80	100						
0.0	70mm asphalt over sand and gravel, trace silt																
	Brown/ Moist grey																
	(FILL)																
	Rockfill																
192.6																	
3.8	End of borehole																
	Refusal on probable boulder																
	* Borehole dry																
	C.F.S.S.A. Denotes Continuous Flight Solid Stem Augers																

RECORD OF BOREHOLE No 604-11

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 13+212.5, o/s 45m Lt. CL Med. ORIGINATED BY A.D.
 DIST 54 HWY 69 BOREHOLE TYPE Power Auger COMPILED BY G.D.
 DATUM Geodetic DATE April 11, 2008 CHECKED BY C.N.

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										
191.5	Ground Surface						20	40	60	80	100							
0.0	Peat, fine fibrous Black					▽*	191											
							190											
							189											
188.0	End of borehole						188											
3.5																		
	* 2008 04 11																	
	▽ Water level observed during drilling																	

1 of 1 **METRIC**

$+^7, \times^5$: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 604-13

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 13+212.5, o/s 40m Rt. CL Med. ORIGINATED BY K.H.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE March 18, 2008 CHECKED BY C.N.

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							
192.0	Top of Ice					▼*	20	40	60	80	100						
0.0	Ice					▽*											
191.5	Water																
0.5	Peat, fine fibrous																
	Dark brown																
190.5	Organic silt		1	SS	WH**												
1.5	Very loose Dark																
190.0	grey																
2.0	Gravelly sand, some silt																
	Compact Grey		2	SS	106/18cm												
189.2	Wet																
2.8	End of borehole																
	Refusal on probable bedrock																
	Sample 2: Sampler bouncing																
	* 2008 03 18																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	WH** Denotes penetration due to weight of rods and hammer																

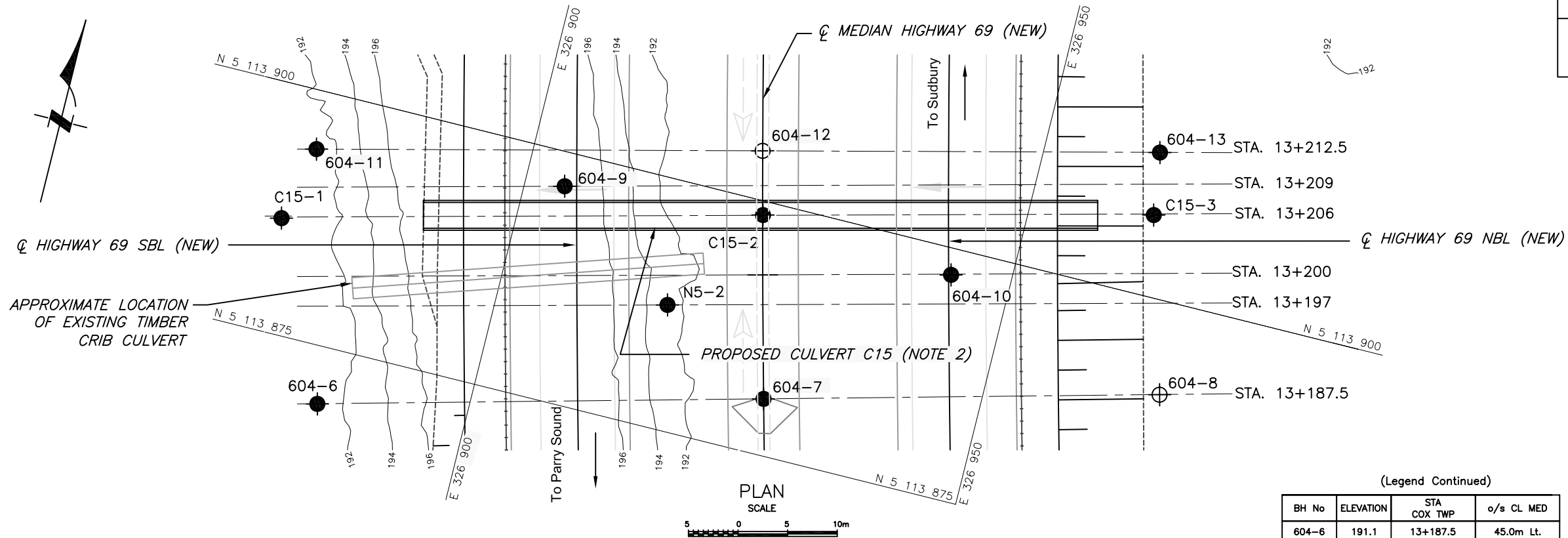
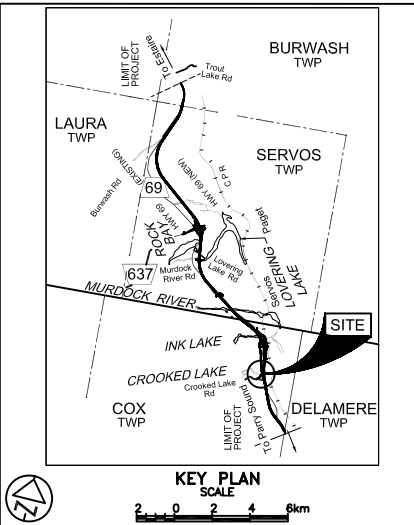
RECORD OF BOREHOLE No N5-2

1 of 1

METRIC

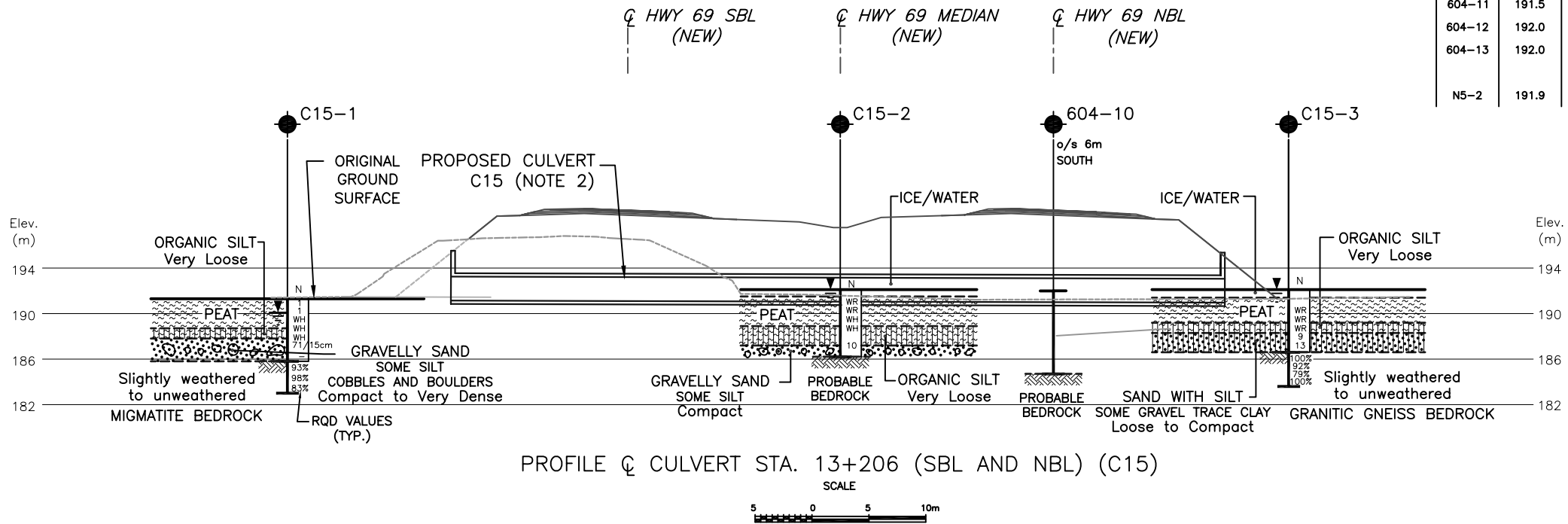
G.W.P. 5217-06-00 LOCATION Hwy. 69 (New), Sta. 13+197, o/s 9.6m Lt.
Co-ords. 5 113 888 N; 326 917 E ORIGINATED BY R.E.
DIST 54 HWY 69 BOREHOLE TYPE Manual Hand Augers COMPILED BY R.E.
DATUM Geodetic DATE April 19, 2004 CHECKED BY C.N.

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								
191.9	Top of Water					▼	▽	*	20	40	60	80	100	20	40	60		
0.0	Water																	
190.9	Organic silt								191									
1.0	Very loose Dark Wet grey (Alluvium) (Unsampled)								190									
189.6	End of borehole																	
2.3	Refusal on probable bedrock or boulders/rockfill																	
<div>* 2004 04 19</div> <div>▽ Water level observed during drilling</div> <div>▼ Water level measured after drilling</div>																		



(Legend Continued)

BH No	ELEVATION	STA COX TWP	o/s CL MED
604-6	191.1	13+187.5	45.0m Lt.
604-7	192.0	13+187.5	CL
604-8	192.0	13+187.5	40.0m Rt.
604-9	196.4	13+209	20.0m Lt.
604-10	192.0	13+200	19.0m Rt.
604-11	191.5	13+212.5	45.0m Lt.
604-12	192.0	13+212.5	CL
604-13	192.0	13+212.5	40.0m Rt.
N5-2	191.9	13+197	9.6m Lt.



LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
WH	Penetration due to weight of hammer and rods		
WR	Penetration due to weight of rods only		
W L	W L at time of investigation February 2010		
Head	Head		
ARTESIAN WATER	ARTESIAN WATER		
Encountered	Encountered		
PIEZOMETER	PIEZOMETER		

BH No	ELEVATION	NORTHINGS	EASTINGS
C15-1	191.3	5 113 886.9	326 877.1
C15-2	192.1	5 113 898.6	326 924.1
C15-3	192.1	5 113 908.1	328 962.4

(Legend Continues)

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262			
HWY No	69	CHECKED MN	DATE AUG. 30, 2010
SUBM'D	MN	CHECKED MN	SITE ---
DRAWN	NA	CHECKED CN	APPROVED BRG
DIST Sudbury Area			DWG C15-1

NOTES:

- DRAWING C15-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THE CULVERT AT STA. 13+206 WAS DESIGNATED AS CULVERT C15 FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REF AECOM Drawings:
C3-Hwy69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010; Hwy 69 Servos - Cont 3 -Structural -PC Conc Box Culv Prof 10+100 10+140 12+750 13+206 CLRSC 8+240.dwg, dated April 23, 2010 and C3-Lidar-ctrs.dwg, dated May 14, 2008.



Culvert at Sta. 8+240 (Crooked Lake Road South Connection) (C16), Cox Township

Data from Geotechnical Pavement Investigation (PML Ref.: 06TF054C)

Record of Borehole Sheets



Drawing C16-1 – Borehole Locations and Soil Strata



Proposed Crooked Lake Road South Connection
DATUM: Proposed Centreline

08+120.	C/L	D	HA	08+250.	C/L	D	HA
0 - 200	Dk Br/Blk Sa(y) Si Tps W Roots Moist			0 - 2.3	Blk Amor Peat Sat		
200 - 2.5	Br/Gry Cl(y) Si Tr Sa Mott Wet-Sat			2.3	NFP BR		
2.5 - 3.3	Gry/Br Sa Some Si Tr Cl Sat				Fr Wat @ 0		
3.3	NFP Bld						
	Fr Wat @ 100			08+250.	14.0	Lt C/L	HA
08+120.	13.0	Lt C/L	D+0.7 HA	0 - 2.3	Blk Amor Peat Sat		
0 - 200	Dk Br Sa(y) Si Tps W Roots Moist			2.3	NFP BR		
200 - 600	Br Sa(y) Si Tr Cl Moist				Fr Wat @ 0		
600	NFP Bld			08+250.	14.0	Rt C/L	HA
08+120.	13.0	Rt C/L	D-0.2 HA	0 - 2.5	Blk Amor Peat Sat		
0 - 200	Dk Br Sa(y) Si Tps W Roots Wet			2.5 - 3.4	Gr(y) Si(y) Cl Sat		
200 - 1.1	Br/Gry Cl(y) Si Mott Sat			3.4 - 3.9	Gry Sa Some Si Tr Gr Sat		
1.1 - 1.7	Gry/Br Sa Some Si Tr Cl Sat				Fr Wat @ 0		
1.7	NFP Bld			08+275.	C/L	D	HA
	Fr Wat @ 200			0	NFP BR		
08+160.	C/L	D	HA	08+300.	C/L	D	HA
0 - 300	Dk Br Sa(y) Si Tps W Roots Moist			0	NFP BR		
300	NFP BR			08+310.	C/L	D	HA
08+200.	C/L	D	HA	0	NFP BR		
0 - 400	Dk Br Sa(y) Si Tps W Roots Moist			08+310.	8.0	Lt C/L	D-0.1 HA
400	NFP BR			0	NFP BR		
08+200.	12.0	Lt C/L	D+0.6 HA	08+310.	8.0	Rt C/L	D+0.5 HA
0 - 100	Dk Br Sa(y) Si Tps W Roots Moist			0 - 100	Dk Br Sa(y) Si Tps W Roots Moist		
100	NFP BR			100	NFP BR		
08+200.	12.0	Rt C/L	D+/-0 HA	08+330.	C/L	D	HA
0 - 100	Dk Br Sa(y) Si Tps W Roots Moist			0	NFP BR		
100	NFP BR			08+330.	8.0	Lt C/L	D-0.2 HA
08+225.	C/L	D	HA	0	NFP BR		
0 - 400	Blk Amor Peat Wet-Sat			08+330.	8.0	Rt C/L	D-0.3 HA
400	NFP BR			0	NFP BR		
	Fr Wat @ 0						

RECORD OF BOREHOLE No C16-1										1 of 1		METRIC						
G.W.P. 5217-06-00			LOCATION Co-ords: 5 113 877.2 N ; 326 838.4 E Crooked Lake Road S. Conn., Sta. 8+240, o/s 13m Lt.			ORIGINATED BY M.R.												
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring			COMPILED BY M.N.												
DATUM Geodetic			DATE February 18 & 19, 2010			CHECKED BY C.N.												
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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											
191.1	Ground surface						20	40	60	80	100							
0.0	Ice																	
190.9 0.2	Peat, fine fibrous Dark brown		1	SS	8	▽*									543	Org. 32.6%		
			2	SS	WH**												352	
189.7	Organic silt																	
1.4	Very loose Dark Wet brown		3	SS	WH													
188.8	Migmatite bedrock																	
2.3	Slightly weathered to unweathered High strength Good to excellent quality		4	RC NQ	REC 100%													
			5	RC NQ	REC 100%													
185.7 5.4	End of borehole		6	RC NQ	REC 100%													
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* 2010 02 18</p> <p>▽ Water level observed during drilling</p> <p>WH** Denotes penetration due to weight of rods and hammer</p> <p>C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers</p> </div> <div style="width: 50%; text-align: right;"> <p>RQD 100%</p> <p>RQD 88%</p> <p>RQD 100%</p> </div> </div>																		

RECORD OF BOREHOLE No C16-2 1 of 1 METRIC															
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 113 883.5 N ; 326 863.5 E Crooked Lake Road S. Conn., Sta. 8+240, o/s 12.5m Rt.				ORIGINATED BY M.R.							
DIST 54 HWY 69		BOREHOLE TYPE		Continuous Flight Hollow Stem Augers				COMPILED BY M.N.							
DATUM Geodetic		DATE		February 19, 2010				CHECKED BY C.N.							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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								
191.0	Ground surface														
0.0	Ice														
190.8 0.2	Peat, fine fibrous Dark brown		1	SS	0									452	
			2	SS	WR**										
			3	SS	WR										
188.6 2.4	Organic silt Very loose Dark Wet brown		4	SS	WH***									337	
187.7 3.3	Gravelly sand, with silt Compact Grey Wet cobbles and boulders		5	SS	11									170	
186.7 4.3	End of borehole Refusal on probable bedrock														
* 2010 02 19  Water level observed during drilling  Water level measured after drilling WR** Denotes penetration due to weight of rods only WH*** Denotes penetration due to weight of rods and hammer															

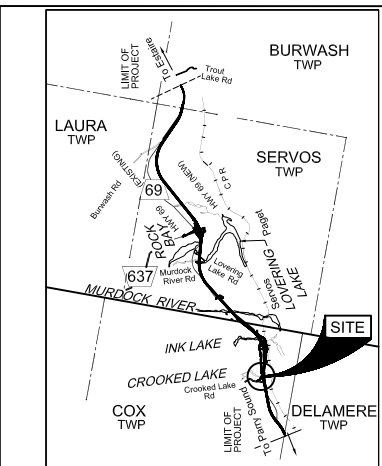
RECORD OF BOREHOLE No C15-1										1 of 1		METRIC				
G.W.P. 5217-06-00			LOCATION Co-ords: 5 113 886.9 N ; 326 877.1 E Hwy 69, Sta. 13+206, o/s 48m Lt.			ORIGINATED BY M.R.										
DIST 54 HWY 69			BOREHOLE TYPE C.F.H.S.A. and Rotary Diamond Coring			COMPILED BY M.N.										
DATUM Geodetic			DATE February 17, 2010			CHECKED BY C.N.										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
191.3 0.0	Ground surface Peat, fine fibrous Dark brown		1	SS	1		191								443 490 81 252 Org. 12.3%	
			2	SS	1		190									
			3	SS	WH**		189									
188.7 2.6	Organic silt Very loose Dark Wet brown		4	SS	WH		188									
187.8 3.5	Gravelly sand, some silt cobbles and boulders Compact to Grey Wet very dense	5	SS	WH	187											
		6	SS	71/15cm	186											
		7	RC NQ	-	185											
185.8 5.5	Migmatite bedrock Slightly weathered to unweathered High strength Good to excellent quality	8	RC NQ	REC 100%	184											
		9	RC NQ	REC 98%	183											
183.0 8.3	End of borehole Sample 6: Sampler bouncing * 2010 02 17 Water level observed during drilling WH** Denotes penetration due to weight of rods and hammer C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers Sample 5 was combined with sample 3 from borehole C15-2 for testing	10	RC NQ	REC 83%												

CONT No
GWP No 5217-06-00
GWP No 5379-02-00



CULVERT AT STA. 8+240
(CROOKED LAKE RD. SOUTH CONN.) (C16)
HIGHWAY 69 FOUR-LANING - COX TWP
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND			
	Borehole		
	Dynamic Cone Penetration Test (Cone)		
	Borehole & Cone		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
WH	Penetration due to weight of hammer and rods		
WR	Penetration due to weight of Rods only		
W L	W L at time of investigation February 2010		
	Head		
	ARTESIAN WATER Encountered		
	PIEZOMETER		

BH No	ELEVATION	NORTHINGS	EASTINGS
C16-1	191.1	5 113 877.2	326 838.4
C16-2	191.0	5 113 883.5	326 863.5
C15-1	191.3	5 113 886.9	326 877.1

(Legend Continues)

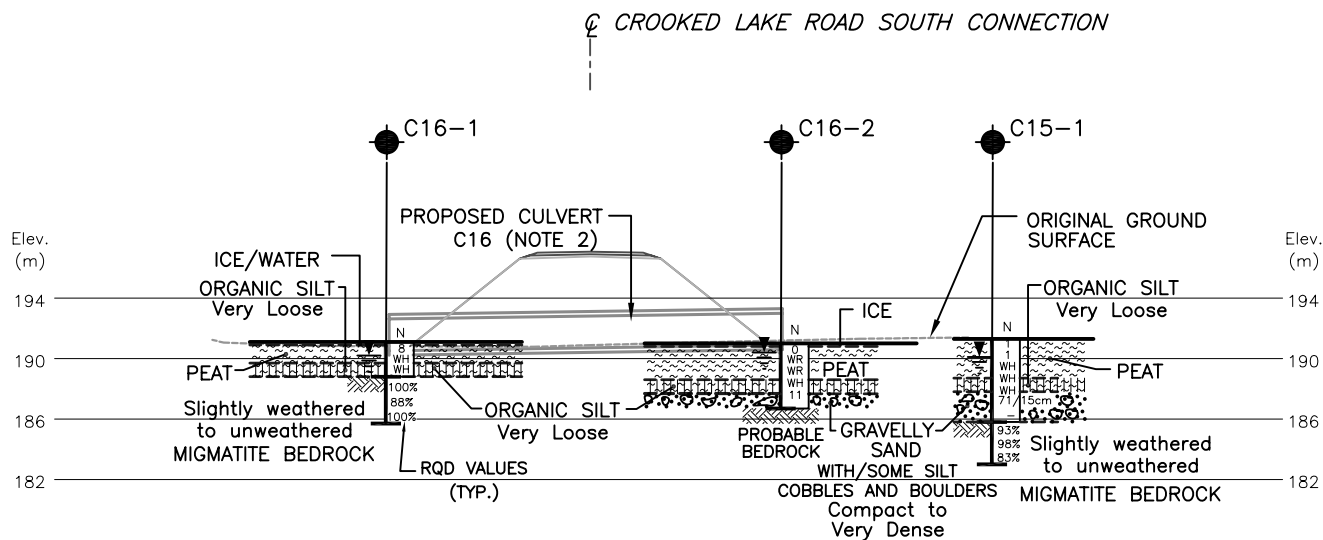
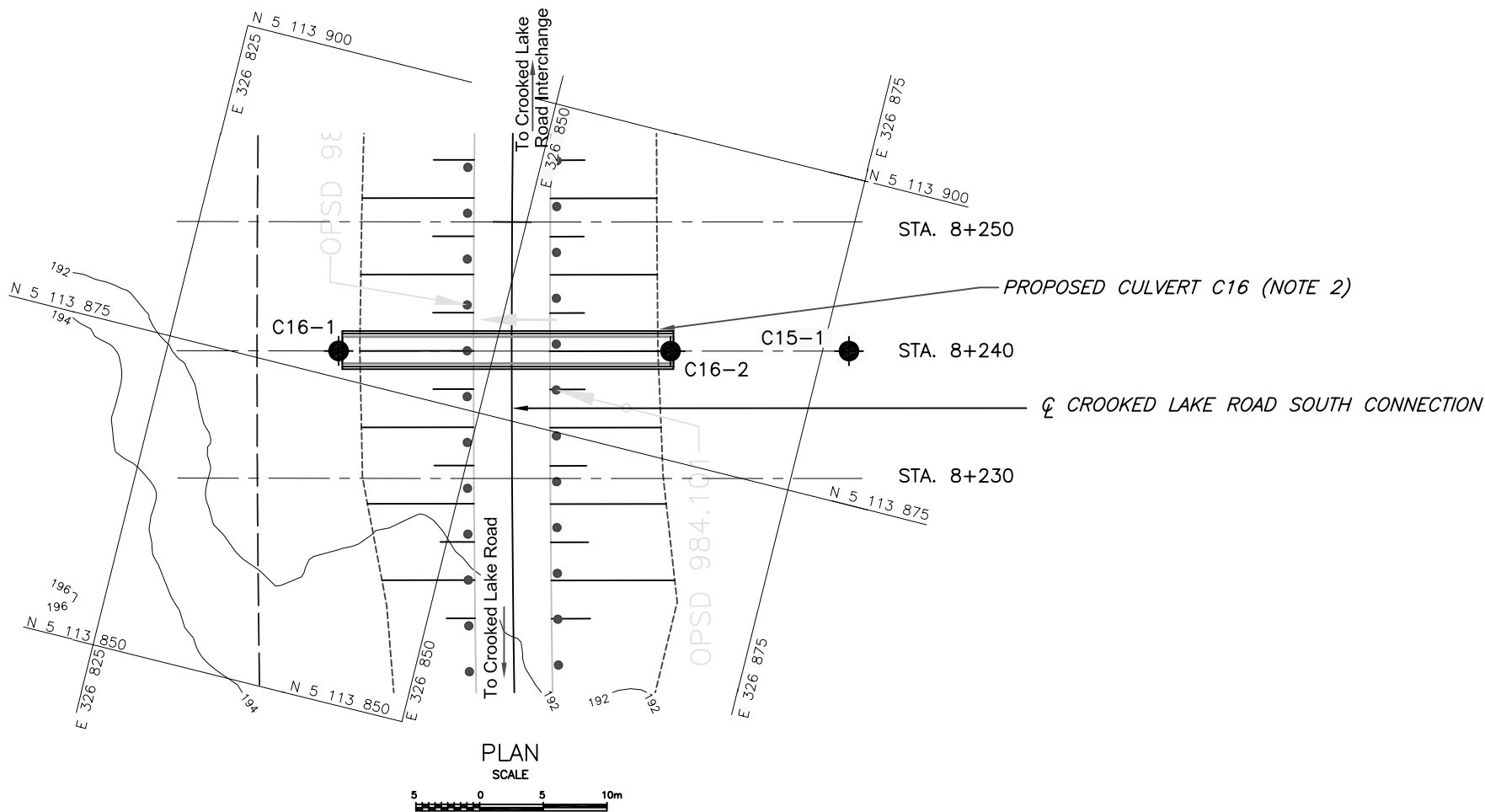
- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-262

HWY No 69	CHECKED MN	DATE AUG. 30, 2010	SITE DIST Sudbury Area
SUBM'D	NA	CHECKED CN	APPROVED BRG
DRAWN	NA	CHECKED CN	APPROVED BRG



PROFILE \perp CULVERT STA. 8+240 (CROOKED LAKE ROAD SOUTH CONNECTION) (C16)

- NOTES:
- DRAWING C16-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
 - THE CULVERT AT STA. 8+240 (CROOKED LAKE ROAD SOUTH CONNECTION) WAS DESIGNATED AS CULVERT C16 FOR THE INVESTIGATION.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

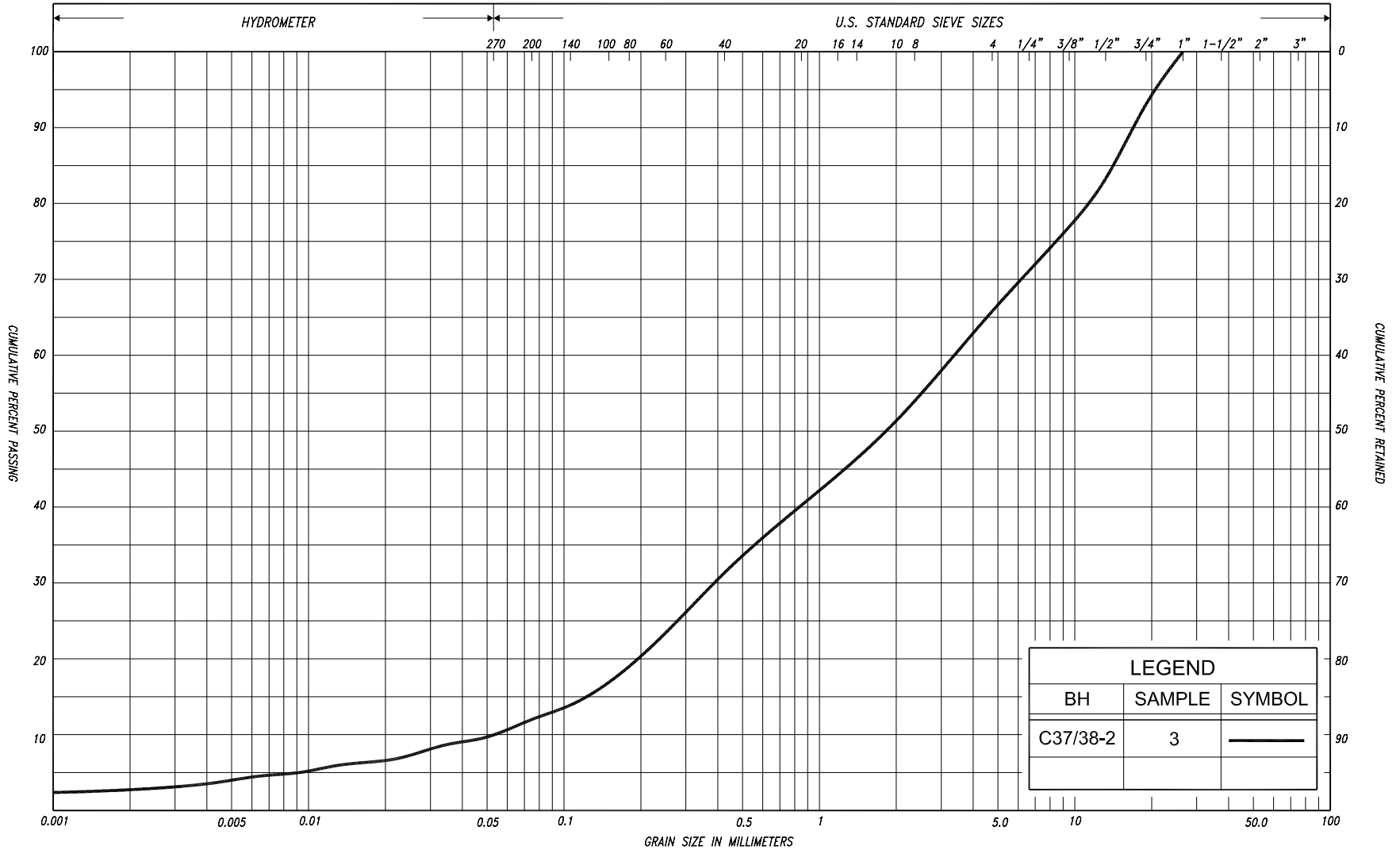
REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010; Hwy 69 Servos - Cont 3 -Structural -PC Conc Box Culv Prof 10+100 10+140 12+750 13+206 CLRSC 8+240.dwg, dated April 23, 2010 and C3-Lidar-ctrs.dwg, dated May 14, 2008.



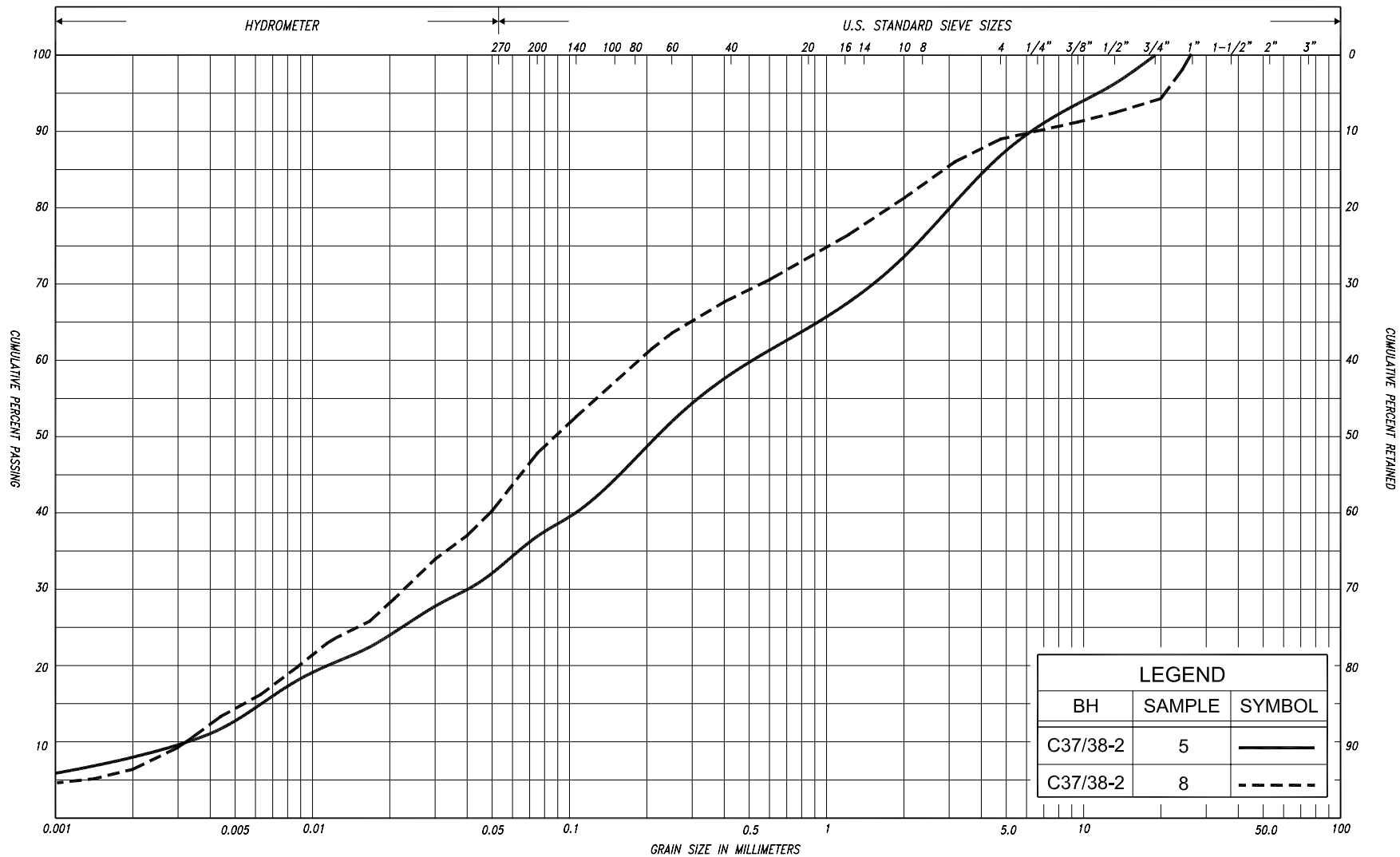
Culvert at Sta. 15+279.1 (SBL and NBL) (C37/38), Cox Township

Figures C37/38-GS-1 and C37/38-GS-2 – Results of Grain Size Distribution Analyses
Record of Borehole Sheets

Drawing C37/38-1 – Borehole Locations and Soil Strata



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED		
				SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.
	SILT				SAND											
CLAY		SILT				V. FINE		FINE		MED.		COARSE		GRAVEL		U.S. BUREAU
						SAND										



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COBBLES	UNIFIED			
				SAND													
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.	
							FINE		SAND								
CLAY			SILT			V. FINE		FINE		MED.		COARSE		GRAVEL			U.S. BUREAU
						SAND											

RECORD OF BOREHOLE No C37/38-1

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 113 884.5 N ; 326 461.0 E
 DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring and Wash Boring
 DATUM Geodetic DATE February 11 & 12, 2010

ORIGINATED BY M.R.

COMPILED BY M.N.

CHECKED BY C.N.

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								○		
								20	40	60	80	100								
197.8	Ground surface																			
0.0	Silty sand		1	SS	7	▽*	197													
197.5	organics																			
0.3	Loose Dark Wet (FILL)		2	SS	80/16cm		196													
	Sand and gravel, some silt cobbles and boulders						195													
	Compact to Brown Moist very dense to wet						194													
	Grey		3	SS	25		193													
							192													
			4	SS	7		191													
							190													
			5	SS	50/10cm		189													
			6	SS	50/0cm															
			7	SS	50/5cm															
188.7	End of borehole		8	SS	50/0cm															
9.1	Samples 2, 6, 7 & 8: Sampler bouncing																			
	Sample 4: Hydrostatic disturbance influenced the "N" value.																			
	* 2010 02 11																			
	▽ Water level observed during drilling																			

METRIC

Hwy 69, Sta. 15+279, o/s 11m Rt.

CHECKED BY C.N.

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C37/38-3

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 115 861.0 N ; 326 358.1 E
Hwy 69, Sta. 15+310, o/s 47m Lt. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Rotary Diamond Coring and Wash Boring COMPILED BY M.N.
DATUM Geodetic DATE February 10, 2010 CHECKED BY C.N.

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												
198.9 0.0	Ground surface Ice					198	197	196	195	194	193	192								
198.4 0.5	Water																			
	Sand and gravel, some silt cobbles and boulders		1	RC NQ	-															
	Compact Brown/ Wet grey																			
			2	SS	23															
			3	SS	19															
194.8 4.1	Migmatite bedrock					193	192													
	Slightly weathered with occasional highly weathered layers		4	RC NQ	REC 100%															
	Medium strength																			
	Good to excellent quality		5	RC NQ	REC 100%															
			6	RC NQ	REC 100%															
191.7 7.2	End of borehole																			
	Sample 2: Sampler bouncing																			
	 * 2010 02 10																			
	▽ Water level observed during drilling																			

RECORD OF BOREHOLE No 605-6

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+262.5, o/s 41.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY M.N.
 DATUM Geodetic DATE May 06, 2009 CHECKED BY C.N.

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									
202.7 0.0								20	40	60	80	100					
202.5 0.2	Topsoil																
202.3 0.4	Gravelly sand, trace silt organic inclusions cobbles																
	Brown Moist																
	End of borehole																
	* Borehole dry																

RECORD OF BOREHOLE No 605-7

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+265.5, o/s 4.0m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY M.N.
 DATUM Geodetic DATE May 06, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
203.0 0.0	Bedrock at surface																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

RECORD OF BOREHOLE No 605-8

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+262.5, o/s 41.0m Rt. CL Med. ORIGINATED BY K.H.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE March 20, 2008 CHECKED BY C.N.

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									
197.7	Ground surface					*		20	40	60	80	100					
0.0 197.4	Peat, fine fibrous																Frozen
0.3	Dark brown																
197.0 0.7	Clayey silt cobbles and boulders						197										
	Dark Wet brown																
	End of borehole																
	Refusal on probable boulder																
											</						

RECORD OF BOREHOLE No 605-9

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+272 o/s 29.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probing COMPILED BY M.N.
 DATUM Geodetic DATE June 15, 2009 CHECKED BY C.N.


SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
201.5	Ground surface					*														
0.0	Bedrock at surface																			
	* Borehole dry																			

RECORD OF BOREHOLE No 605-10

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+275, o/s 18.8m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE April 09, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE					LAB VANE						
197.4	Ground surface					*	197																
0.0	Sand and gravel cobbles and boulders																						
	Brown Moist																						
196.2	End of borehole																						
1.2	Refusal on probable boulder																						
	* Borehole dry																						

METRIC

$+^7, \times^5$: Numbers refer to Sensitivity

RECORD OF PENETRATION TEST No 605-12

1 of 1 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+287.5, o/s 40.0m Rt. CL Med. ORIGINATED BY K.H.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE March 20, 2008 CHECKED BY C.N.


SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	20 40 60 80 100	W _p	W		
203.9 0.0	Top of Snow Snow Probable peat Probable sand cobbles and boulders Compact to dense												
199.6 4.3	End of dynamic cone penetration test												

RECORD OF BOREHOLE No 605-13

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+290, o/s 4.0m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE April 11, 2008 CHECKED BY C.N.

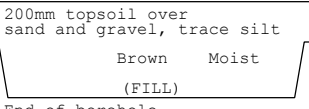
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
197.3	Ground surface																	
0.0	Topsoil																	
197.1 0.2	Silty sand, trace gravel cobbles and boulders																	
	Brown Moist																	
196.1																		
1.2	Sandy silt, trace gravel cobbles and boulders																	
	Dense Grey Moist		1	SS	16/10cm													
195.2	(TILL)																	
2.1	End of borehole																	
	Refusal on probable boulder																	
	Sample 1: Sampler bouncing																	
	* Borehole dry																	

RECORD OF BOREHOLE No 605-14

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+300, o/s 10.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Power Auger COMPILED BY G.D.
 DATUM Geodetic DATE April 14, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								20	40	60	80	100					20	40	60				
205.3	Ground surface																						
0.0	200mm topsoil over sand and gravel, trace silt																						
204.9																							
0.4	Brown Moist (FILL)																						
	End of borehole																						
	Refusal on probable boulder																						
										</													

RECORD OF BOREHOLE No 605-15

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+300, o/s 18.8m Rt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE April 09, 2008 CHECKED BY C.N.

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									
201.5	Ground surface						20	40	60	80	100						
0.0	Sand and gravel cobbles and boulders Brown Moist (FILL)																
200.0																	
1.5	Sand and gravel cobbles and boulders Very dense Brown Wet		1	SS	21/8cm												
198.6																	
2.9	End of borehole Refusal on probable bedrock 																

METRIC

$+^7, \times^5$: Numbers refer to Sensitivity

RECORD OF BOREHOLE No N8-1 1 of 1 METRIC												
G.W.P. 5218-06-00		LOCATION		Hwy. 69 Sta. 15+345, o/s 50m Rt. Co-ords. 5 115 876 N; 326 481 E				ORIGINATED BY RE				
DIST 54 HWY 69		BOREHOLE TYPE		Casing and Washboring				COMPILED BY RE				
DATUM Geodetic		DATE		March 12, 2004				CHECKED BY				
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID		UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L			WATER CONTENT (%)
198.5	Ground Surface	▲				▲						
0.0	Mixture of clay, rootmat, cobbles and boulders	▲										
198.3	(FILL)											
0.2	End of borehole											
	Refusal on probable bedrock											
	* 2004 03 12											
	▽ Water level observed during drilling											
	▼ Water level measured after drilling											

RECORD OF BOREHOLE No N8-2

1 of 1

METRIC

G.W.P. 5217-06-00

LOCATION

Hwy. 69 (New), Sta. 15+257.5, o/s 19.8m Rt.

Co-ords. 5 115 867 N; 326 447 E

ORIGINATED BY R.E.

DIST 54 HWY 69BOREHOLE TYPE Casing and Washboring

COMPILED BY R.E.

DATUM Geodetic

DATE March 12, 2004

CHECKED BY C.N.

[illegible]

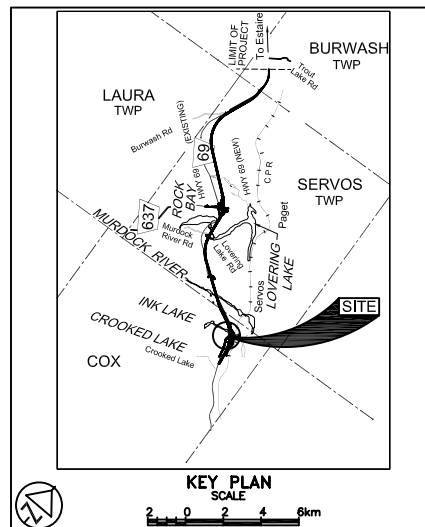
CONT No
GWP No 5217-06-00
GWP No 5379-02-00



CULVERT AT STA. 15+279.1
(SKEWED) (C37/38)
HIGHWAY 69 FOUR-LANING - COX TWP
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

PMI Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation February 2010
- Head
- ARTESIAN WATER
- Encountered
- PIEZOMETER

BH No	ELEVATION	NORTHINGS	EASTINGS
C37/38-1	197.8	5 111 884.5	326 461.0
C37/38-2	198.5	5 115 875.5	326 421.7
C37/38-3	198.9	5 115 861.0	326 358.1

(Legend Continues)

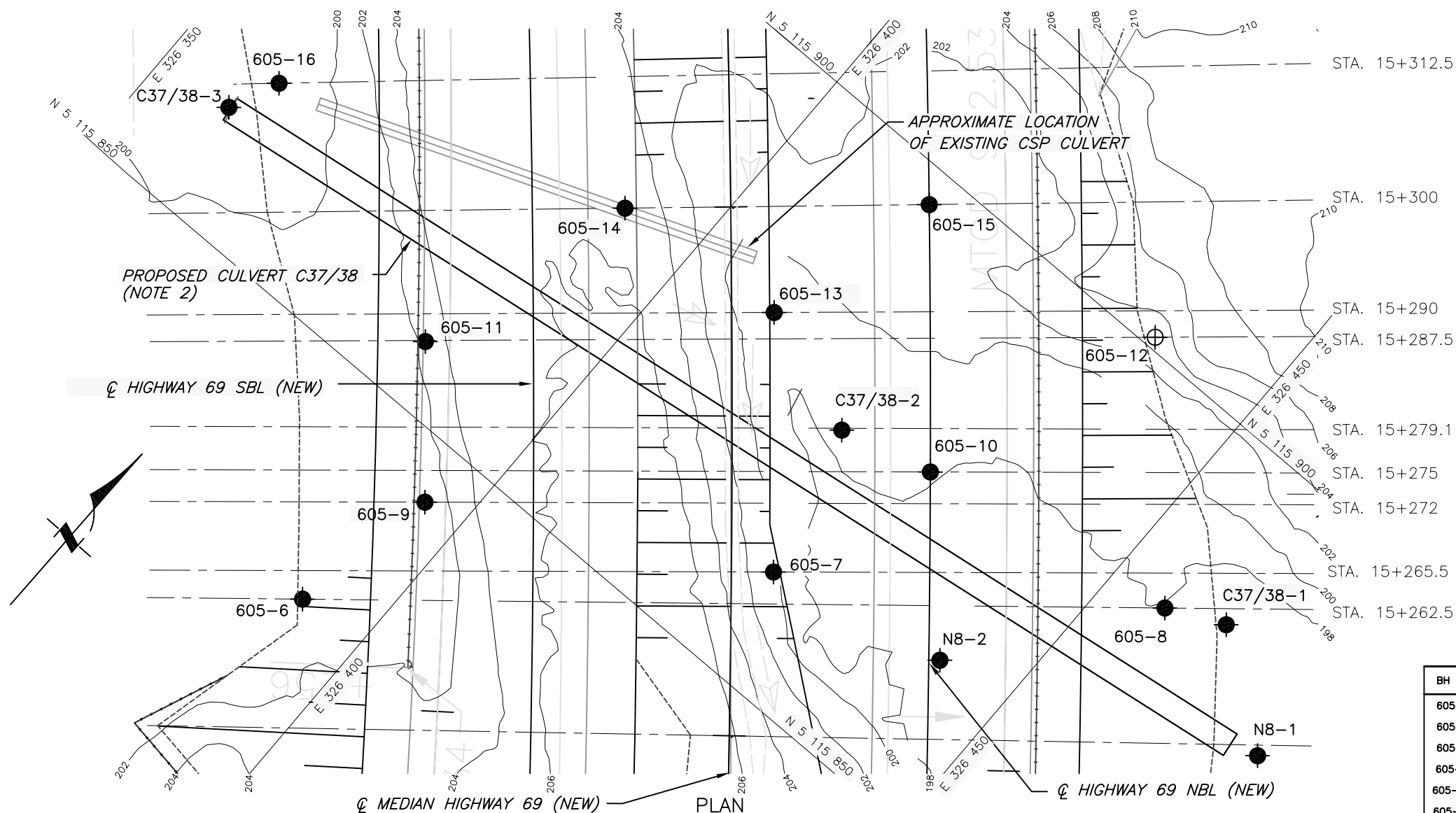
- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

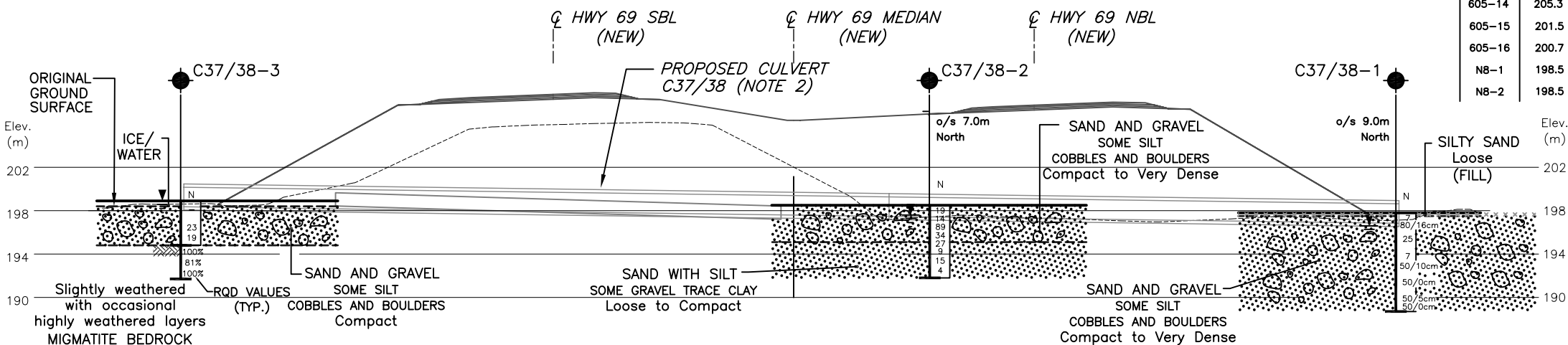
Geocres No. 411-262

HWY No	69	CHECKED	MN	DATE	AUG. 30, 2010	SITE	DIST	Sudbury Area
SUBM'D	MN	CHECKED	CN	APPROVED	BRG	DWG	C37/38-1	



(Legend Continued)

BH No	ELEVATION	STA COX TWP	o/s CL MED
605-6	202.7	15+262.5	41.0m Lt.
605-7	203.0	15+265.5	4.0m Rt.
605-8	197.7	15+262.5	41.0m Rt.
605-9	201.5	15+272	29.0m Lt.
605-10	197.4	15+275	18.8m Rt.
605-11	201.1	15+287.5	29.0m Lt.
605-12	203.9	15+287.5	40.0m Rt.
605-13	197.3	15+290	4.0m Rt.
605-14	205.3	15+300	10.0m Lt.
605-15	201.5	15+300	18.8m Rt.
605-16	200.7	15+312.5	42.5m Lt.
N8-1	198.5	15+249	50.0m Rt.
N8-2	198.5	15+257.5	19.8m Rt.

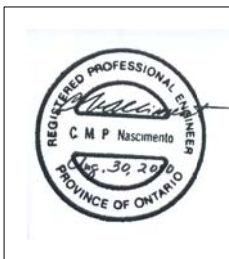


PROFILE Q CULVERT AT STA. 15+279.1 (SKEWED) (C37/38)

NOTES:

- DRAWING C37/38-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
- THE CULVERT AT STA. 15+279.1 (SKEWED) WAS DESIGNATED AS CULVERT C37/38 FOR THE INVESTIGATION.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.
- LOCATION OF CULVERT AT STA. 15+279.1 C37/38 WAS SHIFTED AFTER COMPLETION OF FIELD WORK.

REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-HWY69-Des.dwg dated April 15, 2010;
C3-Ink Lake Culv-15+279.1 Profile.dwg dated June 30, 2010 and
C3-Lidar-ctrs.dwg, dated May 14, 2008



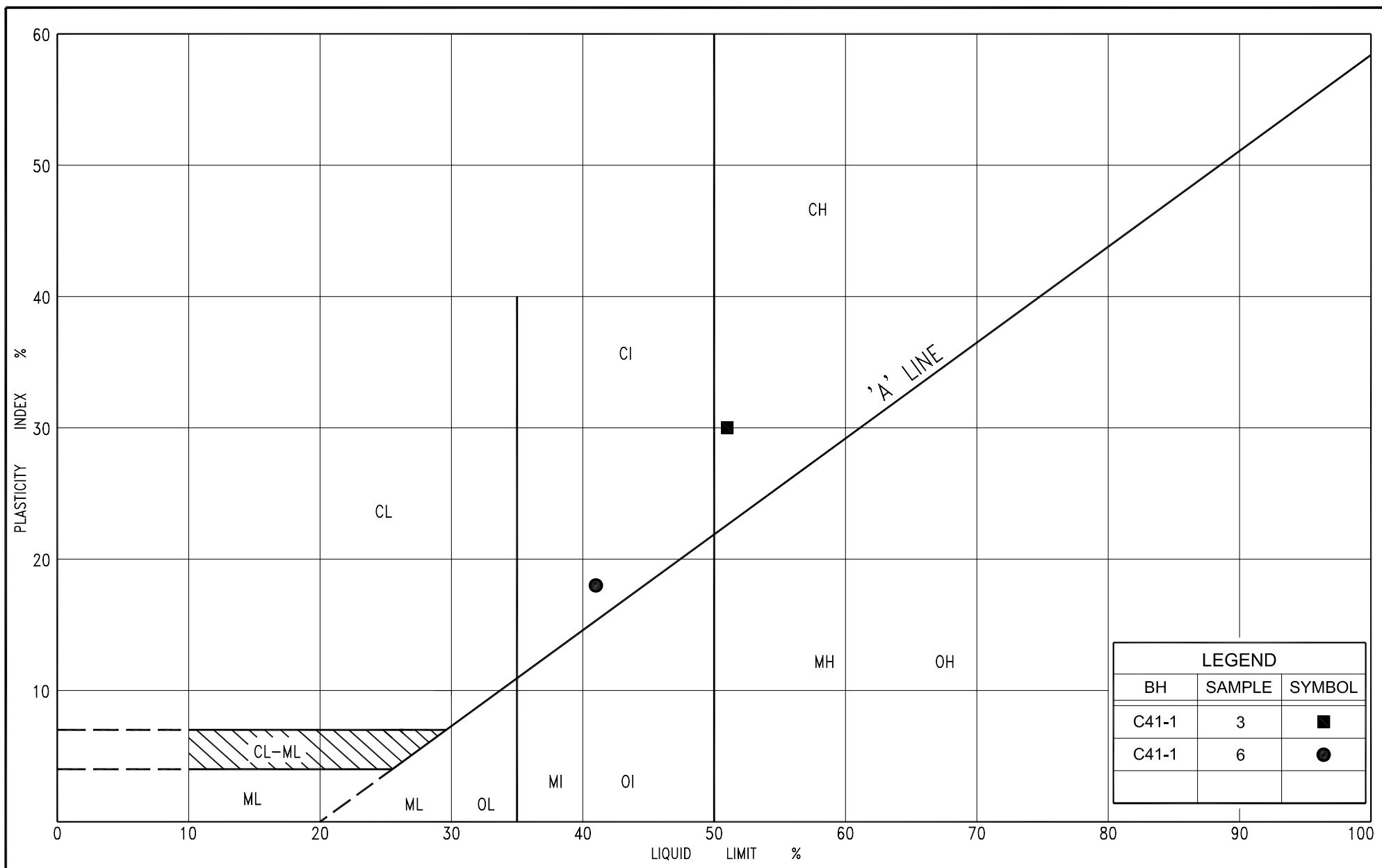
Culvert at Sta. 15+883 (SBL) (C41), Cox Township

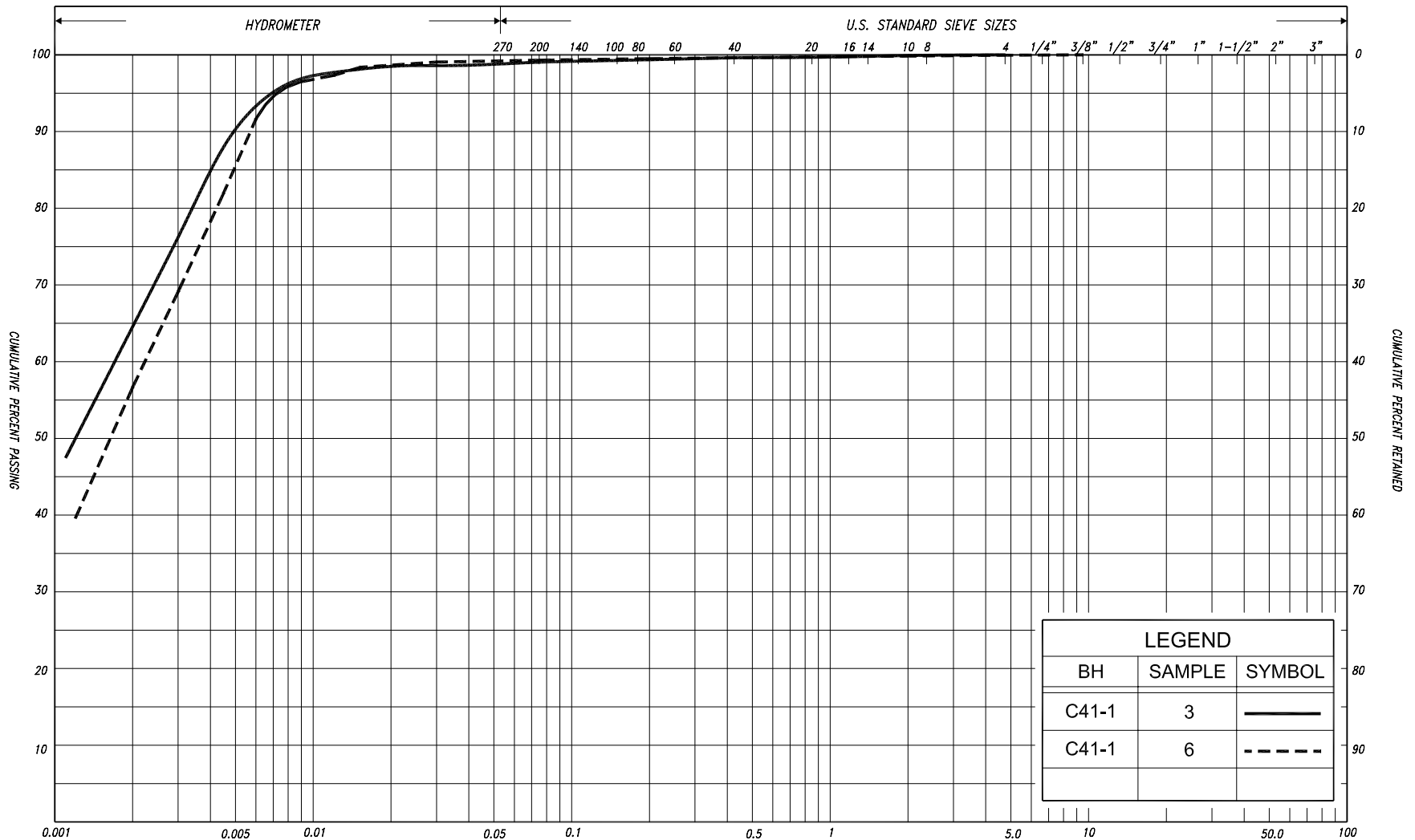
Figure C41-PC-1 – Result of Atterberg Limit Testing

Figure C41-GS-1 – Results of Grain Size Distribution Analyses

Record of Borehole Sheets

Drawing C41-1 – Borehole Locations and Soil Strata





SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL				COB BLES	UNIFIED		
					SAND													
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL				COBBLES	M.I.T.
	SILT																	
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU	
						SAND												

GRAIN SIZE DISTRIBUTION

CLAY / SILTY CLAY, trace sand

FIG No. C41-GS-1

HWY: 69

G.W.P. No. 5217-06-00

RECORD OF BOREHOLE No C41-1										1 of 1		METRIC			
G.W.P. 5217-06-00		LOCATION		Co-ords: 5 116 247.7 N ; 325 946.2 E Hwy 69, Sta. 15+885, o/s 5m Lt.						ORIGINATED BY F.P.					
DIST 54 HWY 69		BOREHOLE TYPE		C.F.S.S.A. and Rotary Diamond Coring						COMPILED BY M.N.					
DATUM Geodetic		DATE		June 17, 2009						CHECKED BY C.N.					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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								
205.7	Ground surface														
0.0	Topsoil		1	SS	2										
205.4	Clay, trace sand organics to 1.4m		2	SS	7										
0.3	Stiff to Mottled Moist firm grey/brown		3	SS	4										
203.4	Silty clay, trace sand		4	SS	3										
2.3	Firm Grey Wet		5	SS	1										
				FV											
	Soft		6	SS	2										
				FV											
199.9	Granitic Gneiss bedrock		7	RC NQ	REC 100%										
5.8	Slightly weathered		8	RC NQ	REC 100%										
	High strength		9	RC NQ	REC 100%										
	Excellent quality														
196.7	End of borehole														
9.0															

* 2009 06 17

▽ Water level observed during drilling

■ Penetrometer test

C.F.S.S.A. denotes Continuous Flight Solid Stem Augers











RECORD OF BOREHOLE No C41-2										1 of 1		METRIC					
G.W.P. 5217-06-00			LOCATION Co-ords: 5 116 213.8N ; 325 923.7 E Hwy 69, Sta. 15+888, o/s 46m Lt.			ORIGINATED BY F.P.											
DIST 54 HWY 69			BOREHOLE TYPE C.F.S.S.A. and Rotary Diamond Coring			COMPILED BY M.N.											
DATUM Geodetic			DATE June 17, 2009			CHECKED BY C.N.											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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										
206.0	Ground surface						20	40	60	80	100						
0.0	Peat, fine fibrous Dark brown		1	SS	1										270	SS 1 and SS 2 comp. Org. 70.7%	
			2	SS	WR**										319		
204.2	Silty sand, some gravel cobbles		3	SS	6												
1.8																	
203.6	Loose Grey Wet		4	SS	8/15cm												
2.4	Biotite Gneiss bedrock Slightly weathered Medium strength Excellent quality		5	RC NQ	REC 100%											RQD 94%	
			6	RC NQ	REC 100%											RQD 100%	
			7	RC NQ	REC 97%											RQD 97%	
200.4	End of borehole																
5.6	Sample 4: Sampler bouncing																
	* 2009 06 17																
	▽ Water level observed during drilling																
	WR** denotes penetration due to weight of rods only																
	C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																

RECORD OF BOREHOLE No C41-3

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 116 235.5 N ; 325 939.3 E
Hwy 69, Sta. 15+885, o/s 19m Lt. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY M.N.
DATUM Geodetic DATE June 18, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa									
205.9	Ground surface							20	40	60	80	100					
0.0	Peat, fine fibrous Dark brown																
	amorphous, with layers of organic clay						205										
204.5	Silty clay, trace sand																
1.4	Mottled Moist grey/brown						▽*										
	Grey Wet																
																	
																	
																	
198.7																	
7.2																	
198.6	Silty sand, some gravel cobbles and boulders																
7.3	Grey Wet																
	End of auger probe Refusal on probable boulders																

RECORD OF BOREHOLE No 606-1

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+870, o/s 18.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE November 13, 2007 CHECKED BY C.N.


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
206.0	Ground Surface						20	40	60	80	100					
0.0 205.7 0.3	Peat, coarse fibrous Dark brown		1	CS	3	▼*										
	Silty clay, trace sand					▽*										
	Soft Mottled Moist to firm grey/Brown															
	Grey															
	layers of silty sand		2	SS	2											
				FV												
	trace gravel cobbles and boulders		3	SS	10/8cm											
201.6 4.4	End of borehole															
	Refusal on probable bedrock															
	Sample 3: Sampler bouncing															
	* 2007 11 13															
	▽ Water level observed during drilling															
	▼ Water level measured after drilling															

RECORD OF BOREHOLE No 606-2

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+870, o/s 18.8m Rt. CL Med. ORIGINATED BY N.L.B.
 DIST 54 HWY 69 BOREHOLE TYPE Test Pit COMPILED BY G.D.
 DATUM Geodetic DATE October 18, 2007 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
208.3 0.0	Ground Surface					*														
207.9 0.4	Topsoil						208													
207.4 0.9	Cobbles and boulders																			
	End of borehole Refusal on probable bedrock																			
	* Borehole dry																			

RECORD OF PENETRATION TEST No 606-3

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+875, o/s 38.8m Lt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 25, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
207.7 0.0	Ground Surface Probable peat ----- Probable silty clay																
205.3 2.4	End of dynamic cone penetration test Refusal on probable bedrock																

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

20
15 — ○ — 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 606-5

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+875, o/s 31.0m Rt. CL Med. ORIGINATED BY N.L.B.
 DIST 54 HWY 69 BOREHOLE TYPE Test Pit COMPILED BY G.D.
 DATUM Geodetic DATE October 18, 2007 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L				WATER CONTENT (%)			
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	×	LAB VANE							
212.0	Ground Surface																			
0.0	Topsoil																			
211.6																				
0.4	Cobbles and boulders																			
211.1																				
0.9	End of borehole Refusal on probable bedrock																			

RECORD OF BOREHOLE No 606-6

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+900, o/s 18.8m Lt. CL Med. ORIGINATED BY F.P.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
DATUM Geodetic DATE November 13, 2007 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	✚ FIELD VANE						
206.4	Ground Surface						● QUICK TRIAXIAL	✕ LAB VANE		WATER CONTENT (%)					
0.0	Peat, coarse fibrous Dark brown		1	CS	3					20	40	60			
205.9	Silty clay, trace sand layers of organic clay and amorphous peat to 1.8m Stiff Grey Moist to firm to wet														
0.5			2	SS	5										
				FV											
			3	SS	2										
				FV											
202.1	Clayey silt, trace sand Firm Grey Wet														
4.3			4	SS	2										
				FV											
			5	SS	2										
				FV											
199.1	Sand some gravel, trace silt Compact Grey Wet														
7.3			6	SS	21										
198.2	End of borehole Refusal on probable bedrock														
8.2															
* 2007 11 13															
▽ Water level observed during drilling															
▽ Water level measured after drilling															

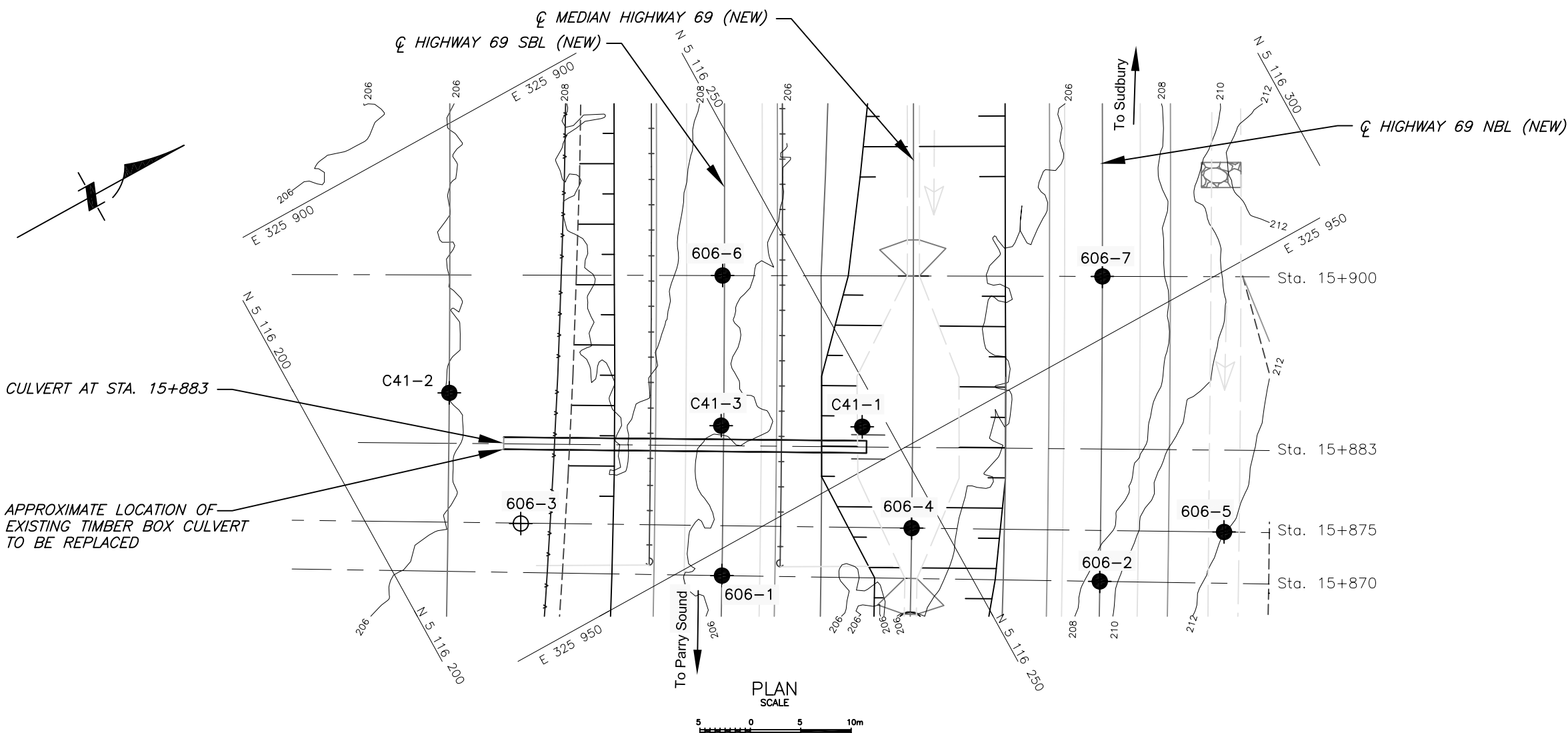
RECORD OF BOREHOLE No 606-7

1 of 1

METRIC

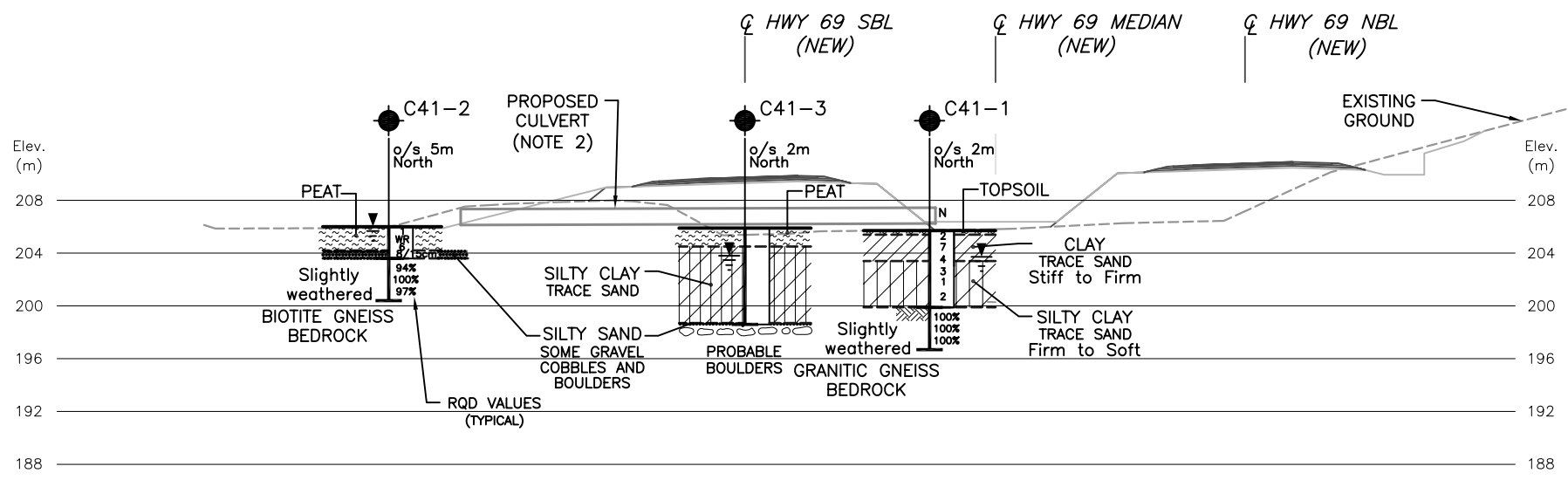
G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 15+900, o/s 18.8m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE November 13, 2007 CHECKED BY C.N.

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									
206.4 0.0	Ground Surface						20	40	60	80	100						
206.2 0.2	Topsoil		1	SS	12	206										1 2 42 55	
205.9 0.5	Silty sand, some gravel																
	Compact Brown Moist Clay trace sand, trace gravel																
	Stiff Brown Moist Mottled grey/ brown		2	SS	9												
						204											
203.2 3.2	End of borehole Refusal on probable bedrock		3	SS	10/5cm												
	Sample 3: Sampler bouncing * Borehole dry ■ Penetrometer test																



CULVERT AT STA. 15+883

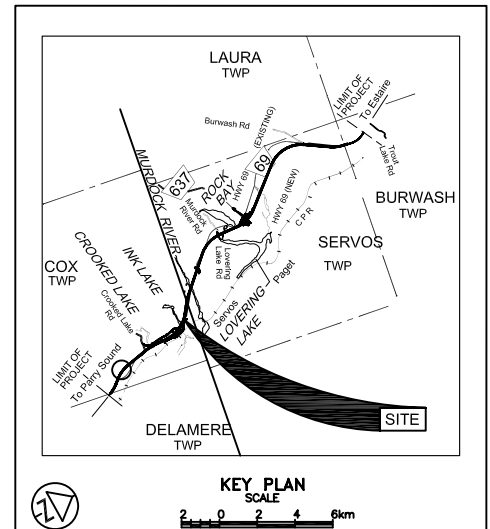
APPROXIMATE LOCATION OF EXISTING TIMBER BOX CULVERT TO BE REPLACED



PROFILE Q CULVERT AT STA. 15+883 (SBL) (C41)

- NOTES:
- DRAWING C41-1 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
 - CULVERT AT STA. 15+883 WAS DESIGNATED AS CULVERT C41 FOR THE INVESTIGATION.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-HWY69-Des.dwg dated April 15, 2010;
Hwy69 Servos-Cont3-Culvert Profiles.dwg dated Jan. 21 2010 and C3-Lidar-ctrs.dwg dated May 14, 2008



LEGEND	
	Borehole
	Dynamic Cone Penetration Test (Cone)
	Borehole & Cone
N	Blows/0.3m (Std. Pen Test, 475 J / blow)
CONE	Blows/0.3m (60° Cone, 475 J / blow)
	W L at time of investigation Oct 2006 Mar 2007
	Head
	ARTESIAN WATER Encountered
	PIEZOMETER

BH No	ELEVATION	COORDINATES	
		NORTHINGS	EASTINGS
C41-1	205.7	5 116 247.7	325 946.2
C41-2	206.0	5 116 213.8	325 923.7
C41-3	205.9	5 116 235.5	325 939.3
BH No	ELEVATION	STA SERVOS TWP	o/s CL MED
606-1	206.0	15+870	18.8m Lt.
606-2	208.3	15+870	18.8m Rt.
606-3	207.7	15+875	38.8m Lt.
606-4	205.9	15+875	CL
606-5	212.0	15+875	31.0m Rt.
606-6	206.4	15+900	18.8m Lt.
606-7	206.4	15+900	18.8m Rt.

NOTE -
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS				
	DATE	BY	DESCRIPTION	

Geacres No. 411-262

HWY No 69				DIST Sudbury Area	
SUBM'D	MN	CHECKED CN	DATE AUG. 30, 2010	SITE	---
DRAWN	NA	CHECKED CN	APPROVED BRG	DWG	C41-1

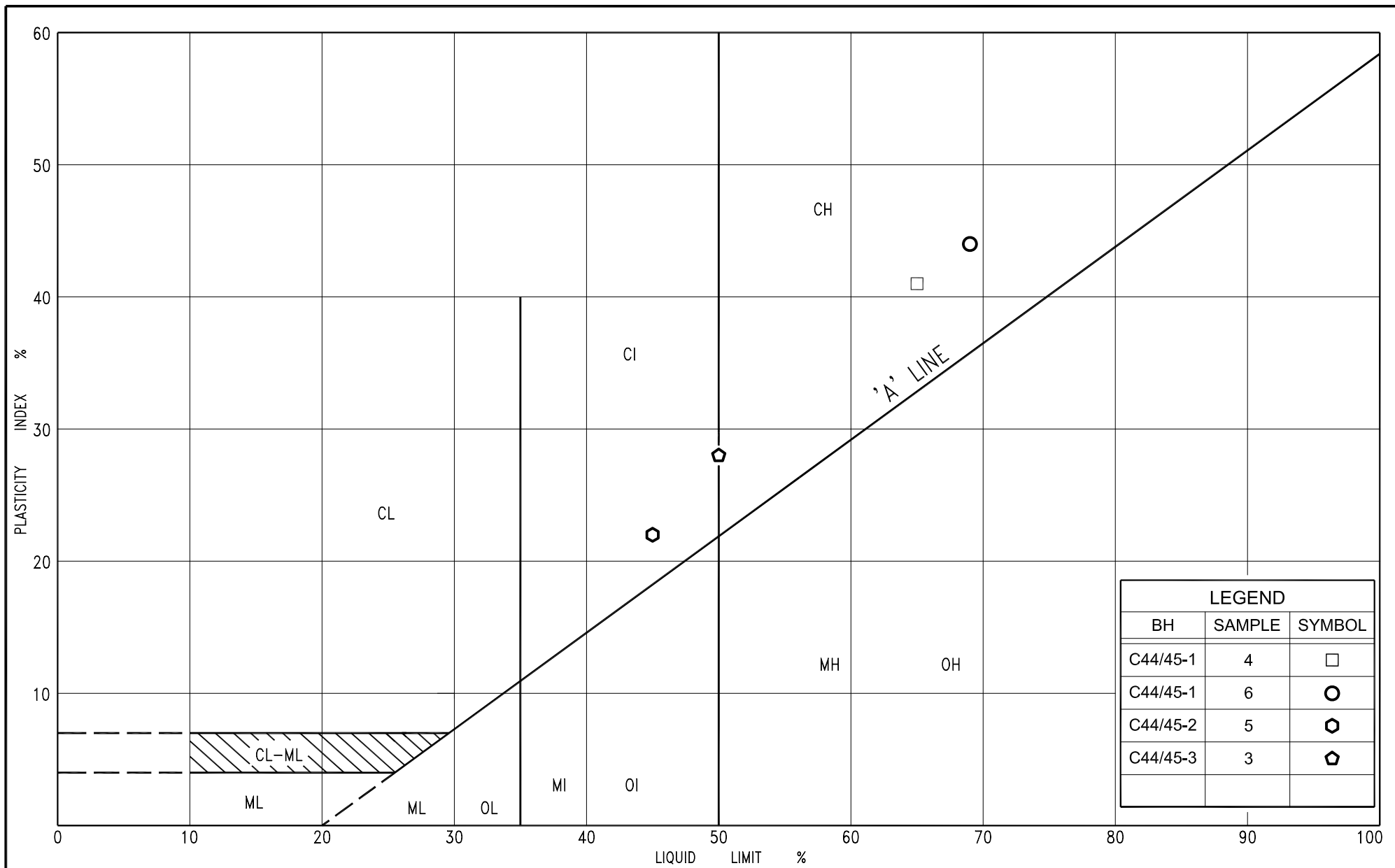
Culvert at Sta. 10+523 (SBL) (C44), Servos Township

Figure C44/45-PC-1 – Result of Atterberg Limit Testing

Figures C44/45-GS-1 to C44/45-GS-3 – Results of Grain Size Distribution Analyses

Record of Borehole Sheets

Drawing C44-1 – Borehole Locations and Soil Strata



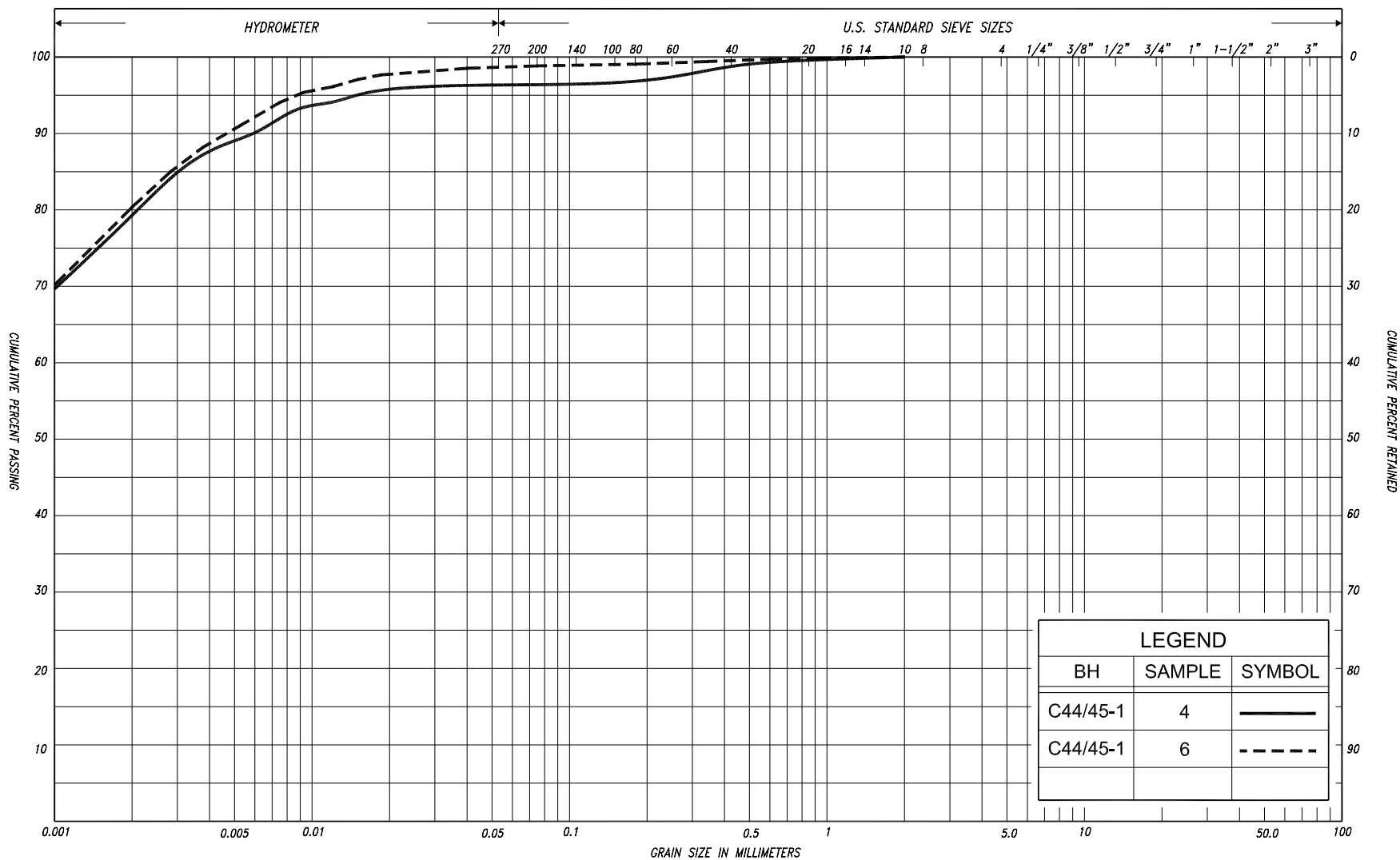
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PLASTICITY CHART
CLAY/SILTY CLAY, trace sand

FIG No. C44/45-PC-1

HWY: 69

G.W.P. No. 5217-06-00



SILT & CLAY			FINE			MEDIUM			COARSE			GRAVEL			COBBLES	UNIFIED
CLAY			FINE			MEDIUM			COARSE			GRAVEL			COBBLES	M.I.T.
CLAY			SILT			SAND			GRAVEL			GRAVEL			U.S. BUREAU	

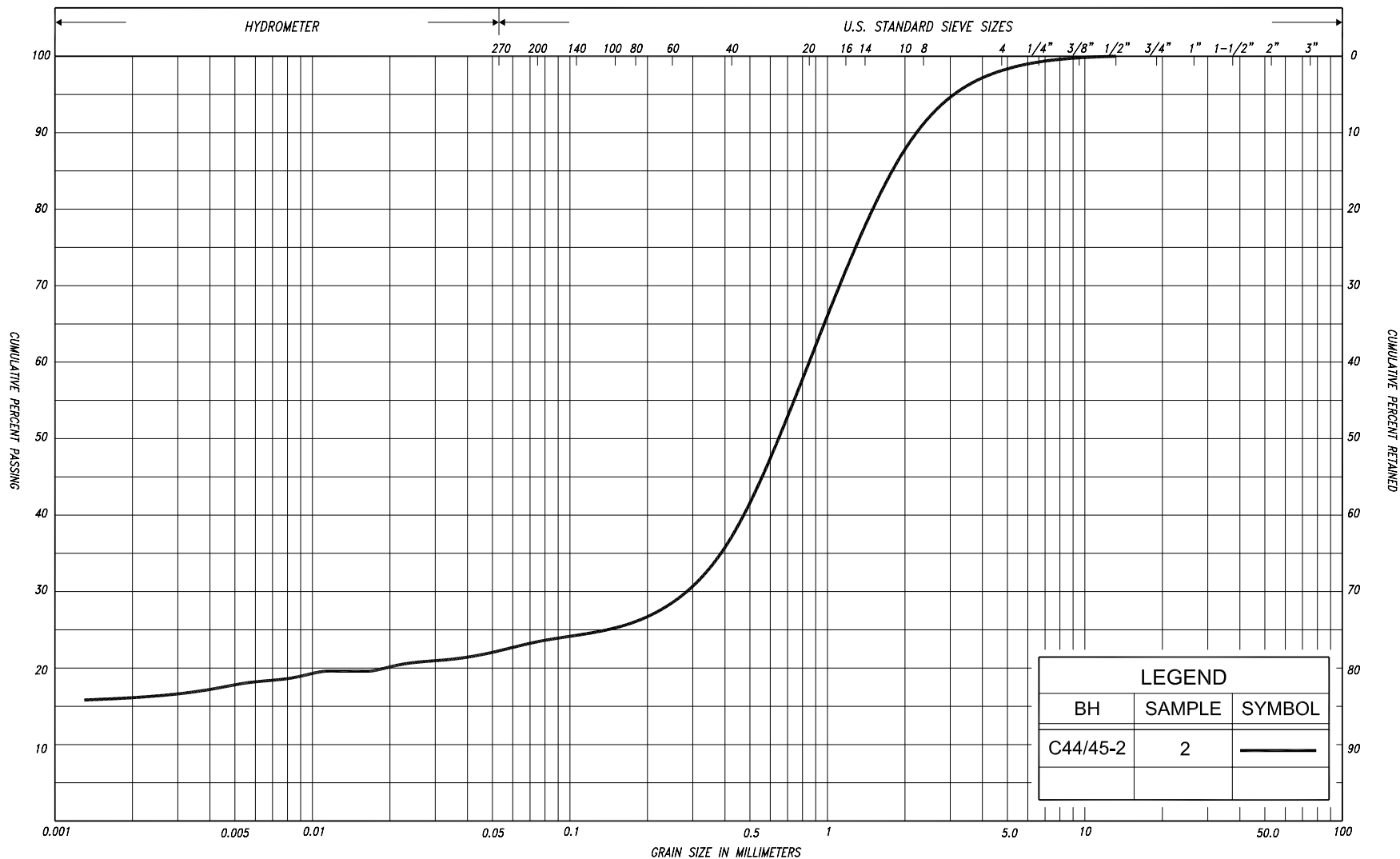
GRAIN SIZE DISTRIBUTION

CLAY, trace sand

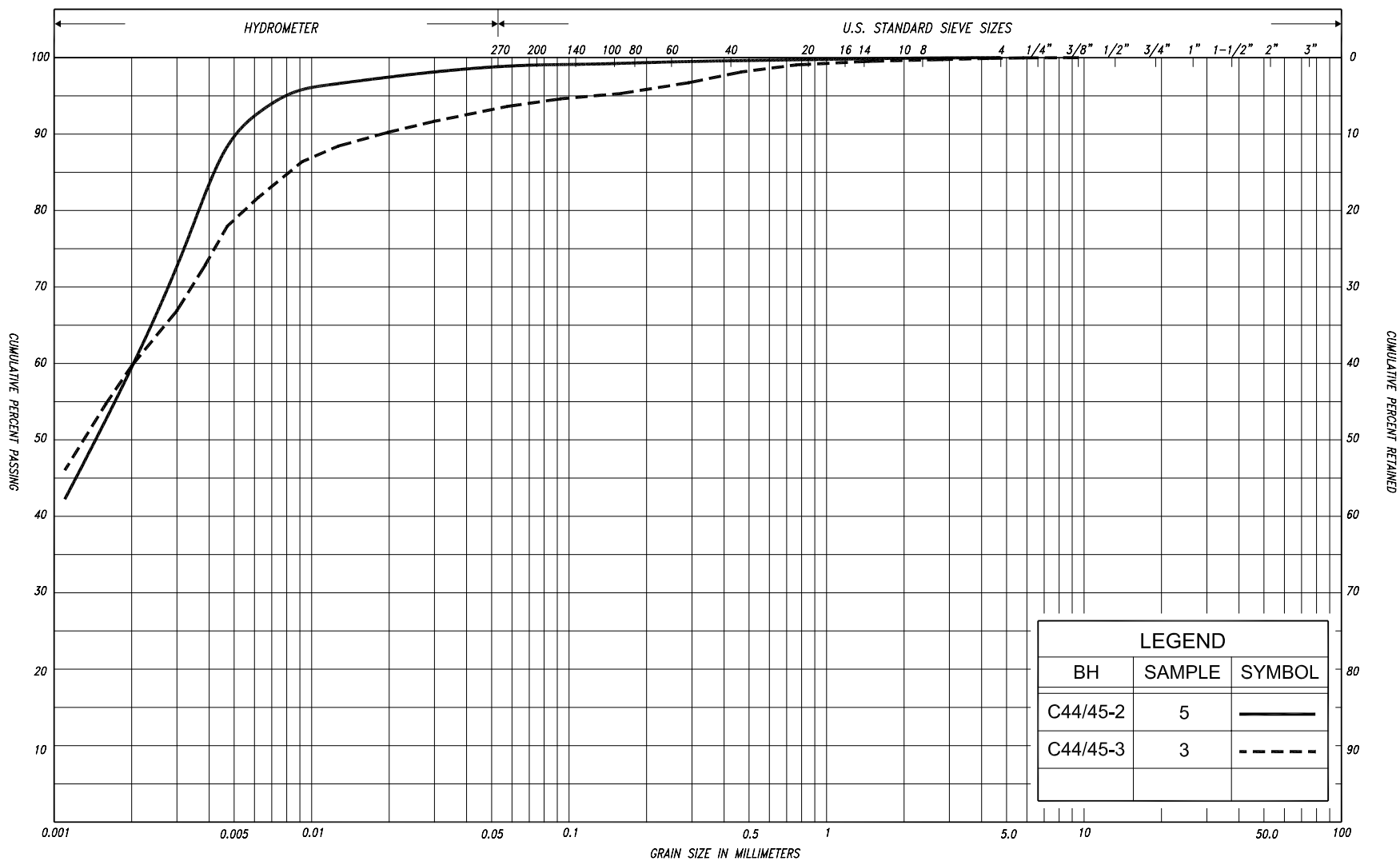
FIG No. C44/45-GS-1

HWY: 69

G.W.P. No. 5217-06-00



SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED	
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM		COARSE	GRAVEL			COBBLES	M.I.T.	
	SILT					SAND				GRAVEL				U.S. BUREAU	
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL							
				SAND											



SILT & CLAY					FINE		MEDIUM		COARSE	GRAVEL				COBBLES	UNIFIED
CLAY	FINE		MEDIUM		COARSE	SAND			GRAVEL				COBBLES	M.I.T.	
	SILT					FINE		MEDIUM		COARSE					
CLAY			SILT			V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU
						SAND									



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Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

FIG No. C44/45-GS-3

HWY: 69

G.W.P. No. 5217-06-00

RECORD OF BOREHOLE No C44/45-1

1 of 1












METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 116 745.1 N ; 325 044.5 E
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE February 10, 2010

ORIGINATED BY M.R.

COMPILED BY M.N.

CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION			STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W			W _L	WATER CONTENT (%)	
204.8 0.0	Ground surface								20	40	60	80	100								
	Silty sand																				
	Loose	Dark brown	Moist to wet		1	SS	5	 *  *	204												
203.9 0.9	(FILL)																				
203.6 1.2	Peat, fine fibrous				2	SS	4														
	Dark brown																				
203.2 1.6	Organic silty clay																				
	Soft to firm	Dark grey	Wet		3	SS	9														
	Sand, some silt																				
	trace clay, trace gravel																				
202.4 2.4	Loose				4	SS	1														
	Dark brown																				
	Wet																				
	Clay, trace sand																				
	Soft to firm				5	SS	WH**														
						FV															
	Mottled grey				6	SS	WH														
						FV															
199.3 5.5	Silty clay, trace sand																				
	Firm																				
	Grey																				
	Wet				7	SS	WH														
197.3 7.5	Sand and gravel																				
	trace silt				8	SS	15														
	Compact																				
	Brown																				
	Wet																				
195.5 9.3	End of borehole																				
	Refusal on probable bedrock																				

* 2010 02 10

▽ Water level observed during drilling

▼ Water level measured after drilling

WH** denotes penetration due to weight of rods and hammer

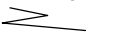
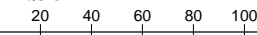


























































































METRIC

G.W.P. <u>5217-06-00</u>		LOCATION <u>Co-ords: 5 116 765.6 N ; 325 058.9 E Hwy 69, Sta. 10+523 CL</u>	ORIGINATED BY <u>M.R.</u>
DIST <u>54</u>	HWY <u>69</u>	BOREHOLE TYPE <u>Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>M.N.</u>
DATUM <u>Geodetic</u>		DATE <u>February 09, 2010</u>	CHECKED BY <u>C.N.</u>

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
ELEV DEPTH	DESCRIPTION			STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					w _p	w		w _L	GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
									○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
204.7 0.0	Ground surface Peat, fine fibrous				1	SS	2		204																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					</

METRIC

G.W.P. <u>5217-06-00</u>	LOCATION <u>Co-ords: 5 116 796.0 N ; 325 080.4 E Hwy 69, Sta. 10+523, o/s 37m Rt.</u>	ORIGINATED BY <u>M.R.</u>
DIST <u>54</u> HWY <u>69</u>	BOREHOLE TYPE <u>C.F.H.S.A. and Rotary Diamond Coring</u>	COMPILED BY <u>M.N.</u>
DATUM <u>Geodetic</u>	DATE <u>February 09, 2010</u>	CHECKED BY <u>C.N.</u>

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION			STRAT PLOT	NUMBER	TYPE			"N" VALUES						w _p	w		w _L	GR	SA	SI	CL
										SHEAR STRENGTH kPa												
										○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
											WATER CONTENT (%)											
																						
204.7	Ground surface																					
0.0	Peat, fine fibrous																					
0.2	Dark brown																					
0.2	Sandy silt, trace clay				1	SS	6															
0.4																						
0.7	Loose Brown Moist																					
	Clayey silt, trace sand				2	SS	4															
203.3	Firm Mottled Moist brown/grey																					
1.4	Silty clay, trace sand																					
	Firm Brown/ grey Moist to wet				3	SS	2															
																						
						FV																
																						
	Clay, trace sand layers																					
																						
					4	SS	WH**															
																						
						FV																
																						
																						
					5	SS	WH															
																						
						FV																
																						
	sand layers cobbles																					
																						
																						
																						
																						
					6	SS	WH															
198.1																						
6.6	Syenite bedrock				7	RC	REC 100%															
	Slightly weathered																					
	High strength				8	RC NQ	REC 100%															
	Good to excellent quality																					
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						
																						

METRIC

+⁷, **×**⁵: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 607-7

1 of 1

METRIC


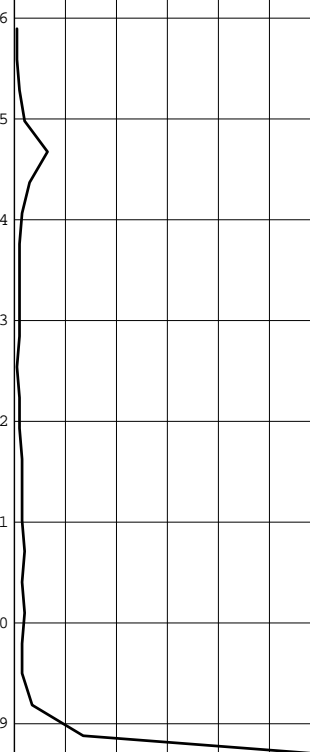
G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+500, 26.7m Rt. CL Med. ORIGINATED BY N.L.B.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
DATUM Geodetic DATE February 27, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE 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
205.8	Ground surface																			
0.0	Peat, coarse fibrous		1	SS	3															
205.6	Dark brown																			
205.2	Sand, some silt																			
0.6	Very loose Brown Wet		2	SS	11		205													
	Clayey silt, some sand layers of sand																			
204.2	Stiff Brown Moist																			
1.6	Silty clay, trace sand		3	SS	8		204													
	Firm Mottled Moist brown/grey																			
	Soft Grey Wet						203													
			4	SS	2		202													
				FV																
			5	SS	WH**		201													
				FV																
							200													
199.6	End of borehole		6	SS	25/3cm															
6.2																				
	Sample 6: Sampler bouncing																			
	* 2008 02 27																			
	▽ Water level observed during drilling																			
	WH** Penetration due to the weight of rods and hammer																			

RECORD OF PENETRATION TEST No 607-8

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+512.5, o/s 27.8m Lt. CL Med. ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
DATUM Geodetic DATE March 05, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
206.2 0.0	Ground surface Probable peat Probable clayey silt Probable clay Probable sand						206 205 204 203 202 201 200 199							
198.7 7.5	End of dynamic cone penetration test Refusal on probable bedrock							120/15cm						


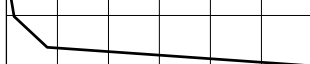
METRIC

+⁷, **×**⁵: Numbers refer to Sensitivity

RECORD OF PENETRATION TEST No 607-10


1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+512.5, o/s 35.4m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 04, 2008 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
206.6 0.0	Ground surface Probable peat Probable clayey silt						206							
	End of dynamic cone penetration test Refusal on probable bedrock							120/15cm						

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity



(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 607-12

1 of 2

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+525, o/s 27.1m Rt. CL Med. ORIGINATED BY N.L.B.
DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			*GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
205.0	Ground surface							20	40	60	80	100		
0.0 204.7	Peat, coarse fibrous Black		1	SS	6									
0.3 204.4	Silty sand organic inclusions													
0.6	Loose Grey Wet Clayey silt, trace sand layers of sand to 1.5m Stiff Brown Moist to firm		2	SS	15									0 71 10 19
			3	SS	4									
				FV										
202.3	Clay, trace sand													
2.7	Firm Grey/ Wet brownish red		4	SS	WH**									
				FV										
	Grey		5	SS	WH									0 3 27 70
				FV										
	thin layers of silt		6	SS	1									
				FV										
			7	SS	1									
				FV										
195.9	Sand, some silt trace gravel, trace clay		8	SS	3									10 62 19 9
9.1	Very loose Grey Wet													
			9	SS	3									
	silty clay pockets													
193.7	End of borehole													
11.3	Probable sand													
	Loose to compact													
191.1	End of dynamic cone penetration test													
13.9	Refusal on probable bedrock													

Cont'd

RECORD OF BOREHOLE No 607-12 2 of 2 METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+525, o/s 27.1m Rt. CL Med. ORIGINATED BY N.L.B.
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
190.0	<p>* 2008 02 26</p> <p>▽ Water level observed during drilling</p> <p>▼ Water level measured after drilling</p> <p>WH** Denotes penetration due to weight of rods and hammer</p> <p>*** C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</p>																

RECORD OF BOREHOLE No 607-13

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 28.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			*GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			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	W _p	W	W _L			
204.8	Ground surface																	
0.0	Peat, fine fibrous Dark brown		1	SS	2											372	Org. 33.4%	
203.9	End of borehole Refusal on probable bedrock		2	SS	20/15cm													
0.9																		
	* 2008 03 05  Water level observed during drilling  Water level measured after drilling																	

RECORD OF PENETRATION TEST No 607-14 1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 9.0m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2008 CHECKED BY C.N.

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							
204.7 0.0	Ground surface Probable peat Probable clayey silt														
201.7 3.0	End of dynamic cone penetration test Refusal on probable bedrock														

RECORD OF PENETRATION TEST No 607-15

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 27.6m Rt. CL Med. ORIGINATED BY N.L.B.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	20 40 60			
204.8 0.0	Ground surface													
	Probable peat													
	Probable clayey silt													
	Probable clay													
195.8 9.0	Probable sand													
	End of dynamic cone penetration test													
	Refusal on probable bedrock													

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

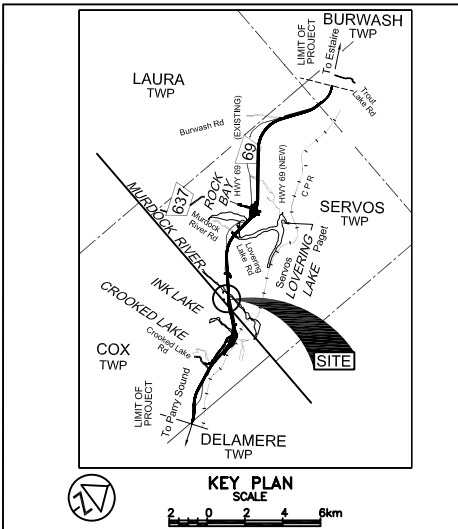
RECORD OF BOREHOLE No N10-2

1 of 1

METRIC

G.W.P. 5379-02-00 LOCATION Hwy. 69 (New), Sta. 10+531, o/s 6.0m Lt.
Co-ords. 5 116 766 N; 325 050 E ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.R.
DATUM Geodetic DATE March 13, 2004 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
204.8	Ground Surface															
0.0	Peat, fine fibrous															
204.5	Dark brown															
0.3	Clay, trace sand															
	Stiff Reddish Moist brown to grey		1	SS	5		204									
							203									0 1 29 70
							202									
201.8	Sand, with gravel, trace silt, trace clay		2	SS	18		201									25 64 (11)
3.0	Compact Brown Wet some silt and gravel						200									
199.9	End of borehole		3	SS	62/15cm											
4.9	Refusal on probable bedrock															
	<div>* 2004 03 13</div> <div>▼ Water level measured after drilling</div> <div>■ Penetrometer test</div>															



LEGEND

Borehole

Dynamic Cone Penetration Test (Cone)

Borehole & Cone

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

CONE Blows/0.3m (60° Cone, 475 J/blow)

WH Penetration due to weight of hammer and rods

WL at time of investigation February 2010

Head

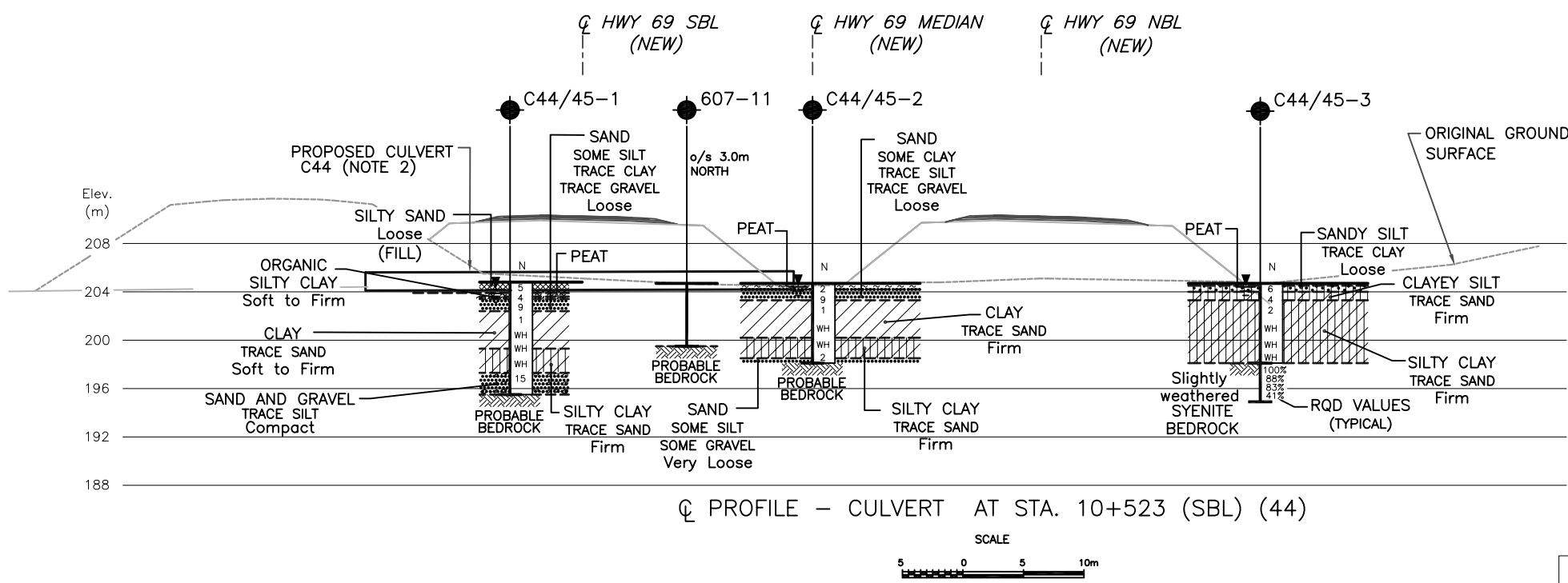
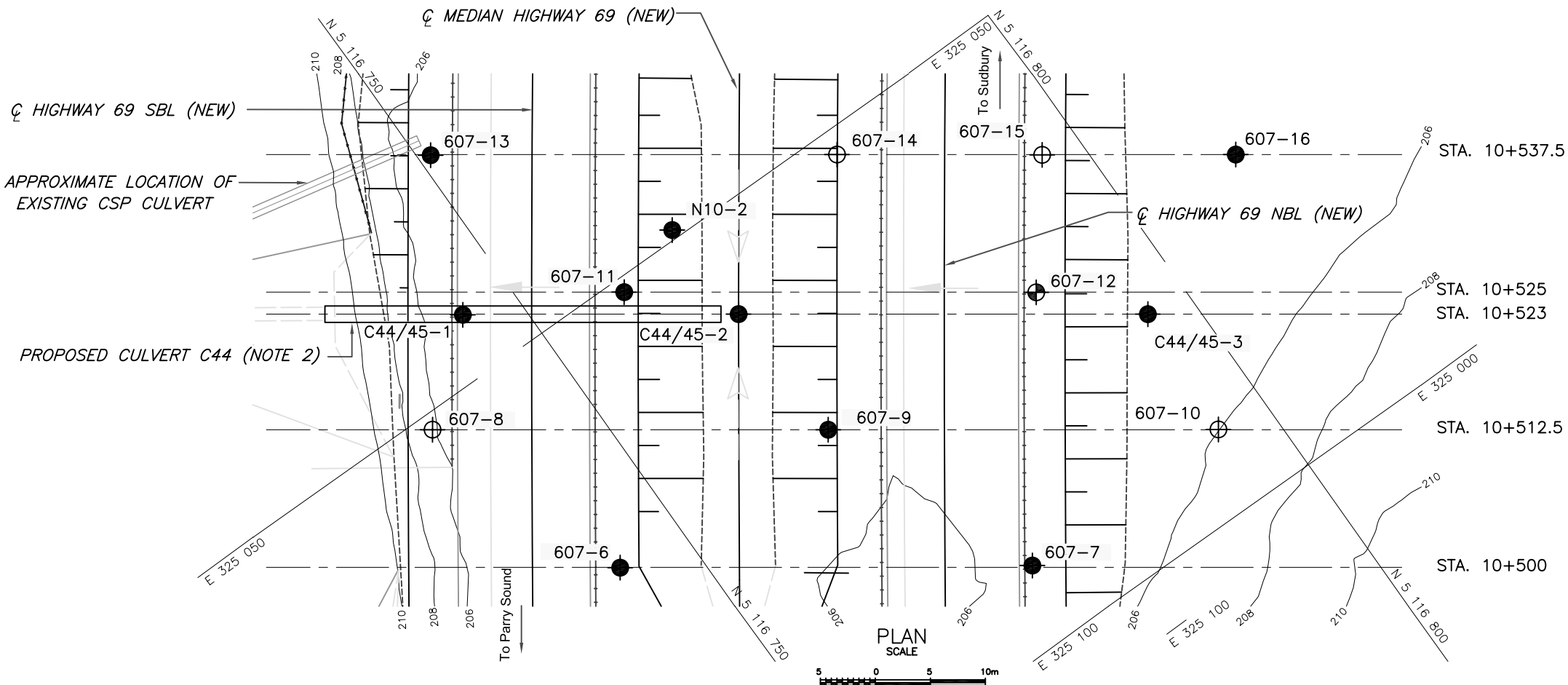
ARTESIAN WATER Encountered

PIEZOMETER

BH No	ELEVATION	COORDINATES	
		NORTHINGS	EASTINGS
C44/45-1	204.8	5 116 745.1	325 044.5
C44/45-2	204.7	5 116 765.6	325 058.9
C44/45-3	204.7	5 116 796.0	325 080.4

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

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- NOTES:
- DRAWING C44 SHOULD BE READ IN CONJUNCTION WITH THE TEXT AND RECORD OF BOREHOLE LOGS.
 - THE CULVERT AT STA. 10+523 WAS DESIGNATED AS CULVERT C44 FOR THE INVESTIGATION.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

REF AECOM Drawings:
C3-HWY69-Base.dwg dated Jan. 15, 2010;
C3-Hwy69-Des.dwg dated April 15, 2010;
Hwy 69 Servos - Contract 3 - Culvert
10+523 (#44) 10+550 (#45) Profile.dwg
dated April 16, 2010; and C3-Lidar-ctrs.dwg,
dated May 14, 2008



Culvert at Sta. 10+550 (NBL) (C45), Servos Township

Record of Borehole Sheets

Drawing C45-1 – Borehole Locations and Soil Strata

RECORD OF BOREHOLE No C44/45-1

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 116 745.1 N ; 325 044.5 E
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers ORIGINATED BY M.R.
DATUM Geodetic DATE February 10, 2010 COMPILED BY M.N.
CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION			STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					w _p	w			w _L
										○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
WATER CONTENT (%)																			
204.8	Ground surface									20	40	60	80	100					
0.0	Silty sand																		
	Loose	Dark brown	Moist to wet		1	SS	5	▽* ▽*	204										
	(FILL)																		
203.9	Peat, fine fibrous				2	SS	4												
0.9	Dark brown																		
203.6	Organic silty clay																		
1.2																			
203.2	Soft to firm				3	SS	9												
1.6	Dark grey																		
	Wet																		
	Sand, some silt																		
202.4	trace clay, trace gravel																		
2.4	Loose				4	SS	1		202										
	Dark brown																		
	Wet																		
	Clay, trace sand																		
	Soft to firm				5	SS	WH**		201										
						FV													
	Mottled grey				6	SS	WH		200										
						FV													
199.3	Silty clay, trace sand																		
5.5	Firm																		
	Grey																		
	Wet				7	SS	WH		199										
197.3	Sand and gravel																		
7.5	trace silt				8	SS	15		197										
	Compact																		
	Brown																		
	Wet																		
195.5	End of borehole																		
9.3	Refusal on probable bedrock																		
										</									

* 2010 02 10

▽ Water level observed during drilling

▼ Water level measured after drilling

WH** denotes penetration due to weight of rods and hammer

+⁷, X⁵: Numbers refer to Sensitivity

20
15—5
10
(%) STRAIN AT FAILURE

METRIC

Co-ords: 5 116 765.6 N ; 325 058.9 E

G.W.P. 5217-06-00

LOCATION

Hwy 69, Sta. 10+523 CL

ORIGINATED BY M.R.

DIST 54

HWY 69

BOREHOLE

Continuous Flight Hollow Stem Augers

COMPILED BY M.N.

DATUM Geodetic

DATE _____

February 09, 2010

CHECKED BY C.N.

[illegible]

METRIC

 CHECKED BY C.N.

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No C44/45-4

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Co-ords: 5 116 781.3.0 N ; 325 036.8 E
 DIST 54 HWY 69 BOREHOLE TYPE Manual Probe
 DATUM Geodetic DATE April 30, 2010

ORIGINATED BY J.H.

COMPILED BY M.N.

CHECKED BY C.N.

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					w _p w w _L			WATER CONTENT (%)	GR	SA		SI	CL			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE																
205.5	Ground surface					*																
0.0	Bedrock at surface																					
	* Borehole dry																					

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

15 — 20 — 5
|
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 607-12

1 of 2

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+525, o/s 27.1m Rt. CL Med. ORIGINATED BY N.L.B.
DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			*GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
205.0	Ground surface													
0.0 204.7	Peat, coarse fibrous Black		1	SS	6									
0.3 204.4	Silty sand organic inclusions													
0.6	Loose Grey Wet Clayey silt, trace sand layers of sand to 1.5m Stiff Brown Moist to firm		2	SS	15									
			3	SS	4									
				FV										
202.3	Clay, trace sand													
2.7	Firm Grey/ Wet brownish red		4	SS	WH**									
				FV										
	Grey		5	SS	WH									
				FV										
	thin layers of silt		6	SS	1									
				FV										
			7	SS	1									
				FV										
195.9	Sand, some silt trace gravel, trace clay Very loose Grey Wet		8	SS	3									
9.1														
	silty clay pockets		9	SS	3									
193.7	End of borehole													
11.3	Probable sand Loose to compact													
191.1	End of dynamic cone penetration test													
13.9	Refusal on probable bedrock													

Cont'd

RECORD OF BOREHOLE No 607-12

2 of 2

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+525, o/s 27.1m Rt. CL Med. ORIGINATED BY N.L.B.
 DIST 54 HWY 69 BOREHOLE TYPE C.F.S.S.A. and Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL	
190.0								20	40	60	80	100									
	<div><div>*</div><div>2008 02 26</div></div> <div><div>▽</div><div>Water level observed during drilling</div></div> <div><div>▼</div><div>Water level measured after drilling</div></div> <div><div>WH**</div><div>Denotes penetration due to weight of rods and hammer</div></div> <div><div>***</div><div>C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</div></div>																				

RECORD OF BOREHOLE No 607-13

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 28.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							W _p W W _L				WATER CONTENT (%)	372 φ	Org. 33.4%	GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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RECORD OF PENETRATION TEST No 607-14 1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 9.0m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2008 CHECKED BY C.N.

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							
204.7 0.0	Ground surface Probable peat Probable clayey silt														
201.7 3.0	End of dynamic cone penetration test Refusal on probable bedrock														

RECORD OF PENETRATION TEST No 607-15

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+537.5, o/s 27.6m Rt. CL Med. ORIGINATED BY N.L.B.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
204.8 0.0	Ground surface													
	Probable peat													
	Probable clayey silt													
	Probable clay													
195.8 9.0	Probable sand													
	End of dynamic cone penetration test													
	Refusal on probable bedrock													

METRIC

SOIL PROFILE					SAMPLES		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	ELEVATION SCALE						
204.6	Ground surface											


SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L			
								○ UNCONFINED + FIELD VANE					WATER CONTENT (%)					
						● QUICK TRIAXIAL × LAB VANE												
204.6	Ground surface							20	40	60	80	100						GR SA SI CL
0.0	Peat, coarse fibrous		1	CS	-													
204.1	Dark brown						204											
0.5	Organic clay some silt, trace sand		2	SS	4													
	Firm Black/ Moist grey grey																	
202.9	Clay, trace sand organics to 2.4 m		3	SS	2		203											
1.7	Stiff Brown/ Moist grey grey			FV			202				8							
	Firm Grey Wet																	
			4	SS	1		201											0 1 27 72
				FV							6							
							200											
			5	SS	1													
							199											
			6	SS	15/5cm		198											
197.3	End of borehole																	
7.3	Refusal on probable bedrock																	
* 2008 02 26																		
▽ Water level observed during drilling																		
▼ Water level measured after drilling																		

RECORD OF BOREHOLE No 607-17

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+550, o/s 9.8m Lt. CL Med. ORIGINATED BY J.H.
 DIST 54 HWY 69 BOREHOLE TYPE Manual Sampling COMPILED BY N.S.B.
 DATUM Geodetic DATE September 27, 2007 CHECKED BY C.N.

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	
205.6	Ground surface								20	40	60	80	100		20	40	60							
0.0	Topsoil																							
205.3	End of borehole																							
0.3	Refusal on probable bedrock																							
	* Borehole dry																							

RECORD OF BOREHOLE No 607-18

1 of 1

METRIC

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+550, o/s 27.8m Rt. CL Med. ORIGINATED BY N.L.B.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 26, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						W _p W W _L							
204.7	Ground surface							20	40	60	80	100									
0.0	Peat, coarse fibrous		1	SS	WH**																
204.2	Black																				
0.5	Silty clay, trace sand																				
	Stiff Grey/ Moist		2	SS	7																
	brown																				
203.2	End of borehole																				
1.5	Refusal on probable bedrock																				

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF PENETRATION TEST No 607-21

1 of 1 **METRIC**

G.W.P. 5217-06-00 LOCATION Hwy 69 (New), Sta. 10+562.5, o/s 45.0m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 04, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
204.9 0.0	Ground surface Probable peat Probable silty clay													
199.7 5.2	End of dynamic cone penetration test Refusal on probable bedrock							120/25cm						

RECORD OF BOREHOLE No N10-2

1 of 1

METRIC

G.W.P. 5379-02-00 LOCATION Hwy. 69 (New), Sta. 10+531, o/s 6.0m Lt.
Co-ords. 5 116 766 N; 325 050 E ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.R.
DATUM Geodetic DATE March 13, 2004 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)								
204.8	Ground Surface						20	40	60	80	100	20	40	60		GR	SA	SI	CL		
0.0	Peat, fine fibrous																				
204.5	Dark brown																				
0.3	Clay, trace sand																				
	Stiff Reddish Moist brown to grey		1	SS	5													0	1	29	70
201.8	Sand, with gravel, trace silt, trace clay		2	SS	18																
3.0	Compact Brown Wet some silt and gravel																	25	64	(11)	
199.9	End of borehole		3	SS	62/15cm																
4.9	Refusal on probable bedrock																				
	<div>* 2004 03 13</div> <div>▼ Water level measured after drilling</div> <div>■ Penetrometer test</div>																				

RECORD OF PENETRATION TEST No N10-3

1 of 1 **METRIC**

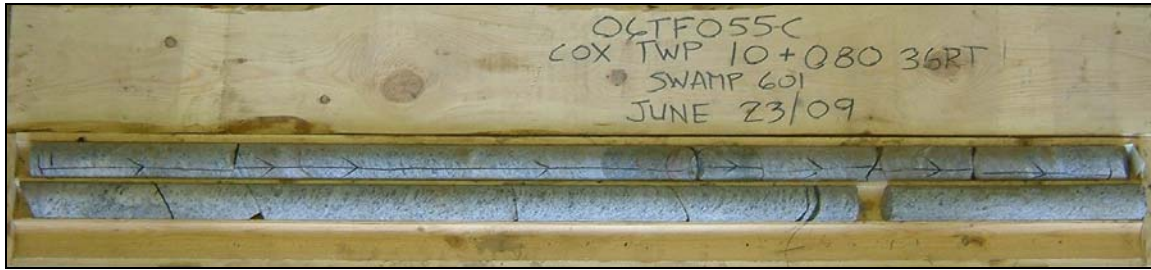
G.W.P. 5379-02-00 LOCATION Hwy. 69 (New), Sta. 10+558, o/s 32.2m Rt.
Co-ords. 5 116 814 N; 325 047 E ORIGINATED BY M.R.
DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY M.R.
DATUM Geodetic DATE March 13, 2004 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
204.9 0.0	Ground Surface Probable Peat													
	Probable Clay, trace sand Firm to stiff													
202.6 2.3	End of dynamic cone penetration test Refusal on probable bedrock Top 0.3 m frozen													



APPENDIX A

Rock Core Photographs



Photograph 1: Culvert at Sta. 10+100 (NBL) (C1), Cox Township, borehole C1-1. Cores 10 and 11 from 6.5 to 9.5 m depth. RQD values of 83 and 93%, indicating good to excellent rock quality.



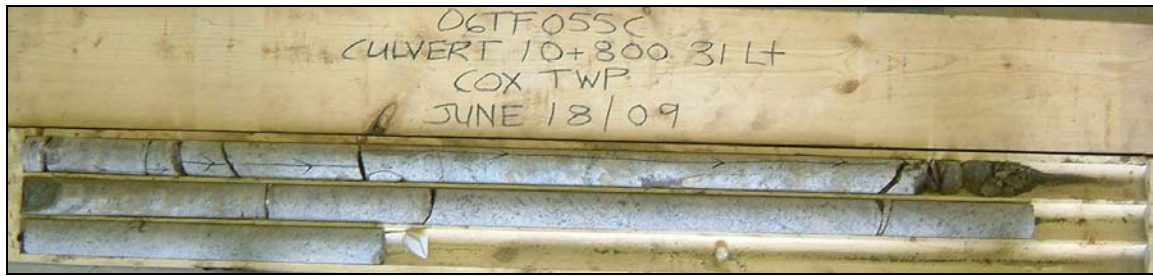
Photograph 2: Culvert at Sta. 10+100 (NBL) (C1), Cox Township, borehole C1-2. Cores 2 to 4 from 0.3 to 3.4 m depth. RQD values ranged from 40 to 79%, indicating poor to good rock quality.



Photograph 3: Culvert at Sta. 10+140 (SBL) (C2), Cox Township, borehole C2-1. Cores 5 and 6 from 3.8 to 6.9 m depth. RQD values ranged from 50 to 52%, indicating fair rock quality.



Photograph 4: Culvert at Sta. 10+140 (SBL) (C2), Cox Township, borehole C2-3. Cores 2 to 4 from 0.9 to 4.2 m depth. RQD values ranged from 33 to 80%, indicating poor to good rock quality.



Photograph 5: Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township, borehole SX-1. Cores 1 and 2 from 0.8 to 3.8 m depth. RQD values ranged from 86 to 99%, indicating good to excellent rock quality.



Photograph 6: Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township, borehole SX-2. Cores 1 to 3 from 1.2 to 4.5 m depth. RQD values of 24 to 98%, indicating very poor to excellent rock quality.



Photograph 7: Culvert at Sta. 10+800 (SBL and NBL) (SX), Cox Township, borehole SX-3. Cores 1 to 3 from 0.7 to 3.8 m depth. RQD values of 38 to 93%, indicating poor to excellent rock quality.



Photograph 8: Culvert at Sta. 12+590 (SBL and NBL) (C8/9), Cox Township, borehole C8/9-1. Cores 5 to 7 from 2.4 to 5.2 m depth. RQD values of 53 to 100%, indicating fair becoming excellent rock quality. Vertical fissures in the upper 0.7 m of the rock resulted in the lower rock quality.



Photograph 9: Culvert at Sta. 12+590 (SBL and NBL) (C8/9), Cox Township, borehole C8/9-4. Cores 9 to 11 from 7.2 to 10.2 m depth. RQD values of 30 to 74%, indicating poor to fair rock quality.



Photograph 10: Culvert at Sta. 13+206 (SBL and NBL) (C15), Cox Township, borehole C15-1. Cores 8 to 10 from 5.5 to 8.3 m depth. RQD values of 83 to 98%, indicating good to excellent rock quality.



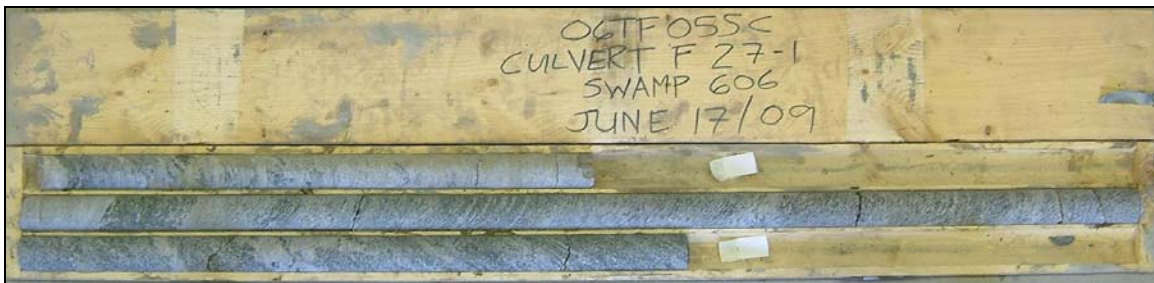
Photograph 11: Culvert at Sta. 13+206 (SBL and NBL) (C15), Cox Township, borehole C15-3. Cores 6 to 9 from 5.5 to 8.5 m depth. RQD values of 79 to 100%, indicating good to excellent rock quality.



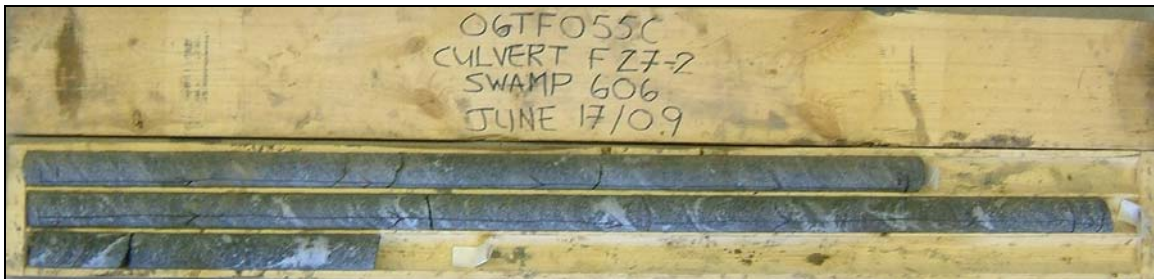
Photograph 12: Culvert at Sta. 8+240 (Crooked Lake Road South Connection) (C16), Cox Township, borehole C16-1. Cores 4 to 6 from 2.3 to 5.4 m depth. RQD values of 88 to 100%, indicating good to excellent rock quality.



Photograph 13: Culvert at Sta. 15+279.1 (SBL and NBL) (C37/38), Cox Township, borehole C37/38-3. Cores 4 to 6 from 4.1 to 7.2 m depth. RQD values of 81 to 100%, indicating good to excellent rock quality.



Photograph 14: Culvert at Sta. 15+883 (SBL) (C41), Cox Township, borehole C41-1. Cores 7 to 9 from 5.8 to 8.9 m depth. RQD values of 100%, indicating excellent rock quality.



Photograph 15: Culvert at Sta. 15+883 (SBL) (C41), Cox Township, borehole C41-2. Cores 5 to 7 from 2.4 to 5.6 m depth. RQD values ranged from 94 to 100%, indicating excellent rock quality.



Photograph 16: Culvert at Sta. 10+523 (SBL) (C44), Servos Township, borehole C44/45-3. Cores 7 to 10 from 6.6 to 9.8 m depth. RQD values ranged from 83 to 100%, indicating good to excellent rock quality. Locally at 9.3 to 9.8 m depth, a RQD value of 41% was found indicating poor rock quality.