JULY 2012

FOUNDATION INVESTIGATION REPORT

SWAMP CROSSINGS AND HIGH FILL AREAS – CONTRACT 2
HIGHWAY 69 FOUR-LANING
FROM 1.7 KM NORTH OF HIGHWAY 529
NORTHERLY TO 3.9 KM NORTH OF HIGHWAY 522
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5404-05-00; WP 5404-05-01

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REPORT

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PART A

FOUNDATION INVESTIGATION REPORT
SWAMP CROSSINGS AND HIGH FILL AREAS – CONTRACT 2
HIGHWAY 69 FOUR-LANING FROM 1.7 KM NORTH OF HIGHWAY 529
NORTHERLY TO 3.9 KM NORTH OF HIGHWAY 522
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5404-05-00; WP 5404-05-01

JULY 2012
Report No. 09-1111-6014-2520

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by URS Canada Inc. (URS) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for five (5) swamp crossing/high fill embankments and one (1) deep cut area within the Contract 2 limits of the new Highway 69 alignment to the north of the junction with Highway 529. The proposed work in Contract 2 is part of the overall four-laning of Highway 69 from 1.7 km north of Highway 529 northerly to 3.9 km north of Highway 522, for a total project distance of 19.7 km. The foundation engineering components within the overall project limits include the engineering of: high fill embankments and embankments over swamps; the Canadian National Railway (CNR) re-alignment; the Bekanon Road and Highway 522 interchanges and structures; the Still River, Straight Lake and Key River structures; the Canadian Pacific Railway (CPR) and Canadian National Railway (CNR) structures; as well as a number of culvert crossings. The proposed embankments in Contract 2 extend from approximately 1.7 km north of the junction of the existing Highway 529 and Highway 69 northerly for a total distance of about 4.5 km. The general location of this section of the new Highway 69 four-laning alignment is shown on the Site Location Plan on Drawing 1.

The terms of reference and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2009. Golder's proposal for foundation engineering services is contained in Section 6.8 of URS's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Quality Control Plan for foundation engineering services for this project, dated April 19, 2010. The Base Plan showing the proposed horizontal alignment and a drawing showing the proposed vertical alignment for the Contract 2 section of Highway 69 four-laning was provided to Golder by URS on December 16, 2009 and November 28, 2011, respectively.

This report addresses the investigation carried out for the Contract 2 swamp crossings and high fill areas only. A detailed list of the Contract 2 swamp crossing/high fill areas is presented in Table 1. Separate reports address the foundation investigations for the related swamp crossing/high fill areas, culverts and other bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions along the new highway alignment at the proposed Contract 2 swamp crossing/high fill areas by methods of borehole drilling, rock coring, in situ testing and laboratory testing on selected samples. The centreline of the proposed swamp crossing/high fill areas was staked in the field by Callon Dietz Inc., a professional surveying company retained by URS and the foundation investigation was carried out within the limits of the swamp crossing/high fill areas as defined in the terms of reference. The investigation areas are shown in plan on Drawing 2.

Preliminary subsurface information for this project was available and was supplied by the MTO, in a report titled:

- Preliminary Foundation Investigation & Design Report, Swamp Crossings, Highway 69 Route Selection Study, 3.5 km N of Hwy 559 to 3.8 km N of Hwy 522, GWP 5377-02-00, Highway 69, GEOCRES No. 41H-51, dated September 2005, by Trow Associates Inc.

2.0 SITE DESCRIPTION

The new four-lane Highway 69 alignment is oriented generally in a south-north direction spanning the Township of Wallbridge to the south and the Township of Henvey to the north. The section of the new highway alignment addressed in this report is approximately 4.5 km long extends northerly from about 1.7 km north of the junction between existing Highway 69 and Highway 529. The proposed new alignment within this section is located

approximately 0.5 km to 2.5 km east of the existing Highway 69 alignment. The proposed highway alignment associated with the four-laning of the new Highway 69 in this area also includes the proposed Still River bridge structures.

In general, the topography of this section of the project consists of rolling terrain, including sparsely or densely populated treed areas and numerous bedrock outcrops separated by valleys, pasture lands and swamps containing areas of standing water and various types of vegetation and organic soils. The ground surface within the limits of the Contract 2 swamp crossing/high fill areas varies between about Elevation 203.8 m and Elevation 181.0 m, referenced to Geodetic datum, and is gently sloping downward from southeast to northwest towards Georgian Bay. A detailed description of each investigated swamp crossing/high fill area is presented in Section 4.0. The locations of these areas are shown in plan on Drawing 2.

3.0 INVESTIGATION PROCEDURES

3.1 Foundation Investigation

The investigation for the Contract 2 swamp crossing/high fill areas was carried out between January 18 and March 4, 2010, and between February 25 and March 14, 2011, during which time a total of seventy-seven (77) boreholes and forty-one (41) Dynamic Cone Penetration Tests (DCPTs) were advanced at the locations of the swamp crossing/high fill areas. The locations of the boreholes and DCPTs are summarized in Table 1 and are shown on Drawings A1 to F1 in Appendices A to F. In general, boreholes and DCPTs were advanced along the centreline and the toes of the proposed embankment alignment (in accordance with the terms of reference).

The field investigation was carried out using a variety of drilling equipment as a result of the varying nature of the terrain and accessibility within the Contract 2 project limits. The details of the drilling equipment and suppliers are listed below. Hand excavation methods were used where appropriate depending on the terrain.

Drilling Equipment	Supplied and Operated By
Track Mounted CME-55	Walker Drilling Ltd. of Utopia, Ontario
Track Mounted D-50	Walker Drilling Ltd. of Utopia, Ontario
Track Mounted D-25	Walker Drilling Ltd. of Utopia, Ontario
Portable Equipment	Walker Drilling Ltd. of Utopia, Ontario and OGS Inc. of Almonte, Ontario

The boreholes were advanced through the overburden using 108 mm inner diameter (I.D.) hollow-stem augers, 127 mm or 165 mm outer diameter (O.D.) solid-stem augers, and/or 'BW', 'NW' or 'HW' casing with wash boring techniques. In general, soil samples were advanced at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm O.D. split-spoon sampler driven by automatic hammers on the track-mounted drill rigs, and carried out in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586, Standard Test Method for Standard Penetration Test). Boreholes advanced by portable equipment employed full-weight hammers or half-weight hammers lifted manually and dropped from the SPT height. Where a half-weight hammer was used, the 'N'-values were corrected for the lower energy drive. Samples of the cohesive soils were obtained at selected locations using 76 mm O.D. thin-walled 'Shelby' tubes (ASTM D1587, Standard Practice for Thin-Walled Tube Sampling) for relatively undisturbed samples. Field vane shear tests were carried out in cohesive soils for assessment of undrained shear strengths (ASTM D2573, Standard Test Method for Field

Vane Strength Shear Test) using MTO Standard 'N' size vanes and 'B' size vanes in the smaller diameter boreholes advanced by portable equipment. Samples of the bedrock were obtained using an 'NQ' size rock core barrel. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The boreholes and DCPTs were advanced to depths up to 45.9 m below existing ground surface, generally penetrating 3 m into competent material, which is defined as material that will provide resistance to settlement or instability of the embankments, or to refusal. In general, boreholes and DCPTs were terminated on refusal to further auger, casing and/or split-spoon advancement, shovel penetration or dynamic cone penetration. These depths to refusal do not confirm bedrock surface elevations, but may be inferred to indicate potential proximity to the bedrock surface. At various borehole locations where refusal was encountered at shallow depth (less than about 0.1 m), the bedrock was exposed by hand shovel excavation to confirm the refusal condition. In two (2) boreholes, bedrock was cored for a depth of about 3 m and photographs of the recovered rock samples are provided in the relevant appendices noted in Section 4.0.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets provided in Appendices A to F. Groundwater elevations as encountered in the boreholes may not be representative of static groundwater levels since the groundwater levels in the boreholes may not have stabilized on completion of drilling. Furthermore, groundwater elevations will vary depending on seasonal fluctuations, precipitation and local soil permeability.

The fieldwork was observed by members of our engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil and rock samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Mississauga geotechnical laboratory where the samples underwent further detailed visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples. In addition, one-dimensional consolidation (oedometer) tests were carried out on select samples of the cohesive deposits and the summary of the consolidation test results is presented in Table 2. The results of the laboratory classification testing are included in the associated appendices.

Classification of the rock mass quality of the bedrock with respect to the Rock Quality Designation (RQD) is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)[1]. The degree of weathering of the bedrock samples (i.e. fresh to slightly weathered – W1 to W2) and the strength classification of the intact rock mass based on field identification (i.e. strong to extremely strong – R4 to R6) are described in accordance with Table B.3 and Table B.6, respectively, of the International Society for Rock Mechanics (ISRM[2]) standard classification system.

The proposed centreline of the new highway alignment was staked in the field by Callon Dietz prior to drilling. The as-drilled borehole locations, in stations and offsets, were measured in reference to the centreline alignment and were subsequently converted into MTM NAD 83 coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to the ground surface elevations at the centreline

[1]Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

[2] International Society for Rock Mechanics Commission on Test Methods, 1985. Int. J. Rock Mech.Min. Sci. & Geomech. Abstr. Vol 22, No. 2, pp. 51-60.

median and to temporary benchmarks which were then surveyed by Callon Dietz upon completion of the fieldwork. The borehole locations shown on Drawings A1 to F1 in Appendices A to F are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in The Physiography of Southern Ontario[3], this section of the new Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the Parry Sound and Muskoka areas, then eastward from Muskoka in patches into the area north of the Kawartha Lakes.

This part of the Georgian Bay Fringe physiographic region was never submerged during periods of glacial recession. As a result, the surficial soils in this area consist of very shallow deposits of sand, silt and clay underlain by metamorphic bedrock and numerous bare knobs and ridges of bedrock are present throughout the area. Localized low-lying swampy areas, containing peat and/or organic soils overlying soft/loose native soils, sometimes to significant depth, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of crystalline gneisses of the Britt Domain of the Central Gneiss Belt, a subdivision of the Grenville Structural Province, as described in Geology of Ontario, OGS Special Volume 4[4]. Deposition of Paleozoic strata initially covered the bedrock and later erosion during glaciation exposed these Precambrian rocks.

4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation (including excavations by hand shovel), together with the results of the laboratory tests carried out on selected soil samples, are presented on the attached Record of Borehole sheets and the laboratory test sheets provided in Appendices A to F. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of SPTs and in situ testing. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations. The thickness of the overburden/depth to refusal in the investigated areas as inferred from the resistance to DCPT advancement are shown on the Record of DCPT sheets in Appendices A to F.

The inferred soil stratigraphy as encountered in the boreholes and DCPTs advanced for the Contract 2 swamp crossing/high fill areas are shown in profile and cross-section on Drawings A1 to F1, inclusive. The orientation (i.e. north, south, east, west) stated in the text of the report is typically referenced to project north and/or up-chainage (along the proposed Highway 69 alignment). For purposes of this report, Highway 69 is oriented north-south.

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[3] Chapman, L.J. and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

[4] Geology of Ontario, 1991. Ontario Geological Society Special Volume 4, Part 2. Ministry of Northern Development and Mines, Ontario.

In general, the stratigraphy encountered at the various borehole locations typically consists of alternating layers of cohesive and cohesionless soils. The overburden (soil material) thickness is variable, ranging from no cover (i.e. bedrock outcrops exposed at ground surface at the edges of the swamps) up to about 45.9 m below ground surface upon borehole termination. The stratigraphy generally consists of:

- Surficial layers of topsoil, silty sand to sand to sand and gravel fill, fibrous and amorphous peat or organic root mat;
- Cohesionless deposits of silty sand to sand to sandy silt, interlayered with clayey silt to clay deposits in some areas;
- Cohesive deposits of clayey silt to clay, interbedded with sand and silt seams and layers in some areas; and,
- Cohesionless deposits of sand to silt deposits below the cohesive deposits and over the inferred bedrock surface.

Detailed descriptions of the subsurface conditions at each investigated swamp crossing/high fill area are provided in the following sections of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit.

4.3 Highway 69 SBL – STA 17+750 to 17+775 (Swamp 201)

The plan and profile along the centreline of the embankment and a cross-section at a selected station of the proposed embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 17+750 and 17+775 in the Township of Wallbridge are shown on Drawing A1 in Appendix A. The alignment extends across a low-lying swamp area with the proposed embankment up to about 4 m high above the existing ground surface.

A total of three (3) boreholes (Boreholes S201-01 to S201-03, inclusive) and one (1) DCPT (DCPT S201-DC01) were completed to investigate the subsurface conditions within this swamp area. The topography in this section of the proposed highway is a relatively flat low-lying area between gently sloping bedrock ridges to the north and south limits of the investigated area, and the ground is moderately tree covered encompassing a wet grassy area.

The subsurface soils along the SBL alignment in Swamp 201 generally consist of surficial layers of root mat, amorphous peat and topsoil at the ground surface, underlain by deposits of sand and silt to sand and gravel, underlain by inferred bedrock. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 1.2 m, being deepest in the vicinity of about STA 17+775. A bedrock outcrop is present in the vicinity of the proposed alignment, at about STA 17+765 along the west toe of the proposed embankment.

Peat / Topsoil

An approximately 0.2 m thick layer of black amorphous peat containing rootlets and 0.1 m thick root mat was encountered at the ground surface at about Elevation 202.8 m and 203.8 m in Boreholes S201-01 and S201-02, respectively. In Borehole S201-02, bedrock was exposed by shovel (hand) excavation to confirm refusal at the

bottom of this deposit and in Borehole S201-01, the bottom of this deposit was defined by refusal to further split-spoon advancement and also inferred by refusal to cone penetration.

One SPT 'N'-value of 25 blows per 0.08 m of penetration was measured at the bottom of Borehole S201-01 (split-spoon refusal on inferred bedrock), however, it is estimated that the peat layer has a very soft consistency.

The natural water content measured on this sample of the peat is about 212 per cent.

A 0.3 m thick layer of topsoil was encountered at the ground surface at about Elevation 202.9 m in Borehole S201-03.

Sand and Silt to Sand and Gravel

A deposit of brown sand and silt, trace gravel and trace clay, underlain by a deposit of grey sand and gravel, trace to some silt, generally containing wood fragments, organics and rootlets were encountered underlying the topsoil in Borehole S201-03. The top of the sand and silt deposit is at about Elevation 202.6 m and the thickness of the deposit is about 0.3 m, and the top of the sand and gravel deposit is at about Elevation 202.3 m and the thickness of the deposit is about 0.6 m. The bottom of the sand and gravel deposit was defined by refusal to further split-spoon advancement in Borehole S201-03 and inferred by refusal to cone penetration in DCPT S201-DC01.

The SPT 'N'-values measured within these deposits are 4 blows and 7 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on a sample of the sand and silt deposit is about 65 per cent.

A grain size distribution of one (1) sample from the sand and silt deposit is shown on Figure A.S201-01 in Appendix A.

Bedrock / Refusal

Bedrock outcrops are present in the vicinity of the swamp area, and along the west toe of the proposed embankment at the location of Borehole S201-02, at about STA 17+765. The bedrock surface at the boreholes and DCPT as inferred by refusal to further split-spoon advancement and shovel excavation or dynamic cone penetration was encountered at depths of between about 0.1 m and 1.6 m below ground surface, corresponding to Elevation 203.7 m and 201.4 m. In general, refusal was encountered at greater depth towards the northern limit of the swamp between about STA 17+765 and 17+775.

Groundwater Conditions

In general, the soil samples taken in the boreholes were wet. Water levels observed in Boreholes S201-01 and S201-03 upon completion of drilling are at about Elevation 202.8 m and 202.5 m, measured at ground surface and at a depth of about 0.4 m below the ground surface, while in Borehole S201-02, the excavation was dry upon completion.

4.4 Highway 69 NBL – STA 17+700 to 17+750 (Swamp 201)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 17+700 and 17+750 in the Township of Wallbridge are shown on Drawings A1 and A2. The alignment extends across a low-lying swamp area with the proposed embankment up to about 4 m high above the existing ground surface.

A total of eight (8) boreholes (Boreholes S201-04 to S201-10 and S201-05A) and four (4) DCPTs (DCPT S201-DC02 to S201-DC04 and S201-DC03A) were completed to investigate the subsurface conditions within this swamp area. The topography in this section of the proposed highway is relatively flat with a low-lying area between gently sloping bedrock ridges beyond the north and south limits of the investigated area, and the ground is moderately tree covered encompassing an open, wet, grassy area and shallow open water in places.

Ice and water was encountered at the surface in some of the boreholes advanced within this swamp. The subsurface soils along the NBL alignment in Swamp 201 generally consist of surficial layers of root mat, amorphous peat and topsoil at the ground surface or below the ice cover, underlain by deposits of silty sand to sand and silty clay, which in turn is underlain by inferred bedrock. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 3.4 m below ground surface, being deepest near the south end of the swamp in the vicinity of about STA 17+700. A bedrock outcrop was observed in the vicinity of the proposed alignment at about STA 17+735 along the west toe of the proposed embankment.

Ice / Water

Ice and water to depths of 0.2 m and 0.3 m was encountered at the ground surface in Boreholes S201-04, S201-05 and S201-09.

Peat / Topsoil

An approximately 0.1 m thick root mat and 0.6 m to 0.7 m thick layer of dark brown amorphous peat and trace sand, containing rootlets and wood fragments, was encountered at the ground surface or under the ice and water cover in Boreholes S201-04 to S201-07 and S201-09. The top of the peat deposit varies between about Elevation 203.4 m and 202.6 m. In Boreholes S201-06 and S201-07, bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of this deposit.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, suggesting a very soft consistency.

The natural water content measured on two (2) samples of the peat is about 389 per cent and 685 per cent.

An approximately 0.2 m thick layer of topsoil was encountered at the ground surface at about Elevation 203.3 m and 203.4 m in Boreholes S201-08 and S201-10, respectively. The bottom of the topsoil deposit is defined by refusal to split-spoon advancement and dynamic cone penetration in Borehole S201-08 and bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of this deposit.

Silty Sand to Sand

A deposit of grey silty sand to sand, trace to some silt, trace to some gravel and trace to some clay containing rootlets was encountered below the peat deposit in Boreholes S201-04, S201-05 and S201-09. The top of this deposit is at about Elevation 202.0 m and its thickness ranges from about 0.3 m to 0.9 m.

The SPT 'N'-values recorded within this deposit are 3 blows and 4 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

The natural water content measured on two (2) samples of this deposit is about 26 per cent and 33 per cent.

A grain size distribution of one (1) sample from the silty sand portion of this deposit is shown on Figure A.S201-02 in Appendix A.

Silty Clay

A deposit of brown to grey silty clay trace to some sand and containing rootlets was encountered below the deposit of silty sand to sand in Boreholes S201-04, S201-05, S201-05A and S201-09. The top of this deposit ranges from about Elevation 201.7 m to 201.1 m and its thickness ranges from about 0.9 m to 1.9 m. The bottom of this deposit is defined by refusal to further split-spoon advancement in Boreholes S201-04, S201-05A and S201-09, and Borehole S201-05 was terminated within this deposit.

The SPT 'N'-values measured within this deposit are 2 blows and 3 blows per 0.3 m of penetration. In situ field vane tests carried out within the silty clay deposit measured undrained shear strengths ranging from about 52 kPa to 63 kPa and the sensitivity is calculated to be about 4 and 5. The field vane tests results indicate that the silty clay deposit has a firm to stiff consistency.

The natural water content measured on two (2) samples of this deposit is about 35 per cent and 43 per cent.

An Atterberg limits test was carried out on one (1) sample of the silty clay deposit and measured a liquid limit of about 43 per cent, a plastic limit of about 20 per cent and a corresponding plasticity index of about 23 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure A.S201-03 in Appendix A and indicates that the material is classified as silty clay of intermediate plasticity.

Bedrock / Refusal

Bedrock outcrops are present in the vicinity of the swamp, and along the west toe of the proposed embankment at the location of Borehole S201-07, at about STA 17+735. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon advancement and shovel excavation or dynamic cone penetration at depths of between about 0.1 m and 3.4 m below the ice or ground surface, corresponding to between about Elevation 203.5 m and 199.5 m. In general, refusal was encountered at greater depth towards the middle of the swamp between about STA 17+700 and 17+715.

Groundwater Conditions

In general, the samples taken in the boreholes were wet to moist. Water levels observed in the boreholes upon completion of excavating/drilling are at about Elevation 202.8 m and 202.9 m, measured either at the ice or

ground surface, with the exception of the shovel excavations in Boreholes S201-07 and S201-08 which were dry upon completion of excavating/drilling.

4.5 Highway 69 SBL – STA 11+175 to 11+275 (Swamp 202)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+175 and 11+275 in the Township of Henvey are shown on Drawings B1 and B2 in Appendix B. The overall alignment extends across high fill sections from STA 11+175 to 11+195 and STA 11+250 to 11+275, and a swamp crossing area about 55 m long from STA 11+195 to 11+250. The proposed embankment in this area will be up to about 6.5 m above the existing ground surface. A cross-section of the critical section in the vicinity of the proposed swamp crossing/high fill embankment corresponding to the greatest new embankment height and/or the maximum thickness of soft, compressible cohesive soils at approximately STA 11+220 is shown on Drawing B4 in Appendix B.

A total of nine (9) boreholes (Boreholes S202-01 to S202-09, inclusive) and four (4) Dynamic Cone Penetration Tests (DCPTs S202-DC01 to S202-DC04, inclusive) were completed along the overall length of the area to investigate the subsurface conditions within the swamp crossing/high fill areas. One (1) borehole (Borehole S202-13) and two (2) Dynamic Cone Penetration Tests (DCPTs S202-DC05 and S202-DC07) advanced (to the south of the investigation area) on the median with the proposed Highway 69 NBL alignment were also utilized to supplement the investigation for the SBL alignment. In addition, four (4) boreholes (Boreholes C201-01, C201-02, C202-01 and C202-02) advanced along the Culverts 201 and 202 alignments traversing the swamp area and the proposed Highway 69 SBL and NBL alignments were further utilized to define the stratigraphic boundaries between the subsurface soils. The details of the field investigations carried out for the culvert alignments and the Record of Boreholes for C201-01, C201-02, C202-01 and C202-02 are not included in this report, but are presented in Golder Associates' Report "Foundation Investigation Report, Culverts – Contract 2, Highway 69 Four-Laning from 1.7 km North of Highway 529 Northerly to 3.9 km North of Highway 522, Ministry of Transportation, Ontario, G.W.P. 5404-05-00" (Report No. 09-1111-6014-2521).

This section of the proposed highway embankment is located within the confines of tree covered valley slopes to the north and south, and consists of wet grassy areas/pasture land and a small creek traversing the valley from east to west near the middle of the area. In general, the ground cover consists of a grassy field with exposed bedrock outcrops and shrub cover and moderately treed areas to the north and south.

The subsurface soils along the SBL alignment in the Swamp 202 swamp crossing/high fill area generally consist of surficial layers of peat and topsoil at the ground surface, underlain by near surface deposits of organic silty sand in places, which in turn is underlain by silty sand to sand. These shallow surficial deposits are underlain by a deposit of clayey silt to clay. The cohesive deposit is underlain in places by cohesionless deposits of sandy silt to sand or silty sand and gravel, in turn underlain by inferred bedrock. At one location, bedrock was cored and samples were retrieved consisting of granite gneiss bedrock. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 25.4 m below ground surface at about STA 11+215. Bedrock outcrops and knobs are present across the site and towards the south east end of the investigated area.

Peat / Topsoil

An approximately 0.1 m to 0.3 m thick layer of peat, topsoil or root mat was encountered at the ground surface at about Elevations 188.0 m and 182.5 m in Boreholes S202-01 and S202-04, respectively on the southern slope of the swamp valley and in Boreholes S202-02, S202-03, S202-05 to S202-09 and S202-13 across the swamp valley and on the northern slope between about Elevation 188.9 m and 182.7 m. In Borehole S202-13, bedrock was inferred at the bottom of topsoil upon refusal to further split-spoon advancement and in Borehole S202-01 and DCPT S202-07, bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of this deposit.

The natural water content measured on one (1) specimen of the peat/topsoil layer is about 44 per cent.

Organic Silty Sand

A deposit of dark grey to brown organic silty sand trace clay containing rootlets was encountered locally below the peat in Boreholes S202-04 and S202-05. The top of this deposit is at about Elevation 182.3 and the thickness of the deposit is about 0.4 m and 0.5 m in the respective boreholes.

Two SPT 'N'-values of 1 blow per 0.3 m of penetration were recorded within this deposit, indicating a very loose relative density.

The natural water content measured on two (2) specimens of this deposit is about 39 per cent and 46 per cent.

Silty Sand to Sand

A deposit of brown to grey silty sand to sand, trace clay and containing wood fragments, rootlets and organics was encountered either below the topsoil or the organic silty sand deposit in Boreholes S202-02 to S202-05, S202-07 and S202-09. The top of this deposit ranges from about Elevation 186.0 m to 181.8 m and its thickness ranges from about 0.2 m to 0.6 m. Borehole S202-02 was terminated within this deposit upon refusal to further auger advancement.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 5 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

The natural water content measured on two (2) samples of this deposit is about 20 per cent and 26 per cent.

Clayey Silt to Clay

A deposit of cohesive soil comprised of brown to grey clayey silt, silty clay and clay containing trace to some sand and silt was encountered below the silty sand to sand deposit or topsoil in Boreholes S202-03 to S202-09. The deposit generally contains sand and silty clay layers within the clayey silt portion of the deposit and silt layers at various intervals across the deposit. The near surface portion of this deposit contains organics, rootlets and fibrous peat layers. Along the centreline of the proposed embankment, a layer of silt was encountered within the cohesive deposit in Borehole S202-07 advanced near the northern limit of the investigated area. The top of the cohesive deposit ranges from about Elevation 182.9 m to 181.6 m, and up to about Elevation 185.5 m in Borehole S202-09 advanced on the valley slope. The thickness of the cohesive deposit ranges from about 4.6 m to 18.9 m. The bottom of this deposit is defined by refusal to further split-spoon and casing advancement

and/or dynamic cone penetration in Boreholes S202-03 and S202-07 and by bedrock in Borehole S202-04. DCPT S202-DC01 was terminated within this deposit upon refusal to further dynamic cone penetration.

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 11 blows per 0.3 m of penetration, with the higher 'N' values being recorded generally within the near surface portion of this deposit underlying the silty sand to sand deposit. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 14 kPa to 96 kPa, but typically less than 45 kPa, and the sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the clayey silt to clay deposit has a soft to stiff consistency with shear strength generally increasing with depth.

The natural water content measured on specimens of this deposit ranges from about 27 per cent to 86 per cent, but are typically greater than 50 per cent.

The grain size distributions of fifteen (15) specimens of the clayey silt to clay deposit are shown on Figures B.S202-01A to B.S202-01C in Appendix B.

Atterberg limits tests were carried out on sixteen (16) specimens of the clayey silt to clay deposit and indicate liquid limits ranging from about 24 per cent to 75 per cent, plastic limits ranging from about 15 per cent to 23 per cent and plasticity indices ranging from about 7 per cent to 52 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures B.S202-02A and B.S202-02B in Appendix B and indicate the material to range from a clayey silt of low plasticity to clay of high plasticity.

A laboratory consolidation test was carried out on one (1) specimen of the clay deposit obtained from a Shelby tube sample in Borehole S202-07. A preconsolidation stress of about 85 kPa was estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. A bulk unit weight of about 15.3 kN/m^3 and a specific gravity of about 2.78 were measured on the consolidation test specimen. Details of the test results are shown on Figure B.S202-03 in Appendix B, and the test results are summarized below.

Borehole Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Borehole S202-07 Sample 7	7.4 m / 176.1 m	85	85	0	1.0	1.69	0.13	2.16	1.3 x 10^{-4}

Note: * For stress range of between effective overburden stress and final stress due to 6.5 m high embankment, that is 85 kPa ≤ σ_v' ≤ 205 kPa

where:
- σ_{vo}' is the in situ vertical effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- σ_v' is the vertical effective stress in kPa
- OCR is overconsolidation ratio
- e_o is initial void ratio
- C_c is the compression index
- C_r is the recompression index
- c_v is the coefficient of consolidation in cm^2/s

Silt (Interlayer)

An approximately 1.1 m thick interlayer of grey silt, trace to some sand and trace clay was encountered within the silty clay to clay deposit in Borehole S202-07 at about Elevation 179.4 m.

One SPT 'N'-value measured within this silt interlayer is 14 blows per 0.3 m of penetration, indicating a compact relative density.

The natural water content measured on one (1) specimen of the silt deposit is about 24 per cent.

A grain size distribution of this sample is shown on Figure B.S202-04 in Appendix B.

Sandy Silt to Sand

A deposit of brown to grey sandy silt to sand some silt containing trace gravel and trace clay was encountered underlying the cohesive deposit in Boreholes S202-05, S202-06 and S202-08. The top of this deposit ranges from about Elevation 166.7 m to 162.7 m and the thickness of the deposit ranges from about 1.8 m to 4.8 m. Borehole S202-05 was terminated on refusal to further split-spoon and casing advancement while Boreholes S202-06 and S202-08 were terminated within this deposit as a result of flowing sand into the casing due to groundwater pressure.

The SPT 'N'-values measured within this deposit range from 7 blows to 12 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on two (2) samples of this deposit is about 21 per cent and 22 per cent.

A grain size distribution of one (1) sample from the sand portion of this deposit is shown on Figure B.S202-05 in Appendix B.

In Borehole S202-09 advanced on the north slope of the valley, the cohesionless layer encountered underlying the silty clay deposit is comprised of silty sand and gravel containing trace clay. The top of this layer is at about Elevation 184.8 m and the thickness of the layer is about 0.3 m. Borehole S202-09 was terminated on refusal to split-spoon and auger advancement. One SPT 'N'-value of 50 blows per 0.05 m of penetration was measured prior to split-spoon refusal, indicating a very dense relative density.

Bedrock / Refusal

Bedrock outcrops and knobs are present to the southern and northern limits of the investigated area. In Boreholes S202-01 and S202-13 located at about STA 11+175 and 11+137.5, bedrock was confirmed by exposure by shovel excavation of the thin layer of topsoil or peat encountered at the ground surface. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon and/or auger/casing advancement and shovel excavation or dynamic cone penetration between depths of about 0.1 m and 25.4 m below the ground surface, corresponding to about Elevation 188.9 m and 157.3 m. In general, refusal was encountered at greater depth within the limits of the swamp crossing/high fill area between about STA 11+215 and 11+240.

Bedrock was encountered and core samples were recovered from Borehole S202-04, as shown on the photograph of the recovered core samples presented on Figure B.S202-06. The depth to the surface of the bedrock in this borehole is about 11.3 m corresponding to Elevation 171.2 m. The bedrock consists of granite gneiss and the core samples are described as fresh, foliated, slightly porous, medium crystalline, strong, pink, grey and black with mafic dyke span encountered at varying intervals. The Rock Quality Designation (RQD) measured on the core samples is about 100 per cent and 92 per cent, indicating a rock mass of very good to

excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the core samples are 100 per cent and 96 per cent, and 100 per cent and 91 per cent, respectively.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Artesian conditions were observed in Boreholes S202-06 and S202-08 with the groundwater level upon completion of drilling measured at about 0.8 m and 1.4 m above ground surface, about Elevation 183.9 m and 184.1 m, respectively. In the other boreholes, the water levels observed upon completion of drilling range from about Elevation 179.4 m to 185.9 m, typically measured at the ground surface to depths ranging from about 0.2 m to 4.1 m below ground surface, except in Boreholes S202-03 and S202-13 which were observed to be dry upon completion of drilling.

4.6 Highway 69 NBL – STA 11+100 to 11+225 (Swamp 202)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+100 and 11+225 in the Township of Henvey are shown on Drawings B1 to B3 in Appendix B. The overall alignment extends across a high fill section from STA 11+100 to 11+175 and a swamp crossing area about 50 m long from STA 11+175 to 11+225. The proposed embankment in this area will be up to about 6.5 m above the existing ground surface. A cross-section of the critical section in the vicinity of the proposed swamp crossing/high fill embankment corresponding to the greatest new embankment height and/or the maximum thickness of soft, compressible cohesive soils at approximately STA 11+220 is shown on Drawing B4 in Appendix B.

A total of eleven (11) boreholes (Boreholes S202-10 to S202-20, inclusive) and three (3) Dynamic Cone Penetration Tests (DCPTs S202-DC05 to S202-DC07, inclusive) were completed along the overall length of the area to investigate the subsurface conditions within the swamp crossing/high fill areas. Two (2) boreholes (Boreholes S202-02 and S202-06) and two (2) Dynamic Cone Penetration Tests (DCPTs S202-DC02 and S202-DC04) advanced on the median with the proposed Highway 69 SBL alignment were also utilized to supplement the investigation for the NBL alignment. In addition, three (3) boreholes (Boreholes C201-03, C201-04 and C202-03) advanced by Golder along the Culverts 201 and 202 alignments traversing the swamp area and the proposed Highway 69 SBL and NBL alignments were further utilized to define the stratigraphic boundaries between the soil deposits. The details of the field investigations carried out for the culvert alignments and the Record of Borehole C201-03, C201-04 and C202-03 are not included in this report, but are presented in Golder Associates' Report "Foundation Investigation Report, Culverts – Contract 2, Highway 69 Four-Laning from 1.7 km North of Highway 529 Northerly to 3.9 km North of Highway 522, Ministry of Transportation, Ontario, G.W.P. 5404-05-00" (Report No. 09-1111-6014-2521).

This section of the proposed highway embankment is located within the confines of tree covered valley slopes to the north and south, and consists of wet grassy areas / pasture land and a small creek traversing the valley from west to east near the middle of the area. In general, the ground cover consists of a grassy field with exposed bedrock outcrops and shrub cover and moderately treed areas to the north and south.

The subsurface soils along the NBL alignment in the Swamp 202 swamp crossing/high fill areas generally consist of surficial layers of peat, topsoil and organics at the ground surface, underlain by a deposit of silty sand to sand, underlain by an extensive deposit of clayey silt to clay. The cohesive deposit is underlain in places by

cohesionless deposits of sandy silt to sand and/or sand and gravel, to refusal depths where the deposit was fully penetrated. At one location, a boulder was encountered within the cohesionless deposit. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 26.5 m below ground surface at about STA 11+195. Bedrock outcrops and knobs are present to the north, south and southeast of the investigated area.

Topsoil

An approximately 0.1 m to 0.4 m thick layer of topsoil was encountered at the ground surface in all the boreholes. The surface of the topsoil layer ranges from about Elevation 184.5 m to 182.9 m at the boreholes advanced within the valley and from about Elevation 191.9 m to 187.3 m at the boreholes advanced along the valley slopes. In Borehole S202-10 and at DCPT S202-DC07, bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of the topsoil layer. In Borehole S202-13, bedrock was inferred at the bottom of the topsoil layer upon refusal to further split-spoon advancement and subsequent refusal in two additional boreholes advanced within the proximity of this borehole to verify the refusal condition.

Silty Sand to Sand

A deposit of brown to grey silty sand to sand trace silt containing trace gravel, trace to some clay, sand seams, wood fragments, rootlets and organics was encountered underlying the topsoil in all the boreholes except in Boreholes S202-06, S202-19 and S202-20. The top of this deposit ranges from about Elevation 188.7 m to 182.7 m and the thickness of the deposit ranges from about 0.4 m to 0.7 m. Boreholes S202-02, S202-12 and S202-14 were terminated within this deposit upon refusal to further split-spoon or auger advancement.

The SPT 'N'-values measured within this deposit range from 3 blows to 11 blows per 0.3 m of penetration, and up to 36 blows per 0.3 m of penetration in one borehole, indicating a very loose to dense relative density.

The natural water content measured on samples of this deposit ranges from about 20 per cent to 40 per cent, and up to about 68 per cent. The higher value was recorded within the deposit containing rootlets and organics.

Clayey Silt to Clay

An extensive deposit of cohesive soil comprised of brown to grey clayey silt, silty clay and clay trace to some silt was encountered below the silty sand to sand deposit or topsoil in Boreholes S202-06, S202-11 and S202-15 to S202-20. The deposit contains trace to some sand, silt and sand layers, silty sand and silt seams while the near surface portion of the deposit contains seams of fibrous peat, rootlets and organics. Discontinuous interlayers of silt and sand were encountered and inferred (based on the resistance to dynamic cone penetration) at varying intervals in some of the boreholes advanced towards the southern limit of the investigated area. The top of the clayey silt to clay deposit across the boreholes ranges from about Elevation 183.7 m to 182.0 m, and up to about Elevation 187.7 m in Borehole S202-11 advanced along the valley slope, and the thickness of the deposit ranges from about 0.9 m to 16.1 m. The bottom of this deposit was defined by refusal to further split-spoon and/or casing advancement in Boreholes S202-15 and S202-16, while Borehole S202-18 was extended deeper by driving a dynamic cone to refusal at a depth of about 26.5 m below ground surface (Elevation 156.4 m).

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 11 blows per 0.3 m of penetration, where the higher 'N' values were recorded within the near surface portion of this deposit underlying the silty sand to sand deposit. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 17 kPa to 96 kPa, but are typically lesser than 40 kPa, and the sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the clayey silt to clay deposit has a soft to stiff consistency.

The natural water content measured on specimens of this deposit ranges from about 27 per cent to 102 per cent, but is typically greater than 41 per cent.

The grain size distributions of nine (9) specimens of the clayey silt to clay deposit are shown on Figures B.S202-07A and B.S202-07B in Appendix B.

Atterberg limits tests were carried out on thirteen (13) specimens of the clayey silt to clay deposit and indicate liquid limits ranging from about 25 per cent to 77 per cent, plastic limits ranging from about 16 per cent to 24 per cent and plasticity indices ranging from about 10 per cent to 54 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures B.S202-08A and B.S202-08B in Appendix B and indicate the material to range from a clayey silt of low plasticity to clay of high plasticity.

Laboratory consolidation tests were carried out on two (2) specimens of the clay deposit obtained from Shelby tube samples in Boreholes S202-17 and S202-20. Preconsolidation stresses of about 100 kPa were estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. Bulk unit weights of about 15.3 kN/m^3 and 15.9 kN/m^3, and specific gravities of about 2.76 and 2.78 were measured on the consolidation test specimens. Details of the test results are shown on Figure B.S202-09 and B.S202-10 in Appendix B, and are summarized below.

Borehole Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Borehole S202-17 Sample 7	11.0 m / 172.1 m	100	100	0	1.0	1.19	0.14	2.14	4.9 x 10^{-4}
Borehole S202-20 Sample 11	10.3 m / 173.0 m	75	100	25	1.3	1.20	0.12	1.86	5.5 x 10^{-5}

Note: * For stress range of between effective overburden stress and final stress due to 6.5 m high embankment, that is 100 kPa ≤ σ_v' ≤ 225 kPa and 75 kPa ≤ σ_v' ≤ 200 kPa

where:
- σ_{vo}' is the in situ vertical effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- σ_v' is the vertical effective stress in kPa
- OCR is overconsolidation ratio
- e_o is initial void ratio
- C_c is the compression index
- C_r is the recompression index
- c_v is the coefficient of consolidation in cm^2/s

Silt and Sand (Interlayers)

Approximately 0.4 m to 1.2 m thick interlayers of grey silt, trace sand and trace clay, and an approximately 0.3 m thick interlayer of sand were encountered within the upper portion of the cohesive deposit in Boreholes S202-18,

and S202-19 and Borehole S202-17, respectively. The top of the silt interlayers is between about Elevation 181.5 m and 179.0 m, and the top of the sand interlayer is at about Elevation 179.4 m.

The SPT 'N'-values measured within the silt and sand interlayers range from 0 blows (weight of hammer) to 20 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on a specimen of the silt deposit is about 24 per cent.

A grain size distribution of one (1) sample from the silt interlayer is shown on Figure B.S202-11 in Appendix B. An Atterberg limits test on one (1) sample of the silt deposit indicates this material to be non-plastic.

Sandy Silt to Sand

A cohesionless deposit comprised of brown to grey sandy silt, silty sand and sand trace to some silt, containing trace to some gravel, trace to some clay, sand seams and cobbles was encountered underlying the cohesive deposit in Boreholes S202-06, S202-11 and S202-17 to S202-20. A 1.0 m thick boulder was encountered at about Elevation 165.5 m within the silty sand to sand deposit in Borehole S202-19. The top of the sandy silt to sand deposit ranges from about Elevation 168.7 m to 166.3 m and is at about Elevation 186.8 m in Borehole S202-11 advanced along the valley slope. The thickness of this deposit ranges from about 0.5 m to 4.8 m, and may be up to about 12.3 m as inferred by resistance to a dynamic cone penetration test in Borehole S202-18. Boreholes S202-06 and S202-17 were terminated within this deposit as a result of sand flowing into the casing due to water pressure confined below the overlying cohesive deposit.

The SPT 'N'-values measured within this deposit range from 7 blows to 36 blows per 0.3 m of penetration, with one 'N'-values of 57 blows per 0.3 m of penetration recorded in Borehole S202-19 within the portion of the deposit containing cobbles and boulders, indicating a loose to very dense relative density.

The natural water content measured on samples of this deposit ranges from about 11 per cent to 24 per cent.

The grain size distributions of two (2) samples from the sand layers of this deposit are shown on Figure B.S202-12 in Appendix B.

An Atterberg limits test was carried out on one (1) sample of the silty sand deposit and measured a liquid limit of about 20 per cent, a plastic limit of about 18 per cent and a corresponding plasticity index of about 2 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure B.S202-13 in Appendix B and indicates that the fines material of the silty sand deposit is classified as silt of slight plasticity.

In Boreholes S202-11 and S202-20, the sandy silt to sand deposit grades to a sand and gravel containing trace to some silt, trace clay and contains cobbles. The top of the coarser portion of the deposit is at about Elevation 186.3 m and 167.5 m and the thickness of this portion of the deposit is about 0.1 m and 1.1 m in the respective boreholes. Boreholes S202-11 and S202-18 were terminated within this deposit upon refusal to further split-spoon advancement. One SPT 'N'-value of 64 blows per 0.3 m of penetration was measured in Borehole S202-20 at the bottom of the borehole, indicating a very dense relative density. A grain size distribution test of one (1) sample of the sand and gravel portion of the deposit is shown on Figure B.S202-14 in Appendix B.

Bedrock / Refusal

Bedrock outcrops and knobs are present along the southern and northern limits of the investigated area. In Borehole S202-01 and DCPT S202-DC07 located at about STA 11+187.5 and 11+162.5, bedrock was confirmed by exposure by shovel excavation of the thin layer of topsoil encountered at the ground surface. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon and/or auger/casing advancement and shovel excavation or dynamic cone penetration between depths of about 0.1 m and 26.5 m below the ground surface, ranging from about Elevation 191.6 m to 156.4 m. In general, refusal was encountered at greater depth within the limits of the swamp crossing between about STA 11+195 and 11+237.5.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Artesian conditions were observed in Boreholes S202-06 and S202-20 with the groundwater level upon completion of drilling measured at about 0.8 m and 0.6 m above ground surface, about Elevation 183.9 m at the respective boreholes. In the other boreholes, the water levels observed upon completion of drilling range from about Elevation 179 m to 188 m, typically measured at the ground surface and to depths ranging from about 0.6 m to 4.0 m below ground surface, except in Borehole S202-13 which was observed to be dry upon completion of drilling.

4.7 Highway 69 SBL – STA 11+350 to 11+375 (Swamp 203)

The plan, profile along the centreline and cross-section across the embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+350 and 11+375 in the Township of Henvey are shown on Drawing C1 in Appendix C. The proposed alignment within this section of the highway is in a cut, up to about 10 m deep below the existing ground surface. A total of three (3) boreholes (Boreholes S203-01 to S203-03, inclusive) and three (3) DCPTs (DCPTs S203-DC01, S203-DC01A and S203-DC01B) were completed to investigate the subsurface conditions within this swamp area. The topography of this cut section of the proposed highway is comprised of bedrock-dominated high ground, containing a relatively flat swamp area located within the confines of tree covered slopes to the north and south. The ground cover around the perimeter of the swamp is comprised of visible bedrock outcrops and occasional areas of shallow water.

Ponded water was encountered in some areas of the site at the time of the investigation. The subsurface soils along the SBL alignment in Swamp 203 generally consist of a surficial layer of topsoil at the ground surface and a deposit of amorphous peat below the ponded water, underlain by a layer of sand, which in turn is underlain by inferred bedrock. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 1.1 m, being deepest in the vicinity of about STA 11+365. Bedrock outcrops were observed in the vicinity of the proposed alignment and to the north and south limits of the swamp at about STA 11+350 and STA 11+375.

Water

Ponded water was encountered overlying ground surface in Borehole S203-02 to a depth of about 0.2 m.

Peat / Topsoil

A deposit of black to dark brown amorphous peat containing rootlets was encountered under the ponded water in Borehole S203-02. The top of the peat deposit is at about Elevation 196.3 m and the thickness of the deposit is about 0.9 m.

The SPT 'N'-values measured within the peat are 0 blows (weight of hammer) and 1 blow per 0.3 m of penetration, indicating a very soft consistency.

The natural water content measured on one (1) sample of the peat is about 405 per cent.

An approximately 0.1 m thick layer of topsoil was encountered in Boreholes S203-01 and S203-03 at the ground surface at about Elevation 197.5 m and 197.2 m, respectively. Bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of this layer.

Sand

A layer of brown sand containing rootlets and organics was encountered below the peat deposit in Borehole S203-02. The top of this layer is at about Elevation 195.4 m and the thickness of the layer is about 0.1 m. The bottom of this deposit was defined by refusal to further split-spoon advancement and dynamic cone penetration.

The natural water content measured on a specimen of this layer is about 35 per cent.

Bedrock / Refusal

Bedrock outcrops are present to the north and south limits of the swamp at the location of Boreholes S203-01 and S203-03 at about STA 11+350 and 11+375, respectively. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon advancement and shovel excavation or dynamic cone penetration at depths between about 0.1 m and 1.1 m below the ground surface, corresponding to between about Elevation 197.5 m and 195.2 m. Refusal was encountered at a greater depth in the middle of the swamp at about STA 11+365.

Groundwater Conditions

The samples taken in the boreholes were wet at the time of the investigation. Water was ponded at the surface at the location of Borehole S203-02 to about Elevation 196.3 m (about 0.2 m deep).

4.8 Highway 69 NBL – STA 11+375 to 11+400 (Swamp 203)

The plan, profile along the centreline and cross-section across the embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+350 and 11+375 in the Township of Henvey are shown on Drawings C1 and C2 in Appendix C. The proposed alignment within this section of the highway is in a cut, up to about 11 m deep below the existing ground surface. A total of three (3) boreholes (Boreholes S203-04 to S203-06, inclusive) and three (3) DCPTs (DCPTs S203-DC02, S203-DC03 and S203-DC03A) were completed to investigate the subsurface conditions within this swamp area.

DCPT S203-DC03 and S203-DC03A are additional DCPTS advanced near the south end of the swamp at about STA 11+365 to further confirm the subsurface conditions and the thickness of the overburden near or at the edge of the swamp. The topography of this cut section of the proposed highway is comprised of bedrock-dominated high ground, undulating within the swamp area and sloping upward to the north and south limits of the swamp. The ground cover in the swamp is characterized by a shallow layer of topsoil and exposed bedrock outcrops.

In general, the subsurface soils consist of a surficial layer of topsoil and a deposit of peat at the ground surface, underlain by a layer of sand, which in turn is underlain by inferred bedrock. Resistance to dynamic cone penetration and shovel excavation, was encountered at depths of up to about 0.9 m, being deepest near the south edge of the swamp at about STA 11+365, while bedrock outcrops are present at the north end of the swamp.

Topsoil

An approximately 0.1 m thick layer of topsoil was encountered in Borehole S203-06 at the ground surface corresponding to about Elevation 197.9 m. At this location, bedrock was exposed by shovel (hand) excavation to confirm refusal at the bottom of this layer.

Bedrock / Refusal

Bedrock outcrops are present at the north end of the swamp at the location of Boreholes S203-04 to S203-06 and DCPT 203-DC02 and the bedrock surface is inferred at depths of 0.7 m and 0.9 m below ground surface at DCPTs S203-DC03 and S203-DC03A, based on refusal to dynamic cone penetration, between about Elevation 197.8 m and 195.8 m. Refusal was encountered at greater depth at or near the south edge of the swamp at about STA 11+365.

Groundwater Conditions

Upon completion of excavation in Borehole S203-06, the excavated topsoil was observed to be moist. Standing / ponded water was observed at ground surface at some locations within this area.

4.9 Highway 69 SBL – STA 11+725 to 11+825 (Swamp 204)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+725 and 11+825 in the Township of Henvey are shown on Drawings D1 and D2 in Appendix D. The alignment extends along a 100 m length of flat to gently sloping ground to the north towards Still River and the proposed highway embankment will be up to about 7.5 m high above the existing ground surface. Two critical cross-sections of the proposed embankment corresponding to the greatest new embankment height and/or the maximum thickness of soft, compressible cohesive soils, at approximately STA 11+760 and 11+810, are shown on Drawing D4 in Appendix D.

A total of nine (9) boreholes (Boreholes S204-01 to S204-09, inclusive) and four (4) Dynamic Cone Penetration Tests (DCPTs S204-DC01 to S204-DC04, inclusive) were completed to investigate the subsurface conditions within this swamp crossing/high fill area. In addition, two (2) boreholes (Boreholes S204-11 and S204-15) and two (2) Dynamic Cone Penetration Tests (DCPTs S204-DC06 and S204-DC08) advanced at the toe of the new Highway 69 NBL alignment were also utilized to supplement this investigation. The topography of this section of the proposed highway is relatively flat and gently sloping down to the north towards Still River, with ground cover consisting of wet grassy areas / pasture land, shrubs and areas of shallow open water. The swamp crossing/high fill area is bounded to the south by a moderately to densely tree covered valley slope and bedrock outcrops, and bounded to the north by Still River flowing in a east-west direction; the south bank is being densely tree covered in places.

In general, the subsurface soils along the SBL alignment in this area consist of localized deposits of sand and gravel/sand/silty sand fill and surficial layers of topsoil, underlain in places by a near surface deposit of sand to silt. The topsoil/fill and/or the sand to silt deposit are underlain by an extensive deposit of alternating layers of cohesive and cohesionless soils comprised of clayey silt to silty clay, sand to sandy silt/silt, clay to clayey silt, sandy silt to silt, silty clay to clay and silt to silty sand, underlain by inferred bedrock. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 45.9 m at about STA 11+825. Bedrock outcrops are present along the southern limit of the investigated area.

Sand and Gravel to Sand/Silty Sand Fill

A cohesionless fill comprised of grey to brown sand and gravel, sand trace to some gravel and silty sand trace gravel, was encountered at the ground surface in Boreholes S204-02 to S204-04. The fill contains rootlets and an approximately 0.1 m thick layer of snow and ice cover was encountered in Borehole S204-04 at the time of the investigation. The top of the fill ranges from about Elevation181.7 m to 181.4 m and the thickness ranges from about 0.5 m to 0.9 m.

An SPT 'N'-value measured within the fill is 49 blows per 0.3 m of penetration, indicating a dense relative density, possibly due to frozen ground conditions.

The natural water content measured on samples of the fill ranges from about 3 per cent to 38 per cent, with the higher water content value measured in the sample containing rootlets.

Topsoil

An approximately 0.1 m to 0.5 m thick layer of topsoil was encountered at the ground surface in Boreholes S204-01 and S204-05 to S204-09. The surface of topsoil across the boreholes typically ranges from about Elevation 183.9 m to 181 m. At DCPT S204-DC01, where bedrock was exposed by shovel (hand) excavation, the topsoil layer is 0.1 m thick and the surface of the topsoil is at about Elevation 186.4 m.

The natural water content measured on two (2) specimens of topsoil is about 34 per cent and 42 per cent.

Sand to Silt

A deposit of cohesionless soil comprised of brown to grey sand trace to some silt, silty sand, sandy silt and silt trace to some sand, and containing trace to some clay, rootlets and pockets of clayey silt was encountered

underlying either the topsoil or fill in Boreholes S204-01, S204-03, S204-04, S204-11 and S204-15. The top of this deposit ranges from about Elevation 183.6 m to 180.6 m and the thickness of the deposit ranges from about 0.3 m to 1.2 m. The bottom of this deposit was defined by refusal to further split-spoon and auger advancement and dynamic cone penetration in Borehole S204-01.

The SPT 'N'-values measured within this deposit range from 3 blows to 11 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 18 per cent to 33 per cent.

A grain size distribution of one (1) sample from the sandy silt portion of this deposit is shown on Figure D.S204-01 in Appendix D.

An Atterberg limits test was carried out on one sample of the silt portion of this deposit, and measured a liquid limit of about 29 per cent, a plastic limit of about 25 per cent and a corresponding plasticity index of about 5 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure D.S204-02 in Appendix D and indicates that the material is classified as silt of slight plasticity.

Clayey Silt to Silty Clay (Near Surface)

A near surface deposit of brown to grey clayey silt to silty clay, trace to some sand and trace gravel, containing rootlets and silty sand seams was encountered underlying the topsoil/fill and/or the sand to silt deposit in all of the boreholes except in Borehole S204-01. In general, the cohesive deposit is comprised of clayey silt to silty clay at the west toe and centre of the proposed embankment to silty clay towards the east toe of the embankment. The top of this deposit ranges from about Elevation 180.9 m to 180 m and the thickness of the deposit ranges from 1.4 m to 2.7 m. Boreholes S204-02 to S204-04 and S204-11 advanced near the south end of the investigated area terminated within this deposit upon refusal to split-spoon and/or auger/casing advancement and/or dynamic cone penetration in DCPTs driven adjacent to some of the boreholes.

The SPT 'N'-values measured within the clayey silt to silty clay deposit range from 0 blow (weight of hammer) to 13 blows per 0.3 m of penetration, but are typically less than 7 blows per 0.3 m of penetration, with a value of 50 blows per 0.02 m of penetration recorded at the depth of auger refusal in Borehole S204-02. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 17 kPa to 58 kPa, but typically less than 27 kPa, and the sensitivity is calculated to range from about 3 to 5. The field vane tests results indicate that the clayey silt to silty clay deposit has a soft to stiff consistency.

The natural water content measured on samples of the clayey silt to silty clay deposit ranges from about 23 per cent to 51 per cent, but is typically greater than 30 per cent.

A grain size distribution of one (1) sample of the silty clay portion of this deposit is shown on Figure D.S204-03 in Appendix D.

Atterberg limits tests were carried out on eight (8) specimens of the clayey silt to silty clay deposit and indicate liquid limits ranging from about 29 per cent to 47 per cent, plastic limits ranging from about 15 per cent to 24 per cent and plasticity indices ranging from about 12 per cent to 25 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-04 in Appendix D and indicate the material to range from a clayey silt of low plasticity to silty clay of intermediate plasticity.

Sand to Sandy Silt to Silt (Upper)

A deposit of cohesionless soil comprised of brown to grey sand trace to some silt, silty sand, sand and silt, sandy silt and silt some sand was encountered underlying the near surface deposit of clayey silt to silty clay in Boreholes S204-05 to S204-09 and S204-15. The deposit generally contains trace to some clay, rootlets and organics. The top of this deposit ranges from about Elevation 179.2 m to 178.2 m and the thickness of the deposit ranges from about 4.0 m to 7.3 m.

The SPT 'N'-values measured within this deposit range from 1 blow to 22 blows per 0.3 m of penetration, with the higher N-values being recorded within the sand portion of this deposit, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 13 per cent to 29 per cent.

The grain size distributions of seven (7) samples of the sand to sandy silt to sand and silt to silty sand portion of this deposit are shown on Figure D.S204-05 in Appendix D.

Clayey Silt to Clay (Upper)

A deposit of cohesive soil comprised of brown to grey clayey silt, silty clay and clay was encountered underlying the upper deposit of sand to sandy silt to silt in Boreholes S204-05 to S204-09 and S204-15. In some boreholes, the deposit contains silt seams and sandy silt interlayers at various depths. The top of this deposit ranges from about Elevation 174.7 m to 171.4 m and the thickness of the deposit ranges from about 2.0 m to 6.6 m.

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 4 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 32 kPa to 96 kPa, and the sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the clay to clayey silt deposit has a firm to stiff consistency.

The natural water content measured on specimens of this deposit ranges from about 29 per cent to 118 per cent, but are generally less than 75 per cent.

Atterberg limits tests were carried out on three (3) specimens of the cohesive deposit and indicate liquid limits ranging from about 22 per cent to 51 per cent, plastic limits ranging from about 16 per cent to 20 per cent and plasticity indices ranging from about 6 per cent to 32 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-06 in Appendix D and indicate the material to range from a clayey silt of low plasticity to clay of high plasticity.

Sandy Silt to Silt (Lower)

A deposit of grey sandy silt to silt trace to some sand, generally containing trace to some clay, was encountered underlying the clayey silt to clay deposit in Boreholes S204-05 to S204-09 and S204-15. Typically, the deposit ranges from sandy silt encountered at/near the centre and west toe of the proposed embankment to silt encountered along the proposed highway median. Within the silt deposit, silty clay interlayers and silty clay seams were encountered at varying depths. The top of this deposit ranges from about Elevation 172.7 m to 166.4 m and the thickness of the deposit typically ranges from about 1.8 m to 4.8 m, and up to about 6.4 m in Borehole S204-15 advanced near the centre of the investigated area.

The SPT 'N'-values measured within this deposit range from 2 blows to 19 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 23 per cent to 32 per cent.

The grain size distributions of four (4) samples of the sandy silt portion of this deposit are shown on Figure D.S204-07 in Appendix D.

Atterberg limits tests were carried out on two (2) specimens of the silt portion of this deposit containing clayey silt seams and indicate liquid limits of about 22 per cent, plastic limits of about 17 per cent and 19 per cent, and plasticity indices of about 3 per cent and 5 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-08 in Appendix D and indicate the material to be silt of slight plasticity.

Silty Clay to Clay (Lower)

A deposit of brown to grey silty clay to clay some silt and trace sand, containing silt and sandy silt interlayers and silt seams at varying depths, was encountered underlying the lower deposit of sandy silt to silt in Boreholes S204-05 to S204-09 and S204-15. The silty clay to clay deposit is intersected by an approximately 2.7 m to 3.0 m thick deposit of sand and silt containing trace to some clay in Boreholes S204-07 to S204-09, as described below. The top of the silty clay to clay deposit ranges from about Elevation 166.3 m to 164.5 m and the overall thickness of the deposit typically ranges from about 14.0 m to 16.4 m, and up to about 23.1 m in Borehole S204-09 advanced near the centre of the investigated area.

The SPT 'N'-values recorded within the silty clay to clay deposit range from 0 blows (weight of hammer) to 11 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 53 kPa to greater than 144 kPa, but are typically less than 99 kPa. The sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the silty clay to clay deposit has a stiff to very stiff consistency.

The natural water content measured on samples of this deposit ranges from about 34 per cent to 56 per cent.

The grain size distributions of three (3) samples of this deposit are shown on Figure D.S204-09 in Appendix D.

Atterberg limits tests were carried out on nine (9) specimens of the cohesive deposit and indicate liquid limits ranging from about 46 per cent to 63 per cent, plastic limits ranging from about 17 per cent to 22 per cent and plasticity indices ranging from about 26 per cent to 43 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-10A and D.S20410B in Appendix D and indicate the material to range from a silty clay of intermediate plasticity to clay of high plasticity.

Laboratory consolidation tests were carried out on two (2) specimens of the clay deposit obtained from Shelby tube samples in Boreholes S204-05 and S204-07. Preconsolidation stresses of about 285 kPa and 305 kPa were estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. Bulk unit weights of about 16.6 kN/m^3 and 17.6 kN/m^3, and specific gravities of about 2.77 were measured on the consolidation test specimens. Details of the test results are shown on Figures D.S204-11 and D.S204-12 in Appendix D, and are summarized below.

Borehole Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Borehole S204-05 Sample 17	21.1 m / 160.1 m	190	285	95	1.5	1.0	0.08	1.57	1.1×10^{-3}
Borehole S204-07 Sample 20	4.1 m / 150.9 m	270	305	35	1.1	0.65	0.07	1.25	2.7×10^{-3}

Note: * For stress range between effective overburden stress and final stress due to 7.5 m high embankment, that is 190 kPa ≤ σ_v' ≤ 330 kPa and 270 kPa ≤ σ_v' ≤ 410 kPa

where:
- σ_{vo}' is the in situ vertical effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- σ_v' is the vertical effective stress in kPa
- OCR is overconsolidation ratio
- e_o is initial void ratio
- C_c is the compression index
- C_r is the recompression index
- c_v is the coefficient of consolidation in cm^2/s

Sand and Silt (Interlayer)

A deposit of grey sand and silt, trace to some clay was encountered within the silty clay to clay deposit in Boreholes S204-07 to S204-09 advanced near the northern limit of the investigated area along the centreline and the west toe of the proposed embankment. The top of this interlayer is at about Elevation 161.1 m and the thickness of the layer is between about 2.7 m and 3.0 m.

The SPT 'N'-values measured within this interlayer range from 4 blows to 19 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on three (3) samples of this deposit ranges between about 21 per cent and 24 per cent.

A grain size distribution of one (1) sample of this deposit is shown on Figure D.S204-13 in Appendix D.

Silt to Silty Sand to Sand and Silt

Underlying the lower deposit of silty clay to clay, Boreholes S204-05, S204-06, S204-08, S204-09 and S204-15 encountered a cohesionless deposit of grey silt trace to some sand, to sandy silt, to sand and silt, to silty sand. The deposit generally contains trace to some clay. The top of this deposit ranges from about Elevation 152.3 m to 138.7 m and the thickness of the deposit ranges from about 3.0 m to 5.1 m in these boreholes. Boreholes S204-05, S204-06, S204-08 and S204-09 were terminated within this deposit; and the bottom of the silt deposit in Borehole S204-15 was defined by refusal to further split-spoon and casing advancement and dynamic cone penetration.

The SPT 'N'-values recorded within this deposit ranges from 11 blows to 42 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on samples of this deposit ranges from about 21 per cent to 27 per cent.

The grain size distributions of five (5) samples from this deposit are shown on Figures D.S204-14 in Appendix D.

Bedrock / Refusal

Bedrock outcrops and knobs are present along the southern limit of the investigated area. In DCPT S204-DC01 located at about STA 11+740, bedrock was confirmed by exposure by shovel excavation of the thin layer of topsoil encountered at the ground surface. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon and/or casing advancement and shovel excavation or dynamic cone penetration at depths between about 0.1 m and 45.9 m below the ground surface, which corresponds to about Elevation 183.0 m to 135.2 m. In general, refusal was encountered at greater depth towards the northern limit of the swamp crossing/high fill area between about STA 11+800 and 11+825.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the boreholes upon completion of drilling range from about Elevation 183.4 m to 177.2 m, measured between 0.5 m and 3.8 m below ground surface, with the exception of Borehole S204-03 which was observed to be dry upon completion of drilling; the water level in BoreholeS204-02 was not recorded.

4.10 Highway 69 NBL – STA 11+700 to 11+800 (Swamp 204)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 11+700 and 11+800 in the Township of Henvey are shown on Drawings D1, D2 and D3 in Appendix D. The alignment extends along a 100 m length of flat to gently sloping ground to the north towards the Still River and the proposed highway embankment will be up to about 7.5 m high above existing grade. Two critical cross-sections of the proposed embankment corresponding to the greatest new embankment height and/or the maximum thickness of soft, compressible cohesive soils, at approximately STA 11+760 and 11+810, are shown on Drawing D4 in Appendix D.

A total of nine (9) boreholes (Boreholes S204-10 to S204-18, inclusive) and four (4) Dynamic Cone Penetration Tests (DCPTs S204-DC05 to S204-DC08, inclusive) were completed to investigate the subsurface conditions within this swamp crossing/high fill area. In addition, two (2) boreholes (Boreholes S204-02 and S204-06) and two (2) Dynamic Cone Penetration Tests (DCPTs S204-DC02 and S204-DC04) advanced for the new Highway 69 SBL alignment were also utilized to supplement this investigation. The topography of this section of the proposed highway is relatively flat to gently sloping down to the north towards the Still River, with ground cover consisting of wet grassy areas / pasture land, shrubs and areas of shallow open water. The swamp crossing/high fill area is bounded to the south by a moderately to densely tree covered valley slope and bedrock outcrops, and bounded to the north by the Still River flowing in a east-west direction, the south bank being densely tree covered.

In general, the subsurface soils along the NBL alignment in this area consist of localized deposits of sand and gravel to sand/silty sand fill and/or topsoil, and surficial layers of topsoil underlain by a near surface deposit of silty sand to silt in places. The topsoil/fill and/or the silty sand to silt deposit are underlain by an extensive deposit of alternating layers of cohesive and cohesionless soils comprised of clayey silt to clay, sand to sand

and silt to silt, underlain by inferred bedrock. At one location, bedrock was cored and samples consisting of granite gneiss bedrock were retrieved. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths up to about 42.8 m below ground surface at about STA 11+800. Bedrock outcrops are present along the southern limit of the investigated area.

Sand and Gravel to Sand/Silty Sand Fill

A cohesionless fill comprised of brown sand and gravel, sand trace gravel, and silty sand, was encountered at the ground surface in Boreholes S204-02 and S204-12, and underlying a layer of topsoil in Borehole S204-13. The fill was interlayered with an approximately 0.1 m thick seam of snow and ice in Borehole S204-12 at the time of the investigation. The top of the fill deposit ranges from about Elevation181.9 m to 181.4 m and the thickness of the deposit ranges from about 0.4 m to 0.9 m.

One SPT 'N'-value measured within the silty sand fill deposit in Borehole S204-13 is 6 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on four (4) samples of the fill deposit ranges from about 3 per cent to 40 per cent, with the higher water content value measured in the sample containing rootlets.

Topsoil

An approximately 0.1 m to 0.5 m thick layer of topsoil was encountered at the ground surface in all the boreholes advanced in this area except in Boreholes S204-02 and S204-12, as well as below the sand and gravel fill in Borehole S204-13. The top of this layer at the borehole locations ranges from about Elevation 181.5 m to 181.0 m, but in Boreholes S204-10 and S204-11 which are located on higher ground near the south edge of the investigated area, the top of topsoil is at about Elevation 184.8 m and 183.6 m. In Borehole S204-10, the bedrock was exposed by shovel (hand) excavation.

The natural water content measured on four (4) specimens of topsoil ranges from about 24 per cent to 47 per cent.

Sand to Silt

A deposit of cohesionless soil comprised of brown to dark brown sand trace to some silt, silty sand and silt trace sand and containing trace to some clay, pockets of clayey silt and rootlets was encountered underlying the topsoil in Boreholes S204-11, S204-14, S204-15 and S204-17. The top of this deposit ranges from about Elevation 181.1 m to 180.8 m, and up to about Elevation 183.4 m in Borehole S204-11 located on higher ground near the south edge of the investigated area, and the thickness of the deposit ranges from about 0.2 m to 1.7 m.

The SPT 'N'-values measured within this deposit range from 4 blows to 9 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on three (3) samples of this deposit ranges from about 21 per cent to 33 per cent.

An Atterberg limits test was carried out on one (1) sample of the silt portion of this deposit, and measured a liquid limit of about 29 per cent, a plastic limit of about 25 per cent and a corresponding plasticity index of about

4 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure D.S204-15 in Appendix D and indicates that the material is classified as silt of slight plasticity.

Clayey Silt to Clay (Near Surface)

A near surface deposit of brown to grey clayey silt to clay, trace to some silt, trace to some sand and trace gravel, containing rootlets, silty sand and silt seams was encountered underlying the topsoil/fill and/or the sand to silt deposit in all of the boreholes advanced for this swamp crossing/high fill area, except in Borehole S204-10. In general, the cohesive deposit is comprised of clayey silt to silty clay along the west and east (median) toes of the proposed embankment to clayey silt to clay towards the centreline of the proposed embankment. The top of this deposit ranges from about Elevation 182.2 m to 180.2 m and the thickness of the deposit ranges from 0.7 m to 2.6 m. Boreholes S204-02 and S204-11 advanced near the south end of the area terminated within this deposit upon refusal to split-spoon/auger advancement and dynamic cone penetration in DCPTs advanced adjacent to some of the boreholes.

The SPT 'N'-values measured within the clayey silt to clay deposit range from 2 blows to 13 blows per 0.3 m of penetration, but are typically less than 7 blows per 0.3 m of penetration; a value of 50 blows per 0.02 m of penetration was recorded at the depth of auger refusal in Borehole S204-02. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 25 kPa to 58 kPa, and the sensitivity is calculated to be about 3 and 4. The field vane tests results indicate that the clayey silt to clay deposit has a firm to stiff consistency.

The natural water content measured on samples of the clayey silt to clay deposit ranges from about 26 per cent to 48 per cent, but is typically greater than 30 per cent.

Atterberg limits tests were carried out on eight (8) specimens of the clayey silt to clay deposit and indicate liquid limits ranging from about 31 per cent to 51 per cent, plastic limits ranging from about 15 per cent to 24 per cent and plasticity indices ranging from about 12 per cent to 29 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-16 in Appendix D and indicate the material to range from a clayey silt of low plasticity to clay of high plasticity.

Sand and Silt to Silt to Silty Sand (Upper)

A deposit of cohesionless soil comprised of brown to grey sand and silt to silt some sand, to sand trace to some silt and silty sand was encountered underlying the near surface deposit of clayey silt to silty clay in Boreholes S204-06 and S204-12 to S204-18. The deposit generally contains trace to some clay and clayey silt pockets. The top of this deposit ranges from about Elevation 179.2 m to 178.3 m and the thickness of the deposit ranges from about 1.0 m to 7.9 m, becoming thinner towards the southern limit of the investigated area.

The SPT 'N'-values measured within this deposit range from 1 blow to 24 blows per 0.3 m of penetration, with the higher N-values being recorded within the sand portion of this deposit, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 11 per cent to 29 per cent.

The grain size distributions of eight (8) samples of the sand and silt to silt to silty sand portion of this deposit are shown on Figures D.S204-17A and D.S204-17B in Appendix D.

Atterberg limits tests were carried out on two (2) samples of the silt portion of this deposit and indicate liquid limits of about 20 per cent and 21 per cent, plastic limits of about 17 per cent and plasticity indices of about 3 per cent to 4 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-18 in Appendix D and indicate the material to be silt of slight plasticity.

Silty Clay (Upper)

A deposit of brown to grey silty clay was encountered underlying the upper cohesionless deposit of silt and sand and silt in Boreholes S204-06 and S204-15 located along the west toe of the proposed embankment. The top of this deposit is at about Elevation 174.4 m and 174.7 m and the thickness of the deposit is about 5.0 m and 2.0 m at the respective boreholes.

The SPT 'N'-values recorded within the upper cohesive deposit range from 0 blows (weight of hammer) to 2 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 32 kPa to 60 kPa, and the sensitivity is calculated to be between about 4 and 5. The field vane tests results indicate that the silty clay deposit has a firm to stiff consistency.

The natural water content measured on two (2) specimens of this deposit is about 50 per cent and 75 per cent.

Silt (Lower)

A deposit of grey silt, trace to some sand and trace to some clay, containing silty clay seams and silty clay interlayers, was encountered underlying the upper deposit of silty clay in Boreholes S204-06 and S204-15, advanced along the proposed highway median. The top of this deposit ranges from about Elevation 169.4 m and 172.7 m and the thickness of the deposit is about 4.8 m in Borehole S204-06 and about 6.4 m in Borehole S204-15.

The SPT 'N'-values measured within this deposit range from 2 blows to 12 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 23 per cent to 32 per cent.

Atterberg limits tests were carried out on two (2) specimens of this deposit and indicate liquid limits of about 22 per cent, plastic limits of about 17 per cent and 19 per cent, and plasticity indices of about 3 per cent and 5 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D.S204-19 in Appendix D and indicate the material to be silt of slight plasticity.

Clayey Silt to Clay (Lower)

A deposit of cohesive soil comprised of brown to grey clayey silt, silty clay and clay was encountered underlying the upper deposit of sand to sand and silt to silt in Boreholes S204-06 and S204-12 to S204-18. In some boreholes, the deposit contains trace sand, silty sand seams and silt interlayers at various depths. In Boreholes S204-06 and S204-15, located along the west toe of the proposed embankment, the cohesive deposit is separated into an upper and a lower deposit by the approximately 4.8 m to 6.4 m thick lower silt deposit, as described above. The top of the cohesive deposit ranges from about Elevation 178.2 m to 170.6 m, while in Boreholes S204-06 and S204-15 the top of the lower portion of the cohesive deposit is at about

Elevation 164.6 m and 166.3 m. The overall thickness of the cohesive deposit ranges from about 2.3 m to 25.1 m. The bottom of this deposit is defined by bedrock in Borehole S204-12 and by refusal to further split-spoon and casing advancement in Borehole S204-13.

The SPT 'N'-values recorded within the cohesive deposit range from 0 blows (weight of hammer) to 14 blows per 0.3 m of penetration. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 23 kPa to greater than 142 kPa, but generally greater than 50 kPa and the sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the clayey silt to clay deposit has a soft to very stiff, but generally stiff consistency.

The natural water content measured on specimens of this deposit ranges from about 34 per cent to 76 per cent, but are generally greater than 40 per cent.

The grain size distributions of six (6) specimens of the silty clay to clay portion of this deposit are shown on Figure D.S204-20 in Appendix D.

Atterberg limits tests were carried out on twelve (12) specimens of the silty clay to clay deposit and indicate liquid limits ranging from about 35 per cent to 64 per cent, plastic limits ranging from about 14 per cent to 21 per cent and plasticity indices ranging from about 21 per cent to 45 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures D.S204-21A and D.S204-21B in Appendix D and indicate the material to range from a silty clay of intermediate plasticity to clay of high plasticity.

A laboratory consolidation test was carried out on one (1) specimen of the clay deposit obtained from a Shelby tube sample in Borehole S204-14. A preconsolidation stress of about 155 kPa was estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. A bulk unit weight of about 16.7 kN/m^3 and a specific gravity of about 2.75 were measured on the consolidation test specimen. Details of the test results are shown on Figure D.S204-22 in Appendix D, and are summarized below.

Borehole Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Borehole S204-14 Sample 13	13.4 m / 168.1 m	95	155	60	1.6	0.87	0.06	1.46	2.7 x 10^{-3}

Note: * For stress range between effective overburden stress and final stress due to 7.5 m high embankment, that is 95 kPa ≤ σ_v' ≤ 240 kPa

where:
- σ_{vo}' is the in situ effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- σ_v' is the vertical effective stress in kPa
- OCR is overconsolidation ratio
- e_o is initial void ratio
- C_c is the compression index
- C_r is the recompression index
- c_v is the coefficient of consolidation in cm^2/s

Sand and Silt to Silt (Interlayers)

An approximately 0.4 m thick pocket of grey silt and an approximately 1.8 m thick interlayer of grey sand and silt were encountered within the clay to silty clay deposit in Boreholes S204-17 at about Elevation 169.5 m and

166.3 m, respectively. Similarly, an approximately 3.1 m thick interlayer of grey silt, trace to some sand and trace clay was encountered within the silty clay to clay deposit in Borehole S204-18 at about Elevation 161.3 m.

Two SPT 'N'-values measured within the sand and silt to silt interlayers are 5 blows and 7 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on a specimen of the silt pocket is about 25 per cent and the natural water content measured on one (1) sample of the silt interlayer is about 27 per cent.

A grain size distribution of one (1) sample of the silt interlayer is shown on Figure D.S204-23 in Appendix D.

An Atterberg limits test carried out on one specimen of the silt pocket measured a liquid limit of about 22 per cent, a plastic limit of about 19 per cent and a corresponding plasticity index of about 3 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure D.S204-24 in Appendix D and classified the material as silt of slight plasticity.

Silt to Sand

Underlying the clayey silt to clay deposit, Boreholes S204-06 and S204-14 to S204-18 encountered a deposit of cohesionless soil grading from grey silt trace to some sand, to sand and silt, to silty sand, to sand trace to some silt. The deposit generally contains trace to some clay and trace to some gravel. Within the sand to silty sand deposit in Borehole S204-14, boulders up to about 0.4 m thick were encountered at about Elevation 155.6 m and 157.9 m. The top of the silt to sand deposit ranges from about Elevation 157.5 m to 143.2 m and the thickness of the deposit ranges from about 2.3 m to 6.4 m. Boreholes S204-06 and S204-16 to S204-18 were terminated within this deposit; where as in Boreholes S204-14 and S204-15, the bottom of this deposit was defined by refusal to further split-spoon and/or casing advancement.

The SPT 'N'-values recorded within this deposit range from 4 blows to 34 blows per 0.3 m of penetration, generally indicating a loose to dense relative density; however, an .SPT 'N'-value of 154 blows per 0.3 m of penetration was recorded at the bottom of Borehole S204-14.

The natural water content measured on samples of this deposit ranges from about 11 per cent to 27 per cent.

The grain size distributions of five (5) samples from the silt to sand and silt to silty sand portion of this deposit and a grain size distribution of one (1) sample of the sand portion of the deposit are shown on Figures D.S204-25A and Figure D.S204-25B, respectively in Appendix D.

Bedrock / Refusal

Bedrock outcrops and knobs are present along the southern limit of the investigated area. In Borehole S204-10 located at about STA 11+700, bedrock was confirmed by exposure by shovel excavation of the layer of topsoil encountered at the ground surface. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon and/or auger/casing advancement and shovel excavation or dynamic cone penetration between depths of about 0.2 m and 35.4 m below the ground surface, corresponding to between about Elevation 184.6 m and 145.7 m. In general, refusal was encountered at greater depth towards the northern limit of the swamp crossing/high fill area between about STA 11+785 and 11+800.

Bedrock was encountered at a depth of about 6 m, corresponding to Elevation 175.9 m, and core samples were recovered from Borehole S204-12. A photograph of the recovered samples is presented on Figure D.S204-26. The bedrock generally consist of granite gneiss and the core samples are described as fresh, medium crystalline, slightly porous, strong, foliated, pink, grey and black. The Rock Quality Designation (RQD) measured on the core samples is about 94 per cent, indicating a rock mass of excellent quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of the core samples are about 90 per cent and 94 per cent, and about 97 per cent and 100 per cent, respectively.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the boreholes upon completion of drilling range from about Elevation 182.8 m to 177.2 m measured at depths between about 0.8 m to 3.8 below ground surface.

4.11 Highway 69 SBL – STA 12+200 to 12+375 (Swamp 205)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 SBL alignment showing the borehole locations and interpreted stratigraphy between about STA 12+200 and 12+375 in the Township of Henvey are shown on Drawing E1 in Appendix E. The alignment extends across a swamp crossing/high fill area and the proposed highway embankment will be up to about 5 m high above existing grade. A total of fifteen (15) boreholes (Boreholes S205-01 to S205-15, inclusive) and nine (9) Dynamic Cone Penetration Tests (DCPTs S205-DC01 to S205-DC07, S205-DC05A and S205-DC06A) were completed to investigate the subsurface conditions within this swamp crossing/high fill area. The topography of this section of the proposed highway is gently sloping downward to the north, with the ground cover consisting of wet grassy areas, bedrock knobs, shrubs and shallow open water; and upward sloping, moderately tree covered terrain to the north of the swamp crossing/high fill area. Towards the northern limit of the swamp crossing/high fill area between about STA 12+250 and 12+375, the natural terrain of the area is undulating, and the ground surface elevation across this area is highly variable.

Ice and/or water were encountered at the surface in most of the boreholes advanced near the west toe of the proposed embankment. The subsurface soils along the SBL alignment in Swamp 205 generally consist of surficial layers of peat and topsoil at the ground surface or below the ice and water cover, underlain by a deposit of sand to silty sand in places. The peat/topsoil layer and/or the sand to silty sand deposit are underlain by a thick deposit of clayey silt to clay, which in turn is underlain by a deposit of silt to sand. At one location, the silt deposit grades to a gravelly sand and silt prior to refusal to split-spoon and casing advancement. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths of up to about 11.3 m below ice surface at about STA 12+300. Bedrock outcrops and knobs are present across the site and towards the north, south and west ends of the swamp crossing/high fill area.

Ice / Water

Ice, in places over ponded water, to depths between about 0.1 m and 0.3 m was encountered at the surface in Boreholes S205-07 to S205-09 and S205-12 at the time of the investigation.

Peat / Topsoil

An approximately 0.1 m to 0.3 m thick root mat and an about 0.3 m to 0.4 m thick layer of brown to black fibrous peat containing rootlets and wood fragments was encountered at the ground surface in Boreholes S205-02, S205-04, S205-06 and underlying the ice or water in Boreholes S205-07 to S205-09. An approximately 0.1 m to 0.4 m thick layer of topsoil was encountered at the ground surface in Boreholes S205-01, S205-03, S205-05, S205-10, S205-11 and S205-14, and below the ice cover in Borehole S205-12. The top of the peat or topsoil deposit ranges from about Elevation 189.4 m to 184.9 m. In Boreholes S205-04 and S205-10, bedrock was exposed below the peat and topsoil by shovel (hand) excavation.

The SPT 'N'-values measured within the peat deposit range from 1 blow to 5 blows per 0.3 m of penetration, indicating a very soft to firm consistency.

The natural water content measured on five (5) samples of the peat ranges from about 34 per cent to 688 per cent, whereas, the natural water content measured on a specimen of topsoil is about 93 per cent.

Sand to Silty Sand

A deposit of brown sand trace to some silt to silty sand containing trace gravel, trace to some clay, rootlets, organics and wood fragments was encountered underlying the topsoil in Boreholes S205-01, S205-03, S205-11 and S205-12, and underlying the peat deposit in Borehole S205-02. The top of this deposit ranges from about Elevation 189.3 m to 184.7 m and the thickness of the deposit ranges from about 0.1 m to 0.4 m in Boreholes S205-01 to S205-03 and S205-11, and is about 1.1 m in Borehole S205-12 where the deposit was fully penetrated. Borehole S205-01 was terminated within this deposit upon refusal to further split-spoon advancement.

The SPT 'N'-values measured within this deposit typically range from 2 blows to 9 blows per 0.3 m of penetration, with one 'N'-value of 26 blows per 0.13 m of penetration recorded prior to split-spoon refusal in Borehole S205-01, generally indicating a very loose to loose relative density.

The natural water content measured on samples of this deposit ranges from about 20 per cent to 26 per cent.

A grain size distribution of one (1) sample from the sand portion of this deposit is shown on Figure E.S205-01 in Appendix E.

Clayey Silt to Clay

A deposit of cohesive soil comprised of brown to grey clayey silt, silty clay and clay was encountered either below the peat/topsoil or below the sand deposit in Boreholes S205-02 to S205-10, S205-11, S205-12 and S205-14. The deposit generally contains trace to some gravel, trace to some sand, silt interlayers, and rootlets and wood fragments within the upper approximately 2.1 m. In Boreholes S205-02, the cohesive deposit is interlayered with an approximately 0.8 m thick deposit of sand. The top of the cohesive deposit ranges from about Elevation 188.1 m to 183.6 m and the thickness of the deposit ranges from about 1.0 m to 8.5 m being thickest in Borehole S205-09 advanced near the middle of the swamp crossing/high fill area. The bottom of this deposit was defined by refusal to further split-spoon advancement in Boreholes S205-03, S205-06, S205-08, S205-11 and S205-12 and dynamic cone penetration in DCPTs advanced adjacent to Boreholes S205-11 and S205-12.

The SPT 'N'-values measured within the clayey silt to clay deposit range from 1 blow to 15 blows per 0.3 m of penetration, but are typically less than 5 blows per 0.3 m of penetration, with a value of 50 blows per 0.13 m of penetration recorded at the bottom of Borehole S205-12. In situ field vane tests carried out within this deposit measured undrained shear strengths ranging from about 20 kPa to greater than 132 kPa, but are typically less than 100 kPa, and the sensitivity is calculated to range from about 2 to 5. The field vane tests results indicate that the clayey silt to clay deposit has a soft to very stiff consistency.

The natural water content measured on samples of this deposit ranges from about 20 per cent to 79 per cent.

Atterberg limits tests were carried out on ten (10) specimens of the cohesive deposit and indicate liquid limits ranging from about 21 per cent to 69 per cent, plastic limits ranging from about 15 per cent to 24 per cent and plasticity indices ranging from about 4 per cent to 45 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figures E.S205-02A and E.S205-02B in Appendix E and indicate the material ranges from clayey silt of low plasticity to clay of high plasticity.

A laboratory consolidation test was carried out on one (1) specimen of the clay deposit obtained from a Shelby tube sample in Borehole S205-07. A preconsolidation stress of about 55 kPa was estimated from the void ratio versus logarithmic pressure plot and from the total work versus pressure plot. A bulk unit weight of about 15.3 kN/m^3 and a specific gravity of about 2.74 were measured on the consolidation test specimen. Details of the test results are shown on Figure E.S205-03 in Appendix E, and are summarized below.

Borehole Sample No.	Sample Depth / Elevation	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_p' - \sigma_{vo}'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Borehole S205-07 Sample 4	4.1 m / 182.7 m	20	55	35	2.8	1.0	0.12	2.10	5.6 x 10^{-4}

Note: * For stress range between effective overburden stress and final stress due to 5.0 m high embankment, that is 20 kPa ≤ σ_v' ≤ 115 kPa

where: σ_{vo}' is the in situ vertical effective overburden stress in kPa
σ_p' is the preconsolidation stress in kPa
σ_v' is the vertical effective stress in kPa
OCR is overconsolidation ratio
e_o is initial void ratio
C_c is the compression index
C_r is the recompression index
c_v is the coefficient of consolidation in cm^2/s

As noted above, a 0.8 m thick layer of brown sand, trace gravel and trace silt containing pockets of clayey was encountered within the deposit of clayey silt to clay in Borehole S205-02 at about Elevation 186.2 m. A SPT 'N'-value of 3 blows per 0.3 m of penetration was recorded in this layer, indicating a very loose relative density.

Silt to Sand

A deposit of cohesionless soil comprised of brown to grey silt trace to some sand, silty sand and sand was encountered underlying the deposit of clayey silt to clay in Boreholes S205-02, S205-05, S205-07, S205-09 and S205-14. The deposit generally contains trace to some gravel, trace to some clay, rootlets and wood fragments. The top of this deposit ranges from about Elevation 187.1 m to 177.4 m and the thickness of the deposit ranges

from about 0.3 m to 1.8 m. Boreholes S205-02, S205-05, S205-07 and S205-14 were terminated within this deposit upon refusal to further split-spoon advancement.

The SPT 'N'-values measured within this deposit range from 7 blows to 44 blows per 0.3 m of penetration, with SPT 'N'-values of 50 blows per 0.03 m of penetration, 75 blows per 0.1 m of penetration and 100 blows per 0.13 m recorded at the bottom of Boreholes S205-05, S205-07 and S205-14, generally indicating loose to very dense relative density.

The natural water content measured on four (4) samples of this deposit ranges from about 16 per cent to 24 per cent.

A grain size distribution of one (1) sample of the silt portion of this deposit is shown on Figure E.S205-04 in Appendix E.

Gravelly Silty Sand

The silt to sand deposit encountered in Borehole S205-09 is underlain by a deposit of grey gravelly silty sand, trace clay and containing silty sand interlayers. The top of this deposit is at about Elevation 176.3 m, the thickness of the deposit is about 1.1 m, and it extends to the bottom of the borehole on refusal to split-spoon and casing advancement.

A SPT 'N'-value recorded within this deposit is 27 blows per 0.3 m of penetration, indicating a compact relative density.

The natural water content measured on one (1) sample of this deposit is about 13 per cent.

A grain size distribution of one (1) sample of this deposit is shown on Figure E.S205-05 in Appendix E.

Bedrock / Refusal

Bedrock outcrops and knobs are present to the north, south and west edges of this swamp crossing/high fill area. In Boreholes S205-04 and S205-10, bedrock was confirmed by exposure by shovel excavation of the thin layers of peat and topsoil, while Boreholes S205-13 and S205-15 and DCPT S205-DC01 are located on bedrock outcrops. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon and/or casing advancement and shovel excavation or dynamic cone penetration to a depth of about 11.2 m below ground surface (11.3 m below ice surface), that is between about Elevation 191.4 m and 175.2 m. In general, refusal was encountered at greater depth towards the middle of the swamp crossing/high fill area between about STA 12+275 and 12+300.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the boreholes upon completion of drilling range from about Elevation 187.4 m to 185.0 m, measured either at the ice or ground surface and to a depth of 1.2 m below the ground surface, with the exception of shovel excavation in Boreholes S205-04 and S205-10 where the water level was not noted upon completion of excavation, and Borehole S205-01 which was observed to be dry upon completion of drilling.

4.12 Highway 69 NBL – STA 12+750 to 12+825 (Swamp 206)

The plan and profiles along the centreline and toes of the proposed embankment of the new Highway 69 NBL alignment showing the borehole locations and interpreted stratigraphy between about STA 12+750 and 12+825 in the Township of Henvey are shown on Drawing F1 in Appendix F. The overall alignment extends across a high fill section 25 m long extending northerly from STA 12+750 to 12+775 and a swamp area about 50 m long from STA 12+775 to 12+825. The proposed embankment in this area will be up to about 5 m high above the existing ground surface. A total of seven (7) boreholes (Boreholes S206-01 to S206-07, inclusive) and six (6) Dynamic Cone Penetration Tests (DCPTs S206-DC01 to S206-DC04, S206-DC01A and S206-DC03A) were completed to investigate the subsurface conditions within the swamp crossing/high fill area. The topography of this section of the proposed highway is undulating, consisting of bedrock knobs and a low-lying swampy area towards the north east section of the site limits, and the ground cover is comprised of bare rock, shrubs and moderately treed areas. As a result of the varying nature of the terrain within this section of the proposed highway, the ground surface elevation across the site is highly variable.

The subsurface soils along the NBL alignment in the swamp crossing/high fill area in Swamp 206 generally consist of surficial layers of peat and topsoil at the ground surface or below ice cover, underlain by a deposit of sand to sandy silt, underlain by inferred bedrock. At one location within the swamp limits, the topsoil is underlain by a deposit of clayey silt which extends to refusal to split-spoon advancement. Resistance to dynamic cone penetration, shovel excavation and borehole advancement, was encountered at depths up to about 2.1 m below ground surface, being deepest at about STA 12+800. Bedrock outcrops and knobs are present along the southeast limit of the investigated area.

Ice / Water

Ice and water cover to a depth of 0.3 m was encountered at the surface in Borehole S206-04 at the time of investigation.

Peat / Topsoil

An approximately 0.3 m thick layer of dark grey fibrous peat containing rootlets and an approximately 0.1 m to 0.2 m thick layer of topsoil was encountered at the ground surface or below the ice and water cover in Boreholes S206-01 to S206-06. The top of the peat/topsoil ranges from about Elevation 189.2 m to 186.1 m. In Borehole S206-02, bedrock was exposed by shovel (hand) excavation.

Two SPT 'N'-values of 2 blows per 0.3 m of penetration were measured within the peat layer and at the interface of the topsoil and underlying clayey silt layers, indicating a very soft consistency.

The natural water content measured on a specimen of the topsoil layer is about 153 per cent.

Sand to Sandy Silt

A deposit of cohesionless soil comprised of brown to grey sand trace silt, sand and silt and sandy silt was encountered below the topsoil in Boreholes S206-01, S206-03 and S206-05, and below the peat in Borehole S206-06. The deposit generally contains trace to some gravel, trace to some clay, rootlets, topsoil and organics. The top of this deposit ranges from about Elevation 189.0 m to 185.8 m and the thickness of the

deposit ranges from about 0.3 m to 1.6 m. These boreholes were terminated within this deposit upon refusal to further split-spoon advancement and dynamic cone penetration.

The SPT 'N'-values measured within this deposit range from 2 blows to 29 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on samples of this deposit ranges from about 9 per cent to 26 per cent. In general, the near surface portion of this deposit was observed to be slightly organic and laboratory testing on specimens of the sand to sand and silt deposit from Borehole S206-03 measured organic contents of about 2 per cent and 3 per cent.

The grain size distributions of two (2) samples of the sand and silt portion of this deposit are shown on Figure F.S206-01 in Appendix F.

Clayey Silt

A cohesive deposit of grey clayey silt, trace sand and containing rootlets, was encountered underlying the topsoil in Borehole S206-04. The top of this deposit is at about Elevation 186.1 m and the thickness of the deposit is about 0.4 m. The bottom of this deposit was defined by refusal to further split-spoon advancement.

The SPT 'N'-value measured at the interface of the topsoil layer and clayey silt deposit is 2 blows per 0.3 m of penetration and at the bottom of the borehole, SPT 'N'-value of 75 blows per 0.1 m of penetration, generally indicating a very soft to very stiff consistency.

The natural water content measured on one (1) sample of this clayey silt deposit is about 31 per cent.

An Atterberg limits test carried out on one (1) specimen of the clayey silt deposit yielded a liquid limit of about 29 per cent and a plastic limit of about 21 per cent, corresponding to a plasticity index of about 8 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure F.S206-2 in Appendix B and indicates the material to be clayey silt of low plasticity.

Bedrock / Refusal

Bedrock outcrops and knobs are present throughout the site and at the location of Boreholes S206-02 and S206-07, at about STA 12+765 and 12+825. The bedrock surface at the boreholes and DCPTs is inferred by refusal to further split-spoon advancement and shovel excavation or dynamic cone penetration at depths between about 0.1 m and 2.1 m below the ice cover or ground surface, corresponding to between about Elevation 188.5 m and 183.9 m. In general, refusal was encountered at greater depth near the northern limit of the swamp area between about STA 12+775 and 12+800.

Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the open boreholes upon completion of drilling range from about Elevation 188.3 m to 186.1 m, measured either at the ice or ground surface, with the exception of shovel excavation in Borehole S206-02 where the water level was not noted upon completion of excavating, and Borehole S206-05 which was observed to be dry upon completion of drilling.

5.0 CLOSURE

The field personnel supervising the drilling program were Messrs. Matt Rhody, Randy Axford and Indulis Dumpis. This report was prepared by Ms. T. Veronica Ayetan, P. Eng., and was reviewed by Mr. J. Paul Dittrich, Ph.D., P.Eng., a senior geotechnical engineer and Principal with Golder. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and Principal with Golder, conducted an independent quality control review of the report.

Report Signature Page

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Http://capws/sites/0911116014highway69FourLaning/Contract 2/Reporting/Final/Swamp Crossings and High Fill Areas/09-1111-6014-2520 RPT 12Jul30 Highway 69 Swamp Crossings and High Fill Areas.docx

LIST OF SYMBOLS

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

I.	**GENERAL**
π	3.1416
ln x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety
II.	**STRESS AND STRAIN**
γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility
III.	**SOIL PROPERTIES**
(a)	**Index Properties**
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

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

(a)	**Index Properties (continued)**
w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)
(b)	**Hydraulic Properties**
h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume
(c)	**Consolidation (one-dimensional)**
C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}
(d)	**Shear Strength**
τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

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

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d:

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

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Cohesionless Soils

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

(b) Cohesive Soils

Consistency

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

IV. SOIL TESTS

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

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

V. MINOR SOIL CONSTITUENTS

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

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN	Joint	PL	Planar
FLT	Fault	CU	Curved
SH	Shear	UN	Undulating
VN	Vein	IR	Irregular
FR	Fracture	K	Slickensided
SY	Stylolite	PO	Polished
BD	Bedding	SM	Smooth
FO	Foliation	SR	Slightly Rough
CO	Contact	RO	Rough
AXJ	Axial Joint	VR	Very Rough
KV	Karstic Void		
MB	Mechanical Break		

TABLES

Table 1: Summary of Swamp Crossings and High Fill Areas
Highway 69 Four-Laning

Foundation Investigation Area	Foundation Investigation Area Designation	Maximum Proposed Embankment Height[1]	Boreholes/DCPT
Highway 69 SBL STA 17+750 to 17+775	Swamp 201	4.0 m	3 Boreholes (S201-01 to S201-03) 1 DCPT (S201-DC01)
Highway 69 NBL STA 17+700 to 17+750	Swamp 201	4.0 m	8 Boreholes (S201-04 to S201-10 and S201-05A) 4 DCPTs (S201-DC02 to S201-DC04 and S201-DC03A)
Highway 69 SBL STA 11+175 to 11+275	Swamp 202	6.5 m	9 Boreholes (S202-01 to S202-09) 4 DCPTs (S202-DC01 to S202-DC04)
Highway 69 NBL STA 11+100 to 11+225	Swamp 202	6.5 m	11 Boreholes (S202-10 to S202-20) 3 DCPTs (S202-DC05 to S202-DC07)
Highway 69 SBL STA 11+350 to 11+375	Swamp 203	10 m Cut	3 Boreholes (S203-01 to S203-03) 3 DCPTs (S203-DC01, S203-DC01A and S203-DC01B)
Highway 69 NBL STA 11+375 to 11+400	Swamp 203	11 m Cut	3 Boreholes (S203-04 to S203-06) 3 DCPTs (S203-DC02, S203-DC03 and S203-DC03A)
Highway 69 SBL STA 11+725 to 11+825	Swamp 204	7.5 m	9 Boreholes (S204-01 to S204-09) 4 DCPTs (S204-DC01 to S204-DC04)
Highway 69 NBL STA 11+700 to 11+800	Swamp 204	7.5 m	9 Boreholes (S204-10 to S204-18) 4 DCPTs (S204-DC05 to S204-DC08)
Highway 69 SBL STA 12+200 to 12+375	Swamp 205	5.0 m	15 Boreholes (S205-01 to S205-15) 9 DCPTs (S205-DC01 to S205-DC07, S205-DC05A and S205-DC06A)
Highway 69 NBL STA 12+750 to 12+825	Swamp 206	5.0 m	7 Boreholes (S206-01 to S206-07) 6 DCPTs (S206-DC01 to S206-DC04, S206-DC01A and S206-DC03A)

Note:
1. Based on centreline profile of highway alignment and existing ground surface profiles provided by URS on November 28, 2011. Embankment height is approximate and is relative to top of peat/original ground.
2. Record of Boreholes sheets for C201-01 to C201-04 and C202-01 to C202-03 are not included in this report. Records of borehole sheets for these boreholes can be found in Golder Associates' Report "Foundation Investigation Report, Culverts – Contract 2, Highway 69 Four-laning from 1.7 km North of Highway 529 Northerly to 3.9 km North of Highway 522, Ministry of Transportation, Ontario, G.W.P. 5404-05-00" (Report No. 09-1111-6014-2521)

Prepared By: TVA

Reviewed By: JPD/JMAC

Table 2: Summary of Consolidation Test Parameters
Highway 69 Four-Laning

Foundation Investigation Area	Borehole and Sample No.	Elevation (m)	σ_{vo}' (kPa)	σ_p' (kPa)	$\sigma_{vo}' - \sigma_p'$ (kPa)	OCR	C_c	C_r	e_o	c_v^* (cm^2/s)
Highway 69 SBL Swamp 202	Borehole S202-07 Sample 7	176.1	85	85	0	1.0	1.69	0.13	2.16	1.3×10^{-4}
Highway 69 NBL Swamp 202	Borehole S202-17 Sample 7	172.1	100	100	0	1.0	1.19	0.14	2.14	4.9×10^{-4}
Highway 69 NBL Swamp 202	Borehole S202-20 Sample 11	173.0	75	100	25	1.3	1.20	0.12	1.86	5.5×10^{-5}
Highway 69 SBL Swamp 204	Borehole S204-05 Sample 17	160.1	190	285	95	1.5	1.00	0.08	1.57	1.1×10^{-3}
Highway 69 SBL Swamp 204	Borehole S204-07 Sample 20	150.9	270	305	35	1.1	0.65	0.07	1.25	2.7×10^{-3}
Highway 69 NBL Swamp 204	Borehole S204-14 Sample 13	168.1	95	155	60	1.6	0.87	0.06	1.46	2.7×10^{-3}
Highway 69 SBL Swamp 205	Borehole S205-07 Sample 4	182.7	20	55	35	2.8	1.0	0.12	2.10	5.6×10^{-4}

Note: *For stress range between sample in situ effective overburden stress and final stress due to embankment construction for all embankments (4.0 m to 8.5 m high) of 20 kPa ≤ σ_v' ≤410 kPa

where:
- σ_{vo}' is the effective overburden stress in kPa
- σ_p' is the preconsolidation stress in kPa
- σ_v' is the vertical effective stress in kPa
- OCR is overconsolidation ratio
- C_c is the compression index
- C_r is the recompression index
- e_o is initial void ratio
- c_v is the coefficient of consolidation in cm^2/s

Prepared By: TVA

Reviewed By: JPD/JMAC

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO

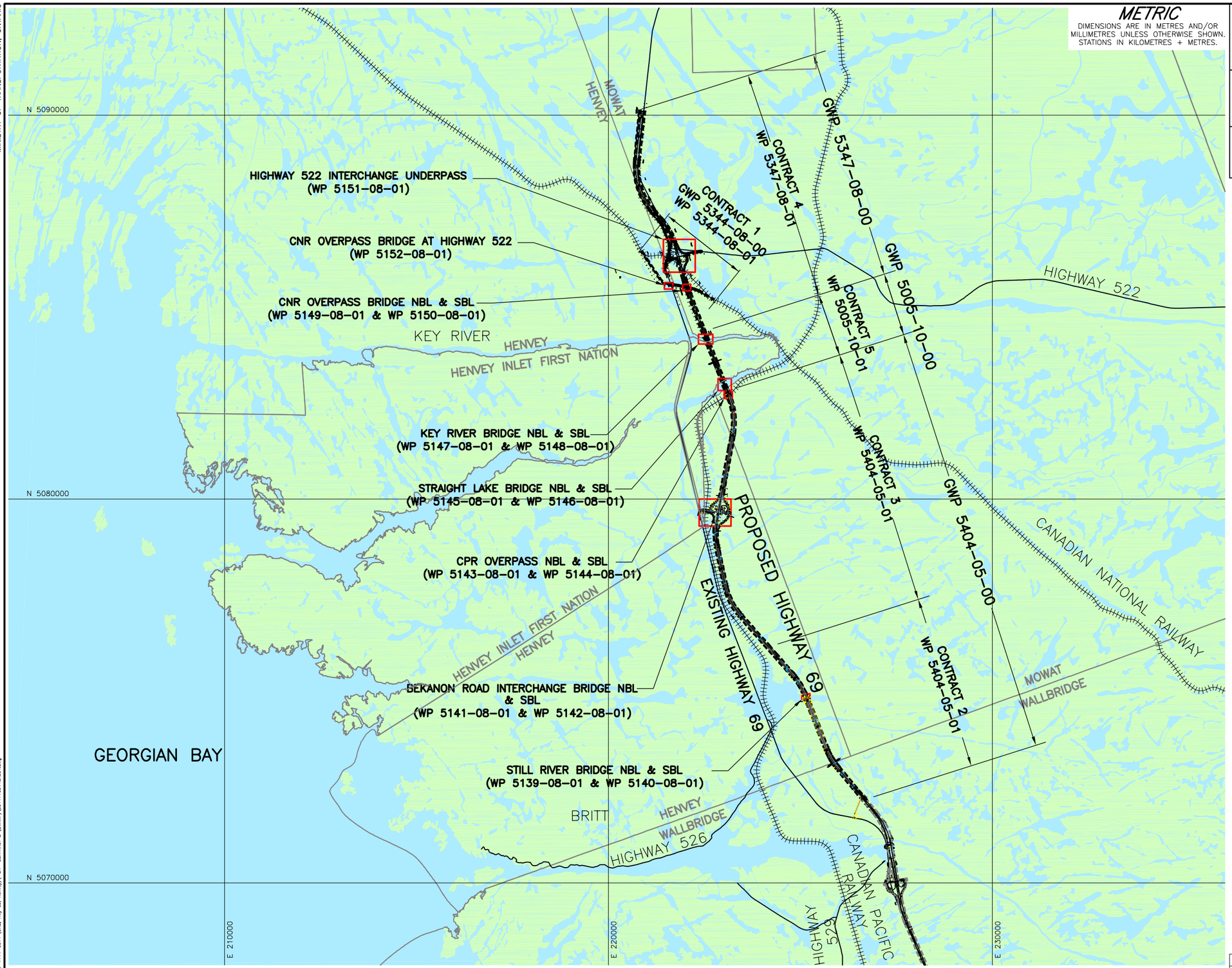
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 5404–05–00

SHEET

HIGHWAY 69
SITE LOCATION PLAN

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN

SCALE
1 0 1 2 km

KEY PLAN
NOT TO SCALE

REFERENCE

Base Data – MNR NRVIS, obtained 2004, CANMAP v2008
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Datum : NAD 83 Projection : MTM Zone 10

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69		PROJECT NO. 09–1111–6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. 1

PLOT DATE: July 30, 2012
FILENAME: f:\Projects\2009\08-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (ENVIRAP)\0911116014CA001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

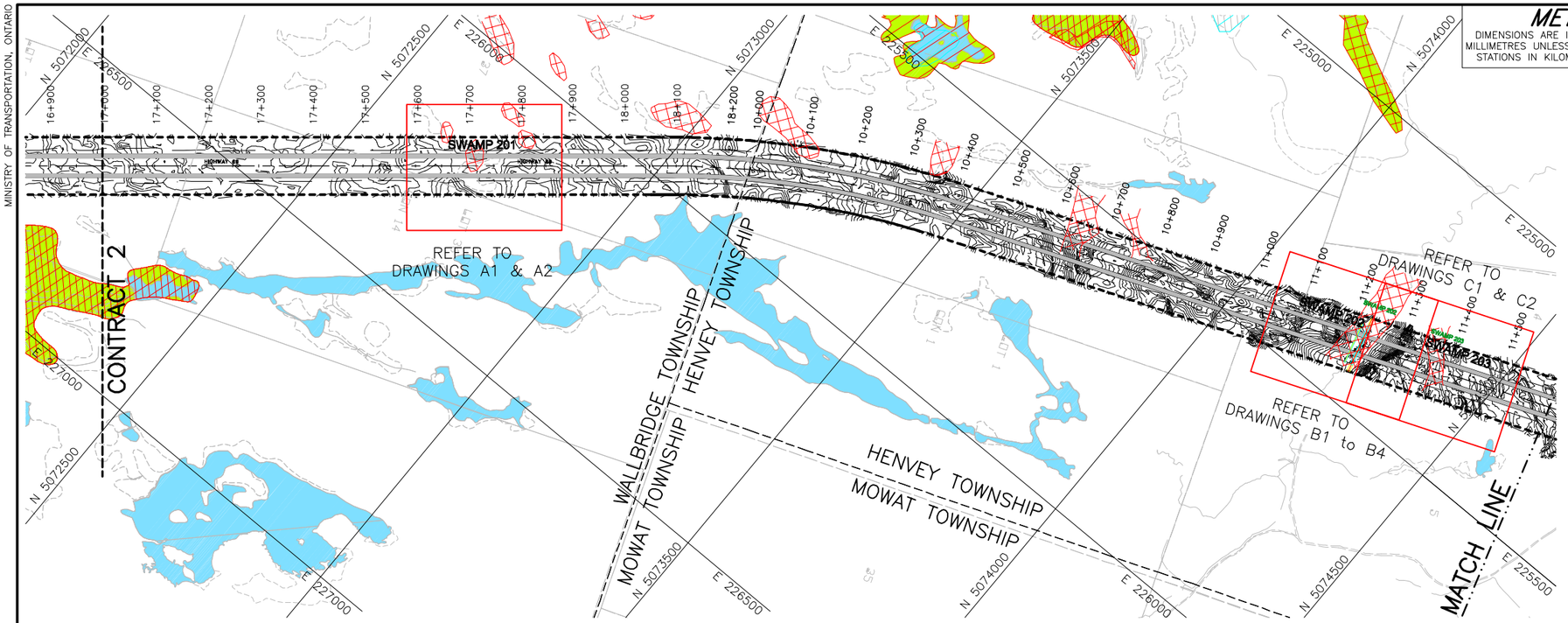
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404-05-01

HIGHWAY 69
SWAMP CROSSINGS AND HIGH FILL AREAS
INDEX PLAN

SHEET

Golder Associates
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN

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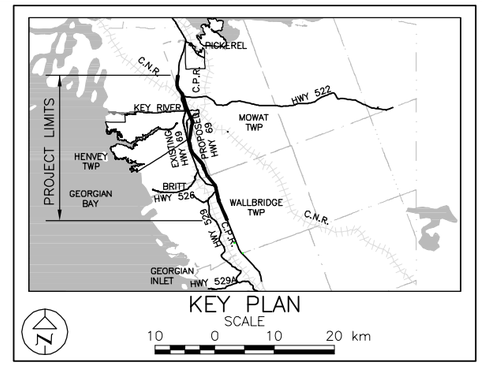

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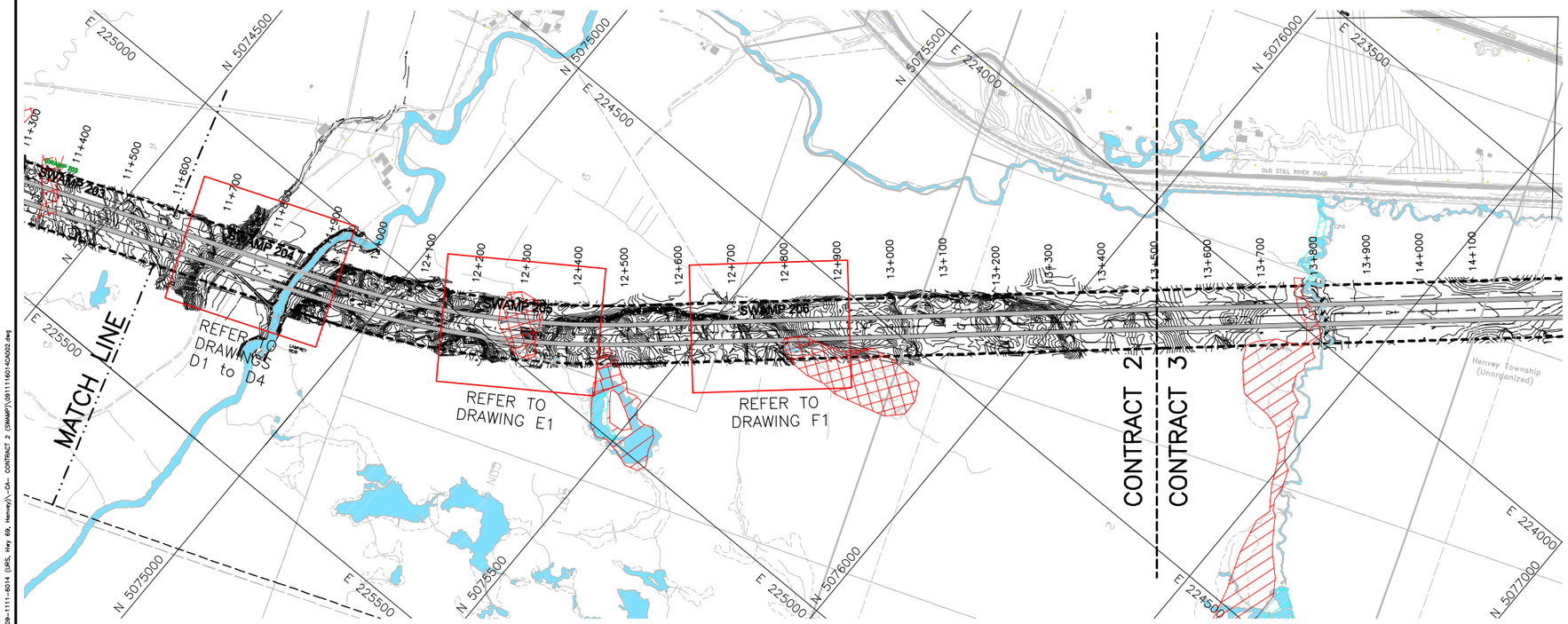


PLAN

SCALE
100 0 100 200 m

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009, Contour drawing file HWY69_Contours-Plan_C2_C3.dwg, received July 14, 2011

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69	PROJECT NO. 09-1111-6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. 2

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-CAD- CONTRACT 2 (SWAMP)\G8111601-KOA002.dwg

APPENDIX A

Highway 69 SBL – STA 17+750 to 17+775 and Highway 69 NBL – STA 17+700 to 17+750 (Swamp 201)

MINISTRY OF TRANSPORTATION, ONTARIO

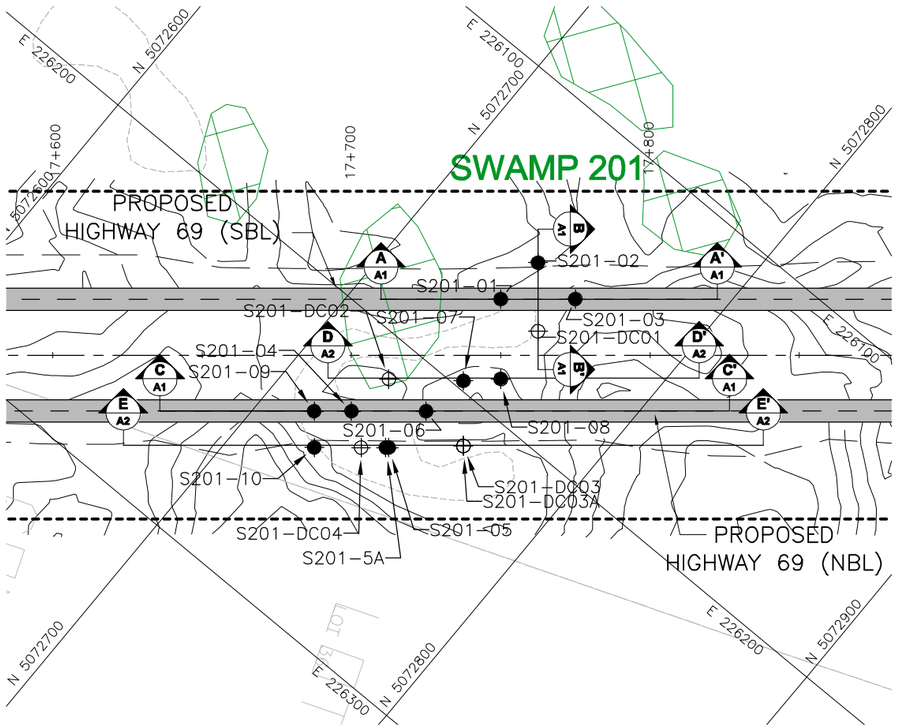
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404-05-01

SHEET

HIGHWAY 69
STA 17+750 TO 17+775 (SBL)
STA. 17+700 TO 17+750 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



PLAN
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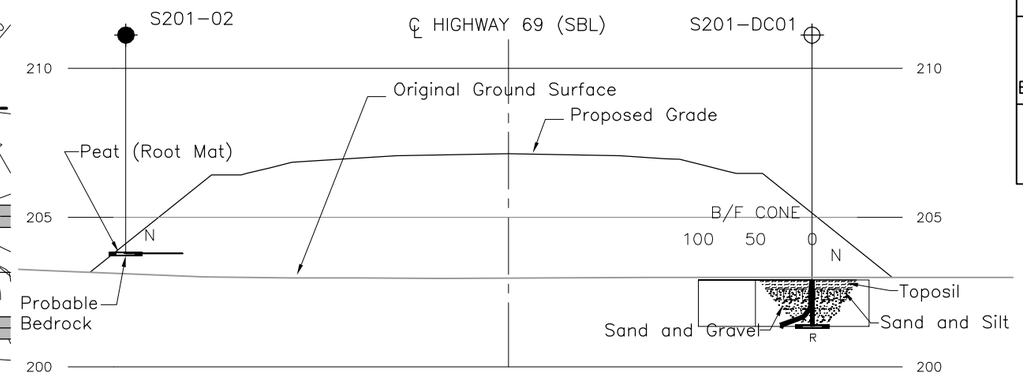
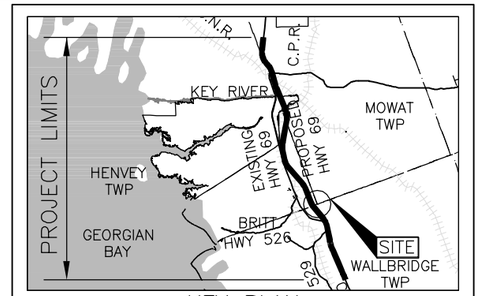
20 0 20 40 m



B-B' A1 CROSS-SECTION STA. 17+762.5
HIGHWAY 69 (SBL)

SCALE
2 0 2 4 m

Note: The Proposed Grade was provided in a digital format by URS, drawing file Hwy69_Contract2_xsections.dwg, received September 9, 2010.



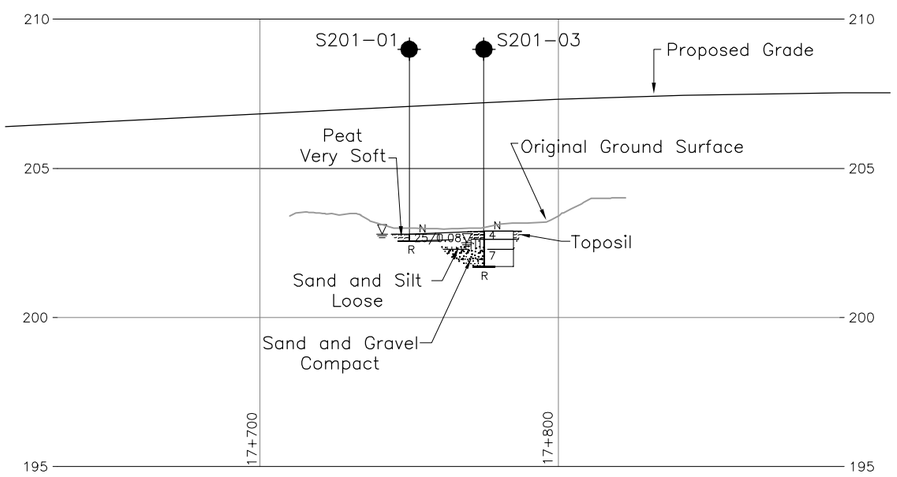
KEY PLAN
SCALE
6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R Refusal

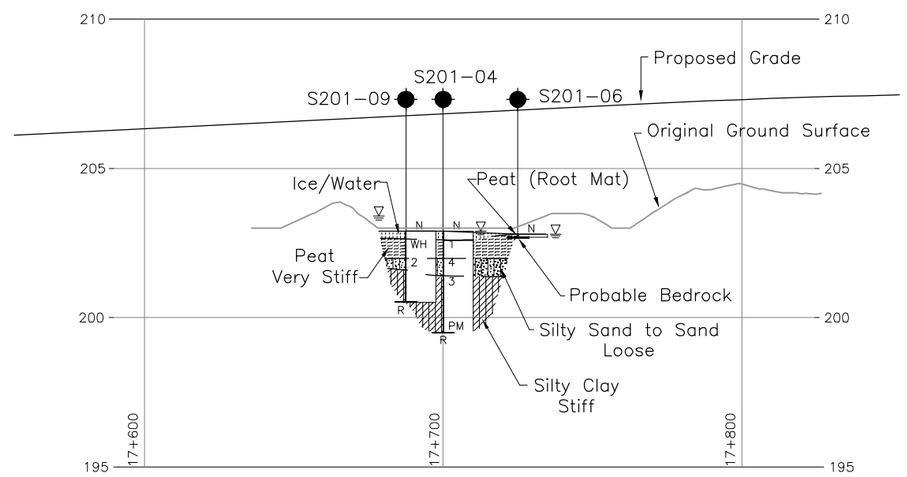
BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S201-01	202.8	5072740.2	226168.1
S201-02	203.8	5072742.0	226150.8
S201-03	202.9	5072759.4	226152.1
S201-04	202.9	5072725.8	226229.0
S201-05	202.9	5072743.2	226230.4
S201-5A	202.9	5072742.4	226231.0
S201-06	202.8	5072745.0	226213.0
S201-07	203.5	5072748.1	226197.2
S201-08	203.3	5072757.3	226188.7
S201-09	202.9	5072716.2	226237.0
S201-10	203.4	5072724.0	226246.3
S201-DC01	202.9	5072756.7	226168.4
S201-DC02	203.1	5072728.5	226212.7
S201-DC03	203.0	5072762.0	226214.0
S201-DC03A	203.0	5072762.0	226214.0
S201-DC04	202.9	5072736.1	226236.3



A-A' A1 CENTRELINE PROFILE
HIGHWAY 69 (SBL)

HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



C-C' A1 CENTRELINE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contour-Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile-nov-18-2011, received December 5, 2011.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69		PROJECT NO. 09-1111-6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC/CD	CHKD. CN	APPD. JPD/JMAC	DWG. A1

PLOT DATE: July 24, 2012
FILENAME: J:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ch- CONTRACT 2 (SWAMP)\09111601KA01.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404–05–01

SHEET

HIGHWAY 69
STA 17+690 TO 17+740 (NBL)
SOIL STRATA

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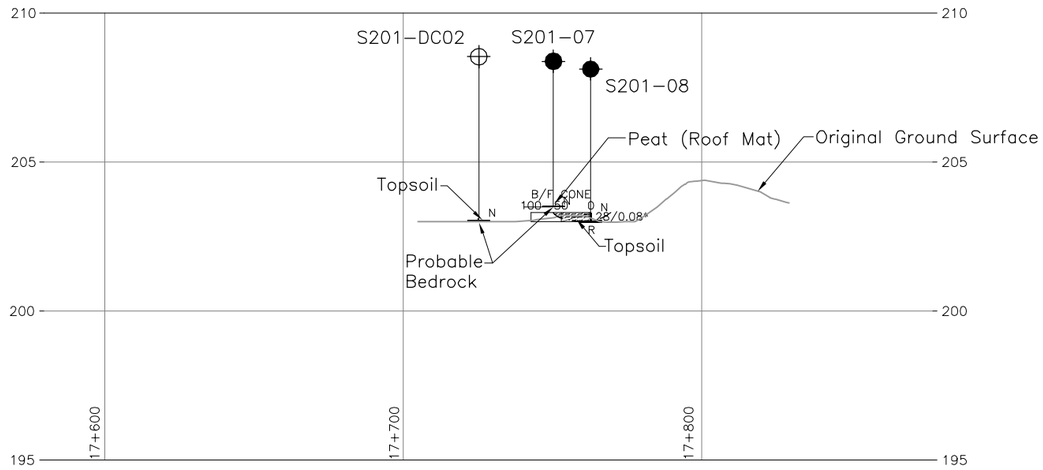
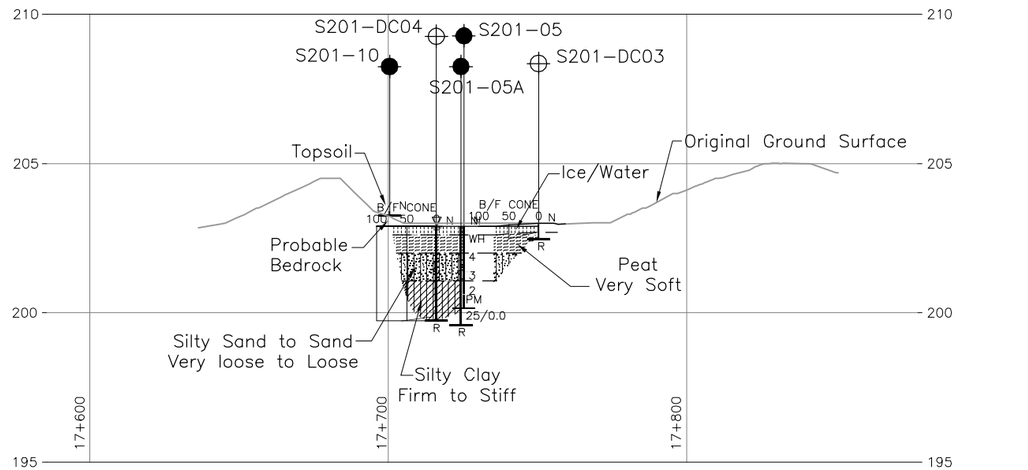
MISSISSAUGA, ONTARIO, CANADA



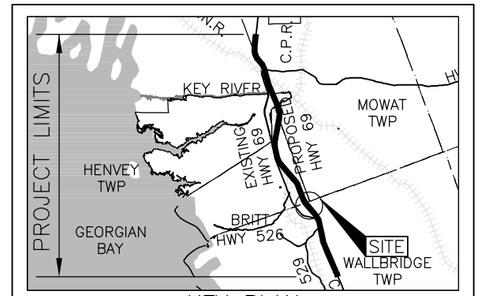
D-D' A2 EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



E-E' A2 EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



KEY PLAN
SCALE
6 0 6 12 km

LEGEND

●	Borehole – Current Investigation
⊕	Dynamic Cone Penetration Test
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
▽	WL upon completion of drilling
R	Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S201–05	202.9	5072743.2	226230.4
S201–05A	202.9	5072742.4	226231.0
S201–07	203.5	5072748.1	226197.2
S201–08	203.3	5072757.3	226188.7
S201–10	203.4	5072724.0	226246.3
S201–DC02	203.1	5072728.5	226212.7
S201–DC03	203.0	5072762.0	226214.0
S201–DC04	202.9	5072736.1	226236.3

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contours–Plan_C2_C3.dwg, received April 5, 2011

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69	PROJECT NO. 09–1111–6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. A2

PLOT DATE : July 24, 2012
FILENAME : I:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-C2- CONTRACT 2 (SWMP)\091111601 4CA02.dwg

Golder Associates

RECORD OF BOREHOLE No S201-01

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072740.2 ;E 226168.1
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY OK
DATUM Geodetic
DATE January 26, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
202.8	GROUND SURFACE										
0.0	PEAT, containing rootlets (Amorphous) Very soft Black Wet		1	SS	25/0.08				212		
0.4	END OF BOREHOLE SPOON REFUSAL										

END OF DCPT
Refusal to Further Penetration (Hammer Bouncing)

NOTES:

1. Water level in open borehole at ground surface (Elev. 202.8 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.0 m east of Borehole S201-01 to confirm depth to refusal; refusal encountered at a depth of 0.4 m below ground surface (Elev. 202.4 m).

3. Borehole and DCPT advanced using portable drilling equipment with a half-weight hammer. SPT 'N' value shown has been adjusted to reflect value that would be obtained with a standard weight hammer.

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

Golder Associates

RECORD OF BOREHOLE No S201-02

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5072742.0 ;E 226150.8
BOREHOLE TYPE Hand Excavation
DATE January 26, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

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	SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	w_P	w	w_L	γ kN/m³	GR SA SI CL
203.8	GROUND SURFACE												
0.0	PEAT (Root Mat)												
	END OF EXCAVATION PROBABLE BEDROCK												

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S201-03

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072759.4 ;E 226152.1
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY OK
DATUM Geodetic
DATE January 26, 2010
CHECKED BY TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.9	GROUND SURFACE										
0.0 / 202.6	TOPSOIL		1A	SS	4	▽					
202.3 / 0.6	SAND and SILT, trace gravel, trace clay, containing wood fragments, organics and rootlets Loose Brown Wet		1B						○		1 45 51 3
201.7 / 1.2	SAND and GRAVEL, trace to some silt, containing rootlets Loose Grey Wet		2	SS	7		202				
	END OF BOREHOLE SPOON REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 0.4 m below ground surface (Elev. 202.5 m) upon completion of drilling.

2. Borehole and DCPT advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

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

Golder Associates

RECORD OF BOREHOLE No S201-04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072725.8 ;E 226229.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Wash Boring, BW Casing	COMPILED BY	OK
DATUM	Geodetic	DATE	January 26, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.9	ICE SURFACE							
0.0	ICE							
	WATER							
0.3	PEAT, trace sand, containing rootlets (Amorphous) Very soft Dark Brown Wet	1	SS	1				
202.0						202		
0.9	SAND, trace silt, containing rootlets Loose Grey Wet	2	SS	4				
201.4								
1.5	SILTY CLAY Stiff Brown to grey Moist	3	SS	3		201		
						200		
199.5		4 5	TO SS	PM* 50/0.0				
3.4	END OF BOREHOLE SPOON REFUSAL							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

NOTES:

* Unable to recover a Shelby tube sample between depths of 3.0 m and 3.4 m.

1. Water level in open borehole at ice surface (Elev. 202.9 m) upon completion of drilling.

2. Upper 1.5 m of borehole advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

3. An additional borehole was drilled 1.0 m south of Borehole S201-04 to obtain a shelby tube sample between depths of 1.5 m and 2.0 m below ice surface (Elev 201.4 m and Elev 200.9 m).

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

Golder Associates

RECORD OF BOREHOLE No S201-05

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5072743.2 ;E 226230.4
BOREHOLE TYPE Portable Equipment
DATE January 26, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%) w	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
202.9	ICE SURFACE										
0.0	ICE										
0.3	WATER										
202.0	PEAT, containing wood fragments and rootlets (Amorphous) Very soft	1	SS	WH	202						
0.9	Dark brown Wet	2	SS	4		40		5	68	23	4
201.4	Silty SAND, trace gravel, trace clay, containing rootlets Loose	3A	SS	3							
201.1	Grey Wet	3B			201	40					
1.8	SAND, trace to some gravel, trace to some silt, some clay Very loose	4	SS	2							
200.2	Grey Wet										
2.7	SILTY CLAY, trace sand Soft to firm Grey Moist										
	END OF BOREHOLE										

NOTES:

1. Water level in open borehole at ice surface (Elev. 202.9 m) upon completion of drilling.

2. An additional borehole was drilled 1.0 m south of Borehole S201-05 to obtain a Shelby tube sample and to carry out in situ vane test; see Record of Borehole No. S201-05A for details.

3. Borehole advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

SOIL PROFILE | STRAT PLOT | SAMPLES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) | SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100) | PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L | WATER CONTENT (%) (20 40 60) | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%)

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

Golder Associates

RECORD OF BOREHOLE No S201-05A

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072742.4 ;E 226231.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, Wash Boring, BW Casing
COMPILED BY OK
DATUM Geodetic
DATE January 26, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
202.9	ICE SURFACE										
0.0	See Record of Borehole S201-05 for subsurface conditions within these elevations.						202				
							201				
200.6											
2.3	SILTY CLAY Firm Grey Moist		5	TO	PM						
			6	SS	25/0.0		200	+ 4			
199.6											
3.3	END OF BOREHOLE SPOON REFUSAL										

NOTE:

1. Unable to push in situ vane past a depth of 3.3 m below ice surface (Elev. 199.6 m).

3. Borehole advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S201-06

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5072745.0 ;E 226213.0
BOREHOLE TYPE Hand Excavation
DATE January 26, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
202.8	GROUND SURFACE												
0.0	PEAT (Root Mat)												
0.1	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Water level in excavation at ground surface (Elev. 202.8 m).

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S201-07

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072748.1 ;E 226197.2
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 26, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P — w — w_L WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
203.5	GROUND SURFACE										
0.0	PEAT (Root Mat)										
	END OF EXCAVATION PROBABLE BEDROCK										

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

3. Bedrock outcrop noted within the vicinity of Borehole S201-07.

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

Golder Associates

RECORD OF BOREHOLE No S201-08

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072757.3 ;E 226188.7
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE Portable Equipment, Uncased
COMPILED BY OK
DATUM Geodetic
DATE January 26, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
203.3	GROUND SURFACE										
0.0	TOPSOIL		1	SS	28/0.08[1]		203		○		
0.3	END OF BOREHOLE SPOON REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Open borehole dry upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.0 m west of Borehole S201-08, refusal encountered at a depth of 0.3 m below ground surface (Elev. 203.0 m).

3. Borehole and DCPT advanced using portable drilling equipment with a half-weight hammer. SPT 'N' value shown has been adjusted to reflect value that would be obtained with a standard weight hammer.

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

Golder Associates

RECORD OF BOREHOLE No S201-09

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072716.2 ;E 226237.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE January 27, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
202.9	ICE SURFACE										
0.0	ICE										
0.2	WATER										
	PEAT, containing rootlets (Amorphous) Very soft Dark brown Wet		1	SS	WH				685		
202.0							202				
201.7			2A 2B	SS	2						
1.2	Silty SAND, trace to some gravel, containing rootlets Very loose Grey Wet						201	5 + 5 +			
200.5	SILTY CLAY, trace to some sand, containing rootlets Stiff Grey Moist		3	SS	50/0.0						
2.4	END OF BOREHOLE SPOON REFUSAL										

NOTE:

1. Water level in open borehole at ice surface (Elev. 202.9 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S201-10

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5072724.0 ;E 226246.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 27, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
203.4	GROUND SURFACE												
0.0	TOPSOIL												
0.2	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTE:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

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

Golder Associates

RECORD OF DCPT No S201-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072756.7 ;E 226168.4	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 26, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
202.9	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						202				
201.4											
1.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.										

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

Golder Associates

RECORD OF DCPT No S201-DC02

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072728.5 ;E 226212.7	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Hand Excavation	COMPILED BY	OK
DATUM	Geodetic	DATE	January 26, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
203.1	GROUND SURFACE										
0.0	TOPSOIL										
0.1	END OF EXCAVATION PROBABLE BEDROCK NOTE: 1. Bedrock outcrop observed in the vicinity of the DCPT; bedrock confirmed by hand excavation at the DCPT location. 2. Excavation dry upon completion.										

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

Golder Associates

RECORD OF DCPT No S201-DC03

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072762.0 ;E 226214.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 26, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
203.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
202.5											
0.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTES: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer. 2. An additional Dynamic Cone Penetration Test was driven adjacent to DCPT S201-DC03; See Record of DCPT S201-DC03A for details.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S201-DC03A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072762.0 ;E 226214.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 26, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
203.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
202.4											
0.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.										

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

Golder Associates

RECORD OF DCPT No S201-DC04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5072736.1 ;E 226236.3	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 27, 2010	CHECKED BY	TVA

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	SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	w_P	w	w_L	γ kN/m³	GR SA SI CL
202.9	GROUND SURFACE												
0.0	Dynamic Cone Penetration Test (DCPT)						202 / 201 / 200						
199.7													
3.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)												

+ 3, × 3: Numbers refer to Sensitivity

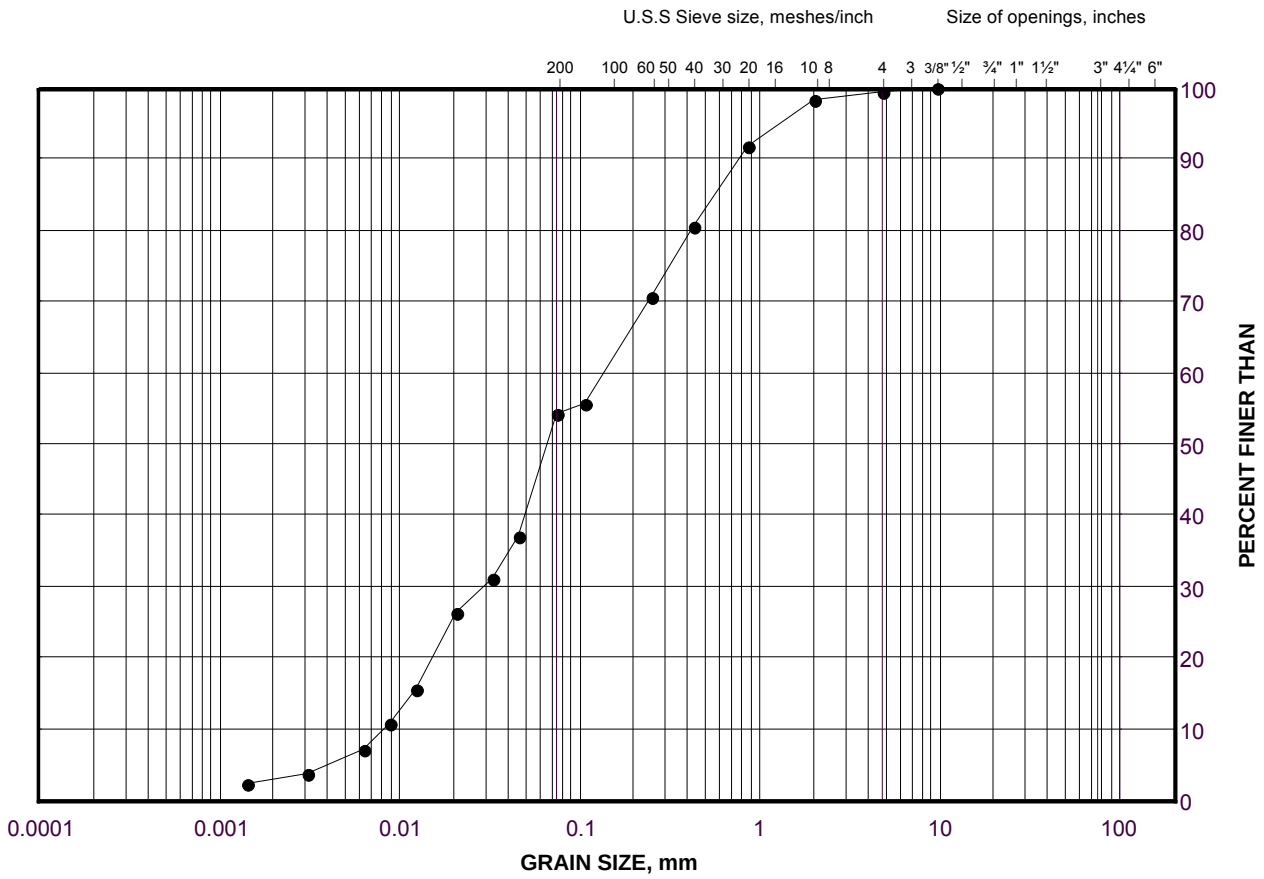
○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Sand and Silt

Highway 69 (SBL) STA 17+750 to 17+775 (Swamp 201)

FIGURE A.S201-01



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S201-03	1B	202.5

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

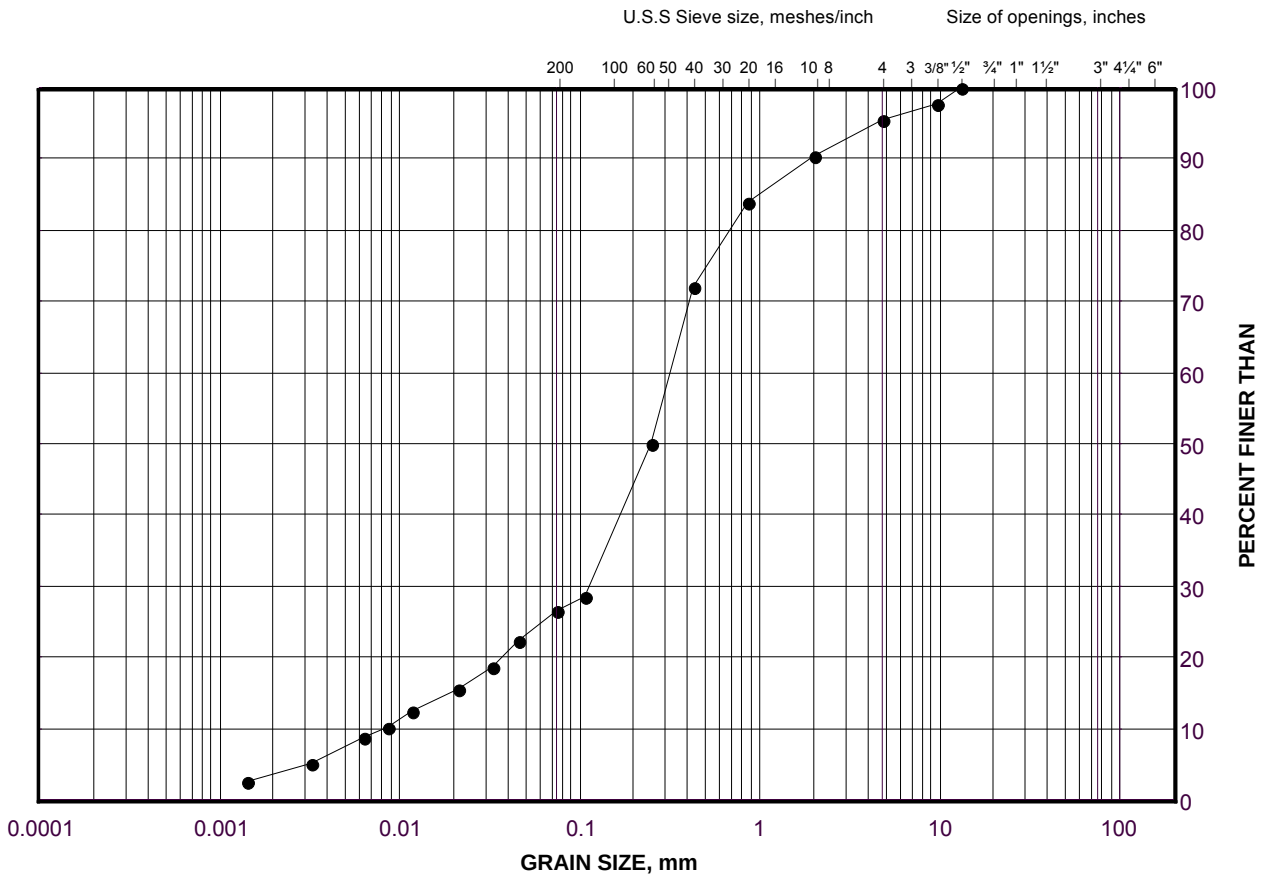
Date: 17-May-11

GRAIN SIZE DISTRIBUTION

Silty Sand

Highway 69 (NBL) STA 17+700 to 17+750 (Swamp 201)

FIGURE A.S201-02



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S201-05	2	201.7

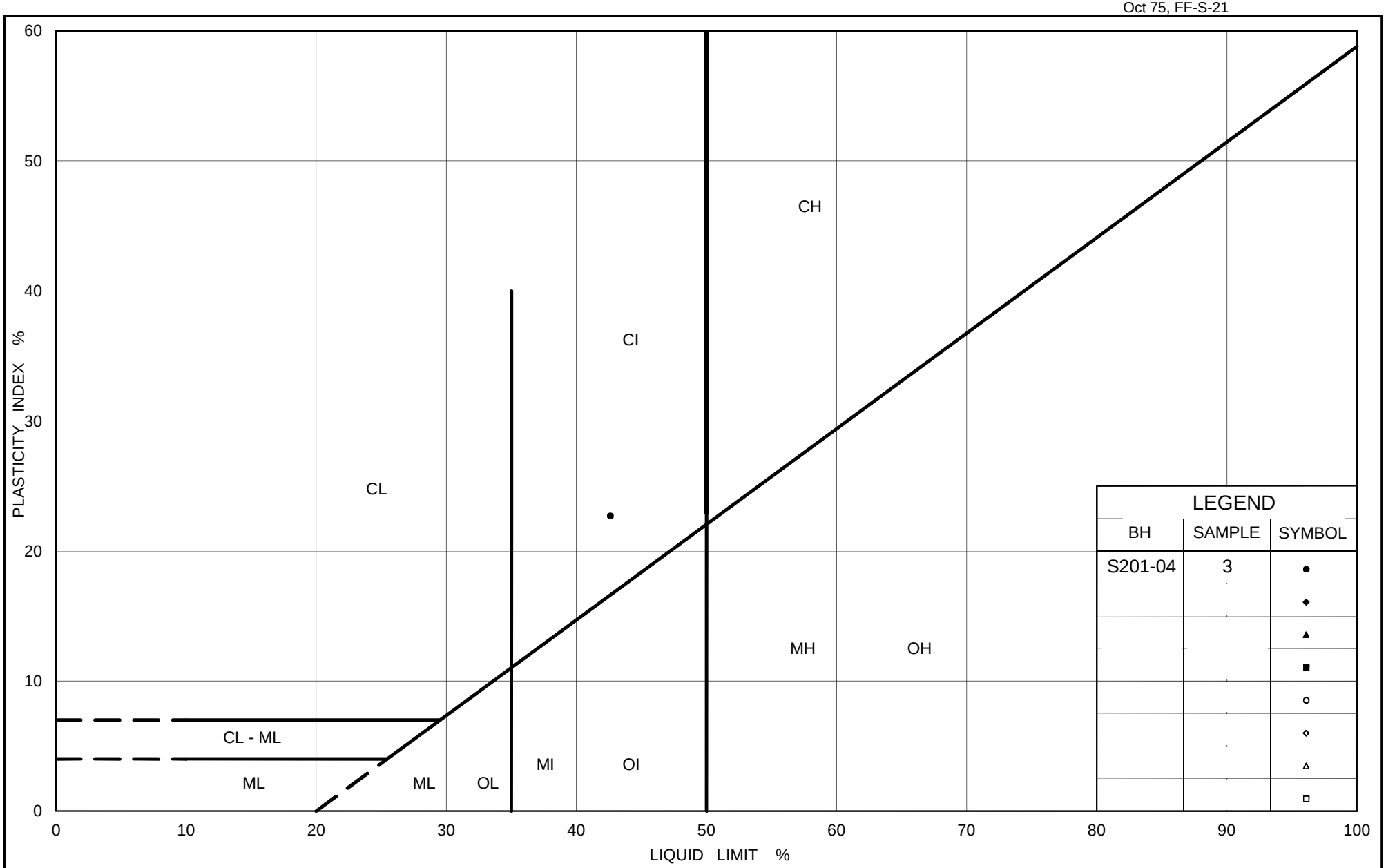
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Silty Clay
Highway 69 (SBL) STA 17+700 to 17+750 (Swamp 201)

Figure No. A.S201-03

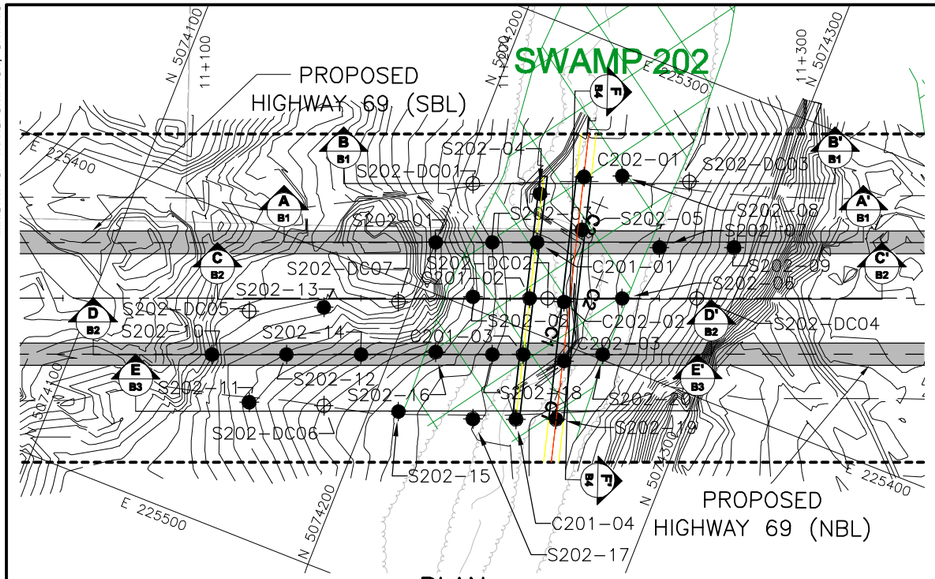
Project No. 09-1111-6014

Checked By: TVA

APPENDIX B

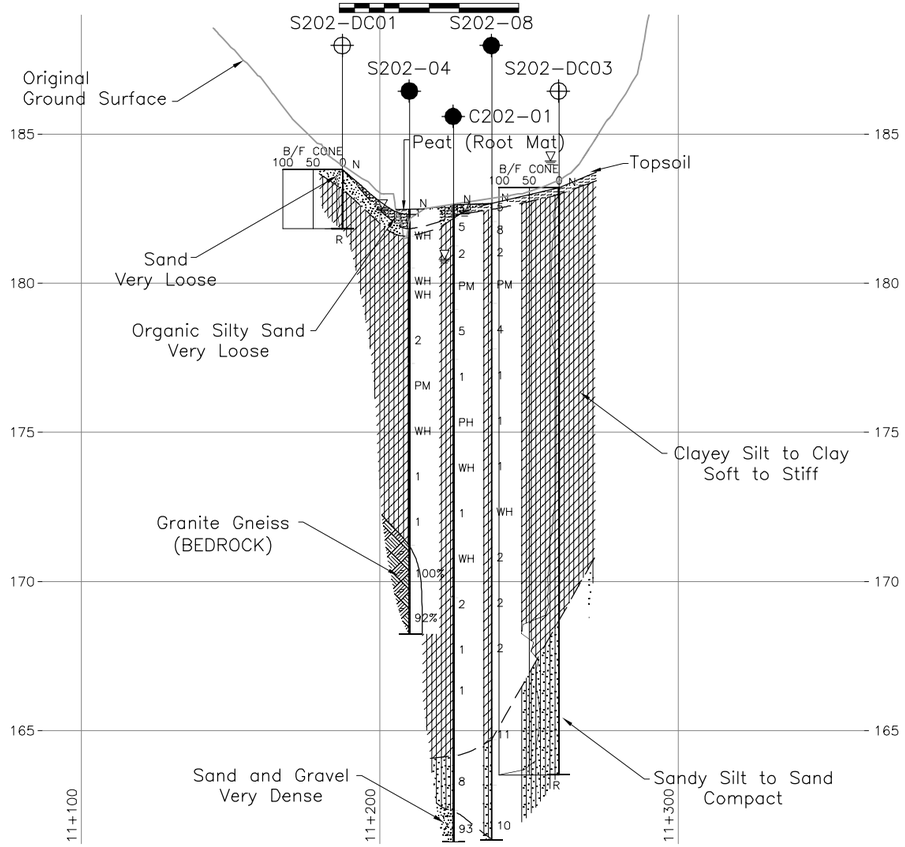
Highway 69 SBL – STA 11+175 to 11+275 and Highway 69 NBL – STA 11+100 to 11+225 (Swamp 202)

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE 20 0 20 40 m



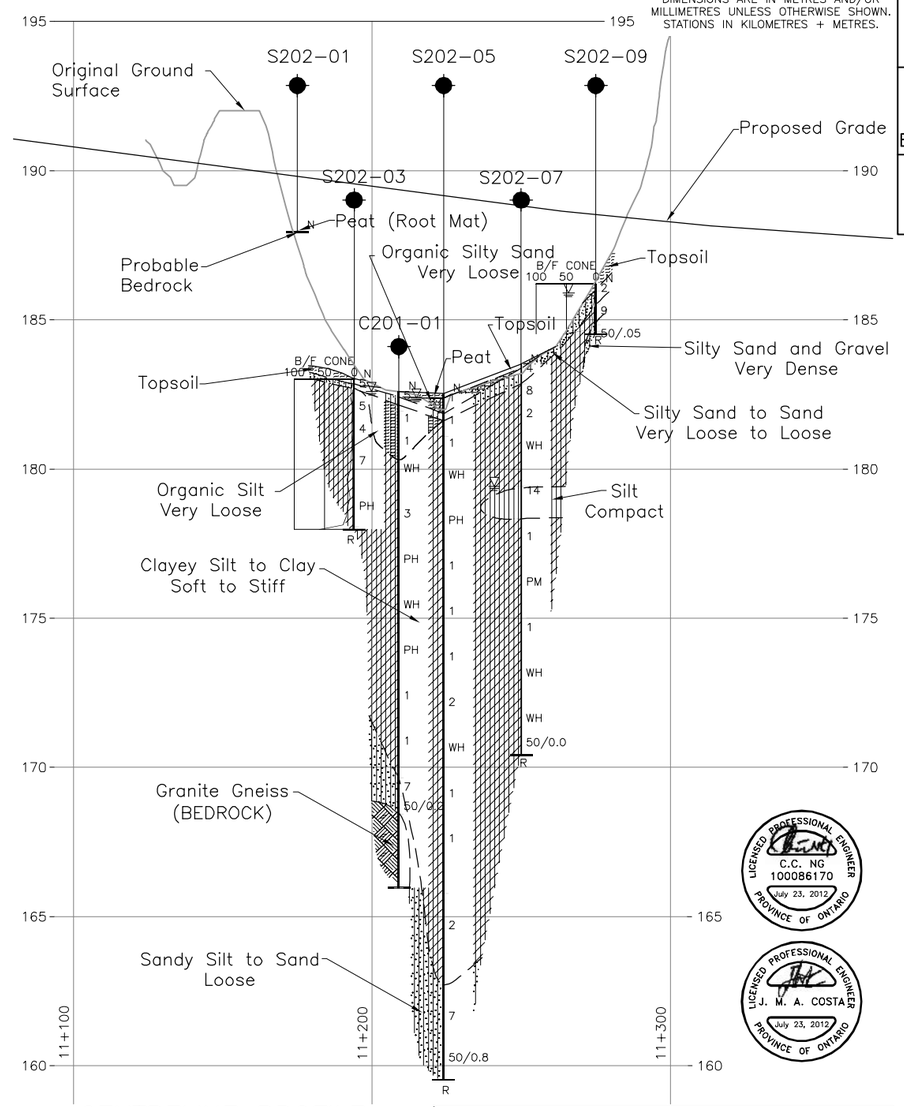
B-B' B1 EMBANKMENT TOE PROFILE HIGHWAY 69 (SBL)

HORIZONTAL SCALE 20 0 20 40 m

VERTICAL SCALE 2 0 2 4 m

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.



A-A' B1 CENTRELINE PROFILE HIGHWAY 69 (SBL)

HORIZONTAL SCALE 20 0 20 40 m

VERTICAL SCALE 2 0 2 4 m

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contour-Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile-nov-18-2011.dwg, received December 5, 2011.

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C201-01	182.6	5074231.7	225371.4
C201-02	182.6	5074236.3	225389.8
C201-03	182.9	5074241.2	225408.1
C201-04	182.7	5074246.9	225429.2
C202-01	182.6	5074238.2	225345.3
C202-02	182.6	5074247.4	225386.7
C202-03	182.8	5074254.7	225405.1

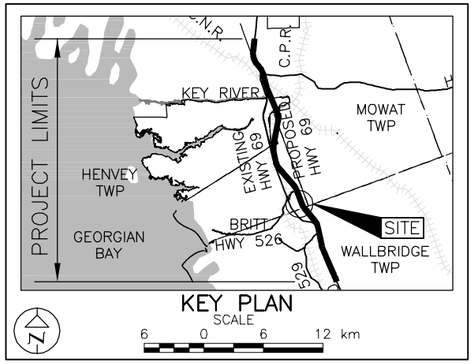
BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S202-DC01	183.8	5074204.5	225361.0
S202-DC02	182.7	5074241.9	225387.6
S202-DC03	183.2	5074271.7	225333.8
S202-DC04	185.6	5074288.4	225369.2
S202-DC05	189.6	5074150.5	225428.4
S202-DC06	185.7	5074185.4	225448.7
S202-DC07	190.3	5074195.8	225407.0

CONT No.
WP No. 5404-05-01

SHEET

HIGHWAY 69
STA 11+175 TO 11+275 (SBL)
STA 11+100 TO 11+225 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN
SCALE 6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL upon completion of drilling
- R Refusal

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTAR July 23, 2012 PROVINCE OF ONTARIO

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S202-01	188.0	5074200.1	225383.9
S202-02	184.5	5074218.4	225396.3
S202-03	183.0	5074217.8	225377.0
S202-04	182.5	5074226.7	225356.0
S202-05	182.5	5074244.1	225362.1
S202-06	183.1	5074265.1	225378.4
S202-07	183.5	5074270.5	225358.0
S202-08	182.7	5074250.0	225340.3
S202-09	186.2	5074293.7	225348.8
S202-10	191.9	5074144.2	225446.5
S202-11	188.3	5074161.7	225456.7
S202-12	188.8	5074167.4	225437.3
S202-13	188.9	5074173.2	225418.0
S202-14	187.3	5074190.7	225428.1
S202-15	184.1	5074209.3	225441.2
S202-16	184.5	5074213.6	225418.1
S202-17	183.1	5074233.5	225434.4
S202-18	182.9	5074231.6	225411.9
S202-19	183.0	5074259.4	225424.2
S202-20	183.3	5074266.0	225398.3

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69	PROJECT NO. 09-1111-6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. B1

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (SWAMP)\09111160140B1.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

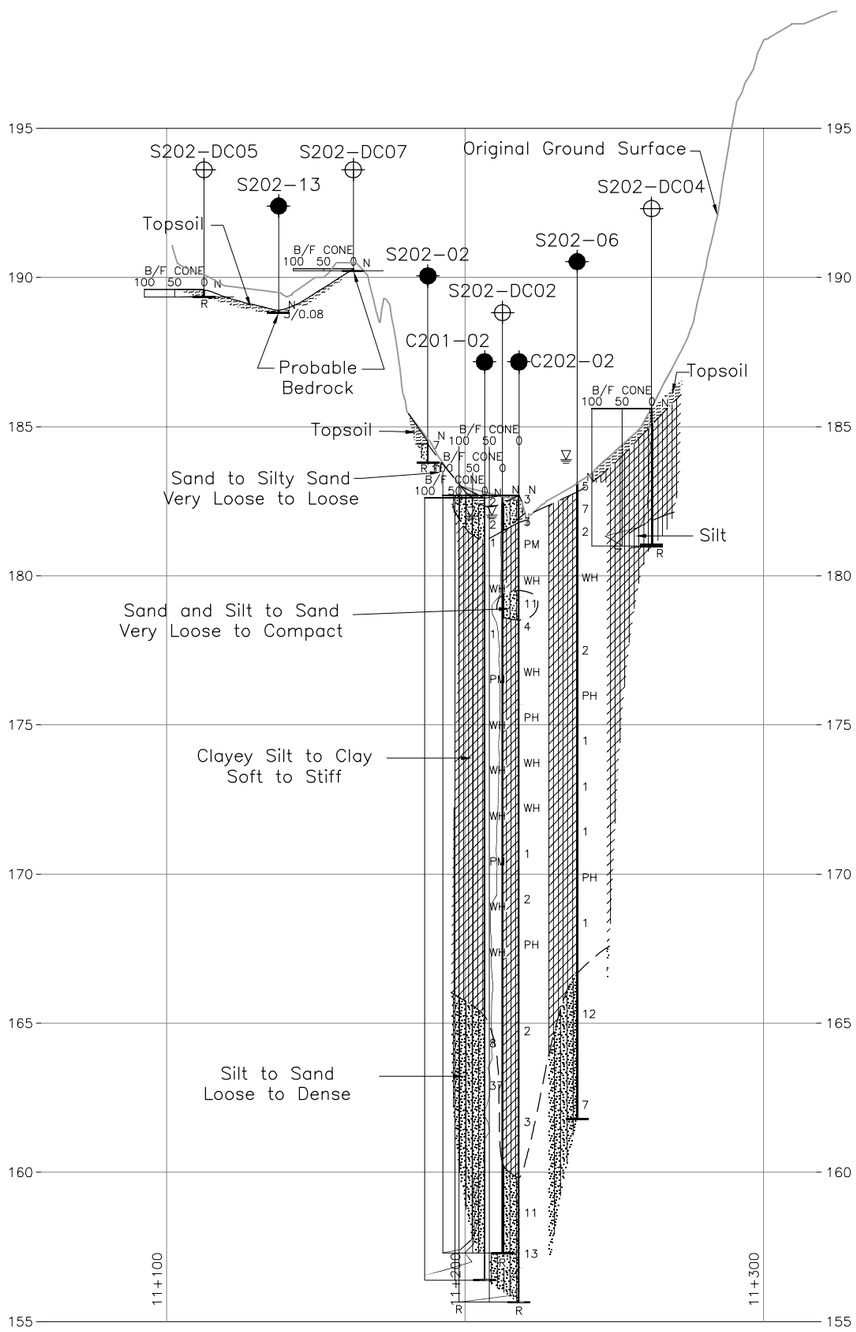
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404-05-01

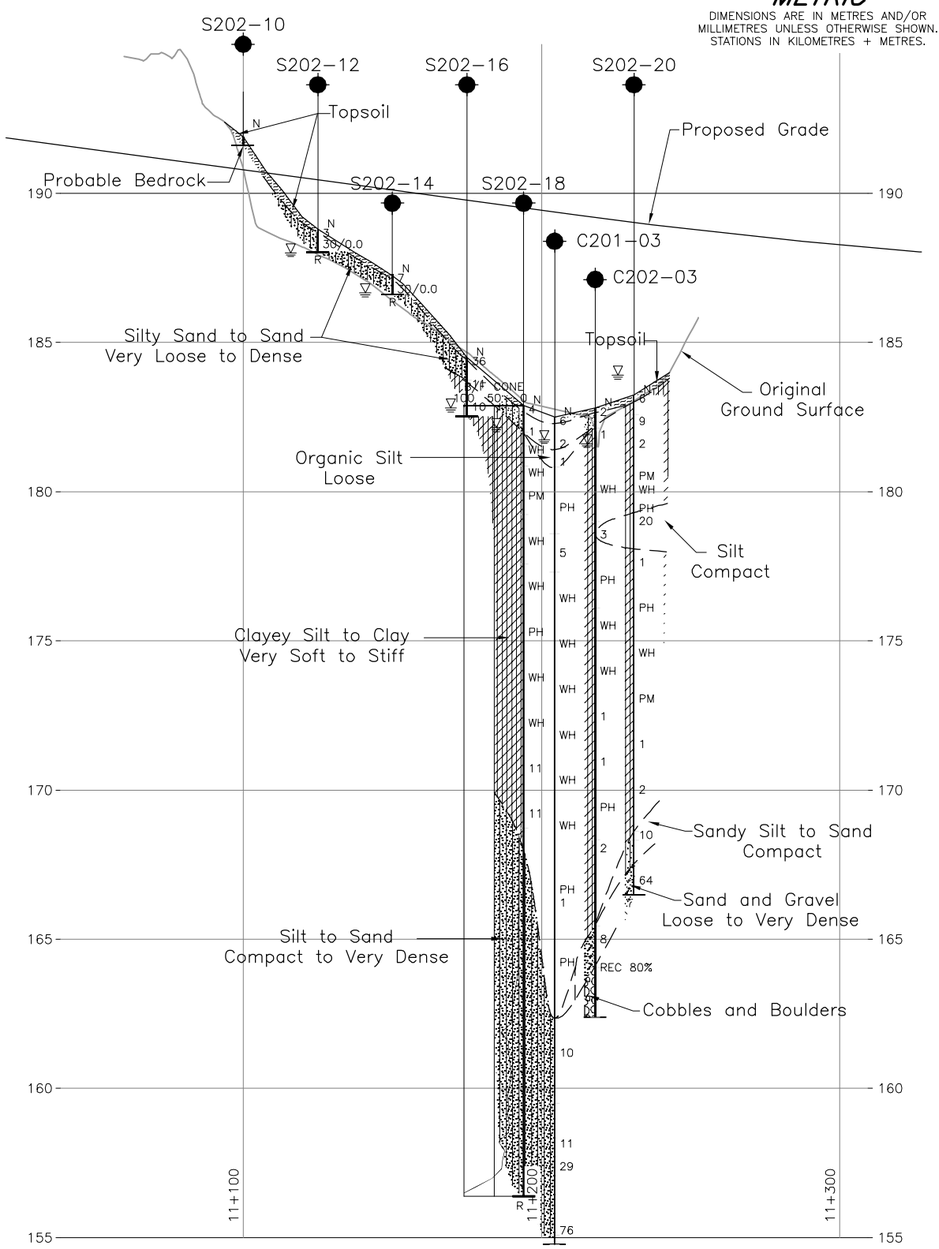
HIGHWAY 69
STA 11+175 TO 11+275 (SBL)
STA 11+100 TO 11+225 (NBL)
SOIL STRATA

SHEET

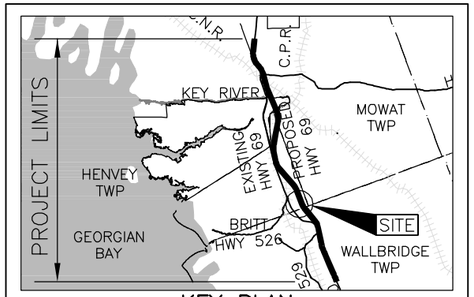
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



C-C' B1 EMBANKMENT TOE PROFILE
HIGHWAY 69 (MEDIAN)
HORIZONTAL SCALE 20 0 20 40 m
VERTICAL SCALE 2 0 2 4 m



D-D' B1 CENTRELINE PROFILE
HIGHWAY 69 (NBL)
HORIZONTAL SCALE 20 0 20 40 m
VERTICAL SCALE 2 0 2 4 m



KEY PLAN
SCALE 6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL upon completion of drilling
- REC Recovery (%)
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C201-02	182.6	5074236.3	225389.8
C201-03	182.9	5074241.2	225408.1
C202-02	182.6	5074247.4	225386.7
C202-03	182.8	5074254.7	225405.1
S202-02	184.5	5074218.4	225396.3
S202-06	183.1	5074265.1	225378.4
S202-10	191.9	5074144.2	225446.5
S202-12	188.8	5074167.4	225437.3
S202-13	188.9	5074173.2	225418.0
S202-14	187.3	5074190.7	225428.1
S202-16	184.5	5074213.6	225418.1
S202-18	182.9	5074231.6	225411.9
S202-20	183.3	5074266.0	225398.3
S202-DC02	182.7	5074241.9	225387.6
S202-DC04	185.6	5074288.4	225369.2
S202-DC05	189.6	5074150.5	225428.4
S202-DC07	190.3	5074195.8	225407.0

REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contour-Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile-nov-18-2011.dwg, received December 5, 2011.

NOTES

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LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69	PROJECT NO. 09-1111-6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. B2

PLOT DATE: July 24, 2012
FILENAME: I:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-CA- CONTRACT 2 (SWMP)\091111601 4CA052.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

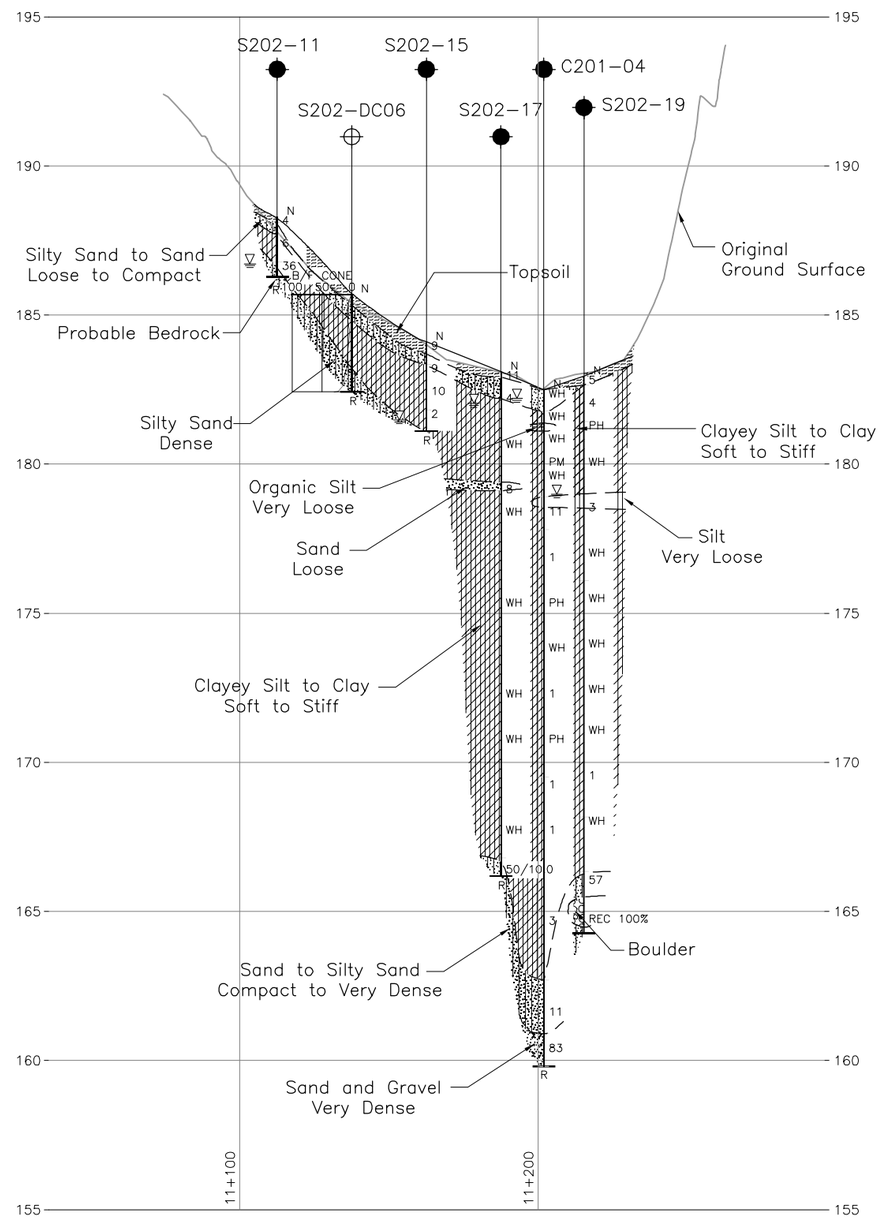
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404–05–01

HIGHWAY 69
STA 11+175 TO 11+275 (SBL)
STA 11+100 TO 11+225 (NBL)
SOIL STRATA

SHEET

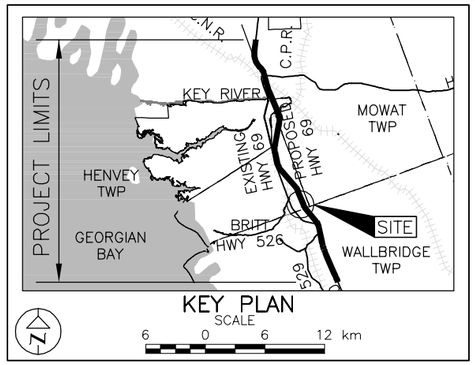
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



E-E'
B1

EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



KEY PLAN
SCALE
6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC — Recovery (%)
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
C201–04	183.0	5074246.9	225429.2
S202–11	188.3	5074161.7	225456.7
S202–15	184.1	5074209.3	225441.2
S202–17	183.1	5074233.5	225434.4
S202–19	183.0	5074259.4	225424.2
S202–DC06	185.7	5074185.4	225448.7

NOTES

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REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contour–Plan_C2_C3.dwg, received July 14, 2011

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69		PROJECT NO. 09–1111–6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. B3

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (UPS, Hwy 69, Henvey)\-CA- CONTRACT 2 (SWAMP)\091111601 4CA083.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

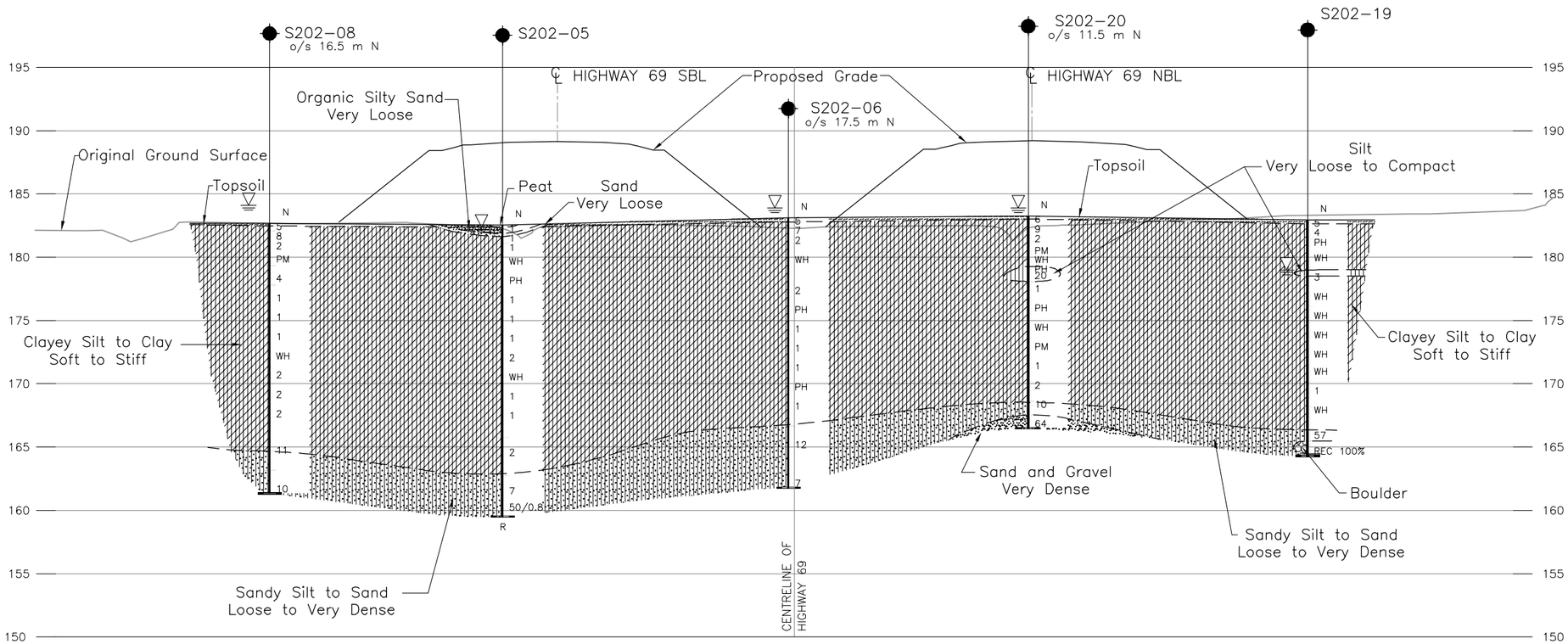
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

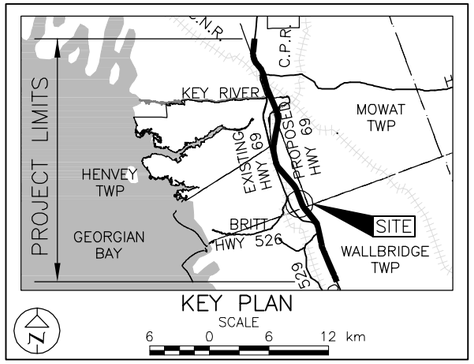
CONT No.
WP No. 5404-05-01

SHEET

HIGHWAY 69
CROSS-SECTION STA. 11+220 (SBL AND NBL)
SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA





LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- REC Recovery (%)
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S202-05	182.5	5074244.1	225362.1
S202-06	183.1	5074265.1	225378.4
S202-08	182.7	5074250.0	225340.3
S202-19	183.0	5074259.4	225424.2
S202-20	183.3	5074266.0	225398.3

NOTES

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REFERENCE

Cross-Section provided in a digital format by URS, drawing file culv_11+220.dwg, received December 23, 2011.

F-F' B1 CROSS-SECTION STA 11+220
HIGHWAY 69

SCALE
4 0 4 8 m

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69		PROJECT NO. 09-1111-6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. B4

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-CA- CONTRACT 2 (SWAMP)\091116014CA084.dwg

Golder Associates

RECORD OF BOREHOLE No S202-01

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074200.1 ;E 225383.9
BOREHOLE TYPE Hand Excavation
DATE March 2, 2010

ORIGINATED BY ID
COMPILED BY NK
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
188.0	GROUND SURFACE												
0.0 / 0.1	PEAT (Root Mat), containing topsoil Moist												
	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-02

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074218.4 ;E 225396.3
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY NK
DATUM Geodetic
DATE March 2, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
184.5	GROUND SURFACE										
0.0	TOPSOIL										
0.1	Silty SAND Loose Dark brown Moist		1	SS	7		184		○		
183.8 0.7	END OF BOREHOLE AUGER REFUSAL										

NOTES:

1. Open borehole dry upon completion of drilling.

2. Two additional boreholes were drilled 1.0 m east and 0.5 m south of Borehole S202-02 to confirm depth to refusal; refusal encountered at a depth of 0.7 m below ground surface (Elev. 183.8 m) in both boreholes.

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

Golder Associates

RECORD OF BOREHOLE No S202-03

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074217.8 ;E 225377.0
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 28, 2011

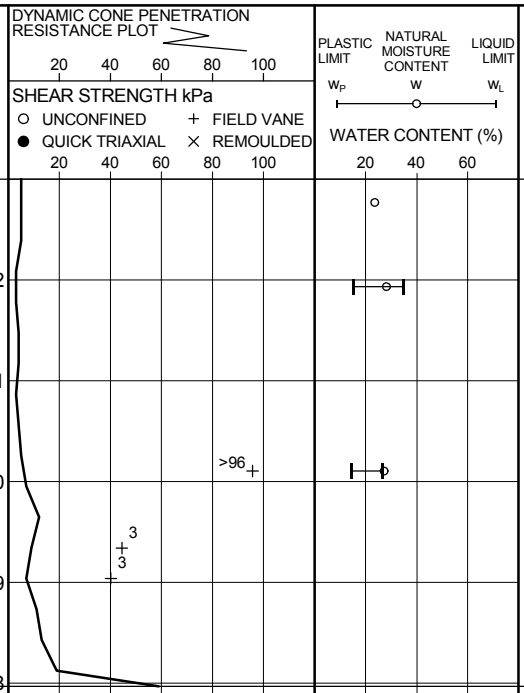
ORIGINATED BY MR
COMPILED BY MAS
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
183.0	GROUND SURFACE							
0.0	TOPSOIL							
0.3	Silty SAND, containing organics and rootlets Loose Brown Moist	1A 1B 1C	SS	5				
	CLAYEY SILT, trace sand Firm to very stiff Brown to grey Moist Becoming grey below a depth of 1.5 m	2	SS	5	0	5	59	36
		3	SS	4				
	Containing silt layers between depths of 2.4 m and 3.4 m	4	SS	7	0	2	71	27
		5	TO	PH				
178.1		6	SS	50/0.0				
5.0	END OF BOREHOLE SPOON AND CASING REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)							

NOTES:

1. Open borehole dry upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.0 m west of Borehole S202-03 to confirm depth to refusal; refusal encountered at a depth of 4.9 m below ground surface (Elev. 178.1 m).



UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-04

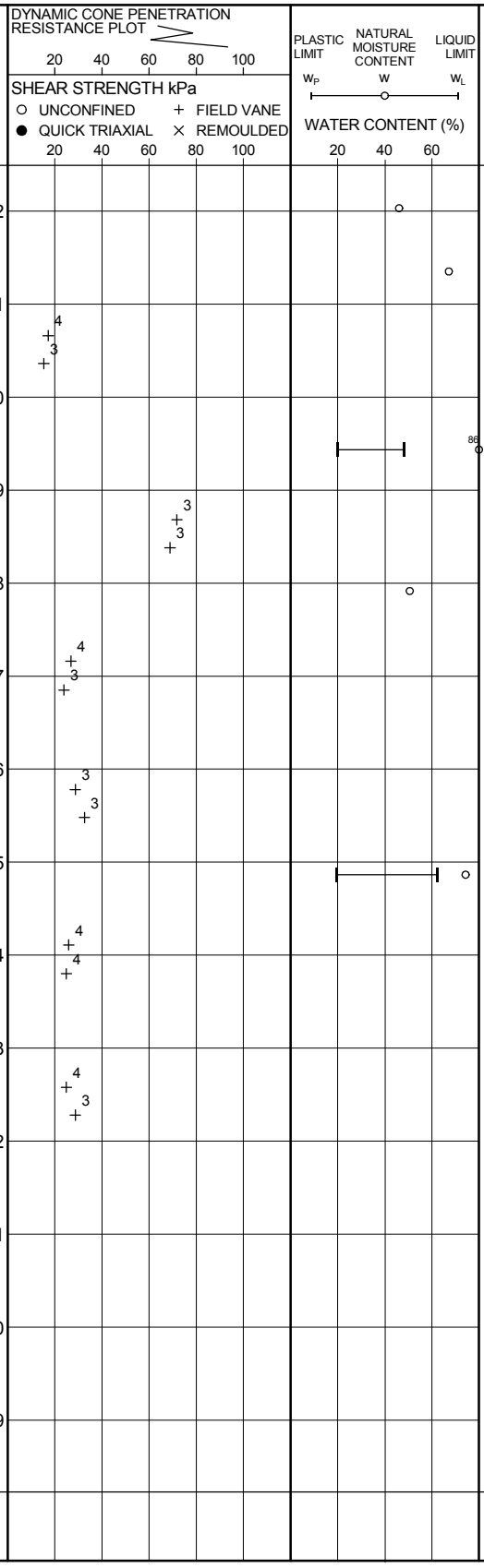
SHEET 1 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074226.7 ;E 225356.0
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 12, 2011

ORIGINATED BY MR
COMPILED BY ARM
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
182.5	GROUND SURFACE							
0.0	Peat (Root Mat)							
0.2	Organic Silty SAND, containing rootlets Very loose Grey Wet	1A 1B	SS	1				
181.8								
0.9	SAND, containing wood fragments Very loose Grey Wet	2A 2B	SS	WH				
180.5	SILTY CLAY, containing organics and fibrous peat layers Soft Grey Wet							
2.0	SILTY CLAY, trace sand Soft to stiff Grey Wet Containing silt layers between depths of 3.7 m and 5.2 m	3	SS	WH				
		4	SS	WH	0	1	51	48
		5	SS	2				
177.3								
5.2	CLAY, trace to some silt, trace sand Soft to firm Brown to grey Wet	6	TO	PM				
		7	SS	WH	0	1	37	62
		8	SS	1				
		9	SS	1				
171.2								
11.3	Granite Gneiss (BEDROCK) Bedrock cored from depths of 11.3 m to 14.3 m For bedrock coring details refer to Record of Drillhole S202-04	1	NQ RC	REC 100%				RQD = 100%
		2	NQ RC	REC 96%				RQD = 92%
168.2								
14.3	END OF BOREHOLE							



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GROUND WATER CONDITIONS

STRAT PLOT

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-04

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074226.7 ;E 225356.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY ARM
DATUM Geodetic
DATE March 12, 2011
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P w w_L WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	NOTE: 1. Water level in open borehole at ground surface (Elev. 182.5 m) upon completion of drilling.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PROJECT: 09-1111-6014

RECORD OF DRILLHOLE: S202-04

SHEET 1 OF 1

LOCATION: N 5074226.7 ;E 225356.0

DRILLING DATE: March 12, 2011

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: D25 Bomb

DRILLING CONTRACTOR: Walker Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD - Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER Meter	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	NOTES
		Continued from Record of Borehole C201-1		171.21														
12	NW Casing March 12, 2011	GRANITE GNEISS Fresh, foliated, slightly porous, medium crystalline, strong, pink, grey and black with mafic dyke between depths of 11.3 m and 11.8 m; and between depths of 12.0 m and 12.1 m		11.28	1						90 90	JN,PL,SM JN,PL,SM				W1 W2 W3 W4 W5 W6		
13	NQRC March 12, 2011				2						90	JN,, JN,PL,SM						
14											90 90	JN,PL,SM JN,PL,SM						
				168.23														
		END OF BOREHOLE		14.26														
15																		
16																		
17																		
18																		
19																		
20																		
21																		

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MR

CHECKED: TVA

Golder Associates

RECORD OF BOREHOLE No S202-05

SHEET 1 OF 2 **METRIC**

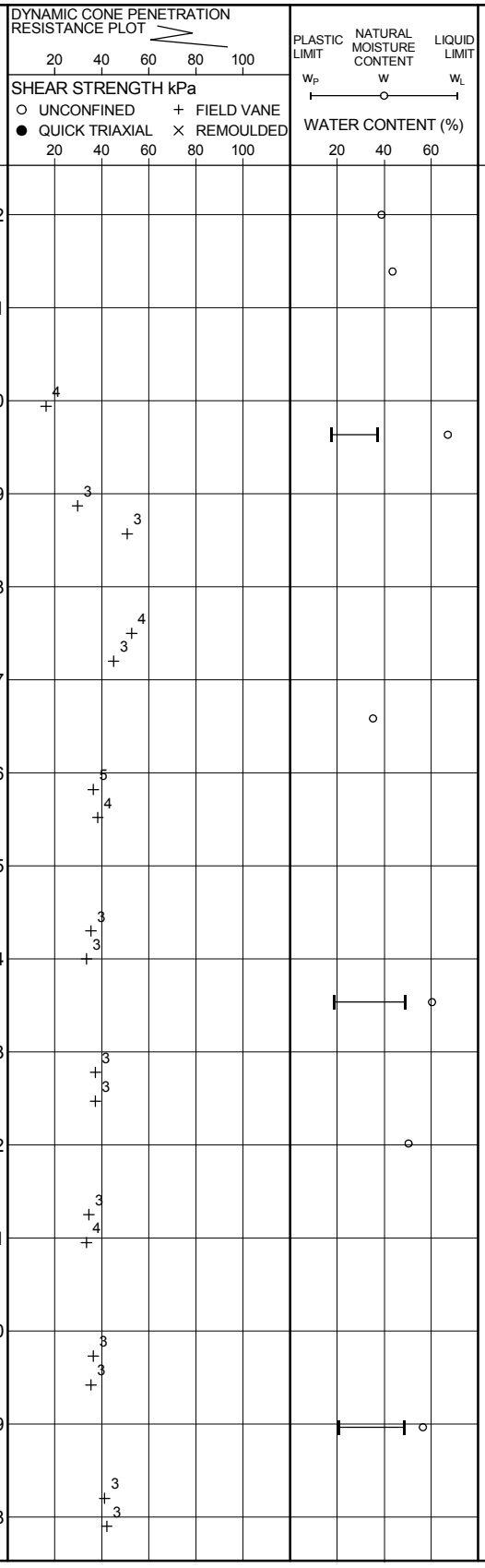
PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074244.1 ;E 225362.1
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 13, 2011

ORIGINATED BY MR
COMPILED BY MAS
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION
182.5	GROUND SURFACE
0.0	Peat (Root Mat)
0.2	Organic Silty SAND, trace clay Very loose Dark grey to brown Wet
181.8	
0.9	SAND, containing organics Brown Wet
181.1	
1.4	SILTY CLAY, containing organics Very soft Brown and grey Wet
	SILTY CLAY, trace to some sand Soft to stiff Grey Wet
	Brown between depths of 6.9 m and 7.8 m

SAMPLE NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
1A, 1B	SS	1				
2A, 2B	SS	1				
3	SS	1				
4	SS	WH	0	2	66	32
5	TO	PH				
6	SS	1				
7	SS	1				
8	SS	1	0	1	42	57
9	SS	2				
10	SS	WH				
11	SS	1	0	13	37	50



UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GROUND WATER CONDITIONS

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

○ $^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-05

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074244.1 ;E 225362.1
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY MAS
DATUM Geodetic
DATE March 13, 2011
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace to some sand Soft to stiff Grey Wet		12	SS	1		167	+ 3, + 4			
165.7							166				
16.8	CLAY, some silt, containing grey silt layers Stiff Brown Wet						165				
			13	SS	2						0 0 37 63
							164	+ 3, + 2			
162.7							163				
19.8	SAND, some silt Loose Grey Wet						162				
			14	SS	7						
							161				
							160				
159.5			15	SS	50/0.0						
23.0	END OF BOREHOLE SPOON AND CASING REFUSAL										

NOTES:

1. Water flowing from top of casing when advanced to a depth of 20.7 m below ground surface (Elev. 161.8 m).

Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 182.3 m) upon completion of drilling.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-06

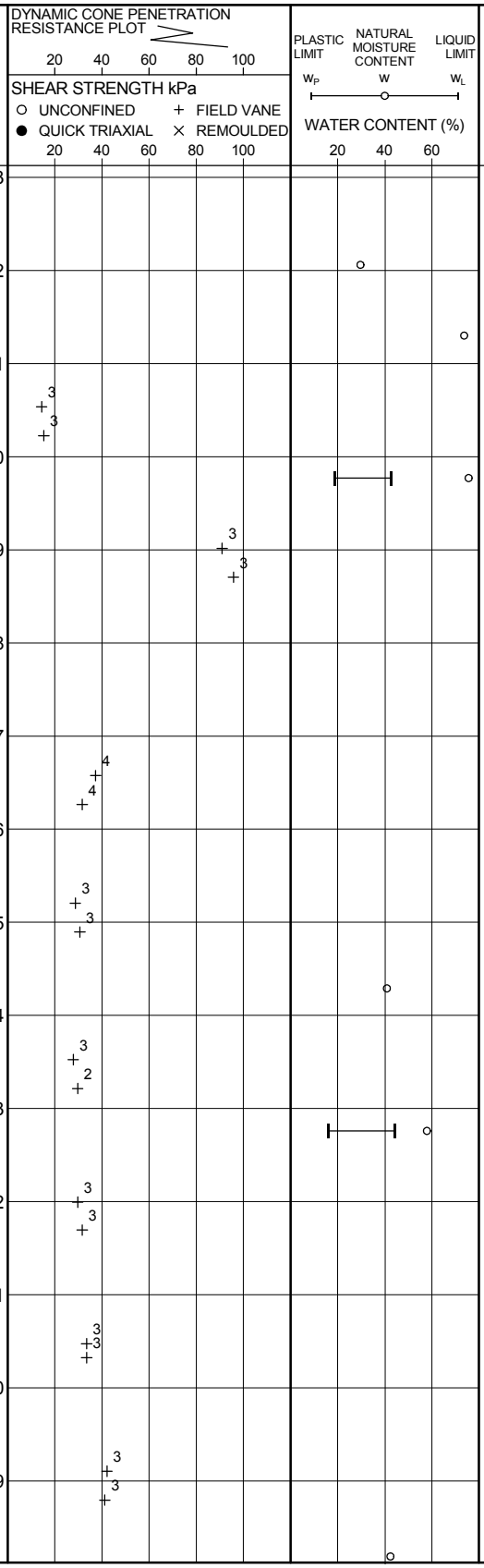
SHEET 1 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074265.1 ;E 225378.4
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 1 and March 9, 2011

ORIGINATED BY MR
COMPILED BY AM
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
183.1	GROUND SURFACE							
0.0 / 182.8	TOPSOIL							
182.4 / 0.7	CLAYEY SILT, containing sand layers Firm Brownish grey Moist	1	SS	5				
	SILTY CLAY, trace sand Soft to stiff Brown and grey Moist	2	SS	7				
		3	SS	2				
		4	SS	WH	0	1	61	38
	Silt layers encountered between depths of 4.3 m and 6.6 m	5	SS	2				
		6	TO	PH				
		7	SS	1				
		8	SS	1	0	1	50	49
		9	SS	1				
		10	TO	PH				
		11	SS	1				



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-06

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074265.1 ;E 225378.4
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 1 and March 9, 2011

ORIGINATED BY MR
COMPILED BY AM
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace sand Soft to stiff Brown and grey Moist						168				
								+ 2			
								+ 2			
							167				
166.6											
16.5	SAND, some silt, trace gravel and clay Loose to compact Grey Wet						166				
			12	SS	12		165		○		2 84 12 2
							164				
							163				
			13	SS	7		162				
161.8											
21.3	END OF BOREHOLE										

NOTES:

* Water flowing from top of casing when advanced to a depth of 17.7 m below ground surface (Elev. 165.4 m): height of casing at about 0.8 m above ground surface.

1. Water level (not-stabilized) in casing at 0.8 m above ground surface (Elev. 183.9 m) during drilling - Artesian Condition.

2. Open borehole filled with drilling mud inorder to continue borehole advancement; Water level measured in open casing prior to grouting at a depth of 2.8 m below ground surface (Elev. 180.3 m)

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

Golder Associates

RECORD OF BOREHOLE No S202-07

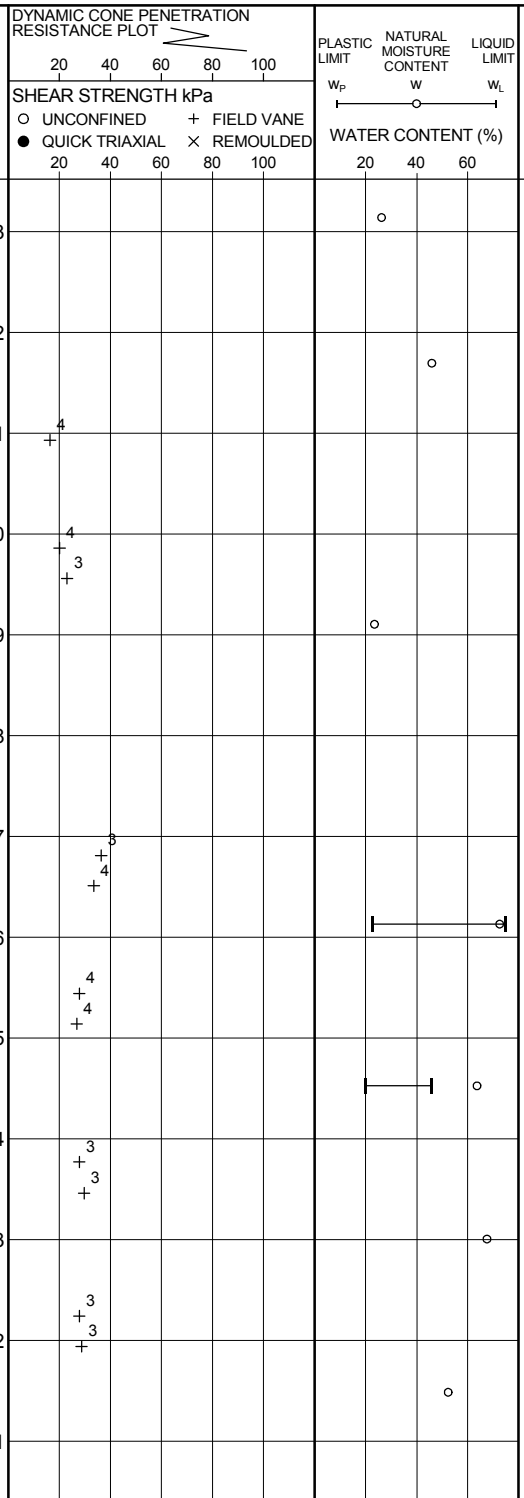
SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074270.5 ;E 225358.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY AM
DATUM Geodetic
DATE March 14, 2011
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
183.5	GROUND SURFACE							
0.0	TOPSOIL	1A						
0.2	Silty SAND, trace clay Loose Brownish grey Wet	1B	SS	4				
182.8 / 0.7	SILTY CLAY, trace sand Soft Brown and grey Moist to wet	2	SS	8				
		3	SS	2				
	Becoming grey below a depth of 2.4 m	4	SS	WH				
179.4								
4.1	SILT, trace clay, trace to some sand Compact Grey Wet	5	SS	14	0	6	79	15
178.3								
5.2	CLAY, some silt, trace sand Firm Brown to grey Moist	6	SS	1				
		7	TO	PM				
175.0								
8.5	SILTY CLAY, trace sand Firm Brown to grey Moist	8	SS	1	0	2	45	53
		9	SS	WH				
		10	SS	WH				
170.4								
13.1	END OF BOREHOLE SPOON AND CASING REFUSAL	11	SS	50/0.0				

NOTE:

1. Water level in open borehole at a depth of 4.1 m below ground surface (Elev. 179.4 m) upon completion of drilling.



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-08

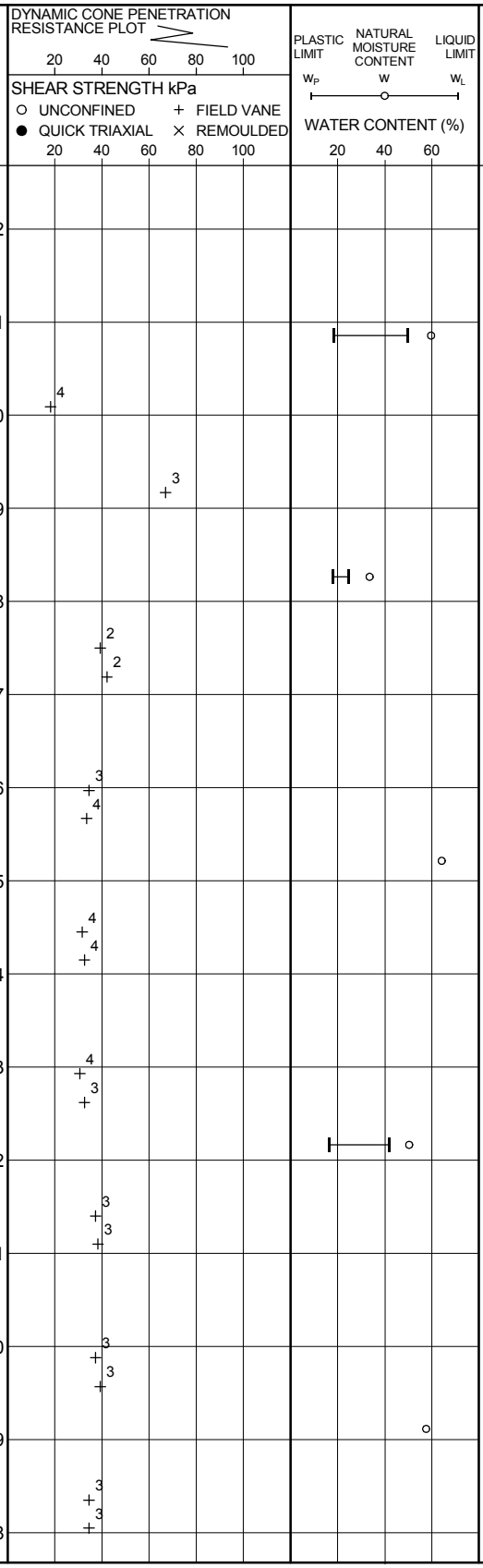
SHEET 1 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074250.0 ;E 225340.3
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 11, 2011

ORIGINATED BY MR
COMPILED BY MAS
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
182.7	GROUND SURFACE								
0.0	TOPSOIL								
182.1 / 0.6	CLAYEY SILT, trace to some sand, containing sand layers Firm Brown and grey Moist	1	SS	5					
	SILTY CLAY, trace sand, containing rootlets to a depth of 1.5 m Soft Brown and grey Moist Becoming grey below a depth of 1.4 m	2	SS	8					
		3	SS	2		0	2	54	44
		4	TO	PM					
179.4 / 3.4	CLAYEY SILT, trace sand, containing silty clay layers Stiff Grey Moist	5	SS	4		0	0	76	24
177.8 / 4.9	SILTY CLAY, trace sand, containing silt layers up to a depth of 6.7 m Firm Grey Moist	6	SS	1					
		7	SS	1					
		8	SS	1					
		9	SS	WH		0	2	47	51
		10	SS	2					
		11	SS	2					



GROUND WATER CONDITIONS

STRAT PLOT

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-08

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074250.0 ;E 225340.3
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY MAS
DATUM Geodetic
DATE March 11, 2011
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%))	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace sand, containing silt layers up to a depth of 6.7 m Firm Grey Moist		12	SS	2		167 166 165	3 3			
164.7			13A 13B	SS	11				○		
18.0	Sandy SILT, trace clay Compact Grey Wet						164				
163.2											
19.5	SAND, some silt Compact Grey Wet						163 162				
			14	SS	10				○		
161.4											
21.3	END OF BOREHOLE										

NOTES:

* Water flowing from top of casing when advanced to a depth of 19.2 m below ground surface (Elev. 163.5 m).

1. Water level (not-stabilized) in casing at a depth of 0.3 m below ground surface (Elev. 182.0 m) measured at about 6:30 pm on March 11, 2011.

2. Water level (stabilized) in casing at a depth of 1.4 m above ground surface (Elev. 184.1 m) measured at about 7:00 am on March 12, 2011 - Artesian Condition.

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

Golder Associates

RECORD OF BOREHOLE No S202-09

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074293.7 ;E 225348.8
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers
COMPILED BY AM
DATUM Geodetic
DATE March 14, 2011
CHECKED BY TVA

SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.2	GROUND SURFACE										
0.0	TOPSOIL		1A	SS	2	▽	186				
0.2	Silty SAND, containing rootlets Very loose Brown Wet		1B								
185.5 0.7	SILTY CLAY, trace sand Stiff Brown and grey Moist		2	SS	9		185				0 3 54 43
184.8			3	SS	50/.05						
1.7	Silty SAND and GRAVEL, trace clay Very dense Brown Moist to wet										

END OF BOREHOLE
SPOON AND AUGER REFUSAL

END OF DCPT
Refusal to Further Penetration (Hammer Bouncing)

NOTES:

1. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 185.9 m) upon completion of drilling.

2. Auger grinding at a depth of 1.6 m below ground surface (Elev. 184.6 m).

3. A Dynamic Cone Penetration Test was advanced 1.0 m north of Borehole S202-09 to confirm depth to refusal; refusal encountered at a depth of 1.7 m below ground surface (Elev. 184.5 m).

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-10

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074144.2 ;E 225446.5
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY NK
DATUM Geodetic
DATE March 1, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
191.9	SNOW SURFACE										
0.0 / 191.6	TOPSOIL										
0.3	END OF EXCAVATION PROBABLE BEDROCK NOTES: 1. Hand digging carried out at proposed borehole location to expose bedrock. 2. Excavation dry upon completion.										

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

Golder Associates

RECORD OF BOREHOLE No S202-11

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074161.7 ;E 225456.7
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing
COMPILED BY NK
DATUM Geodetic
DATE March 1, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
188.3	GROUND SURFACE										
0.0	TOPSOIL										
0.2 / 187.7	Silty SAND, trace gravel, containing organics Loose Brown Moist		1	SS	4		188				
			2	SS	6		187				
0.6 / 186.8	SILTY CLAY, containing organics Firm Brown to grey Wet					▽					
1.5 / 186.3	Silty SAND, trace gravel, trace to some clay, containing sand seams Dense Brown Wet		3	SS	36						
			4	SS	30/0.0						
2.0	GRAVEL										
	END OF BOREHOLE SPOON REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 1.6 m below ground surface (Elev. 186.7 m) upon completion of drilling.

2. Borehole caved to a depth of 2.0 m below ground surface (Elev. 186.0 m) upon removal of casing.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-12

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074167.4 ;E 225437.3
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY NK
DATUM Geodetic
DATE March 2, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
188.8	GROUND SURFACE												
0.0	TOPSOIL												
0.1	Silty SAND, trace to some clay, containing sand seams Very loose Brown to grey Wet		1	SS	3					○			
188.0 / 0.8	END OF BOREHOLE SPOON REFUSAL		2	SS	30/0.0	▽							

WATER CONTENT (%) 20 40 60

NOTES:

1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 188.0 m) upon completion of drilling.

2. Borehole caved to a depth of 0.7 m below ground surface (Elev. 188.1 m) upon removal of casing.

3. Two additional boreholes were drilled 0.5 m west and 1.0 m south of Borehole S202-12 to confirm depth to refusal; refusal encountered at a depth of 0.8 m below ground surface (Elev. 188.0 m) in both boreholes.

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

Golder Associates

RECORD OF BOREHOLE No S202-13

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074173.2 ;E 225418.0
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY NK
DATUM Geodetic
DATE March 2, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
188.9	GROUND SURFACE										
0.0	TOPSOIL		1	SS	3/0.08						
0.1	END OF BOREHOLE SPOON REFUSAL PROBABLE BEDROCK										

NOTES:

1. Borehole dry upon completion of drilling.

2. Two additional boreholes were drilled 0.5 m south and 1.0 m west of Borehole S202-13 to confirm depth to refusal; refusal encountered at a depth of 0.1 m below ground surface (Elev. 188.8 m) in both boreholes.

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

Golder Associates

RECORD OF BOREHOLE No S202-14

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074190.7 ;E 225428.1
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY NK
DATUM Geodetic
DATE March 2, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES													
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.3	GROUND SURFACE										
0.0	TOPSOIL										
0.1	Silty SAND, trace to some clay, trace gravel, containing sand seams		1	SS	7		187		○		
186.6			2	SS	30/0.0	▽					
0.7	Loose Brown Moist										
	END OF BOREHOLE SPOON REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 186.7 m) upon completion of drilling.

2. An additional borehole was drilled 0.6 m south of Borehole S202-14 to confirm depth to refusal; refusal encountered at a depth of 0.7 m below ground surface (Elev. 186.6 m).

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

Golder Associates

RECORD OF BOREHOLE No S202-15

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074209.3 ;E 225441.2
BOREHOLE TYPE Portable Equipment, BW Casing
DATE March 2, 2010

ORIGINATED BY ID
COMPILED BY NK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.1	GROUND SURFACE										
0.0 / 183.7	TOPSOIL		1	SS	9		184				
183.3	SAND, Loose, Brown, Moist										
0.8	SILTY CLAY, containing silt seams, organics and rootlets, Stiff, Grey, Wet		2	SS	9		183				
			3	SS	10						
181.8							182				
2.3	CLAY, some silt, Soft, Grey, Wet		4	SS	2	▽		+ 4, + 4			
181.1											
3.0	END OF BOREHOLE CASING REFUSAL PROBABLE BEDROCK										

NOTES:

1. Water level in open borehole at a depth of 2.6 m below ground surface (Elev. 181.5 m) upon completion of drilling.

2. An additional borehole was drilled 1.0 m north of Borehole S202-15 to carry out in situ vane test between depths of 2.4 m and 2.7 m below ground surface (Elev. 181.7 m and Elev. 181.4 m).

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-16

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074213.6 ;E 225418.1
ORIGINATED BY ID
DIST HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing
COMPILED BY NK
DATUM Geodetic
DATE March 2, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES															
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.5	GROUND SURFACE										
0.0	TOPSOIL										
0.1	Silty SAND Dense Dark brown Moist to wet		1	SS	36		184		○		
183.7											
0.8	SILTY CLAY, containing silty sand seams and organics Stiff Grey Wet		2	SS	11						
			3	SS	10	▽	183		○		
182.5											
2.0	END OF BOREHOLE SPOON AND CASING REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 1.7 m below ground surface (Elev. 182.8 m) upon completion of drilling.

2. Borehole caved to a depth of 1.9 m below ground surface (Elev. 182.6 m) upon removal of casing.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-17

SHEET 1 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

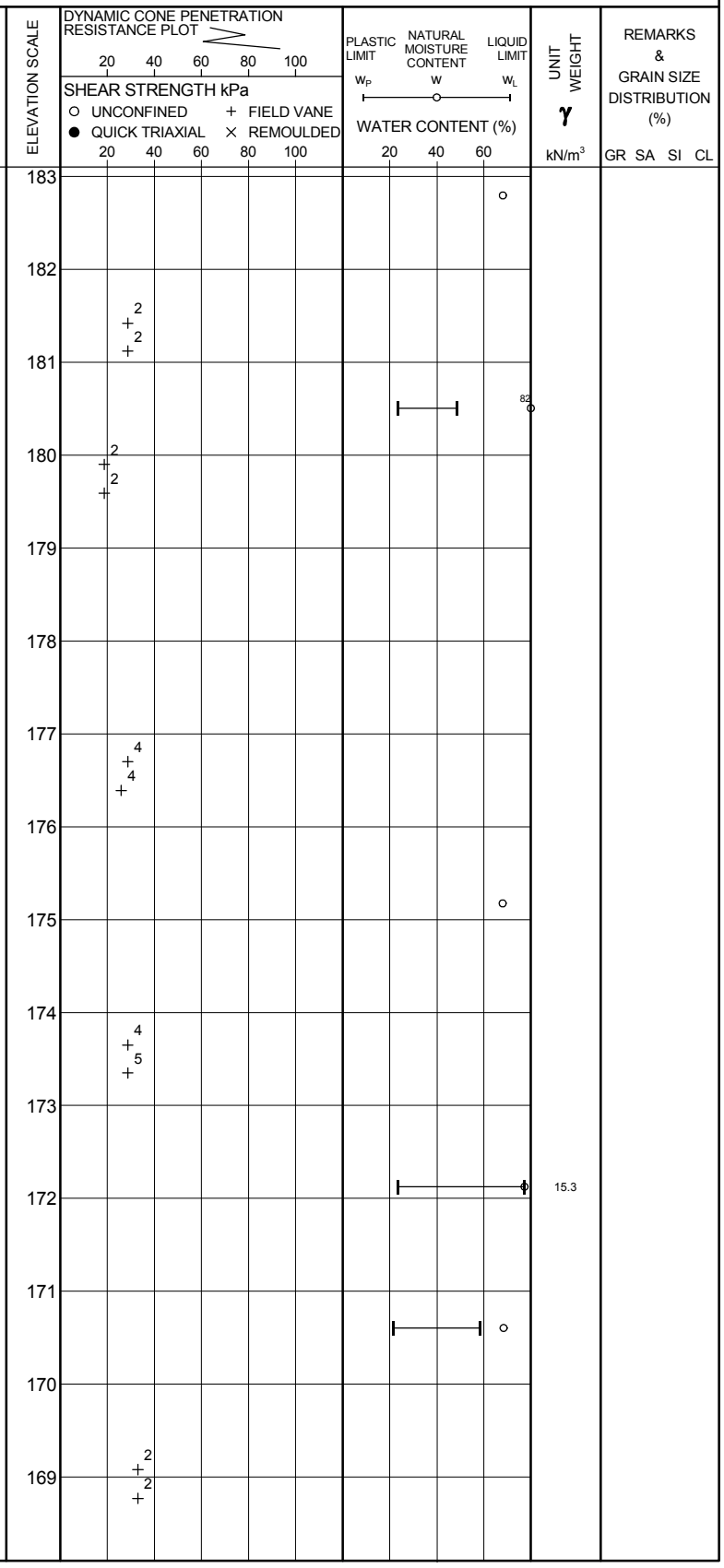
LOCATION N 5074233.5 ;E 225434.4
BOREHOLE TYPE Portable Equipment, BW Casing
DATE March 3, 2010

ORIGINATED BY ID
COMPILED BY NK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION
183.1	GROUND SURFACE
0.0	TOPSOIL
0.2	SAND, containing rootlets and organics Loose to compact Brown Wet
182.2 0.9	SILTY CLAY Soft to firm Grey Wet
179.4	
179.1 4.0	SAND Loose Grey Wet
	CLAY, trace silt Firm Grey Wet

NUMBER	TYPE	"N" VALUES
1	SS	11
2	SS	4
3	SS	WH
4	SS	8
5	TO	WH
6	SS	WH
7	TO	WH
8	SS	WH

GROUND WATER CONDITIONS: ▽



REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S202-17

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074233.5 ;E 225434.4
ORIGINATED BY ID
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing
COMPILED BY NK
DATUM Geodetic
DATE March 3, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	CLAY, trace silt Firm Grey Wet		9	TO	WH		168				
166.8							167				
16.3	SAND, some silt, trace clay Compact Grey										
166.2	Wet		10	SS	58/0.15				○		0 83 13 4
16.9	END OF BOREHOLE SPOON AND CASING REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 182.0 m) upon completion of drilling.

2. Borehole caved to a depth of 16.1 m below ground surface (Elev. 167.0 m) upon removal of casing.

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

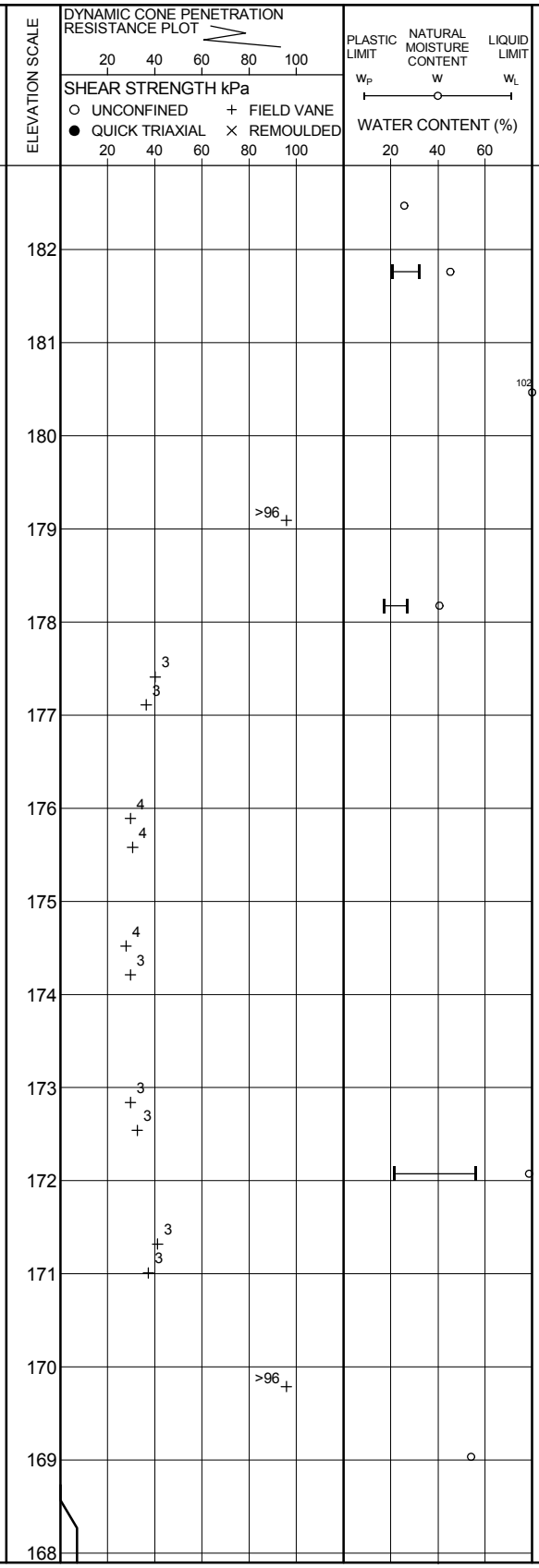
RECORD OF BOREHOLE No S202-18

SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074231.6 ;E 225411.9
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE NW Casing Tricone, Wash Boring
COMPILED BY AM
DATUM Geodetic
DATE February 25, 2011
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
182.9	GROUND SURFACE							
0.0	TOPSOIL							
0.2	SAND, trace silt, containing rootlets and organics Very loose Brown Wet	1A 1B	SS	4				
182.0 / 0.9	CLAYEY SILT, some sand, containing organics and rootlets Very soft Dark grey Wet	2A 2B	SS	1	0	13	66	21
181.5 / 1.4	SILT, containing organics and rootlets Very loose Dark brown Wet	3	SS	WH				
180.9 / 2.0	SILTY CLAY, trace sand, containing organics to a depth of 2.8 m and silt layers between depths of 2.8 m and 3.7 m Very soft Grey Moist	4	SS	WH				
179.2 / 3.7	CLAYEY SILT, trace sand Stiff Brown to grey Moist	5	TO	PM				
177.6 / 5.3	CLAY, some silt, trace sand, containing silt layers Firm to stiff Brown Moist	6	SS	WH	0	1	73	26
		7	SS	WH				
		8	TO	PH				
		9	SS	WH				
		10	SS	WH	0	1	33	66
		11	SS	11				
168.7 / 14.2	Dynamic Cone Penetration Test (DCPT)	12	SS	11				

GROUND WATER CONDITIONS



UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

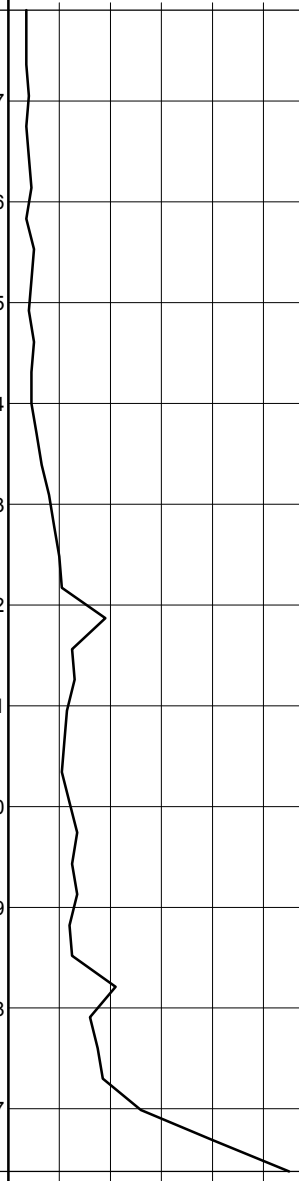
Golder Associates

RECORD OF BOREHOLE No S202-18

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074231.6 ;E 225411.9
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE NW Casing Tricone, Wash Boring
COMPILED BY AM
DATUM Geodetic
DATE February 25, 2011
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	END OF BOREHOLE CASING AND TRICONE REFUSAL Dynamic Cone Penetration Test (DCPT)						167 166 165 164 163 162 161 160 159 158 157				
156.4 26.5											



Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-18

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074231.6 ;E 225411.9
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE NW Casing Tricone, Wash Boring
COMPILED BY AM
DATUM Geodetic
DATE February 25, 2011
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---									WATER CONTENT (%) 20 40 60			
	END OF DCPT Refusal to Further Penetration (110 Blows / 0.30 m)												

NOTES:

* Unable to push insitu vane test past a depth of 14.6 m below ground surface (Elev. 168.3 m).

1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 182.1 m) upon completion of drilling.

2. Casing refusal at a depth of 14.2 m; then lowered tricone to confirm depth of refusal but was grinding at a depth of 13.7 m; likely that casing is broken; pull out rods and tricone and advanced DCPT to refusal.

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

Golder Associates

RECORD OF BOREHOLE No S202-19

SHEET 1 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074259.4 ;E 225424.2
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY MAS
DATUM Geodetic
DATE March 3, 2011
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
183.0	GROUND SURFACE							
0.0 / 182.7	TOPSOIL	1A, 1B	SS	5				
0.3 / 181.5	CLAYEY SILT, trace sand, containing organics and rootlets Soft to firm Brown to grey	2	SS	4				
1.5 / 179.0	SILTY CLAY, trace sand, containing organics and fibrous peat layers to a depth of 2.0 m Soft Grey Moist	3	TO	PH				
		4	SS	WH				
4.0 / 178.6	SILT, trace clay, trace sand Grey Wet							
4.4 / 176.1	CLAYEY SILT, trace sand, containing silt layers Firm Grey Moist	5A, 5B	SS	3	0	2	72	26
		6	SS	WH				
6.9 / 168.2	CLAY, some silt, trace sand Firm Grey Moist	7	SS	WH				
		8	SS	WH	0	1	42	57
		9	SS	WH				
		10	SS	WH				
		11	SS	1	0	2	36	62
14.8								

GROUND WATER CONDITIONS: ∇

ELEVATION SCALE: 182, 181, 180, 179, 178, 177, 176, 175, 174, 173, 172, 171, 170, 169

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-19

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074259.4 ;E 225424.2
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 3, 2011

ORIGINATED BY MR
COMPILED BY MAS
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%) 20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace sand, containing grey silt interlayers Stiff Brown Moist		12	SS	WH			+ 2, + 2			
166.4							167				
16.6	Silty SAND, some gravel, containing cobbles Very dense Grey Wet		13	SS	57		166		○		
165.5											
17.5	Boulder Dark grey with reddish pink bands		14	SC	REC 100%		165				
164.5											
	SAND		15	SC	REC 100%						RQD = %
18.7	COBBLE Dark grey										
	END OF BOREHOLE										

NOTES:

1. Water flowing from top of casing when advanced to a depth of 17.1 m below ground surface (Elev. 165.9 m), height of casing at about 0.7 m above ground surface.

Water level in open borehole at a depth of 4.0 m below ground surface (Elev. 179.0 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S202-20

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074266.0 ;E 225398.3	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	MAS
DATUM	Geodetic	DATE	March 9, 2011	CHECKED BY	TVA

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
183.3	GROUND SURFACE
0.0	TOPSOIL
0.2 / 182.6	CLAYEY SILT, containing sand layers Firm Brown Moist
0.7	SILTY CLAY, trace sand, containing organics and layers of fibrous peat to a depth of 2.4 m Soft Brown Moist Becoming grey below a depth of 1.2 m
179.3	
4.0	SILT, trace clay, trace sand Compact Grey Moist
178.1	
5.2	CLAY, some silt, trace sand Firm to stiff Grey Moist
168.7	
168.4	

STRAT PLOT

SAMPLES

NUMBER	TYPE	"N" VALUES
1A, 1B	SS	6
2	SS	9
3	SS	2
4	TO	PM
5	SS	WH
6	TO	PH
7	SS	20
8	SS	1
9	TO	PH
10	SS	WH
11	TO	PM
12	SS	1
13	SS	2
14	SS	10

GROUND WATER CONDITIONS

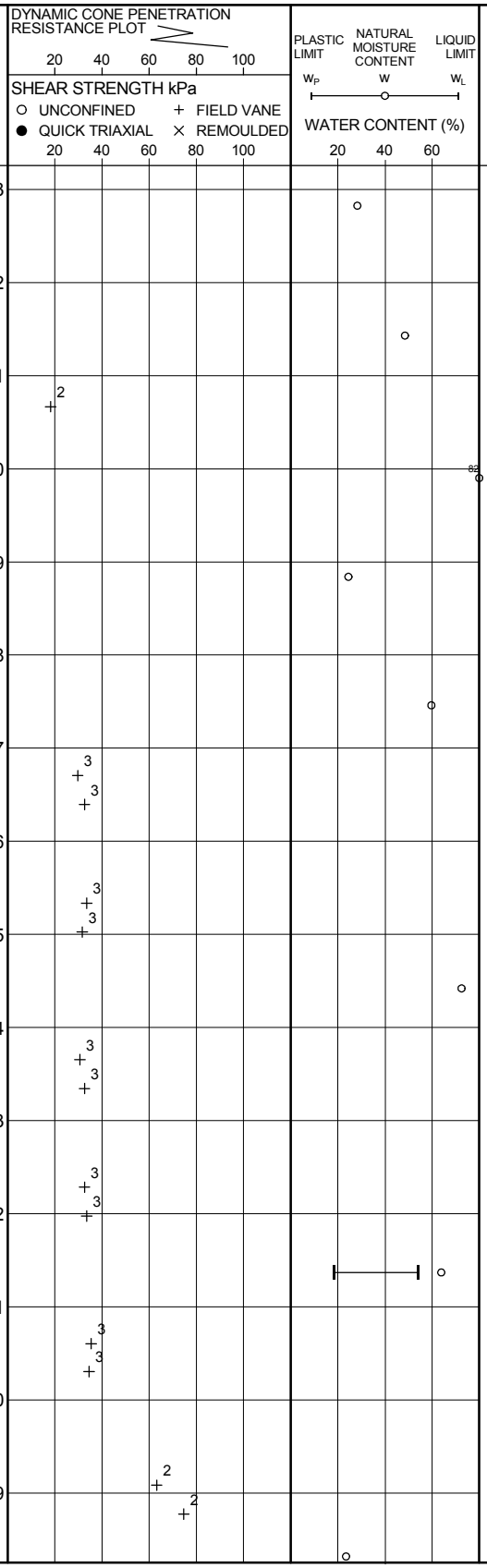
ELEVATION SCALE

DYNAMIC CONE PENETRATION RESISTANCE PLOT

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%)



UNIT WEIGHT γ kN/m³

15.9

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL	REMARKS
0	2	90	8	Non -Plastic
0	3	40	57	

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S202-20

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074266.0 ;E 225398.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY MAS
DATUM Geodetic
DATE March 9, 2011
CHECKED BY TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
14.9	Sandy SILT, trace clay Compact Grey Wet						168				
167.6											
15.7	SAND, trace silt, trace gravel Compact Grey Wet										
	SAND and GRAVEL, trace to some silt, trace clay. Cobbles at 16.2 m depth Very dense Grey Wet		15	SS	64		167		○		40 52 7 1
166.5											
16.8	END OF BOREHOLE										

NOTES:

* Water flowing from top and around casing at ground surface (Elev. 183.3 m) upon completion of drilling.

1. Water level (not-stabilized) in casing at 0.6 m above ground surface (Elev. 183.9 m) measured at about 6:30 pm on March 9, 2011 - Artesian Condition.

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

Golder Associates

RECORD OF DCPT No S202-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074204.5 ;E 225361.0	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	NK
DATUM	Geodetic	DATE	March 4, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.8	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						183				
181.8							182				
2.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Bedrock outcrop observed east of DCPT S202-DC01.										

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

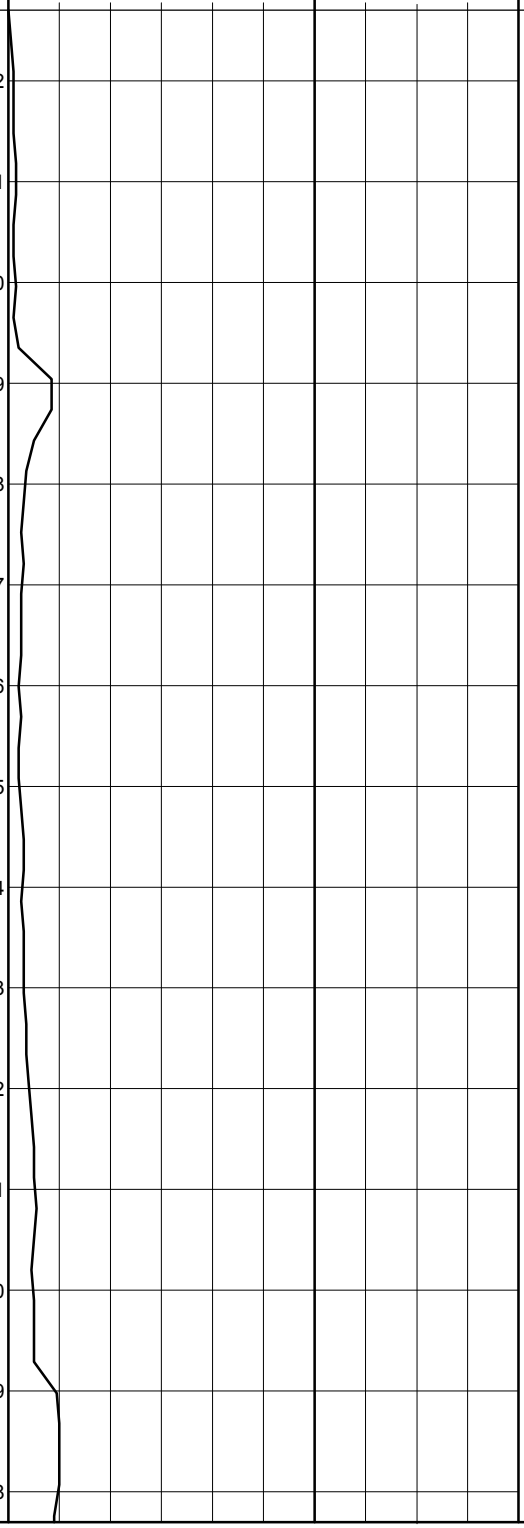
Golder Associates

RECORD OF DCPT No S202-DC02

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074241.9 ;E 225387.6	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	NK
DATUM	Geodetic	DATE	March 4, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
182.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



γ kN/m³

GR SA SI CL

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

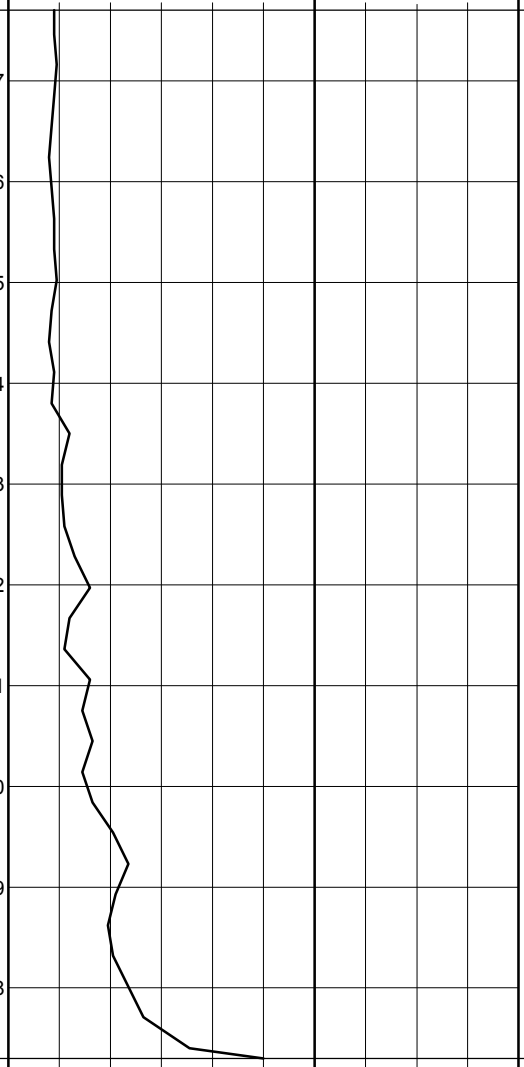
Golder Associates

RECORD OF DCPT No S202-DC02

SHEET 2 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074241.9 ;E 225387.6	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	NK
DATUM	Geodetic	DATE	March 4, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)										
157.3 / 25.4	END OF DCPT Refusal to Further Penetration (100 Blows / 0.10 m)										



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

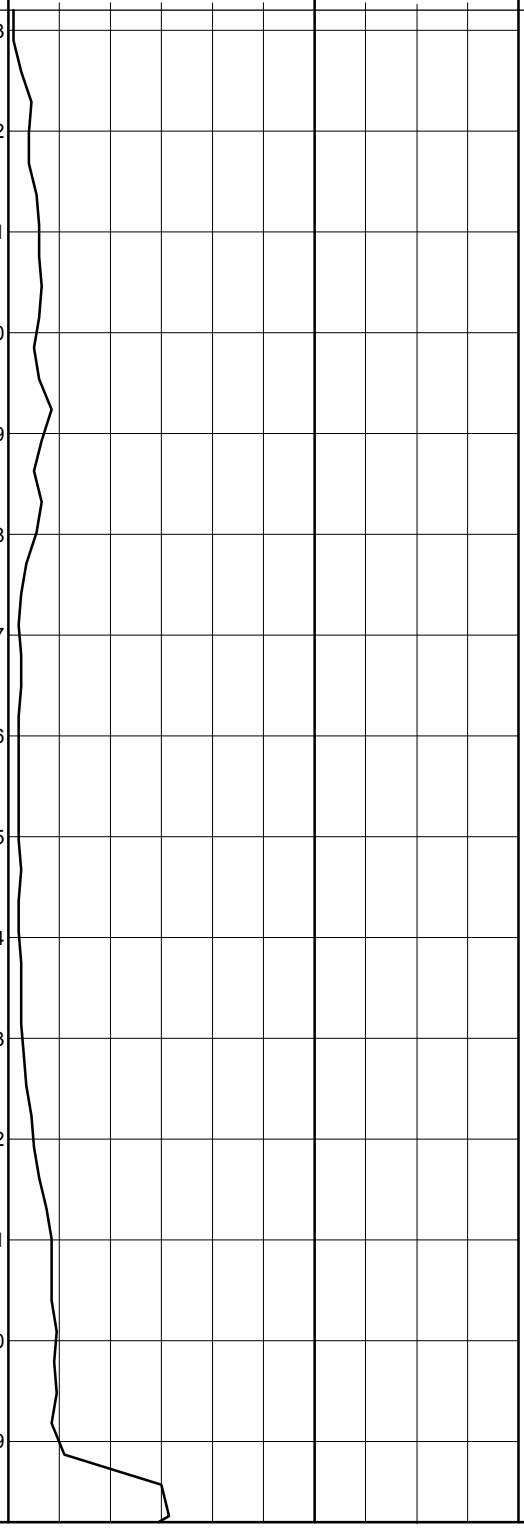
Golder Associates

RECORD OF DCPT No S202-DC03

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074271.7 ;E 225333.8	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Dynamic Cone Penetration Test	COMPILED BY	MAS
DATUM	Geodetic	DATE	March 10, 2011	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.2	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

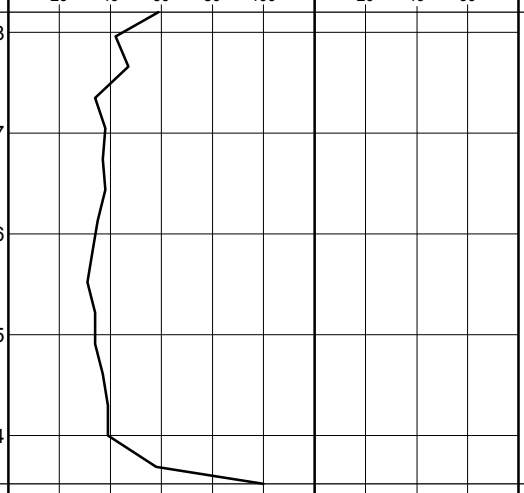
Golder Associates

RECORD OF DCPT No S202-DC03

SHEET 2 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074271.7 ;E 225333.8	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Dynamic Cone Penetration Test	COMPILED BY	MAS
DATUM	Geodetic	DATE	March 10, 2011	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						168				
							167				
							166				
							165				
							164				
163.5											
19.7	END OF DCPT Refusal to Further Penetration (100 Blows / 0.18 m) NOTE: 1. Water flowing out of the DCPT hole at ground surface upon completion of penetration test.										



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

Golder Associates

RECORD OF DCPT No S202-DC04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074288.4 ;E 225369.2	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Dynamic Cone Penetration Test	COMPILED BY	MAS
DATUM	Geodetic	DATE	March 14, 2011	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.6	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						185, 184, 183, 182				
181.0							181				
4.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Bedrock outcrop observed in the vicinity of the DCPT.										

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

Golder Associates

RECORD OF DCPT No S202-DC05

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074150.5 ;E 225428.4	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	NK
DATUM	Geodetic	DATE	March 1, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
189.6	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
0.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Additional Dynamic Cone Penetration Tests were advanced within 1.5 m radius of DCPT S202-DC05; refusal encountered at a depth of 0.3 m below ground surface (Elev. 189.3 m) in all the DCPTs.										

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

Golder Associates

RECORD OF DCPT No S202-DC06

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074185.4 ;E 225448.7	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	NK
DATUM	Geodetic	DATE	March 1, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						185, 184, 183				
182.4											
3.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S202-DC07

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074195.8 ;E 225407.0	ORIGINATED BY	ID
DIST		HWY	69	BOREHOLE TYPE	Hand Excavation	COMPILED BY	NK
DATUM	Geodetic	DATE	March 2, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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			SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P — w — w_L WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
190.3	GROUND SURFACE										
0.0	TOPSOIL										
0.1	END OF EXCAVATION PROBABLE BEDROCK										

NOTES:

1. Bedrock outcrop observed in the vicinity of the DCPT; bedrock confirmed by hand excavation at the DCPT location.

2. Excavation dry upon completion.

+ 3, × 3: Numbers refer to Sensitivity

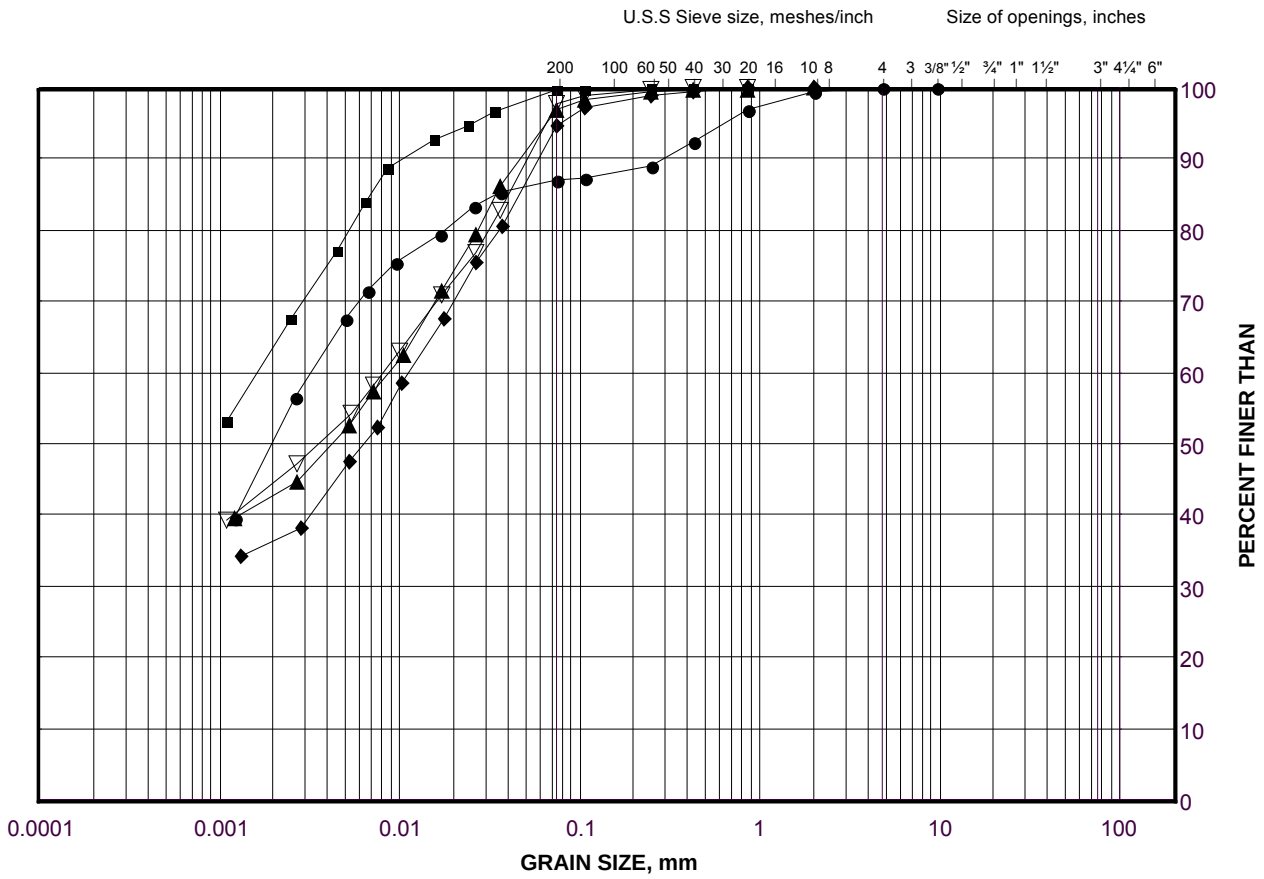
○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clay

Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

FIGURE B.S202-01A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-05	11	169.9
■	S202-05	13	164.5
◆	S202-03	2	181.9
▲	S202-09	2	185.1
▽	S202-08	3	180.9

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

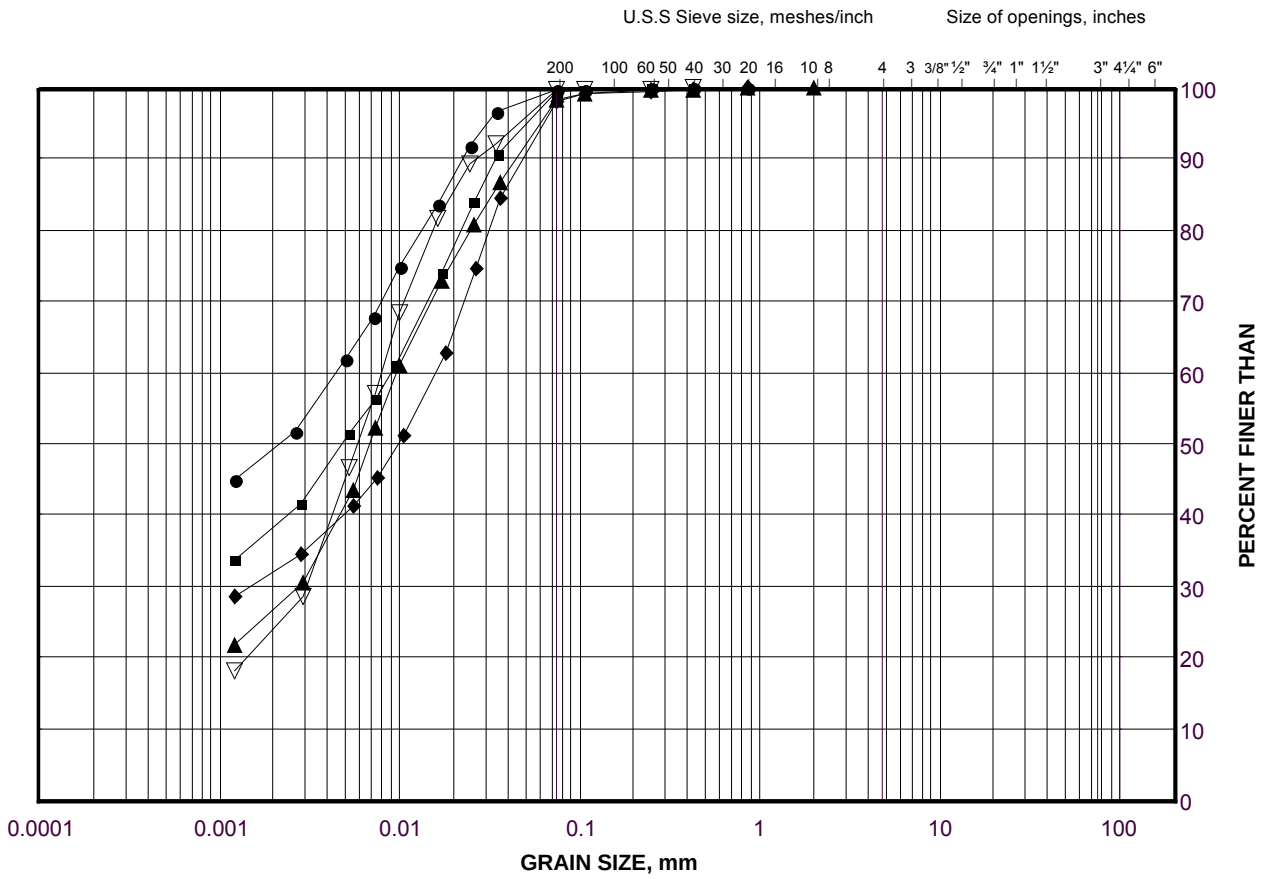
Date: 24-May-11

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clay

Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

FIGURE B.S202-01B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-04	4	179.5
■	S202-06	4	179.7
◆	S202-05	4	179.6
▲	S202-03	4	180.1
▽	S202-08	5	178.3

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

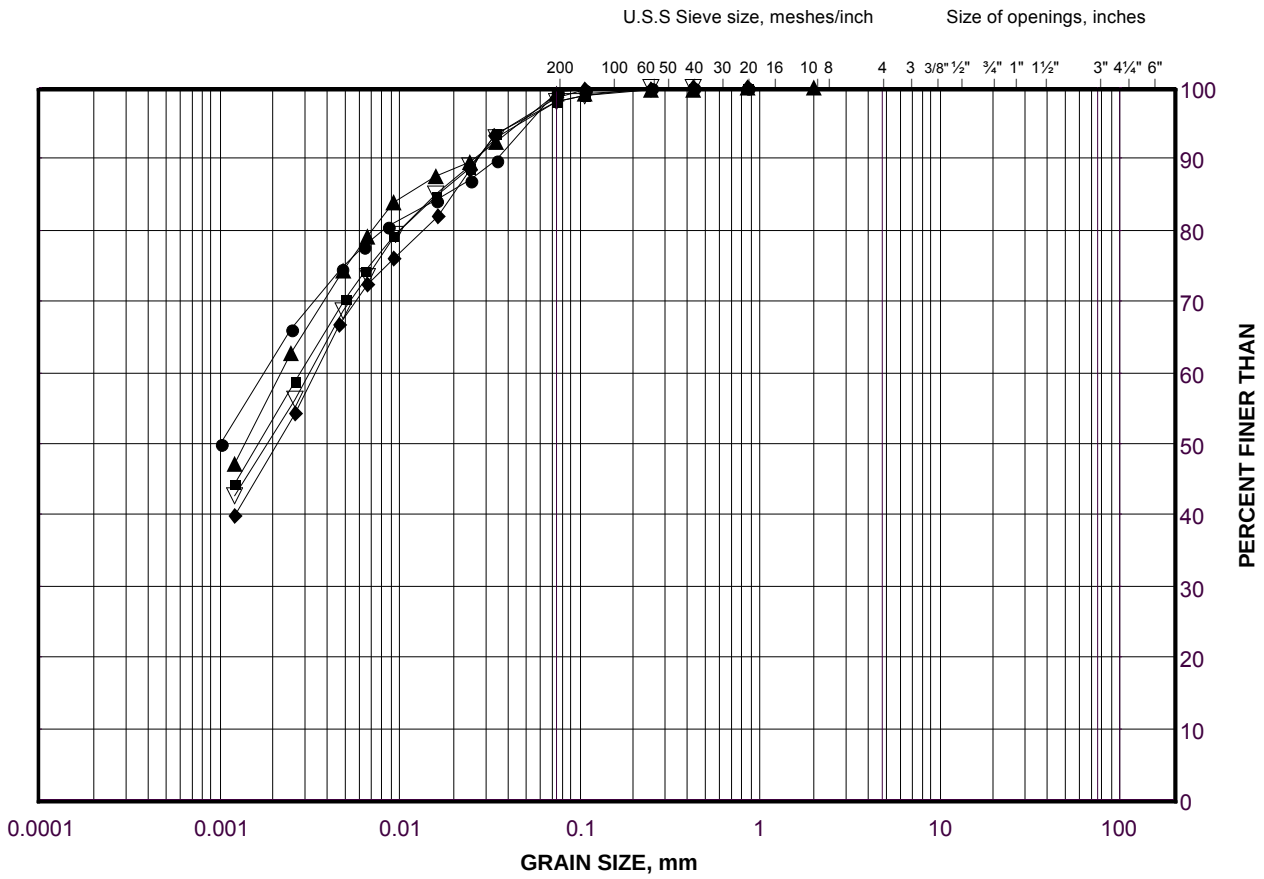
Date: 25-May-11

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clay

Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

FIGURE B.S202-01C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-04	7	174.9
■	S202-07	8	174.5
◆	S202-06	8	172.7
▲	S202-05	8	173.5
▽	S202-08	9	172.2

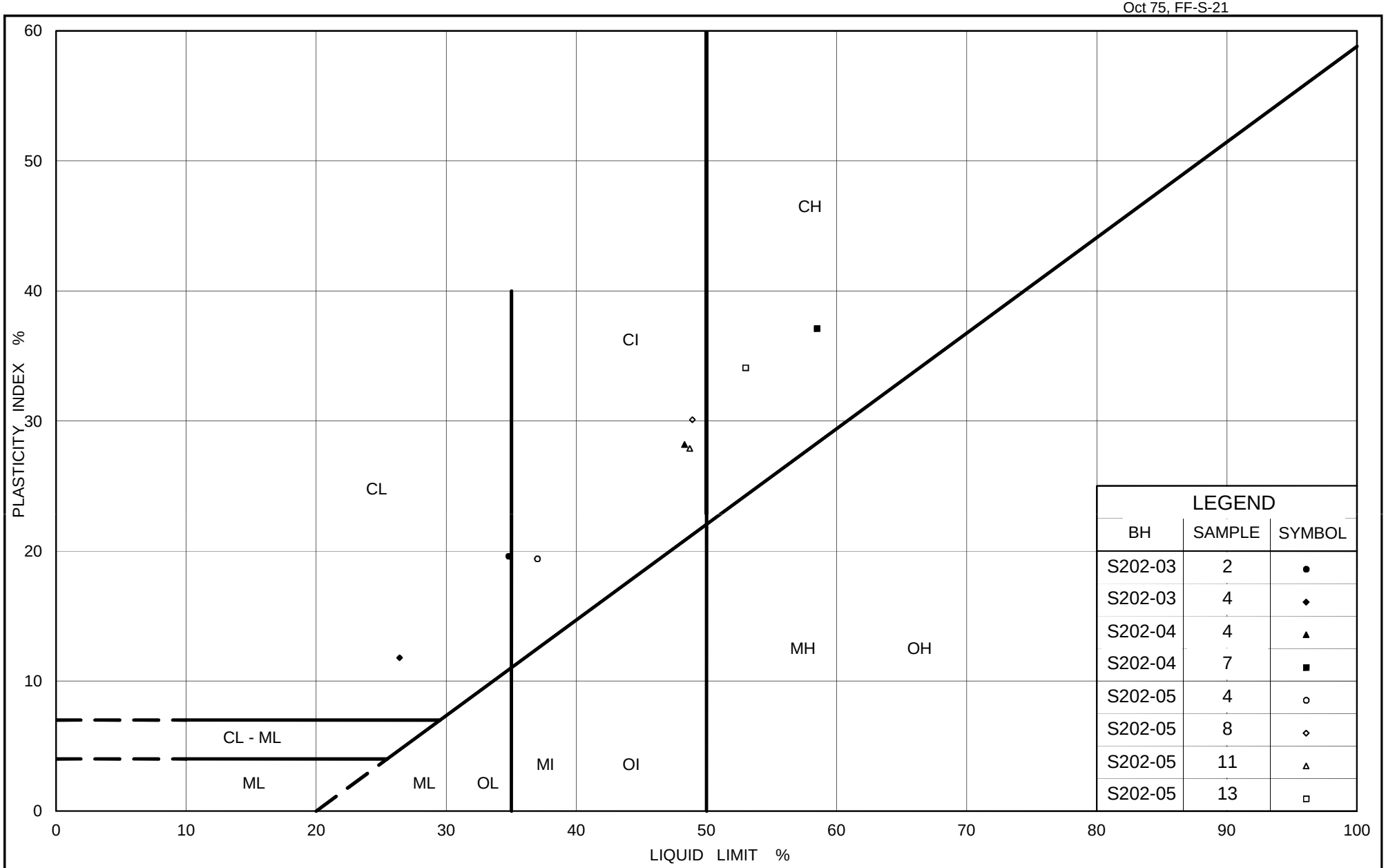
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 24-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

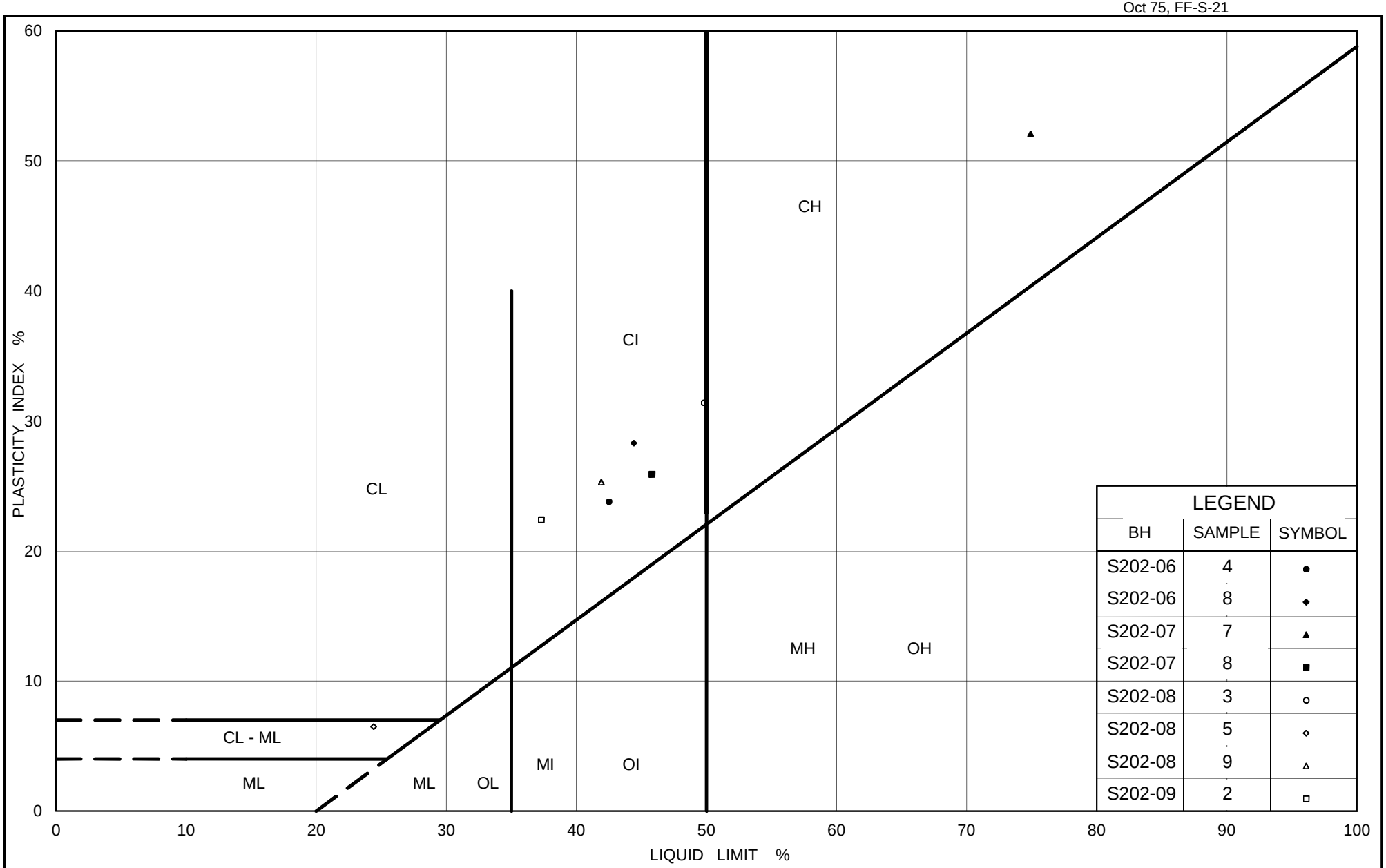
PLASTICITY CHART
Clayey Silt to Clay
Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

Figure No. B.S202-02A

Project No. 09-1111-6014

Checked By: TVA

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Clayey Silt to Clay
Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

Figure No. B.S202-02B

Project No. 09-1111-6014

Checked By: TVA

CONSOLIDATION TEST SUMMARY

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-03

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	7
Borehole Number	S202-07	Sample Depth, m	7.2-7.6

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	7		
Date Started	5/24/2011		
Date Completed	6/19/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m^3	15.33
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	8.62
Area, cm^2	31.48	Specific Gravity, measured	2.78
Volume, cm^3	59.62	Solids Height, cm	0.599
Water Content, %	77.82	Volume of Solids, cm^3	18.85
Wet Mass, g	93.18	Volume of Voids, cm^3	40.77
Dry Mass, g	52.4	Degree of Saturation, %	100.0

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.894	2.163	1.894				
5.00	1.892	2.160	1.893	7	1.09E-01	2.01E-04	2.13E-06
10.00	1.890	2.157	1.891	58	1.31E-02	2.01E-04	2.57E-07
19.99	1.883	2.145	1.887	154	4.90E-03	3.81E-04	1.83E-07
40.00	1.871	2.125	1.877	240	3.11E-03	3.09E-04	9.42E-08
59.96	1.858	2.104	1.865	1874	3.93E-04	3.41E-04	1.32E-08
79.99	1.832	2.059	1.845	6000	1.20E-04	7.09E-04	8.36E-09
99.91	1.738	1.902	1.785	22685	2.98E-05	2.49E-03	7.26E-09
119.93	1.648	1.752	1.693	20093	3.02E-05	2.37E-03	7.03E-09
159.90	1.531	1.556	1.589	5289	1.01E-04	1.54E-03	1.53E-08
319.80	1.343	1.242	1.437	1284	3.41E-04	6.21E-04	2.07E-08
630.22	1.199	1.002	1.271	228	1.50E-03	2.45E-04	3.61E-08
1254.09	1.091	0.822	1.145	441	6.30E-04	9.12E-05	5.63E-09
2503.19	0.998	0.667	1.045	454	5.10E-04	3.91E-05	1.95E-09
1254.09	1.016	0.697	1.007				
318.71	1.048	0.750	1.032				
119.93	1.084	0.810	1.066				
79.99	1.096	0.831	1.090				
39.95	1.121	0.872	1.108				
10.00	1.152	0.924	1.136				
5.00	1.170	0.955	1.161				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.05	Unit Weight, kN/m^3	21.35
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	15.57
Area, cm^2	31.48	Specific Gravity, measured	2.78
Volume, cm^3	32.99	Solids Height, cm	0.599
Water Content, %	37.10	Volume of Solids, cm^3	18.85
Wet Mass, g	71.84	Volume of Voids, cm^3	14.15
Dry Mass, g	52.4		

Prepared By: LH

Golder Associates

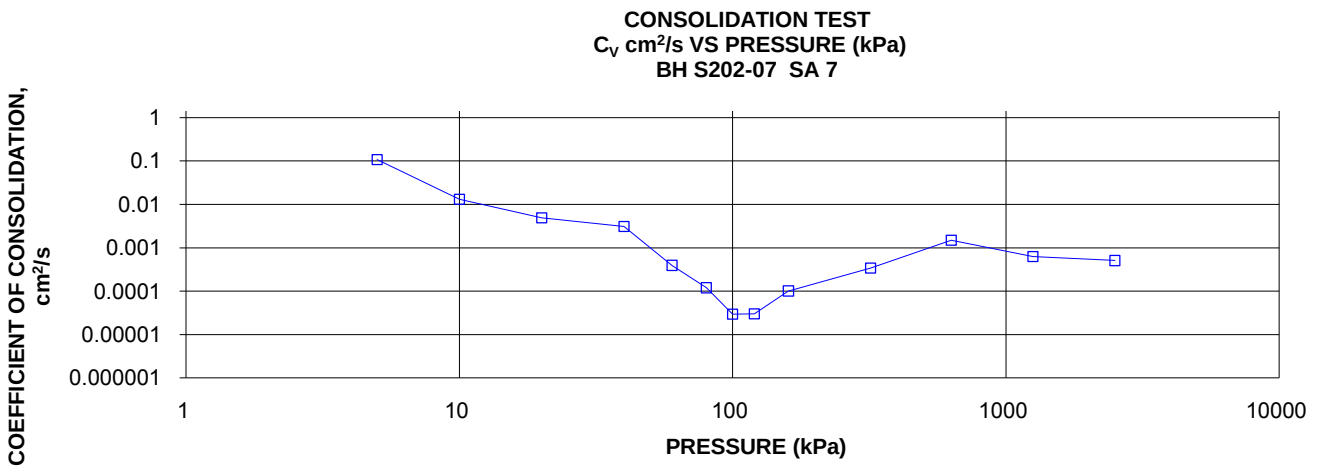
Checked By: TVA

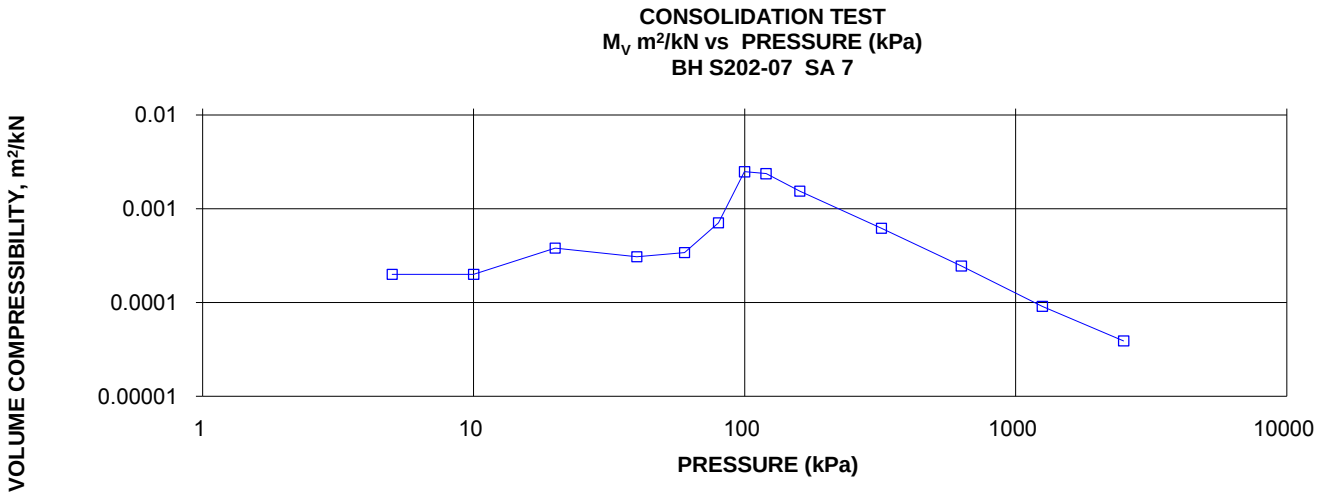
CONSOLIDATION TEST SUMMARY

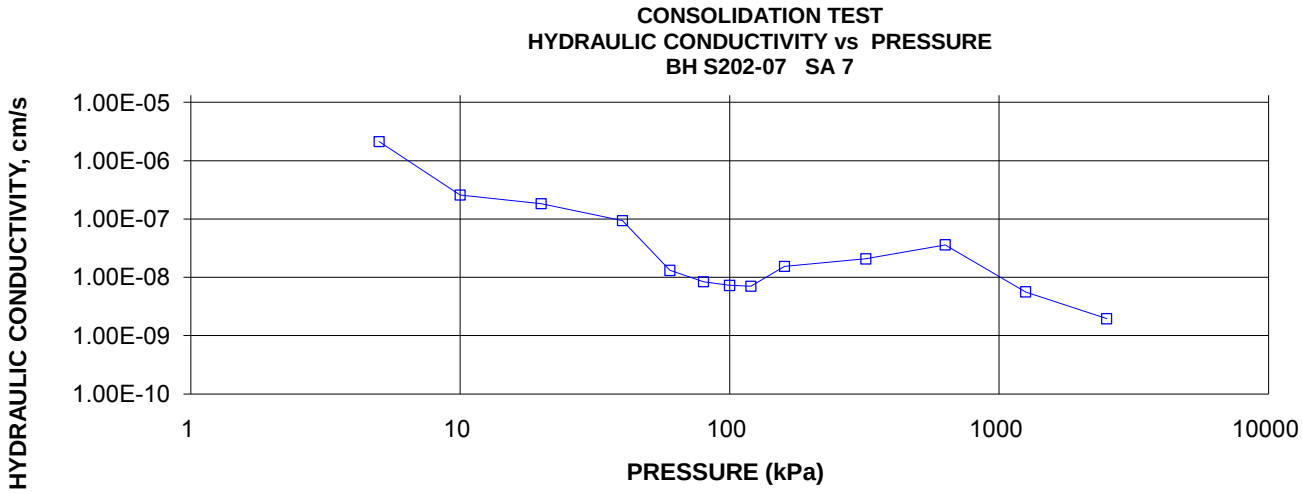
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-03

Sheet 2 of 4







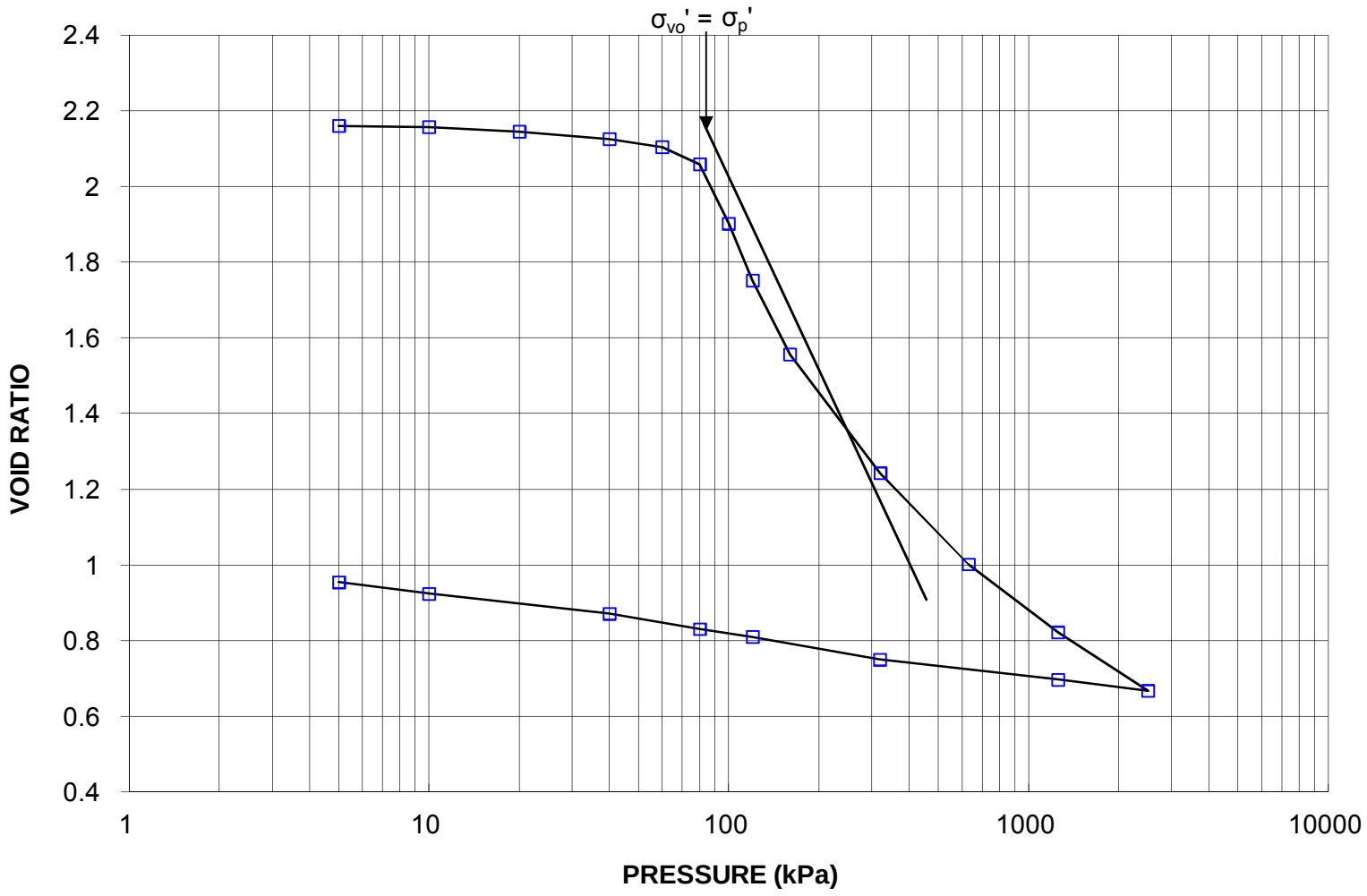
Project No. 09-1111-6014

Prepared By: LH

Golder Associates

Checked By: TVA

CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH S202-07 SA 7



Project No. 09-1111-6014

Prepared By: LH

Golder Associates

Checked By: TVA

CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE B.S202-03
Sheet 3 of 4

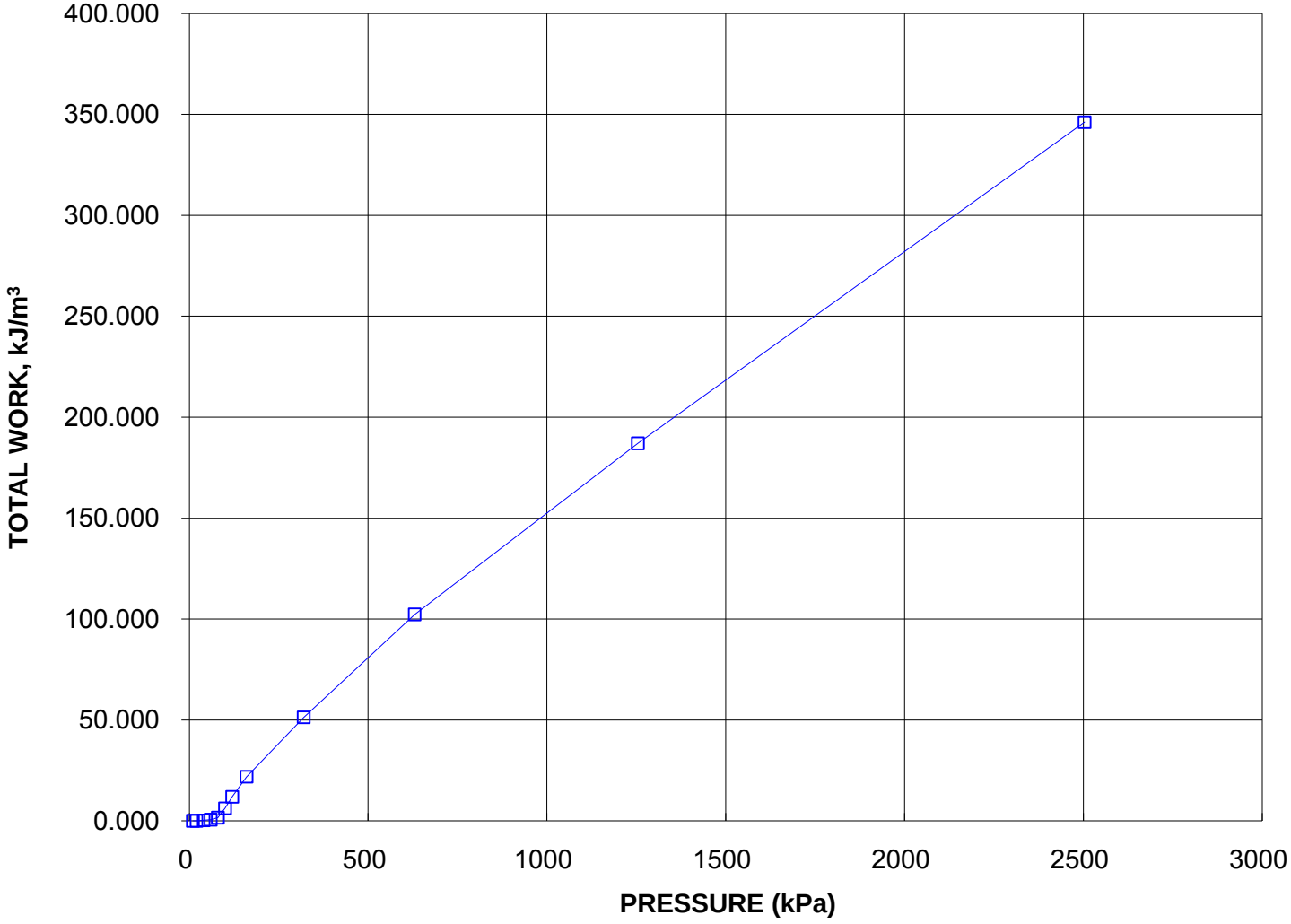
Project No. 09-1111-6014

Prepared By: LH

Golder Associates

Checked By: TVA

CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs PRESSURE
BH S202-07 SA 7



CONSOLIDATION TEST
TOTAL WORK VS PRESSURE

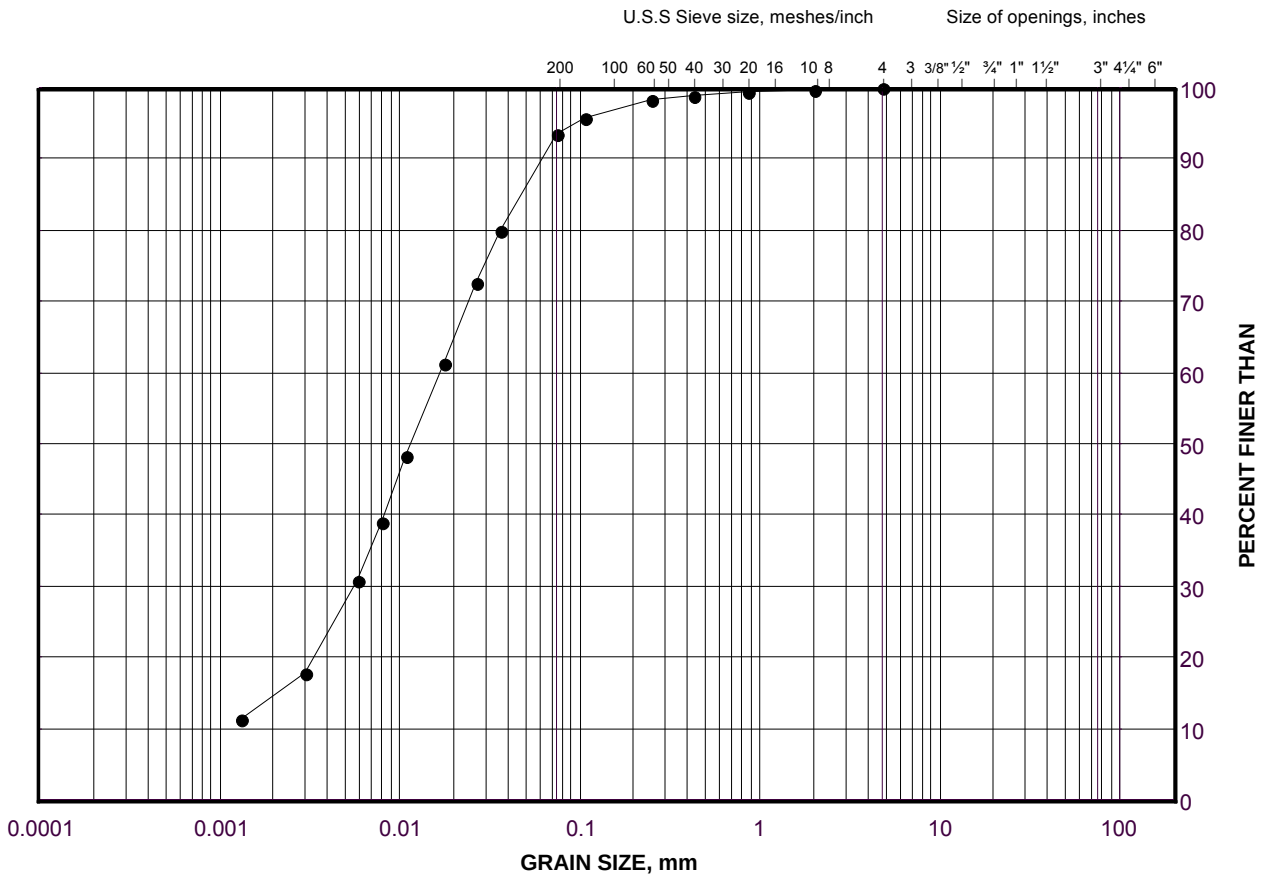
FIGURE B.S202-03
Sheet 4 of 4

GRAIN SIZE DISTRIBUTION

Silt (Interlayer)

Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

FIGURE B.S202-04



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-07	5	179.1

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

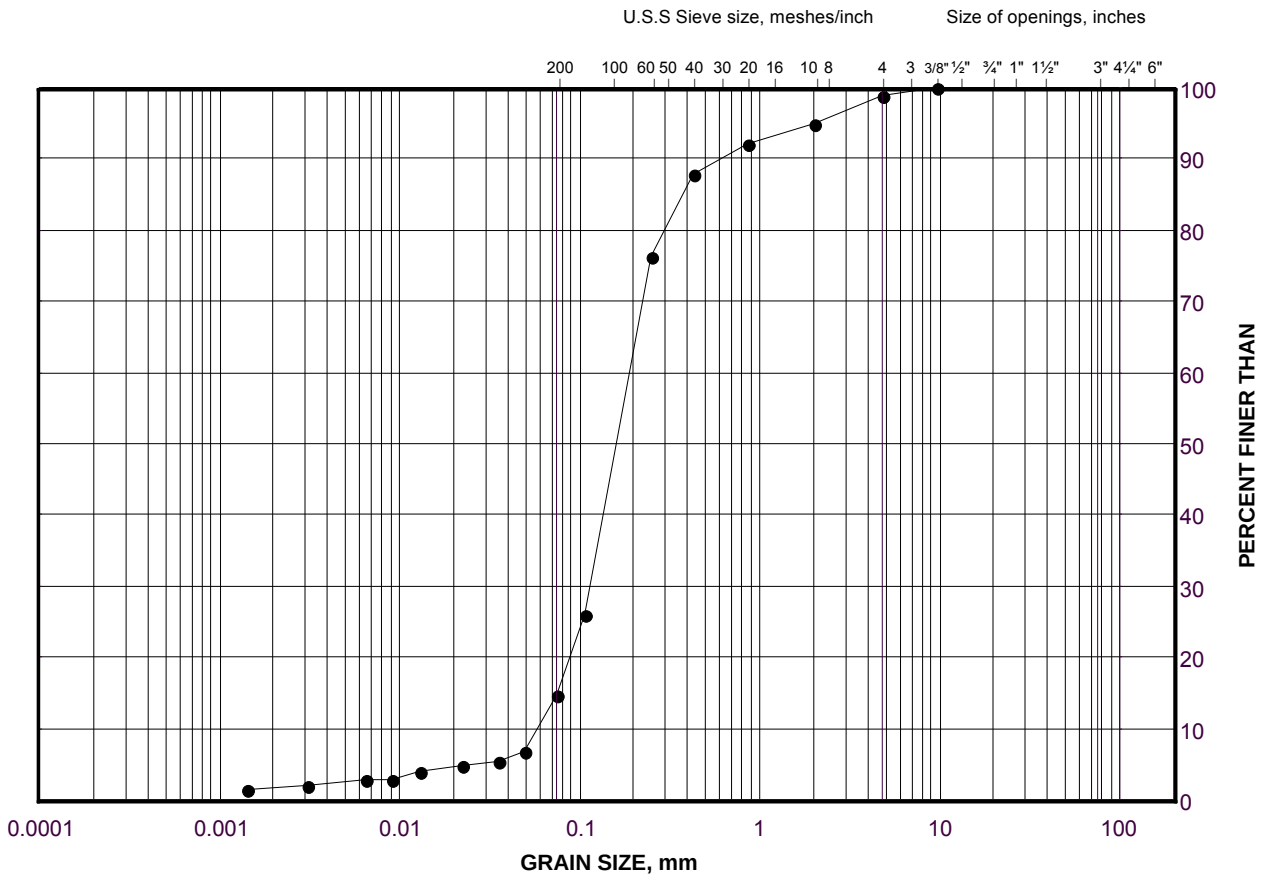
Date: 24-May-11

GRAIN SIZE DISTRIBUTION

Sand

Highway 69 (SBL) STA 11+175 to 11+275 (Swamp 202)

FIGURE B.S202-05



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-06	12	165.1

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 24-May-11

Borehole S202-04

Box 1: 11.27 m – 14.26 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

PROJECT
Swamp Crossings and High Fill Areas
Highway 69 Four-Laning
GWP 5404-05-00; WP 5404-05-01

TITLE
Core Photo – Swamp 202
Highway 69 (SBL) STA 11+175 to 11+275

Golder Associates

PROJECT No. 09-1111-6014			FILE No. ----	
DESIGN	AT		SCALE NTS	REV.
CADD	--		**FIGURE B.S202-06**	
CHECK	AT			
REVIEW	TVA			

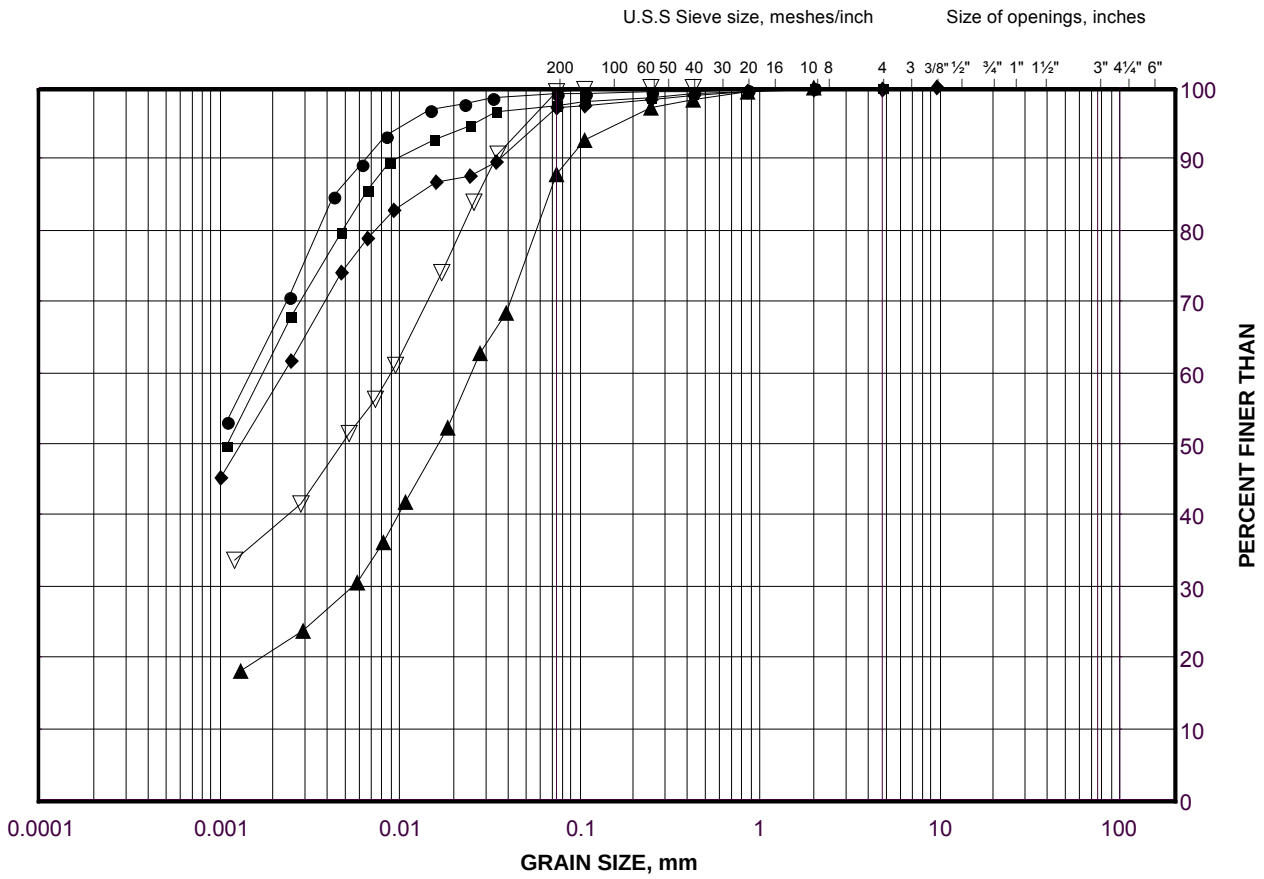
REVISION DATE: MAY 1 ', 2011 BY: VA Project: 09-1111-6014

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clay

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-07A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-18	10	172.1
■	S202-19	11	169.4
◆	S202-20	12	171.4
▲	S202-18	2B	181.8
▽	S202-06	4	179.7

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

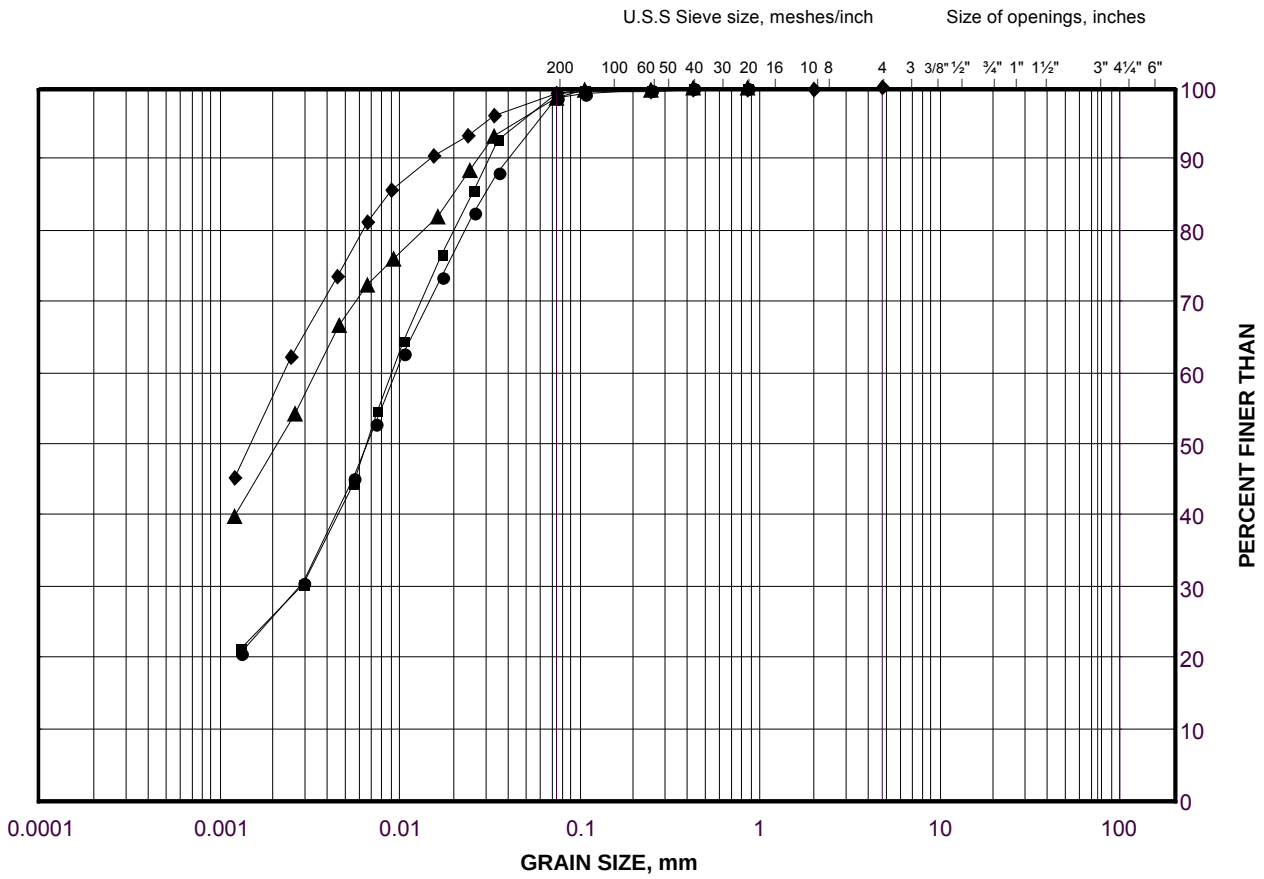
Date: 24-May-11

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clay

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-07B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-19	5B	178.3
■	S202-18	6	178.2
◆	S202-19	8	173.9
▲	S202-06	8	172.7

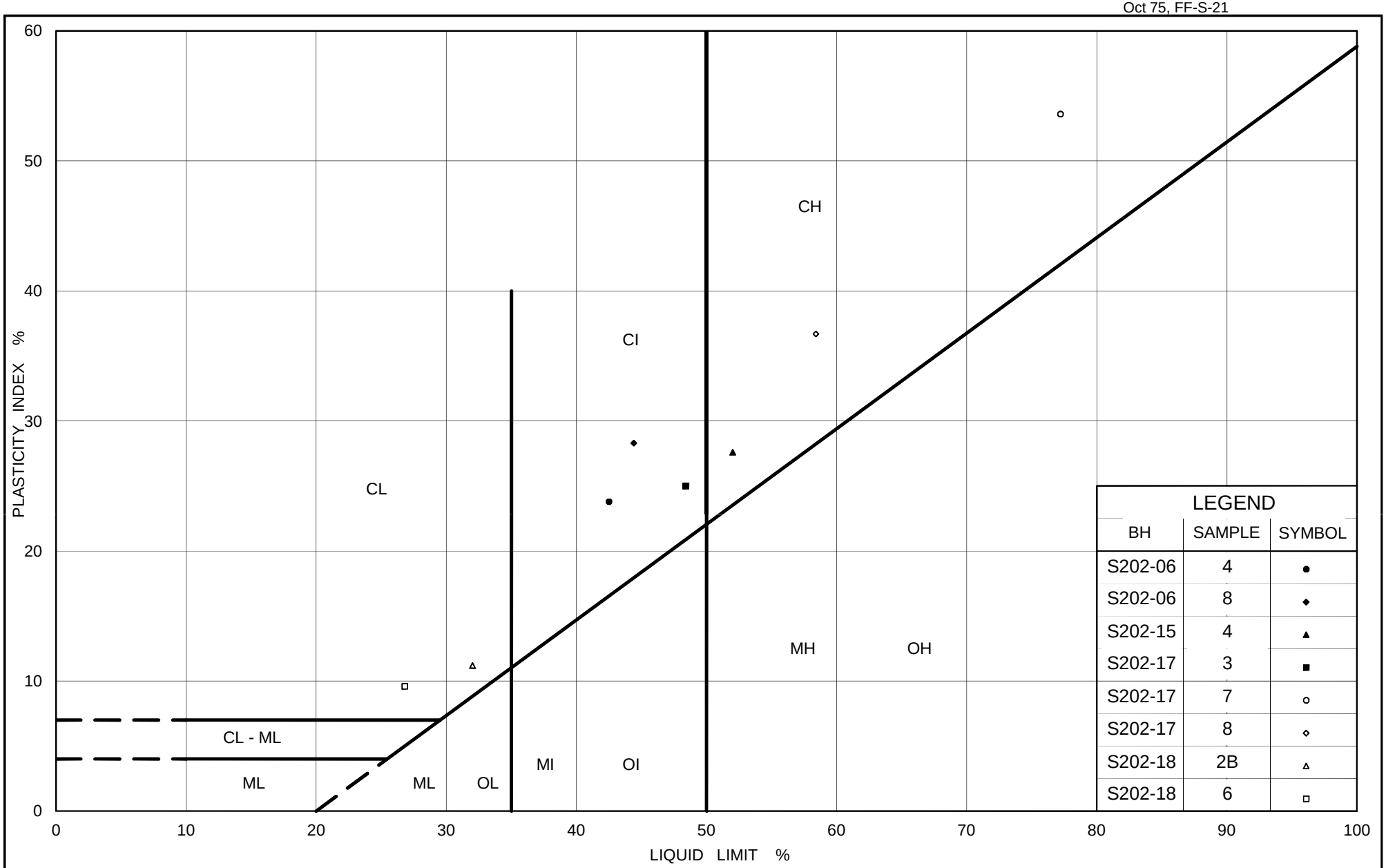
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 24-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

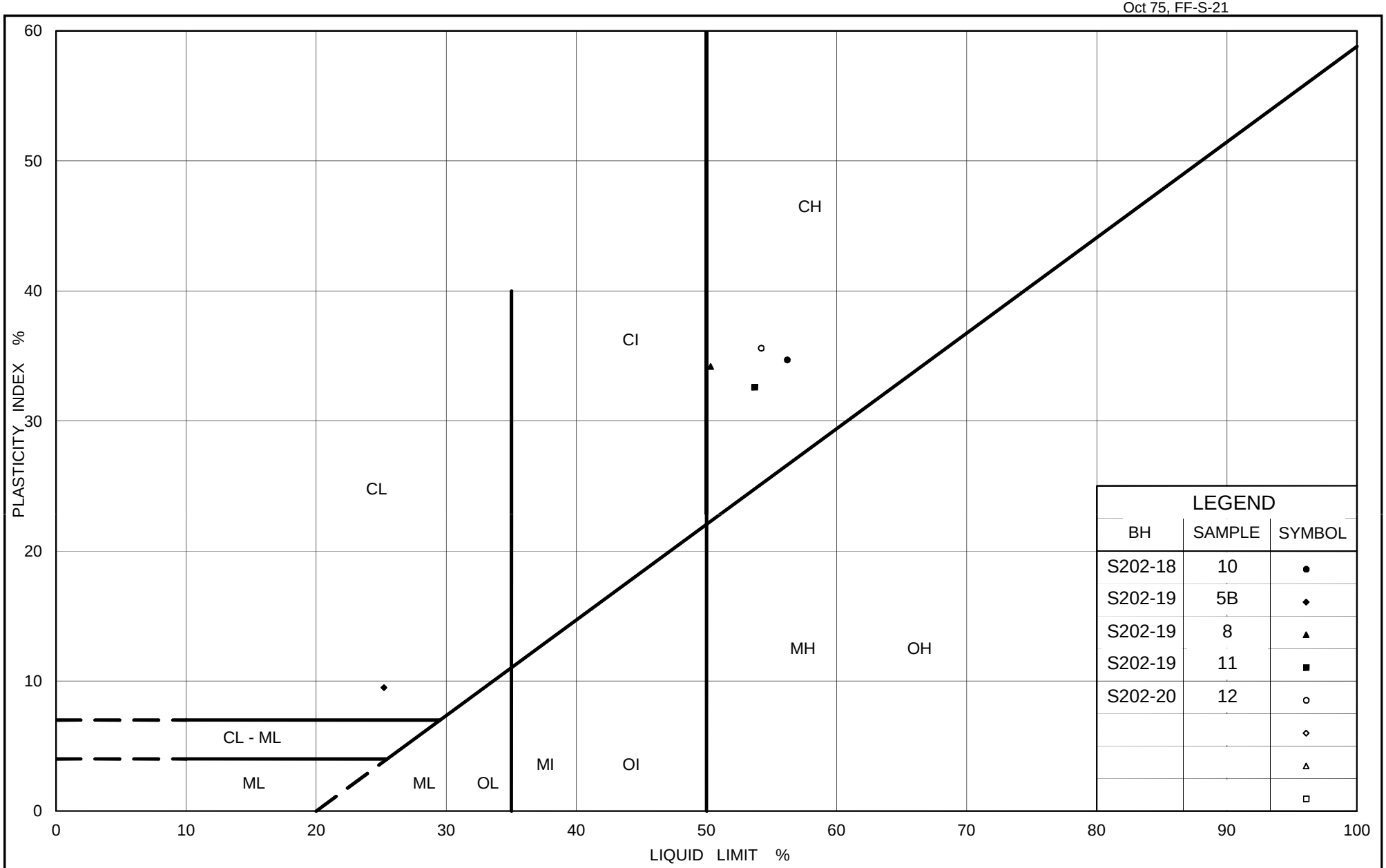
PLASTICITY CHART
Clayey Silt to Clay
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

Figure No. B.S202-08A

Project No. 09-1111-6014

Checked By: TVA

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Clayey Silt and Clay
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

Figure No. B.S202-08B

Project No. 09-1111-6014

Checked By: TVA

CONSOLIDATION TEST SUMMARY

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-09

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	7
Borehole Number	S202-17	Sample Depth, m	11.0

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	5		
Date Started	4/19/2011		
Date Completed	4/30/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.26	Unit Weight, kN/m^3	15.29
Sample Diameter, cm	4.96	Dry Unit Weight, kN/m^3	8.62
Area, cm^2	19.34	Specific Gravity, measured	2.76
Volume, cm^3	24.42	Solids Height, cm	0.402
Water Content, %	77.32	Volume of Solids, cm^3	7.78
Wet Mass, g	38.07	Volume of Voids, cm^3	16.64
Dry Mass, g	21.47	Degree of Saturation, %	99.7

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.263	2.140	1.263				
3.96	1.263	2.140	1.263	1	3.38E-01	0.00E+00	0.00E+00
8.79	1.259	2.130	1.261	889	3.79E-04	6.56E-04	2.44E-08
18.96	1.248	2.102	1.254	487	6.84E-04	8.56E-04	5.74E-08
38.97	1.220	2.033	1.234	359	8.99E-04	1.11E-03	9.76E-08
78.94	1.182	1.938	1.201	470	6.51E-04	7.53E-04	4.80E-08
158.97	1.082	1.690	1.132	540	5.03E-04	9.89E-04	4.88E-08
318.97	0.959	1.384	1.021	463	4.77E-04	6.09E-04	2.84E-08
507.07	0.898	1.232	0.928	194	9.42E-04	2.57E-04	2.37E-08
1278.98	0.731	0.817	0.814	375	3.75E-04	1.71E-04	6.29E-09
2559.01	0.655	0.628	0.693	228	4.47E-04	4.70E-05	2.06E-09
1278.98	0.663	0.648	0.659				
319.14	0.684	0.700	0.674				
78.94	0.717	0.782	0.701				
18.96	0.750	0.864	0.734				
3.96	0.774	0.924	0.762				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

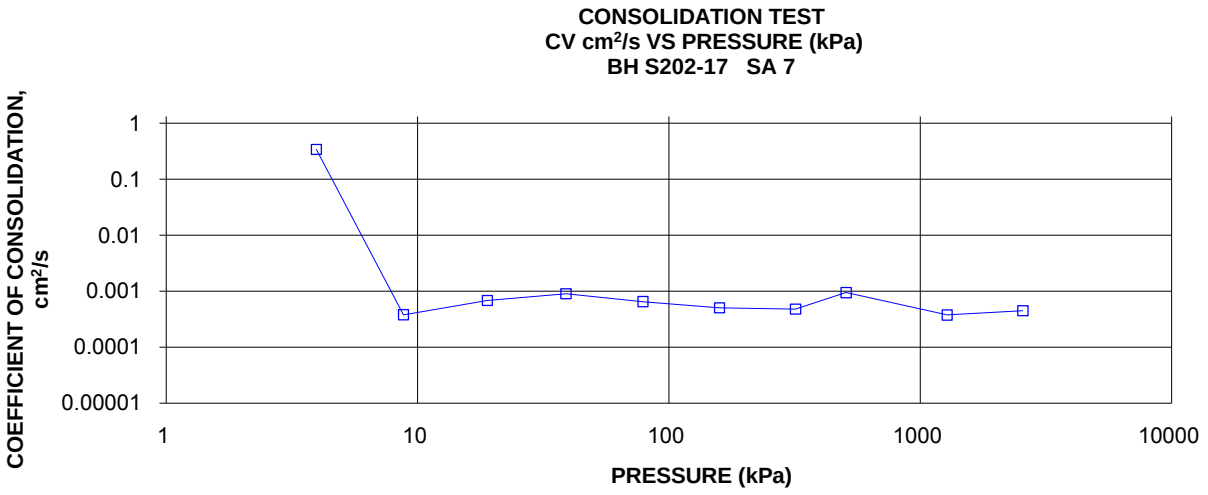
Sample Height, cm	0.77	Unit Weight, kN/m^3	19.15
Sample Diameter, cm	4.96	Dry Unit Weight, kN/m^3	14.07
Area, cm^2	19.34	Specific Gravity, measured	2.76
Volume, cm^3	14.97	Solids Height, cm	0.402
Water Content, %	36.14	Volume of Solids, cm^3	7.78
Wet Mass, g	29.23	Volume of Voids, cm^3	7.19
Dry Mass, g	21.47		

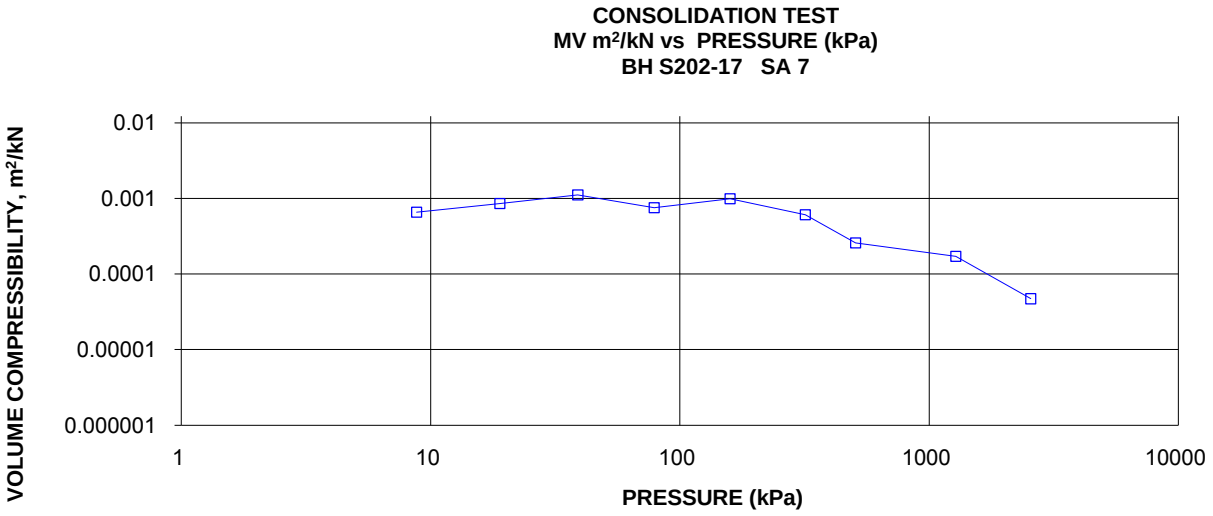
Prepared By: LFG

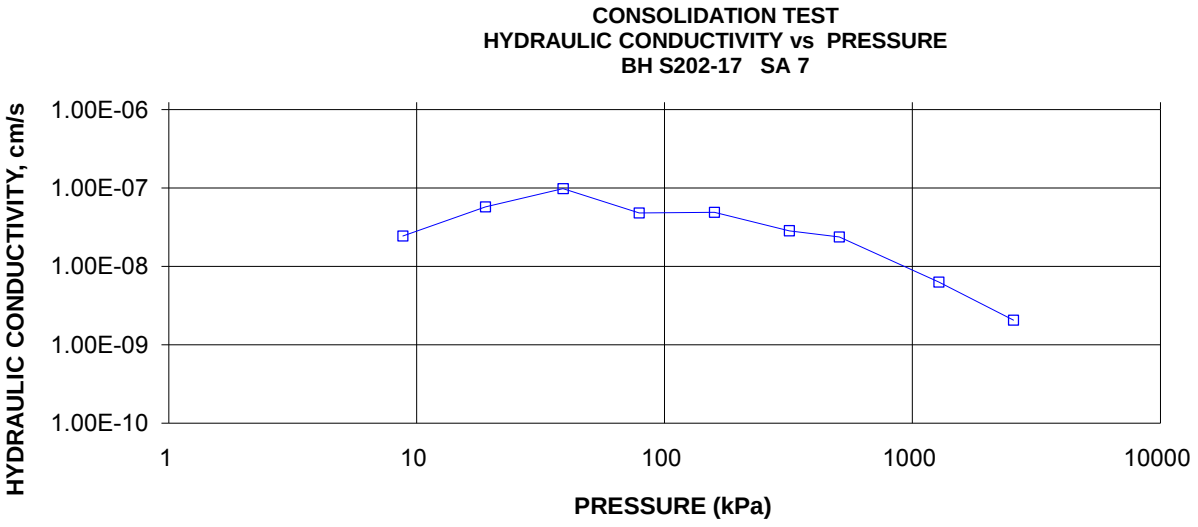
Golder Associates

Checked By: TVA

CONSOLIDATION TEST SUMMARY	FIGURE B.S202-09
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)	Sheet 2 of 4







Project No. 09-1111-6014

Prepared By: LFG

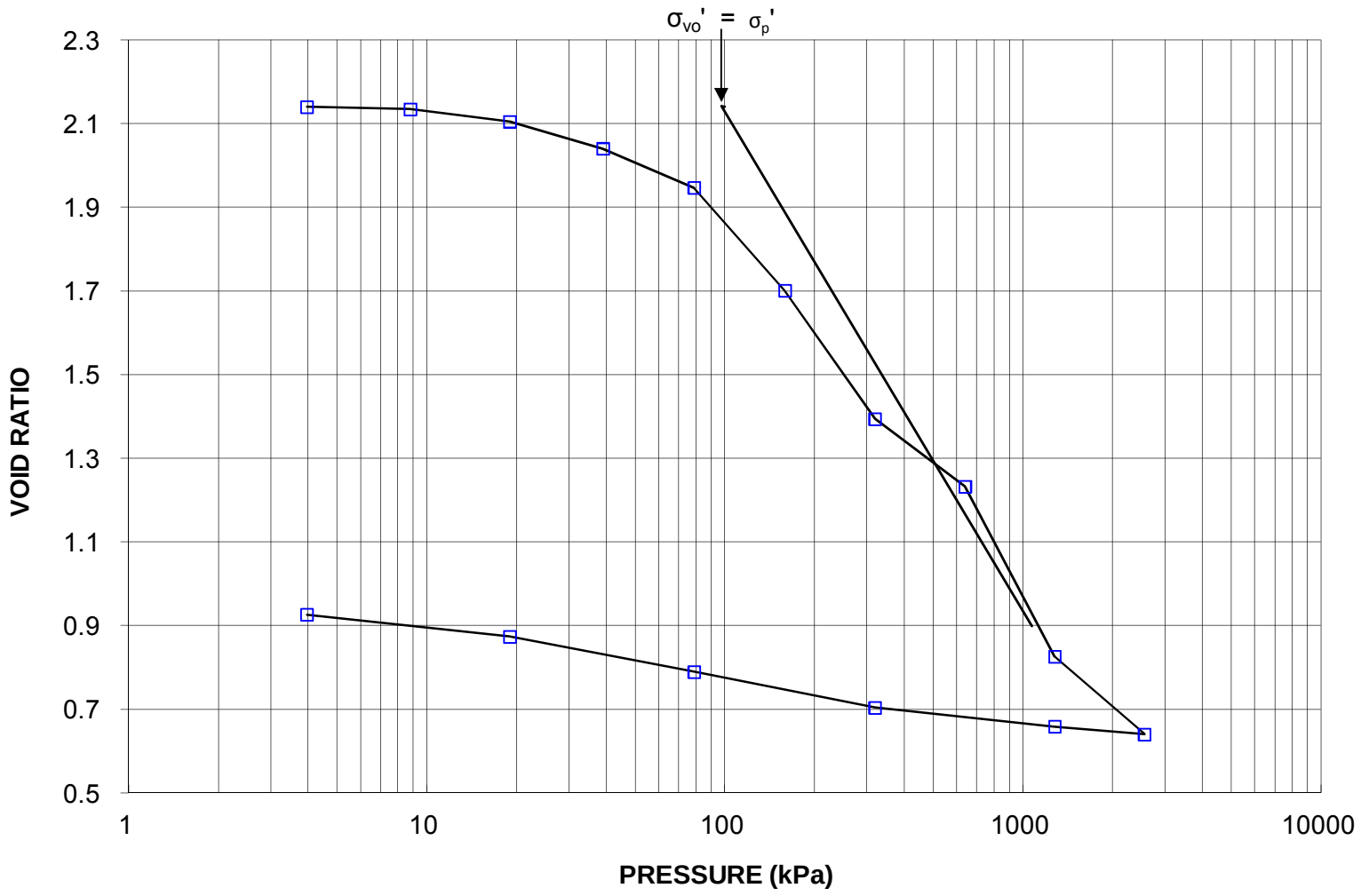
Golder Associates

Checked By: TVA

CONSOLIDATION TEST SUMMARY
VOID RATIO VS LOG PRESSURE

FIGURE B. S202-09
Sheet 3 of 4

CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH S202-17 SA 7



Project No. 09-1111-6014

Prepared By: LFG

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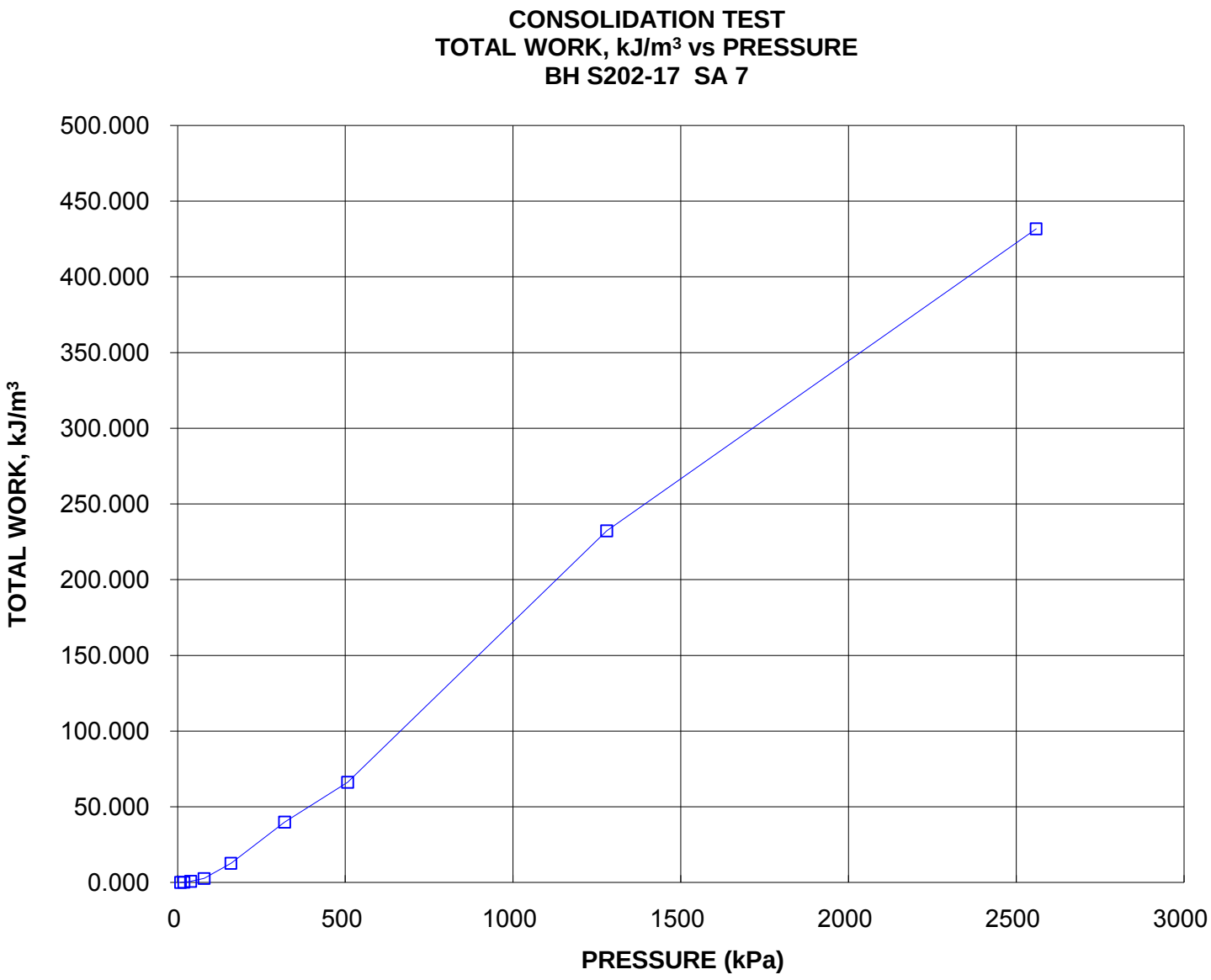
Project No. 09-1111-6014

Prepared By: LFG

Golder Associates

Checked By: TVA



CONSOLIDATION TEST SUMMARY
TOTAL WORK VS PRESSURE

FIGURE B.S202-09
Sheet 4 of 4

CONSOLIDATION TEST SUMMARY

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-10

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	11
Borehole Number	S202-20	Sample Depth, m	10.1-10.5

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	5/27/2011		
Date Completed	6/20/2011		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m^3	15.89
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	9.52
Area, cm^2	31.46	Specific Gravity, measured	2.78
Volume, cm^3	59.46	Solids Height, cm	0.660
Water Content, %	66.99	Volume of Solids, cm^3	20.76
Wet Mass, g	96.37	Volume of Voids, cm^3	38.70
Dry Mass, g	57.71	Degree of Saturation, %	99.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	c_v cm^2/s	m_v m^2/kN	k cm/s
0.00	1.890	1.864	1.890				
5.01	1.892	1.867	1.891	1	7.58E-01	-	-
10.01	1.890	1.865	1.891	214	3.54E-03	1.69E-04	5.88E-08
20.01	1.884	1.855	1.887	205	3.68E-03	3.33E-04	1.20E-07
40.03	1.869	1.833	1.877	501	1.49E-03	3.91E-04	5.71E-08
60.01	1.853	1.808	1.861	3375	2.18E-04	4.32E-04	9.20E-09
80.01	1.833	1.777	1.843	8930	8.06E-05	5.40E-04	4.26E-09
100.01	1.802	1.730	1.817	17238	4.06E-05	8.22E-04	3.27E-09
120.01	1.749	1.651	1.775	24970	2.68E-05	1.39E-03	3.64E-09
160.01	1.621	1.457	1.685	8247	7.30E-05	1.69E-03	1.21E-08
315.82	1.418	1.149	1.520	1815	2.70E-04	6.92E-04	1.83E-08
627.15	1.271	0.925	1.344	922	4.15E-04	2.50E-04	1.02E-08
1251.42	1.160	0.758	1.215	540	5.80E-04	9.37E-05	5.33E-09
2500.20	1.083	0.641	1.121	406	6.57E-04	3.26E-05	2.10E-09
1251.42	1.098	0.664	1.090				
315.82	1.130	0.712	1.114				
120.01	1.165	0.765	1.147				
80.01	1.176	0.783	1.171				
40.03	1.198	0.815	1.187				
10.01	1.246	0.889	1.222				
5.01	1.258	0.906	1.252				

Note:
k calculated using cv based on t_{90} values.
Specimen swelled under 5kPa

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.13	Unit Weight, kN/m^3	21.36
Sample Diameter, cm	6.33	Dry Unit Weight, kN/m^3	15.93
Area, cm^2	31.46	Specific Gravity, measured	2.78
Volume, cm^3	35.54	Solids Height, cm	0.660
Water Content, %	34.12	Volume of Solids, cm^3	20.76
Wet Mass, g	77.40	Volume of Voids, cm^3	14.78
Dry Mass, g	57.71		

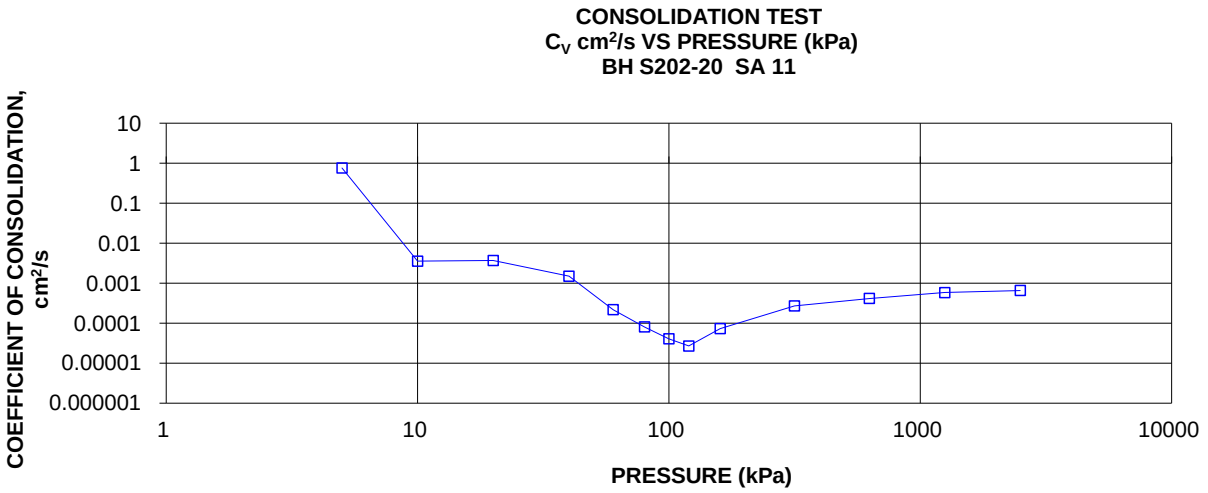
Prepared By: LH **Golder Associates** Checked By: MM

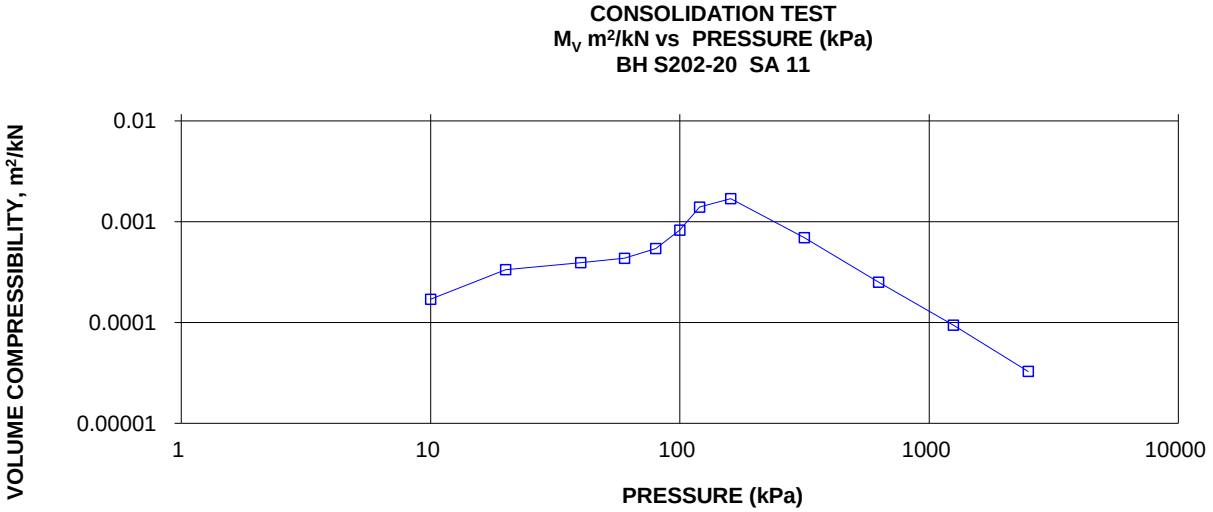
CONSOLIDATION TEST SUMMARY

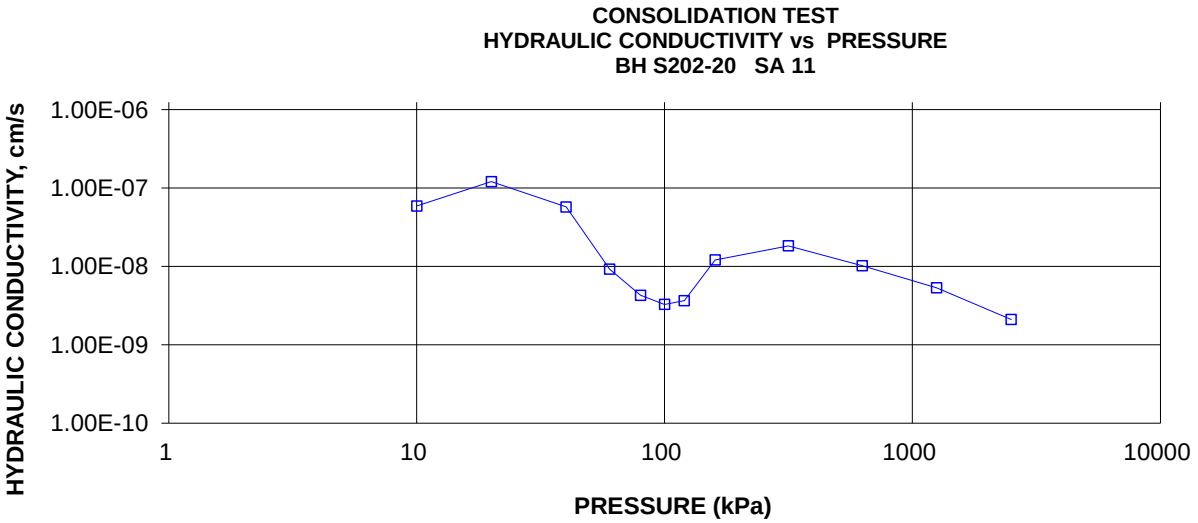
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-10

Sheet 2 of 4







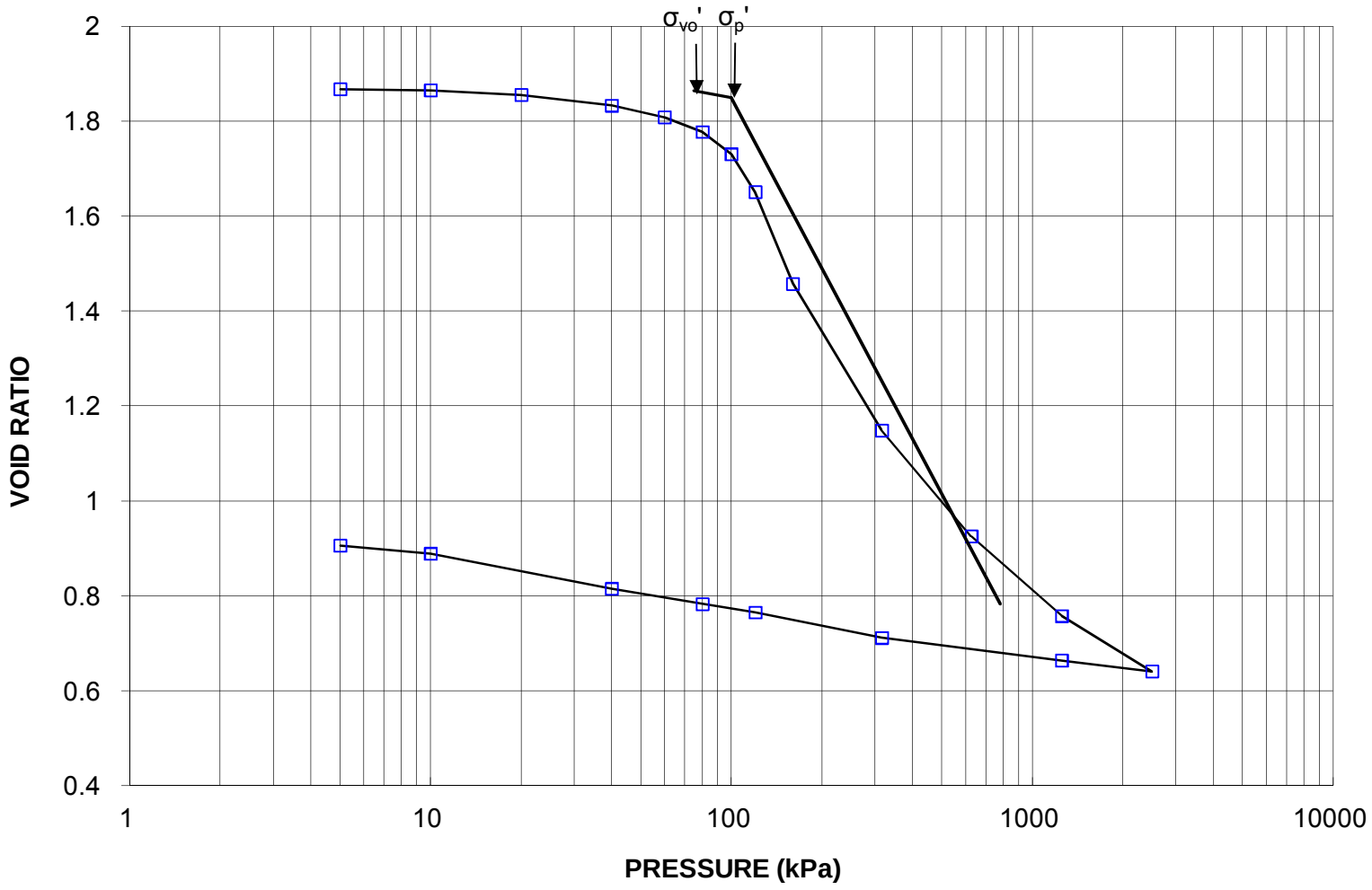
Project No. 09-1111-6014

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH S202-20 SA 11



Project No. 09-1111-6014

Prepared By: LH

Golder Associates

Checked By: MM

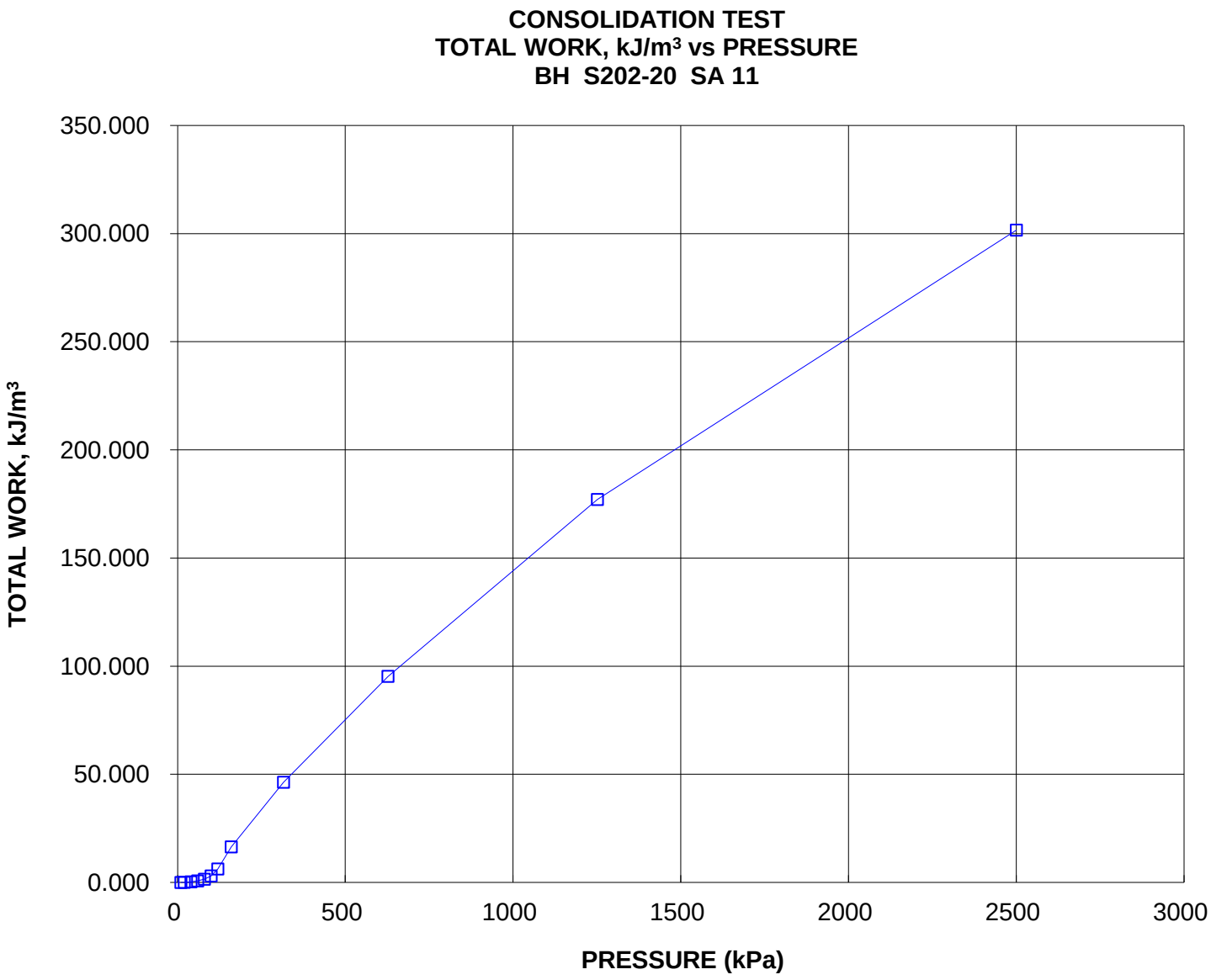
CONSOLIDATION TEST
VOID RATIO VS LOG PRESSURE

FIGURE B.S202-10
Sheet 3 of 4

Project No. 09-1111-6014

Prepared By: LH

Golder Associates



Checked By: MM

CONSOLIDATION TEST
TOTAL WORK VS PRESSURE

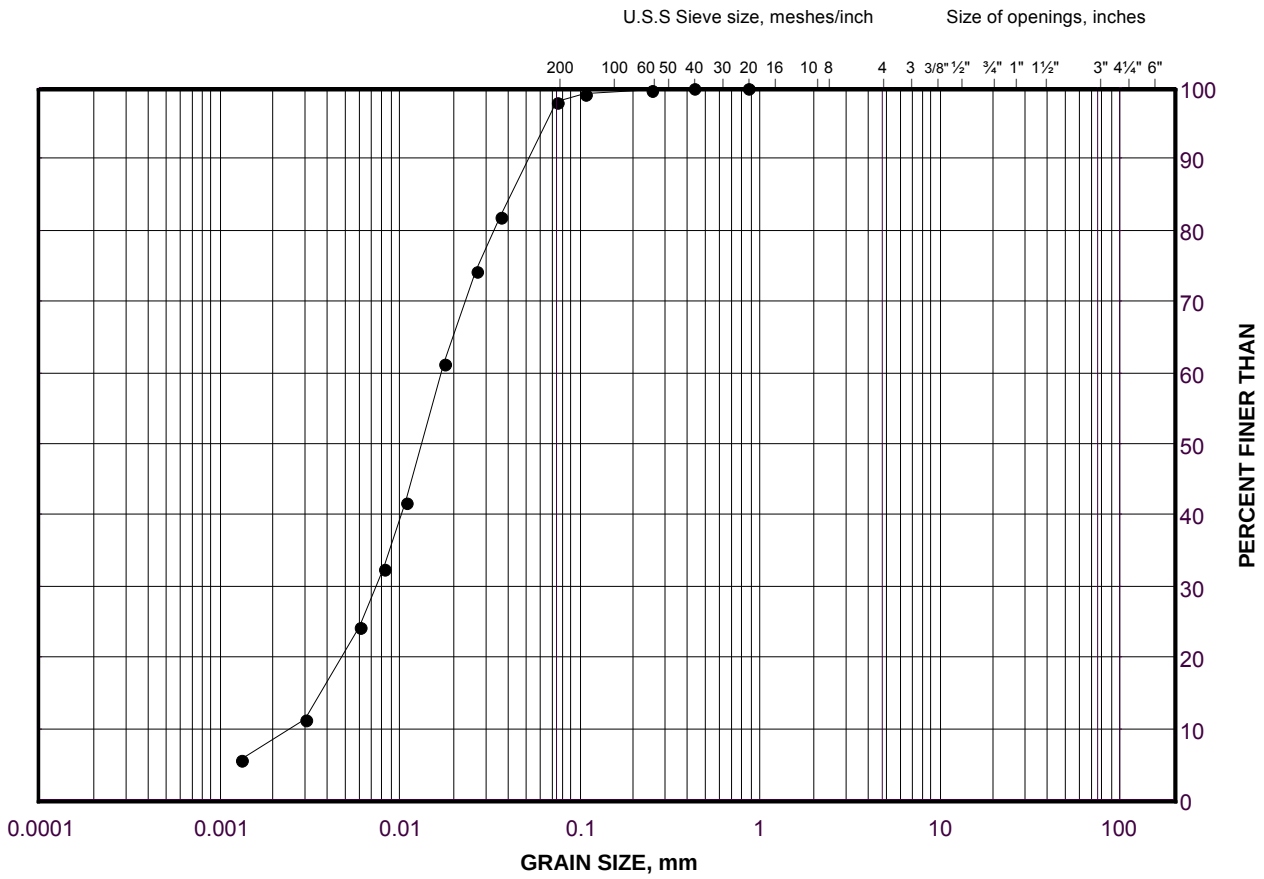
FIGURE B.S202-10
Sheet 4 of 4

GRAIN SIZE DISTRIBUTION

Silt (Interlayer)

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-11



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-20	7	178.9

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

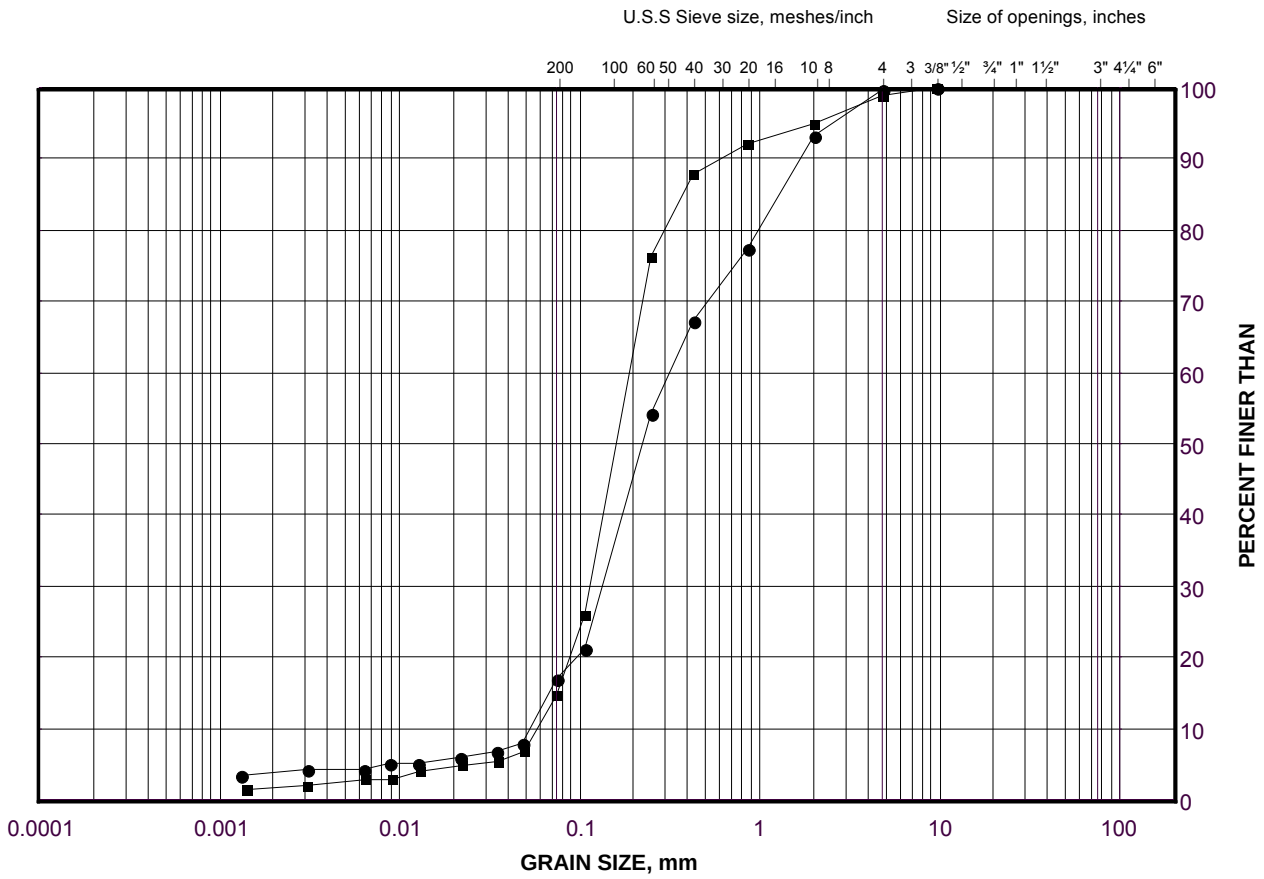
Date: 24-May-11

GRAIN SIZE DISTRIBUTION

Sand

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-12



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-17	10	166.3
■	S202-06	12	165.1

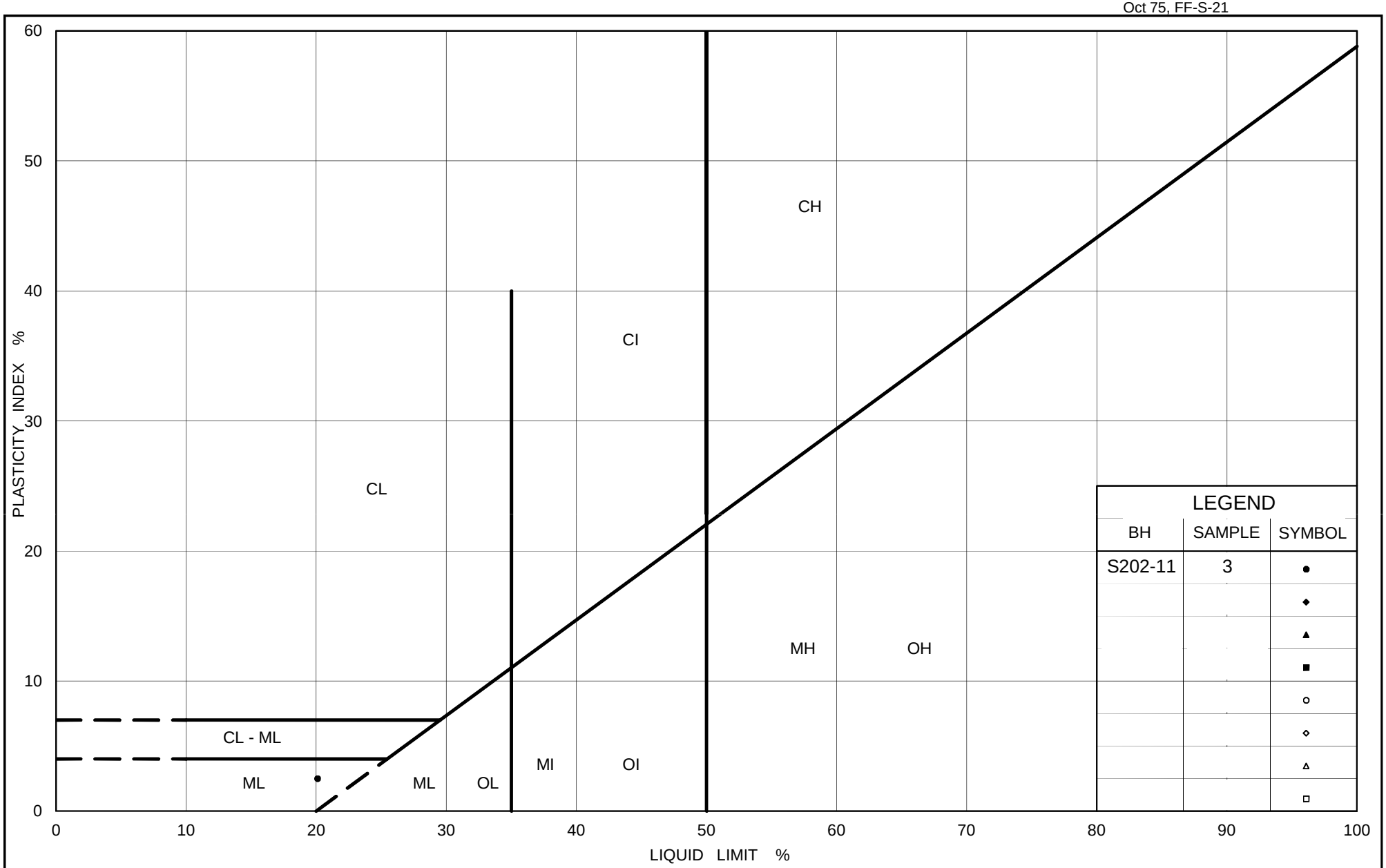
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 24-May-11

Oct 75, FF-S-21



Ministry of Transportation

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PLASTICITY CHART
Silty Sand (Slight Plasticity)
Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

Figure No. B.S202-13

Project No. 09-1111-6014

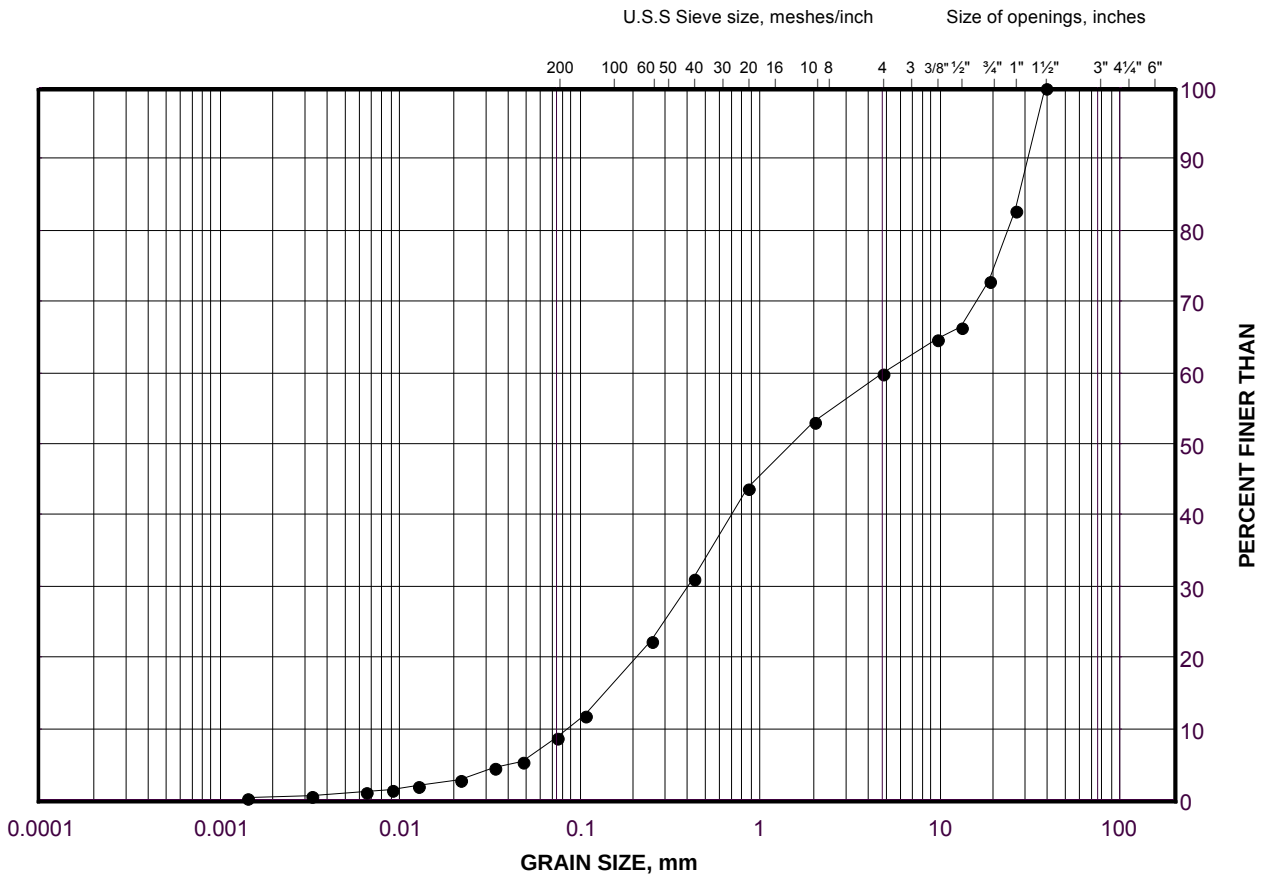
Checked By: TVA

GRAIN SIZE DISTRIBUTION

Sand and Gravel

Highway 69 (NBL) STA 11+100 to 11+225 (Swamp 202)

FIGURE B.S202-14



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S202-20	15	166.8

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 24-May-11

APPENDIX C

Highway 69 SBL – STA 11+350 to 11+375 and Highway 69 NBL – STA 11+375 to 11+400 (Swamp 203)

MINISTRY OF TRANSPORTATION, ONTARIO

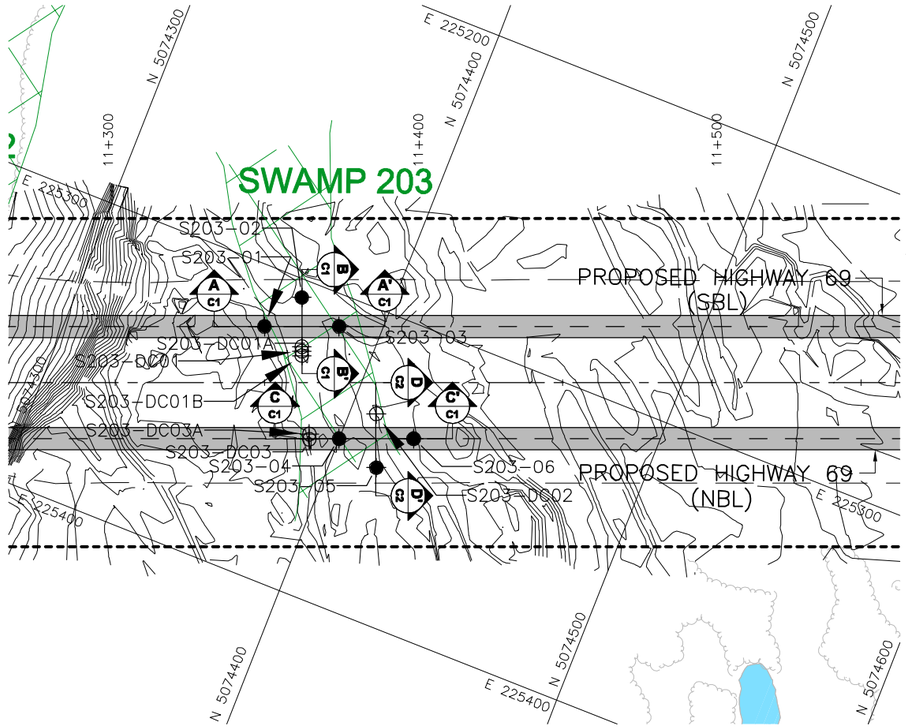
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404–05–01

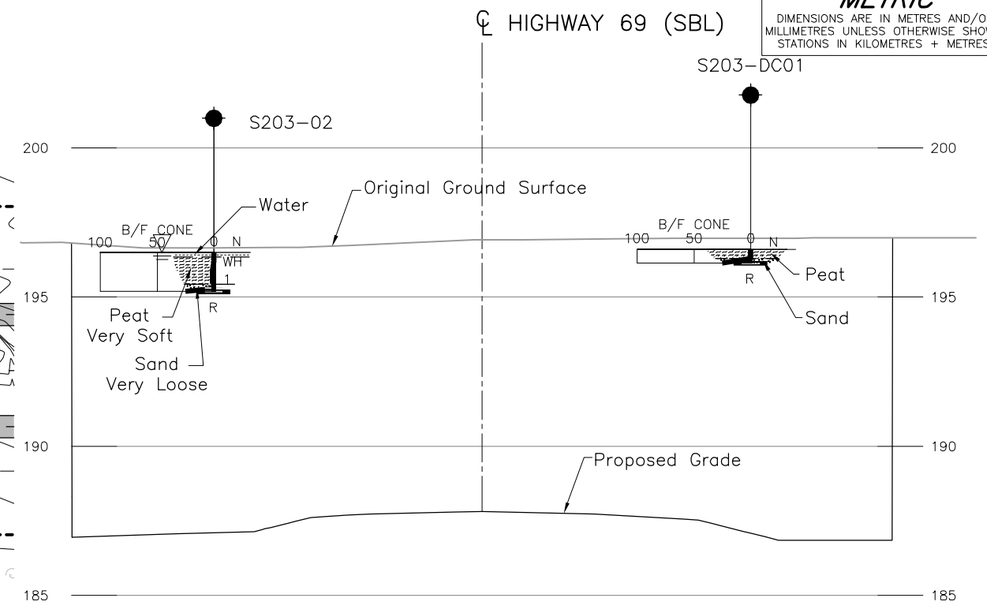
SHEET

HIGHWAY 69
STA 11+350 TO 11+375 (SBL)
STA 11+375 TO 11+400 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA

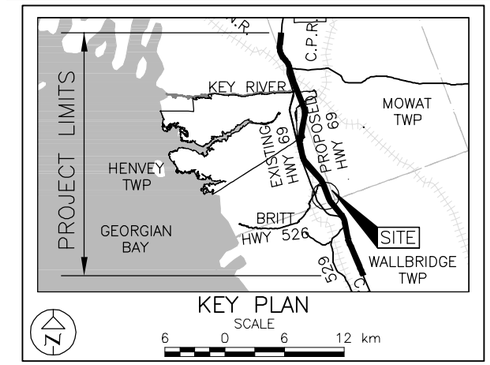


PLAN
SCALE
20 0 20 40 m



B-B' C1 CROSS–SECTION STA 11+362.5
HIGHWAY 69 (SBL)
SCALE
2 0 2 4 m

Note: The Proposed Grade at STA. 11+362.5 was provided in a digital format by URS, drawing file_revised_XS_to_golder–dec–07–2011.dwg, received December 7, 2011.



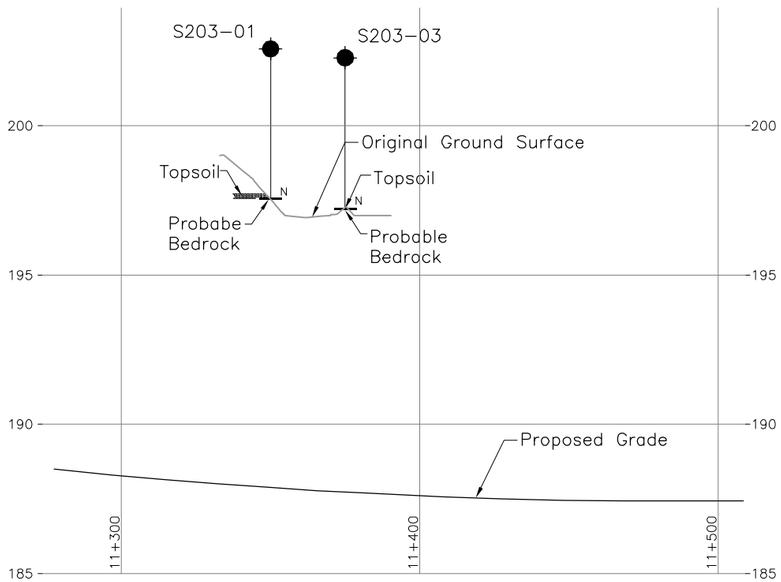
KEY PLAN
SCALE
6 0 6 12 km

LEGEND

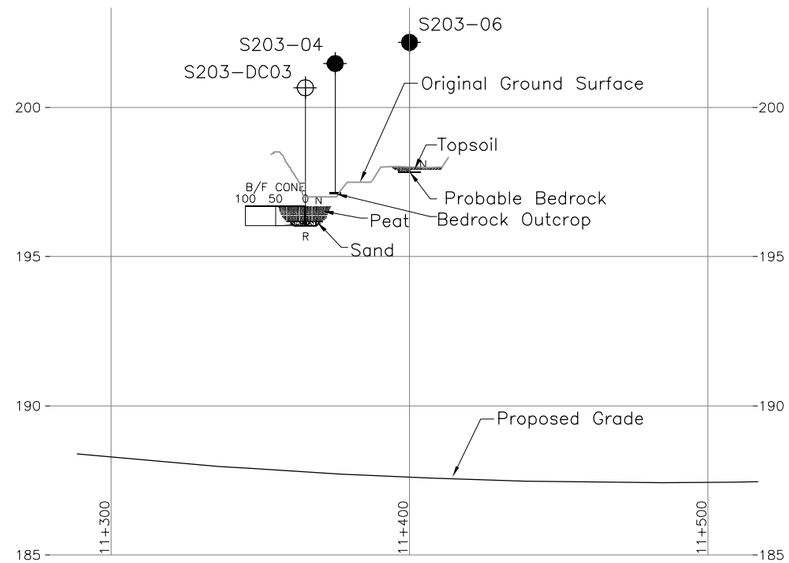
- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S203–01	197.6	5074362.8	225319.6
S203–02	196.5	5074370.9	225305.9
S203–03	197.3	5074386.1	225310.4
S203–04	197.2	5074399.9	225345.3
S203–05	197.0	5074415.1	225349.7
S203–06	197.9	5074423.1	225336.1
S203–DC01	196.6	5074377.5	225322.7
S203–DC01A	196.6	5074376.9	225321.3
S203–DC01B	196.6	5074378.0	225324.1
S203–DC02	198.0	5074408.5	225333.0
S203–DC03	196.7	5074390.7	225349.2
S203–DC03A	196.7	5074390.0	225347.6



A-A' C1 CENTRELINE PROFILE
HIGHWAY 69 (SBL)
HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



C-C' C1 CENTRELINE PROFILE
HIGHWAY 69 (NBL)
HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contour–Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing files Hwy69_profile–nov–18–2011 received November 18, 2011.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69	PROJECT NO. 09–1111–6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. C1

PLOT DATE: July 24, 2012
FILENAME: f:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-CA- CONTRACT 2 (SWAMP)\0911116014CA0C1.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

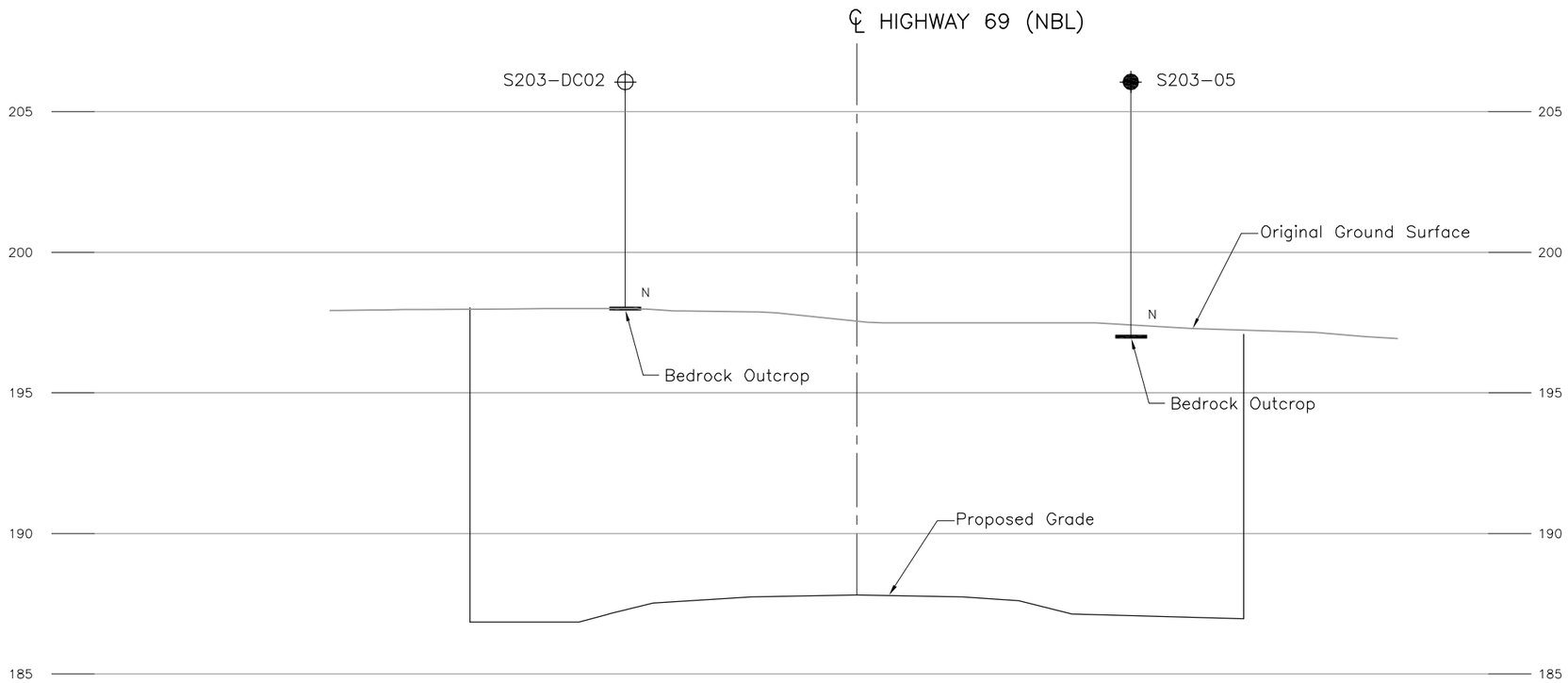
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

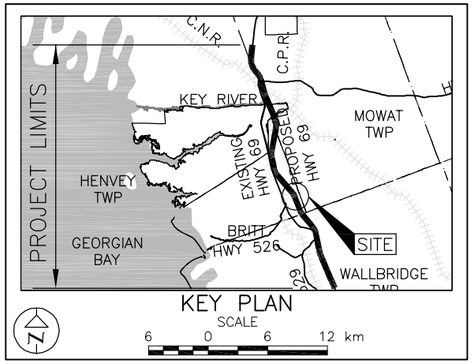
CONT No.
WP No. 5404–05–01

SHEET

HIGHWAY 69
STA 11+375 TO 11+400 (NBL)
SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA





LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S203–05	197.0	5074415.1	225349.7
S203–DC02	198.0	5074408.5	225333.0

D-D' C2

CROSS–SECTION STA. 11+387.5
HIGHWAY 69 (NBL)

SCALE
2 0 2 4 m

Note: The Proposed Grade at STA. 11+387.5 was provided in a digital format by URS, drawing file_revised_XS_to_golder–dec–07–2011.dwg, received December 5, 2011.

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contour–Plan_C2_C3.dwg, received July 14, 2011

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69		PROJECT NO. 09–1111–6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. C2

PLOT DATE: July 25, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\--CA-- CONTRACT 2 (SWAMP)\09111160142A0C2.dwg

Golder Associates

RECORD OF BOREHOLE No S203-01

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074362.8 ;E 225319.6
BOREHOLE TYPE Hand Excavation
DATE January 25, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES						
197.6	GROUND SURFACE										
0.0	TOPSOIL										
	END OF EXCAVATION PROBABLE BEDROCK										

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S203-02

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074370.9 ;E 225305.9	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Uncased	COMPILED BY	OK
DATUM	Geodetic	DATE	January 25, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.5	WATER SURFACE										
0.0	WATER										
0.2	PEAT, containing rootlets (Amorphous) Very soft Black to dark brown Wet		1	SS	WH		196		405		
195.4	SAND, containing rootlets and organics Very loose Brown Wet		2A 2B	SS	1						
1.3	END OF BOREHOLE SPOON REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. A Dynamic Cone Penetration Test was advanced 1.5 m east of Borehole S203-02 to confirm depth to refusal; refusal encountered at a depth of 1.3 m below water surface (Elev. 195.2 m).

2. Borehole and DCPT advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

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

Golder Associates

RECORD OF BOREHOLE No S203-03

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074386.1 ;E 225310.4
BOREHOLE TYPE Hand Excavation
DATE January 25, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
197.3	GROUND SURFACE												
0.0	TOPSOIL												
0.1	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

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

Golder Associates

RECORD OF BOREHOLE No S203-04

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074399.9 ;E 225345.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 25, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
197.2	GROUND SURFACE										
0.0	BEDROCK OUTCROP										

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

Golder Associates

RECORD OF BOREHOLE No S203-05

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074415.1 ;E 225349.7
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 25, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
197.0	GROUND SURFACE												
0.0	BEDROCK OUTCROP												

WATER CONTENT (%) 20 40 60

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S203-06

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074423.1 ;E 225336.1
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 25, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
197.9	GROUND SURFACE												
0.0	TOPSOIL												
0.1	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S203-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074377.5 ;E 225322.7	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 25, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
196.6	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
196.1											
0.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Two additional DCPTs were drilled 1.5 m west and 1.5 m east of DCPT S203-DC01 to confirm depth to refusal; see Records of DCPT S203-DC01A and DCPT S203-DC01B for details.										

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

Golder Associates

RECORD OF DCPT No S203-DC01A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014		
W.P.	5404-05-01	LOCATION	N 5074376.9 ;E 225321.3
DIST		HWY	69
DATUM	Geodetic	DATE	January 25, 2010
BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test		
ORIGINATED BY	MR	COMPILED BY	OK
CHECKED BY	TVA		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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			SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	w_P — w — w_L WATER CONTENT (%)	γ kN/m³	GR SA SI CL
196.6	GROUND SURFACE										
0.0 / 196.2	Dynamic Cone Penetration Test (DCPT)										
0.4	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S203-DC01B

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074378.0 ;E 225324.1	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 25, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
196.6	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
196.1											
0.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

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

Golder Associates

RECORD OF DCPT No S203-DC02

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074408.5 ;E 225333.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 25, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
198.0	GROUND SURFACE										
0.0	BEDROCK OUTCROP										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S203-DC03

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014		
W.P.	5404-05-01	LOCATION	N 5074390.7 ;E 225349.2
DIST		HWY	69
DATUM	Geodetic	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test
		DATE	January 25, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
196.0											
0.7	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTES: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer. 2. An additional DCPT was drilled 1.5 m west of DCPT S203-DC03 to confirm depth to refusal; see Record of DCPT S203-DC03A for details.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S203-DC03A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074390.0 ;E 225347.6	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 25, 2010	CHECKED BY	TVA

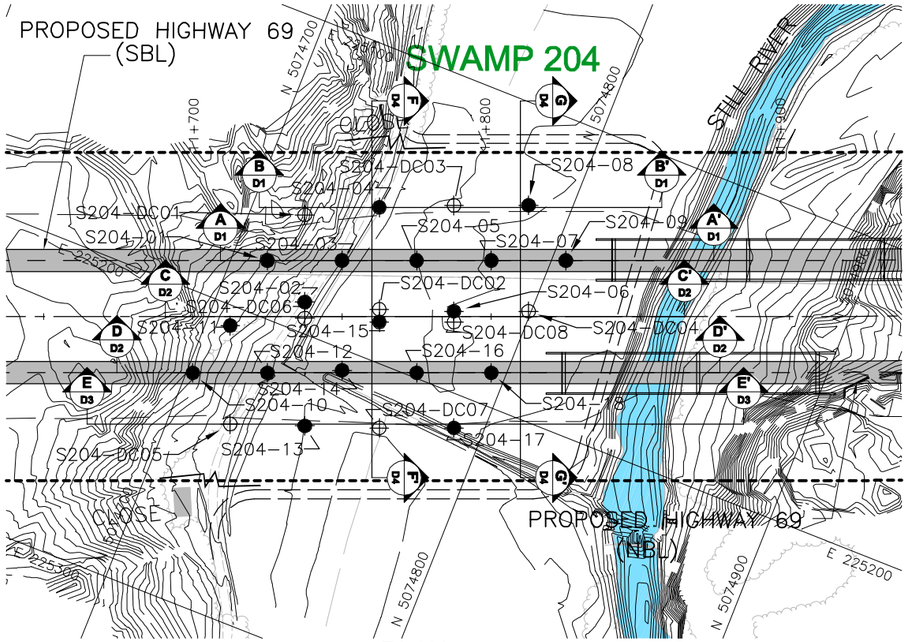
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) 20 40 60 80 100	w_P — w — w_L; WATER CONTENT (%) 20 40 60	γ kN/m³	GR SA SI CL
196.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
195.8							196				
0.9	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.										

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

APPENDIX D

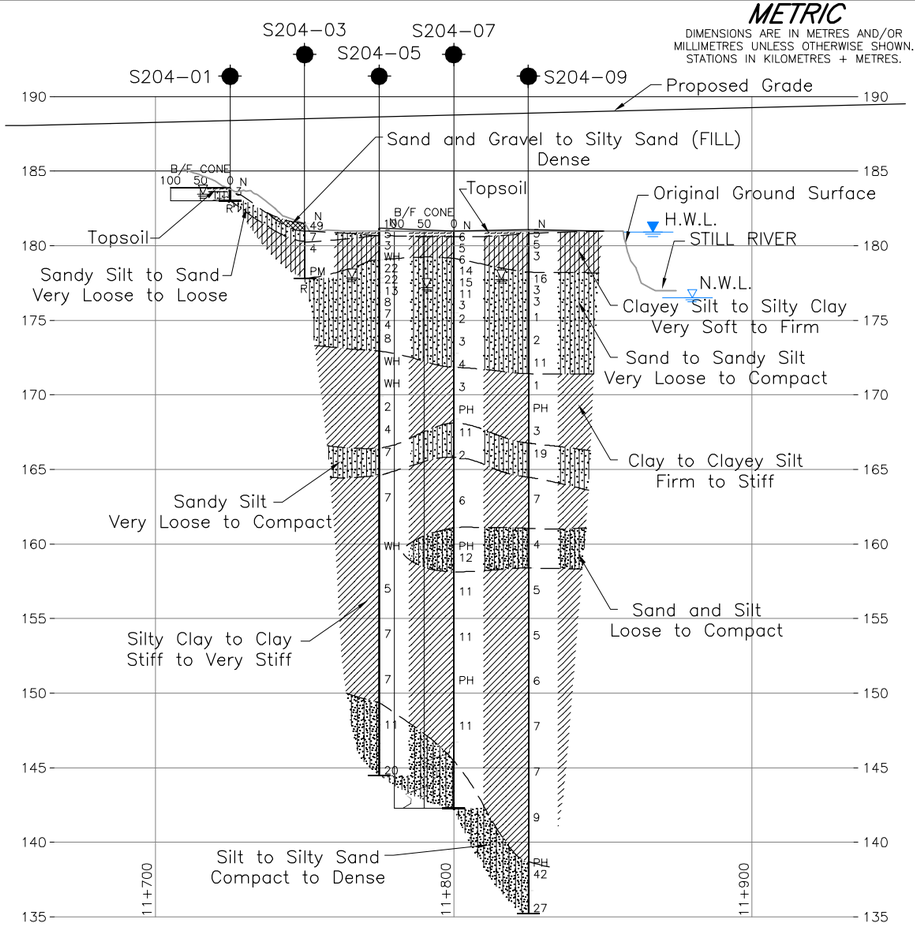
Highway 69 SBL – STA 11+725 to 11+825 and Highway 69 NBL – STA 11+700 to 11+800 (Swamp 204)

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

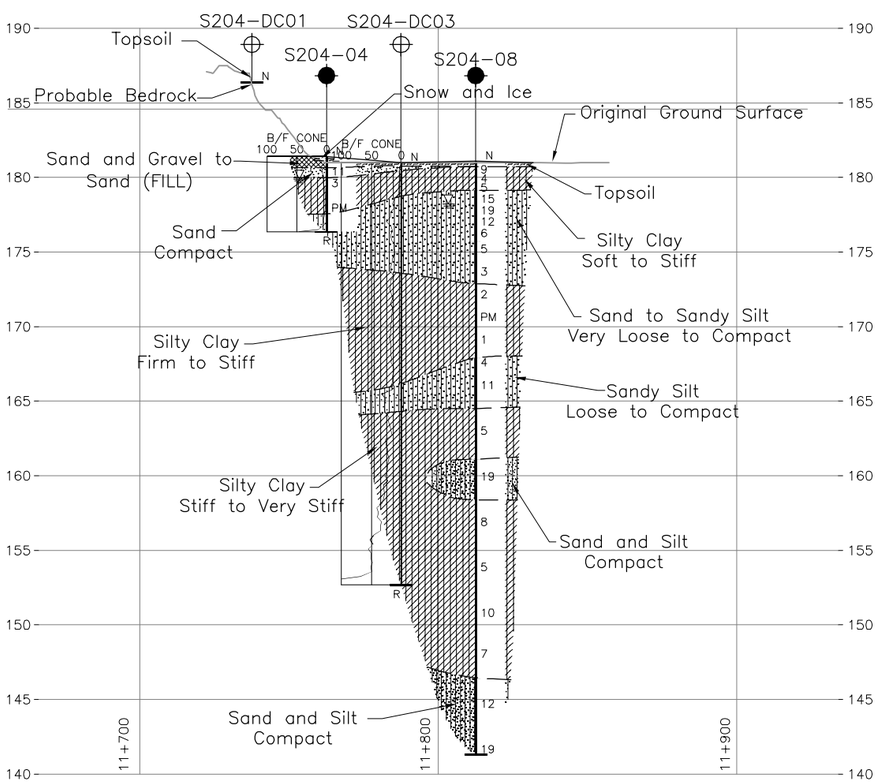
SCALE 20 0 20 40 m



A-A' D1 CENTRELINE PROFILE HIGHWAY 69 (SBL)

HORIZONTAL SCALE 20 0 20 40 m

VERTICAL SCALE 4 0 4 8 m



B-B' D1 EMBANKMENT TOE PROFILE HIGHWAY 69 (SBL)

HORIZONTAL SCALE 20 0 20 40 m

VERTICAL SCALE 4 0 4 8 m

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.

WP No. 5404-05-01

SHEET

HIGHWAY 69

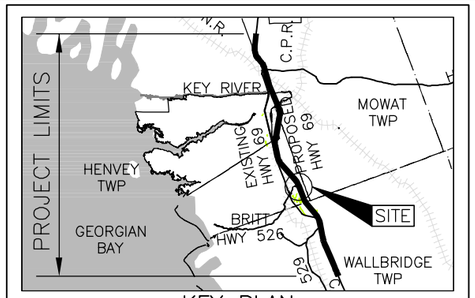
STA 11+725 TO 11+825 (SBL)

STA. 11+700 TO 11+800 (NBL)

BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE 6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S204-01	183.9	5074711.5	225181.6
S204-02	181.7	5074728.3	225190.0
S204-03	181.6	5074734.8	225172.4
S204-04	181.4	5074739.9	225151.3
S204-05	181.2	5074758.0	225163.3
S204-06	181.1	5074775.9	225174.5
S204-07	181.0	5074781.3	225154.1
S204-08	181.1	5074786.1	225132.3
S204-09	181.1	5074804.5	225144.9
S204-10	184.8	5074702.1	225225.8
S204-11	183.6	5074707.9	225206.5
S204-12	181.9	5074725.4	225216.6
S204-13	181.5	5074743.5	225228.6
S204-14	181.4	5074748.3	225206.7
S204-15	181.4	5074754.0	225187.0
S204-16	181.0	5074771.9	225198.2
S204-17	181.1	5074790.3	225210.8
S204-18	181.1	5074795.1	225189.0

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S204-DC01	186.4	5074717.5	225162.8
S204-DC02	181.4	5074752.4	225183.1
S204-DC03	181.0	5074762.9	225141.5
S204-DC04	181.1	5074799.2	225165.3
S204-DC05	182.1	5074720.1	225237.2
S204-DC06	181.6	5074730.3	225195.0
S204-DC07	181.4	5074767.0	225220.0
S204-DC08	181.0	5074777.2	225177.8

NOTES

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The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contour-Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile-nov-18-2011.dwg, received December 5, 2011.

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69		PROJECT NO. 09-1111-6014	DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. D1

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (SWAMP)\091116014D001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

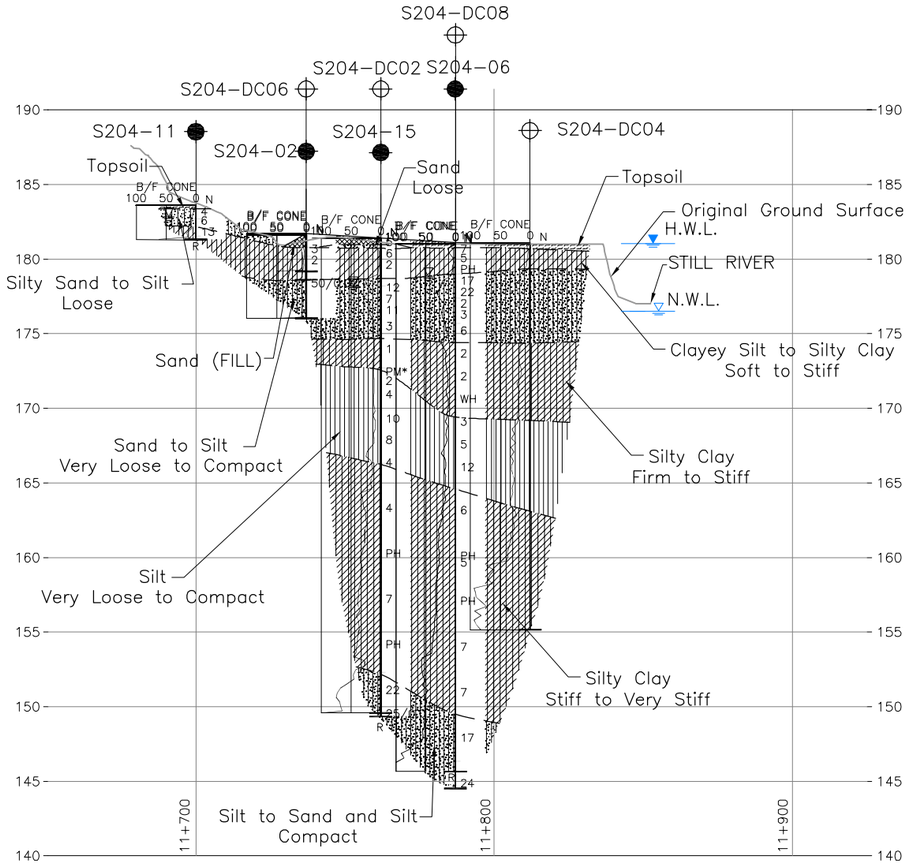
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

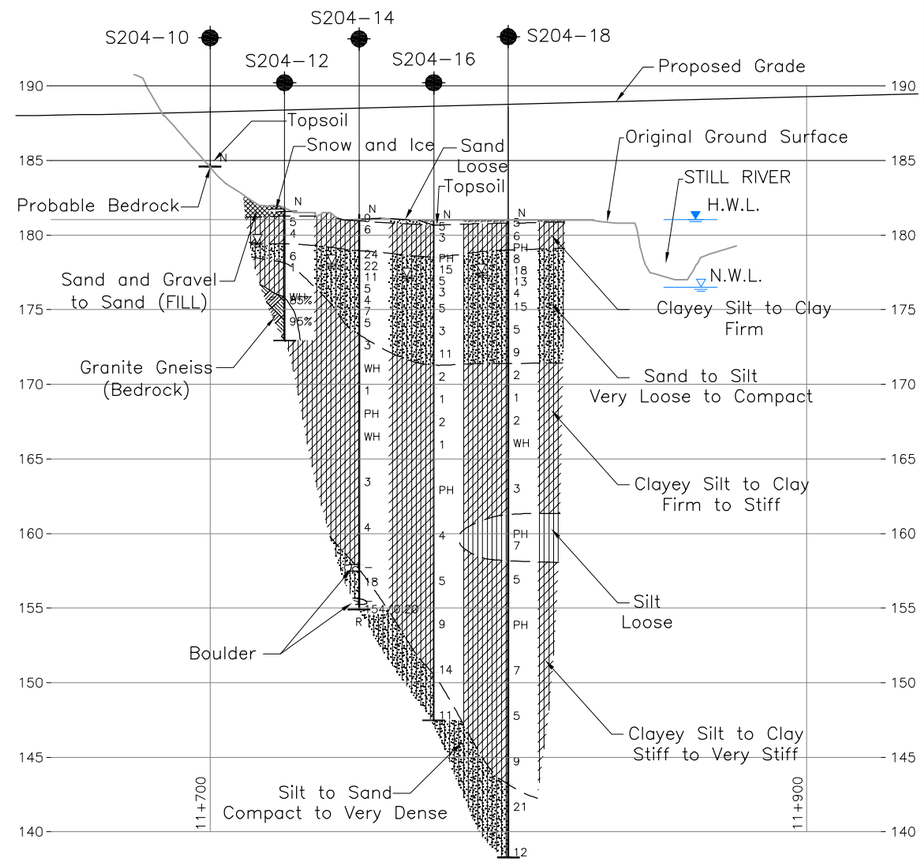
CONT No.
WP No. 5404–05–01

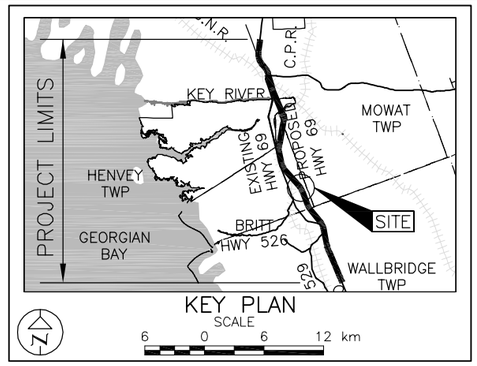
HIGHWAY 69
STA. 11+725 TO 11+825 (SBL)
STA. 11+700 TO 11+800 (NBL)
SOIL STRATA

SHEET

Golder Associates
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA







LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S204–02	181.7	5074728.3	225190.0
S204–06	181.1	5074775.9	225174.5
S204–10	184.8	5074702.1	225225.8
S204–11	183.6	5074707.9	225206.5
S204–12	181.9	5074725.4	225216.6
S204–15	181.4	5074754.0	225187.0
S204–16	181.0	5074771.9	225198.2
S204–18	181.1	5074795.1	225189.0
S204–DC02	181.4	5074752.4	225183.1
S204–DC04	181.1	5074799.2	225165.3
S204–DC06	181.6	5074730.3	225195.0
S204–DC08	181.0	5074777.2	225177.8

C-C' D1

EMBANKMENT TOE PROFILE
HIGHWAY 69 (MEDIAN)

HORIZONTAL SCALE
20 0 20 40 m
4 0 4 8 m
VERTICAL SCALE

D-D' D1

CENTRELINE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
4 0 4 8 m
VERTICAL SCALE

NOTES

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LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contour–Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile–nov–18–2011.dwg, received December 5, 2011.

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69	PROJECT NO. 09–1111–6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. D2

PLOT DATE: July 25, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (SWAMP)\09111160140D02.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

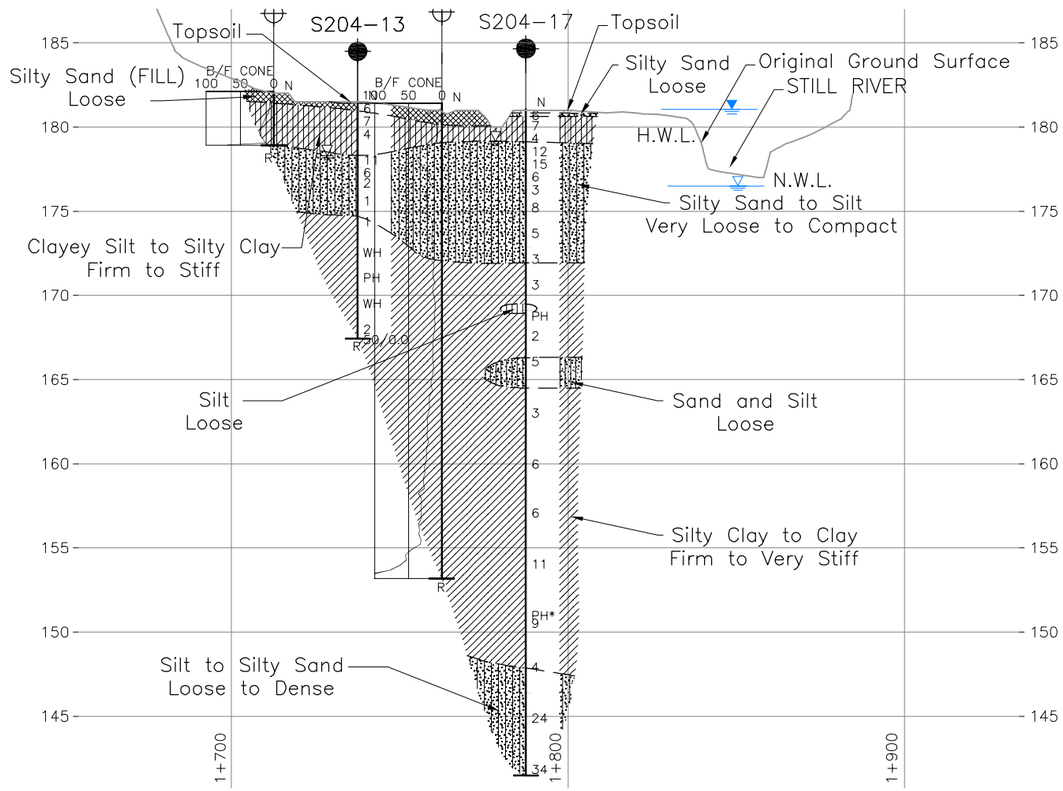
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404–05–01

SHEET

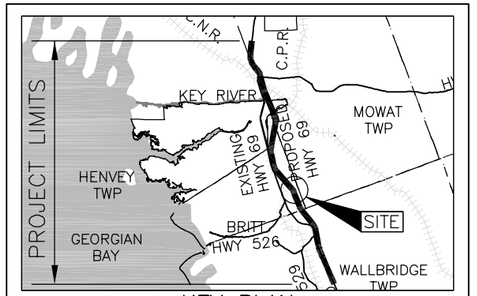
HIGHWAY 69
STA. 11+700 TO 11+800 (NBL)
SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



E-E' / D1 EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)

HORIZONTAL SCALE
20 0 20 40 m
4 0 4 8 m
VERTICAL SCALE



KEY PLAN
SCALE
6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R — Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S204–13	181.5	5074743.5	225228.6
S204–17	181.1	5074790.3	225210.8
S204–DC05	182.1	5074720.1	225237.2
S204–DC07	181.4	5074767.0	225220.0

NOTES

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REFERENCE

Original Ground Surface cut from contour drawing file HWY69_Contour–Plan_C2_C3.dwg, received July 14, 2011.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69	PROJECT NO. 09–1111–6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. D3

PLOT DATE: July 25, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (JRS, Hwy 69, Henvey)\-Da- CONTRACT 2 (SWMP)\091116014D003.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

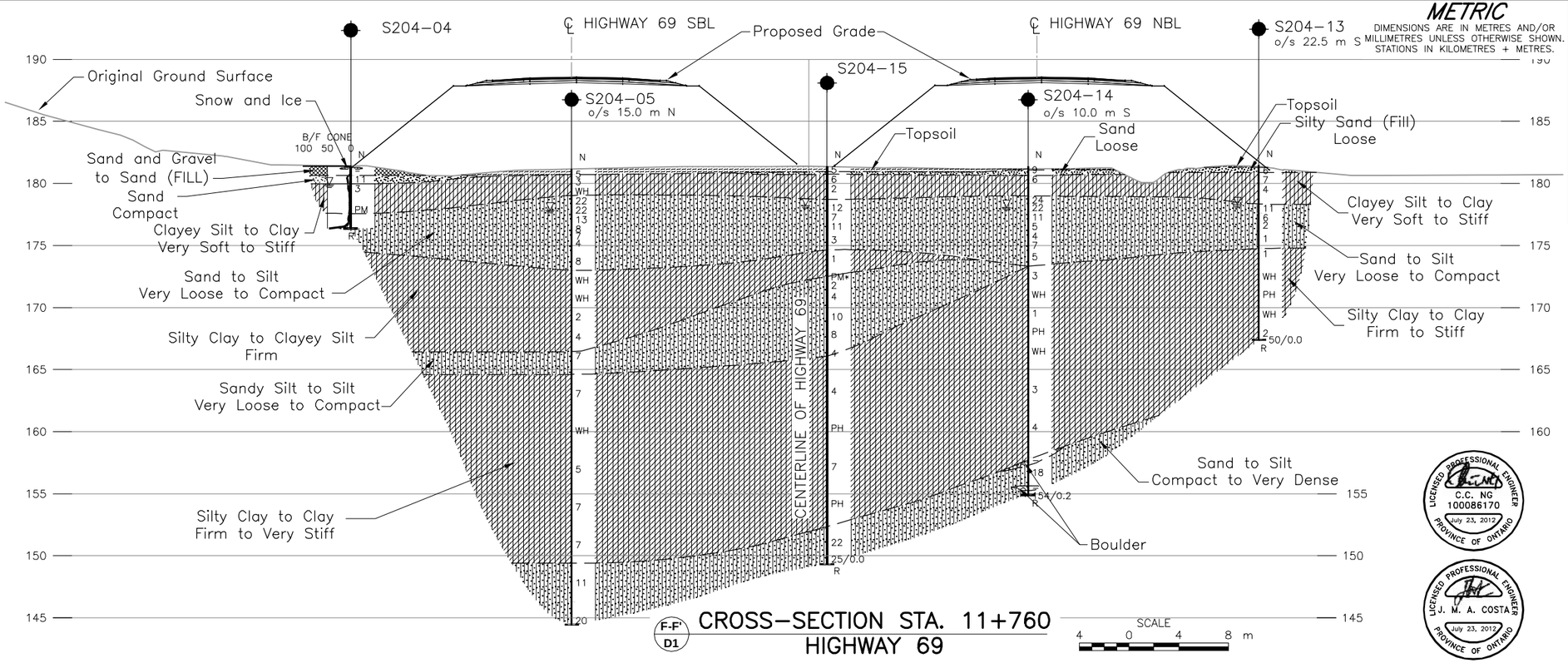
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404-05-01

HIGHWAY 69
CROSS-SECTIONS
STA. 11+760 AND 11+810 (SBL AND NBL)
SOIL STRATA

SHEET

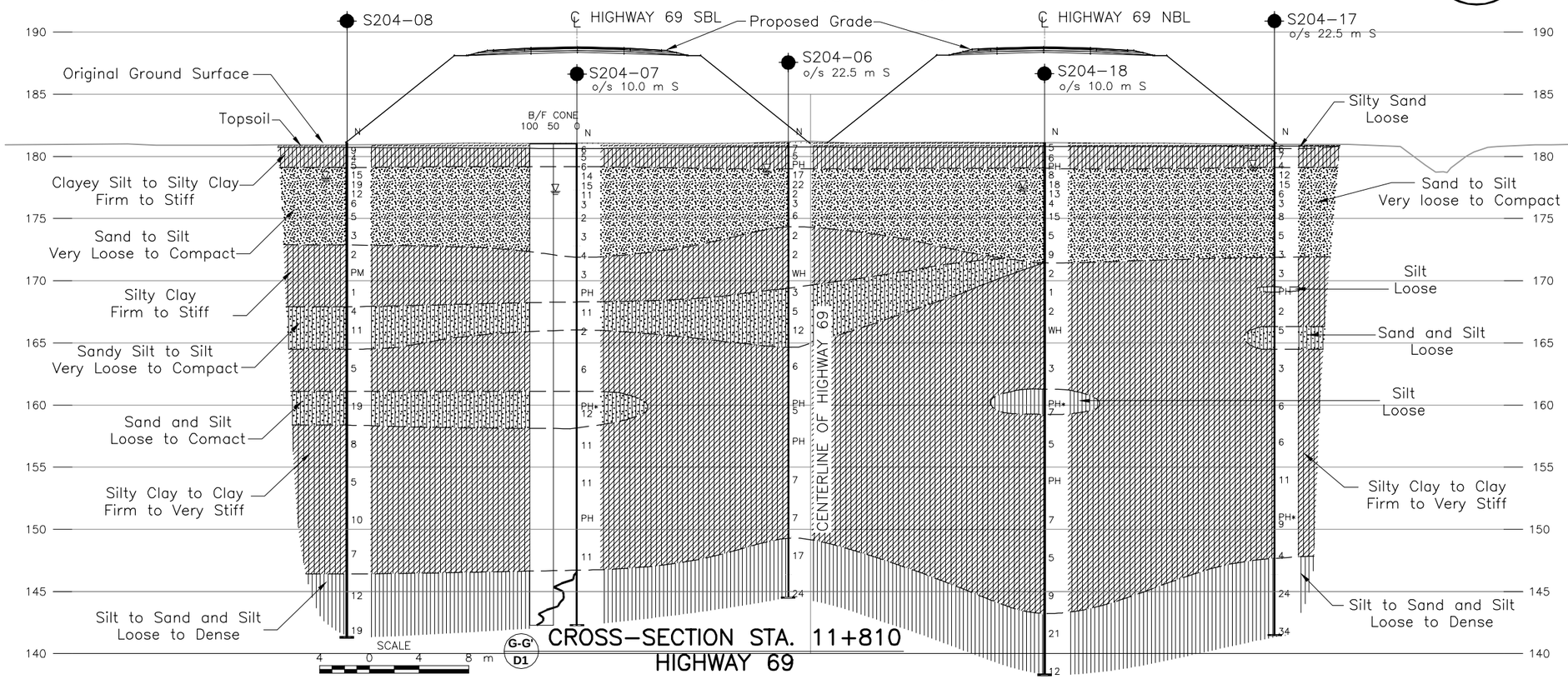
Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



F-F' D1

CROSS-SECTION STA. 11+760
HIGHWAY 69

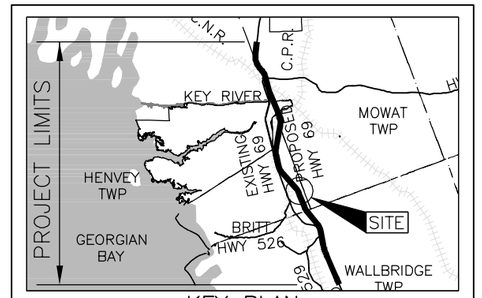
SCALE
4 0 4 8 m



SCALE
4 0 4 8 m

G-G' D1

CROSS-SECTION STA. 11+810
HIGHWAY 69



KEY PLAN
SCALE
6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
S204-04	181.4	5074739.9	225151.3
S204-05	181.2	5074758.0	225163.3
S204-06	181.1	5074775.9	225174.5
S204-07	181.0	5074781.3	225154.1
S204-08	181.1	5074786.1	225132.3
S204-13	181.5	5074743.5	225228.6
S204-14	181.4	5074748.3	225206.7
S204-15	181.4	5074754.0	225187.0
S204-17	181.1	5074790.3	225210.8
S204-18	181.1	5074795.1	225189.0

NOTES

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REFERENCE

Cross-Sections provided in a digital format by URS, drawing files Hwy69_Xs.dwg, received June 06, 2011

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69	PROJECT NO. 09-1111-6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC/CD	CHKD. CN	APPD. JPD/JMAC	DWG. D4

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (SWMP)\09111160142404.dwg

Golder Associates

RECORD OF BOREHOLE No S204-01

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074711.5 ;E 225181.6
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers
COMPILED BY OK
DATUM Geodetic
DATE February 16, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w (WATER CONTENT (%) 20 40 60)	w_L	γ kN/m³	GR	SA	SI	CL
183.9	GROUND SURFACE															
0.0 / 183.6	TOPSOIL		1A	SS	3	▽										
183.3	Sandy SILT, some clay, trace gravel, containing rootlets		1B							○			2	29	57	12
183.0	Very loose Brown Moist to wet															
0.9	END OF BOREHOLE SPOON AND AUGER REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)															

NOTES:

1. Water level in open borehole at a depth of 0.5 m below ground surface (Elev. 183.4 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m east of Borehole S204-01 to confirm depth to refusal; refusal encountered at a depth of 0.9 m below ground surface (Elev. 183.0 m).

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

Golder Associates

RECORD OF BOREHOLE No S204-02

SHEET 1 OF 1 **METRIC**

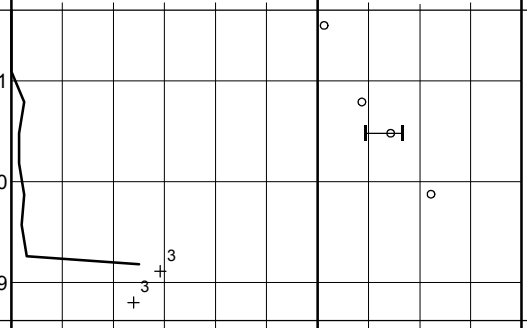
PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074728.3 ;E 225190.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers
COMPILED BY OK
DATUM Geodetic
DATE February 16, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.7	GROUND SURFACE								
0.0	Sand and gravel (FILL)								
0.1	Sand, trace gravel, trace silt (FILL) Brown Moist		1A 1B	AS	-				
180.8									
0.9	CLAYEY SILT, trace sand Soft Brown and grey Moist		2A 2B	SS	3				
180.2									
1.5	SILTY CLAY Firm to stiff Grey Moist		3	SS	2				
178.6			4	SS	50/0.02				
3.1	END OF BOREHOLE SPOON AND AUGER REFUSAL								

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

SHEAR STRENGTH kPa
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20, 40, 60, 80, 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20, 40, 60)



NOTES:

1. Water level in open borehole not noted.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S204-02 to confirm depth to refusal; refusal encountered at a depth of 2.5 m below ground surface (Elev. 179.2 m).

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

Golder Associates

RECORD OF BOREHOLE No S204-03

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074734.8 ;E 225172.4	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers	COMPILED BY	OK
DATUM	Geodetic	DATE	February 16, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.6	GROUND SURFACE								
0.0	Sand and gravel (FILL)		1A	SS	49				
0.1	Silty sand, trace gravel, trace clay, containing rootlets (FILL)		1B						
181.0	Dense Brown Moist		2A	SS	7		181		
0.6			2B						
180.4	SAND, trace to some gravel, trace to some silt, trace clay, containing rootlets Loose Brown Moist		3A	SS	4		180		0 11 50 39
1.4			3B						
	CLAYEY SILT, trace sand, containing rootlets Firm Grey Moist						179		
	SILTY CLAY, trace to some sand containing rootlets to a depth of 2.1 m Firm Grey Moist		4	TO	PM		178		
177.8									
3.8	END OF BOREHOLE AUGER REFUSAL								

NOTE:

1. Open borehole dry upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60

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

Golder Associates

RECORD OF BOREHOLE No S204-04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074739.9 ;E 225151.3	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	February 17, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.4	GROUND SURFACE								
0.0	Sand and gravel (FILL) Grey Moist		1A	AS	-		181		
0.2	SNOW and ICE		1B						
180.6	Sand, some gravel (FILL) Brown Moist		2	SS	11				
0.8	SAND, trace silt, trace clay Compact Brown Moist					▽	180		
180.0	SILTY CLAY, trace to some sand Soft Grey Moist		3	SS	3				
1.4			4	TO	PM		179		
177.5	END OF BOREHOLE CASING AND AUGER REFUSAL						178		
3.9	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)						177		
176.4									
5.0									

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20 40 60)

NOTES:

1. Water level in open borehole at a depth of 1.5 m below ground surface (Elev. 179.9 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S204-04 to confirm depth to refusal; refusal encountered at a depth of 5.0 m below ground surface (Elev. 176.4 m).

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

Golder Associates

RECORD OF BOREHOLE No S204-05

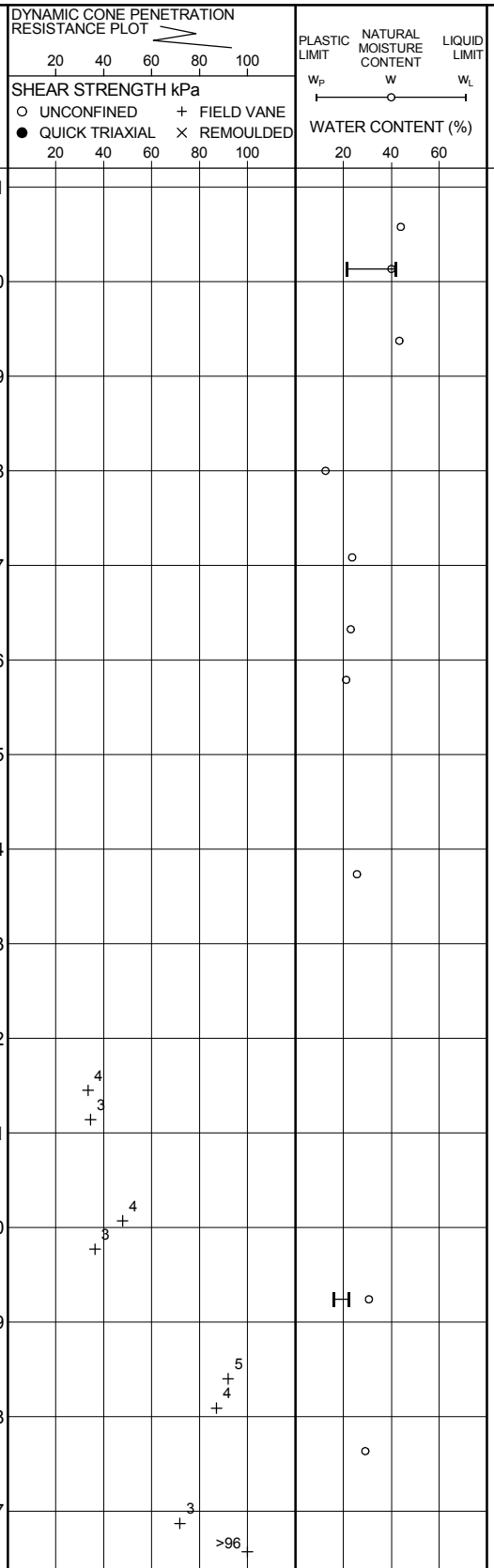
SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074758.0 ;E 225163.3
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 8 and 9, 2010

ORIGINATED BY RA
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
181.2	GROUND SURFACE									
0.0 / 180.7	TOPSOIL									
0.5 / 179.1	SILTY CLAY, trace sand, containing rootlets Very soft to firm Brown to grey Moist	1A 1B	SS	5						
		2	SS	3						
		3	SS	WH						
2.1 / 177.9	SAND, trace to some silt, trace clay Compact Brown Moist	4	SS	22						
3.4 / 173.0	SAND and SILT, trace clay Loose to compact Grey Moist to wet	5A 5B	SS	22	▽					
		6	SS	13						
		7	SS	8			0	52	44	4
		8	SS	7						
		9	SS	4						
		10	SS	8						
8.2 / 169.7	SILTY CLAY Firm Grey Moist	11	SS	WH						
		12	TO	WH						
11.5 / 166.4	CLAYEY SILT containing silt seams Stiff Grey Moist	13	SS	2						
		14	SS	4						
14.8										



Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-05

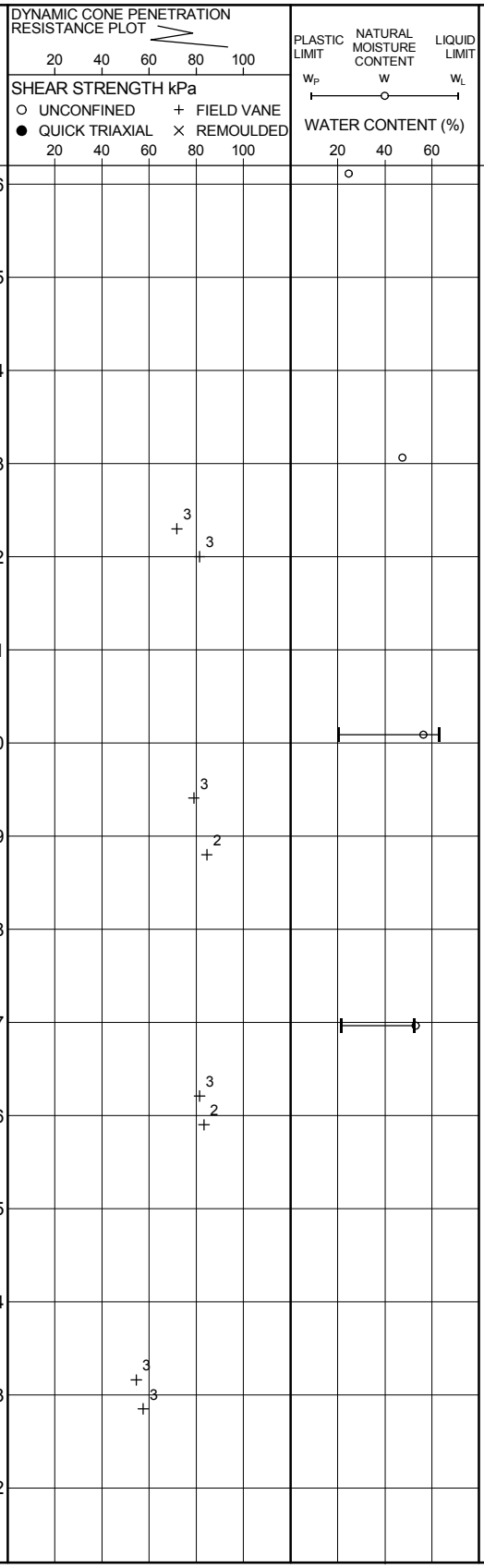
SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074758.0 ;E 225163.3
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 8 and 9, 2010

ORIGINATED BY RA
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---								
	Sandy SILT, trace clay Loose Grey Wet	15	SS	7		0	25	71	4
164.6 16.6	CLAY, some silt, containing silt seams to a depth of 19.7 m Stiff Grey Moist	16	SS	7					
		17	TO	WH	16.6				
		18	SS	5					
		19	SS	7					



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-05

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074758.0 ;E 225163.3
ORIGINATED BY RA
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 8 and 9, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%))	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	CLAY, some silt, containing silt seams to a depth of 19.7 m Stiff Grey Moist		20	SS	7		151		○		0 1 31 68
							150	+ 3, + 2			
149.4											
31.8	Sandy SILT, trace clay Compact Grey Wet						149				
			21	SS	11		148				
							147				
146.3											
34.9	Silty SAND Compact Grey Wet						146				
			22	SS	20		145		○		0 71 29 0
144.5											
36.7	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 3.4 m below ground surface (Elev. 177.8 m) upon completion of drilling.										

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

Golder Associates

RECORD OF BOREHOLE No S204-06

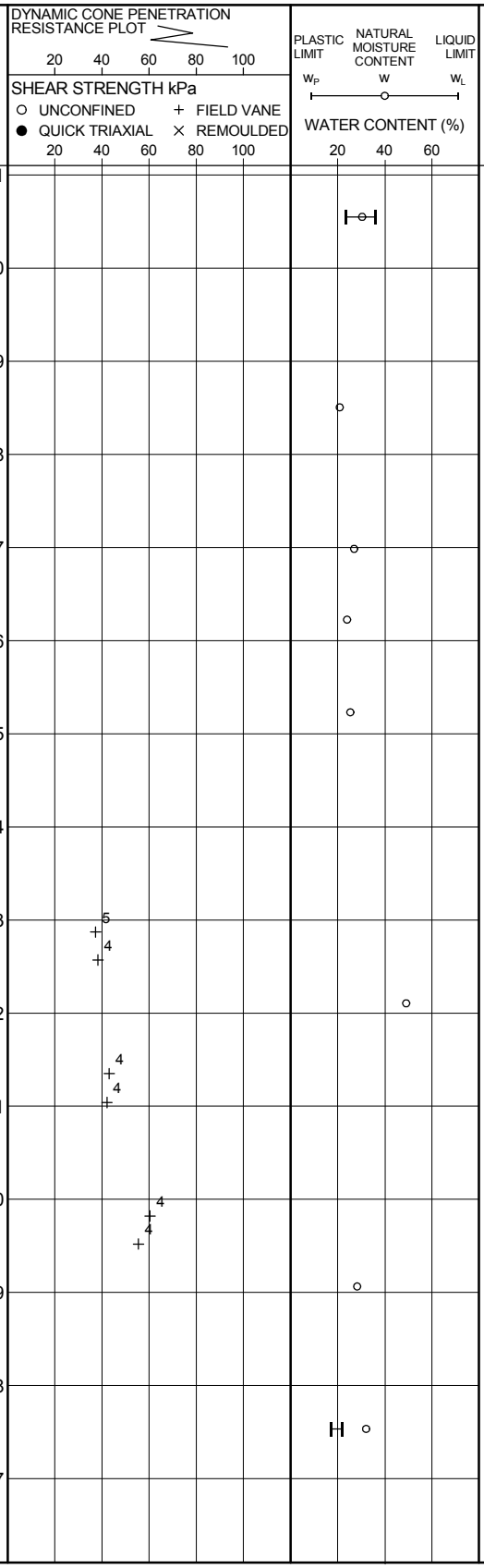
SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST ____ HWY 69
DATUM Geodetic

LOCATION N 5074775.9 ;E 225174.5
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 21 to 23, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
181.1	GROUND SURFACE										
0.0 / 180.8	TOPSOIL										
0.3	SILTY CLAY, trace sand, containing rootlets Firm Brown to grey Moist	1A 1B	SS	7							
		2	SS	5							
		3	TO	PH							
179.0											
2.1	SAND, trace to some silt, trace clay Compact Brown Wet	4	SS	17	▽						
		5	SS	22							
177.4											
3.7	SAND and SILT, trace clay Very loose Brown Wet	6	SS	2							
		7	SS	3				0	38	58	4
175.7											
5.4	SILT, some sand, trace clay Loose Grey Wet	8	SS	6							
174.4											
6.7	SILTY CLAY Firm to stiff Grey Moist	9	SS	2							
		10	SS	2							
		11	SS	WH							
169.4											
11.7	SILT, trace to some sand, trace to some clay Loose to compact Grey Wet	12	SS	3							
	Clayey silt seams encountered at a depth of 13.3 m	13	SS	5							



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

Golder Associates

RECORD OF BOREHOLE No S204-06

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074775.9 ;E 225174.5
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 21 to 23, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---							
	SILT, trace to some sand, trace to some clay Loose to compact Grey Wet	14	SS	12				
164.6 16.5	SILTY CLAY, trace sand Stiff Grey Moist							
		15	SS	6				
		16	TO	PH				
		17	SS	5	0	1	47	52
		18	TO	PH				
		19	SS	7				

Columns: STRAT PLOT; GROUND WATER CONDITIONS; ELEVATION SCALE (166, 165, 164, 163, 162, 161, 160, 159, 158, 157, 156, 155, 154, 153, 152)

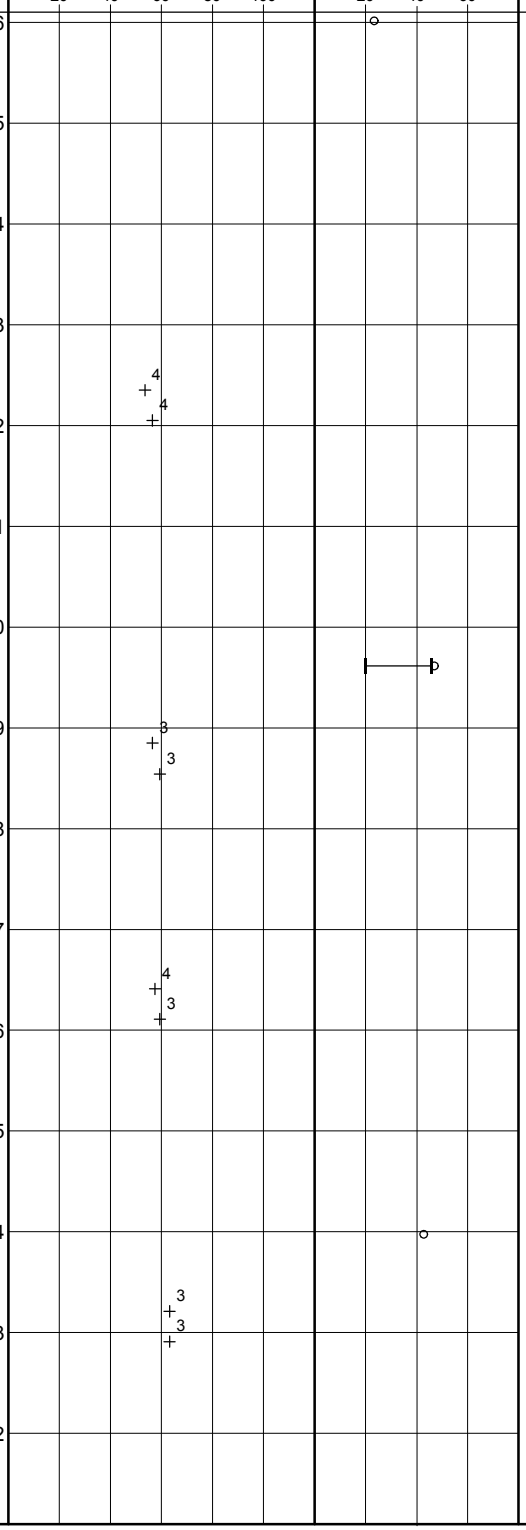
DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
(20, 40, 60, 80, 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20, 40, 60)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-06

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074775.9 ;E 225174.5
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 21 to 23, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace sand Stiff Grey Moist		20	SS	7		151				
							150	+ 3, + 2			
149.4											
31.7	SILT, trace to some sand, trace clay Compact Grey Wet						149				
			21	SS	17		148		○		
							147				
146.4											
34.7	SAND and SILT, trace clay Compact Grey Wet						146				
			22	SS	24		145		○		0 55 41 4
144.5											
36.6	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 2.3 m below ground surface (Elev. 178.8 m) upon completion of drilling.										

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

Golder Associates

RECORD OF BOREHOLE No S204-07

SHEET 1 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074781.3 ;E 225154.1	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	March 2 and 3, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
181.0	GROUND SURFACE										
0.0 / 180.6	TOPSOIL										
0.4	SILTY CLAY, containing rootlets and silty sand seams Firm Brown to grey Moist	1A 1B	SS	6							
		2	SS	5		180					
179.2		3A 3B	SS	6		179					
1.8	Silty SAND, trace clay Loose to compact Brown Moist	4	SS	14				0	72	26	2
		5	SS	15		178					
177.3					▽						
3.7	SAND and SILT, trace clay Very loose to compact Grey Wet	6	SS	11		177					
		7	SS	3		176					
175.5											
5.5	Sandy SILT, trace clay Very loose Grey Wet	8	SS	2		175					
		9	SS	3		174		0	20	76	4
172.8						173					
8.2	Silty SAND, trace clay Loose Grey Wet	10A 10B	SS	4		172					
171.9											
9.1	SILTY CLAY Firm to stiff Grey Moist					171	4, 4				
		11	SS	3		170	4, 4				
		12	TO	PH		169					
168.3							2				
12.7	Sandy SILT, trace clay Very loose to compact Grey Moist to wet	13	SS	11		168		0	24	73	3
						167					
166.1		14A									

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

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

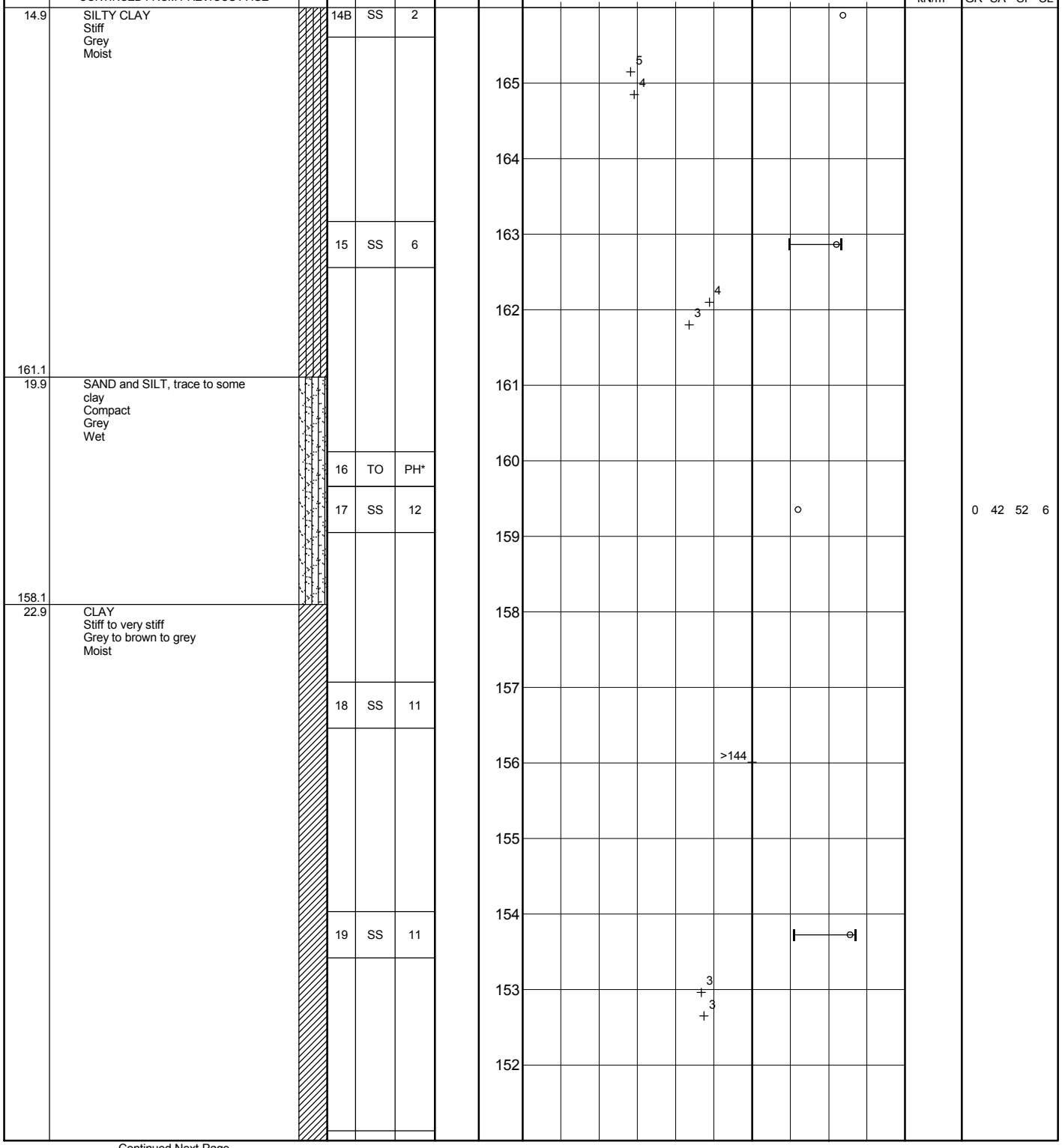
Golder Associates

RECORD OF BOREHOLE No S204-07

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074781.3 ;E 225154.1
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE March 2 and 3, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---							
14.9	SILTY CLAY Stiff Grey Moist	14B	SS	2				
		15	SS	6				
161.1								
19.9	SAND and SILT, trace to some clay Compact Grey Wet	16	TO	PH*				
		17	SS	12	0	42	52	6
158.1								
22.9	CLAY Stiff to very stiff Grey to brown to grey Moist	18	SS	11				
		19	SS	11				



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-07

SHEET 3 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074781.3 ;E 225154.1	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	March 2 and 3, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	CLAY Stiff to very stiff Grey to brown to grey Moist		20	TO	PH					17.6	
			21	SS	11						
146.7 / 34.3	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)										
142.3 / 38.7	END OF DCPT										

Elevation scale: 150, 149, 148, 147, 146, 145, 144, 143

Dynamic cone penetration resistance plot: 20, 40, 60, 80, 100

Shear strength kPa: 20, 40, 60, 80, 100

Water content (%): 20, 40, 60

Sensitivity values: 3, 3, 3, >121

NOTES:

* Unable to recover a Shelby tube sample between depths of 20.9 m and 21.3 m

1. Water level in open borehole at a depth of 3.8 m below ground surface (Elev. 177.2 m) upon completion of drilling.

2.A Dynamic Cone Penetration Test was carried out below a depth of 34.3 m; end of DCPT at a depth of 38.7 m below ground surface.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

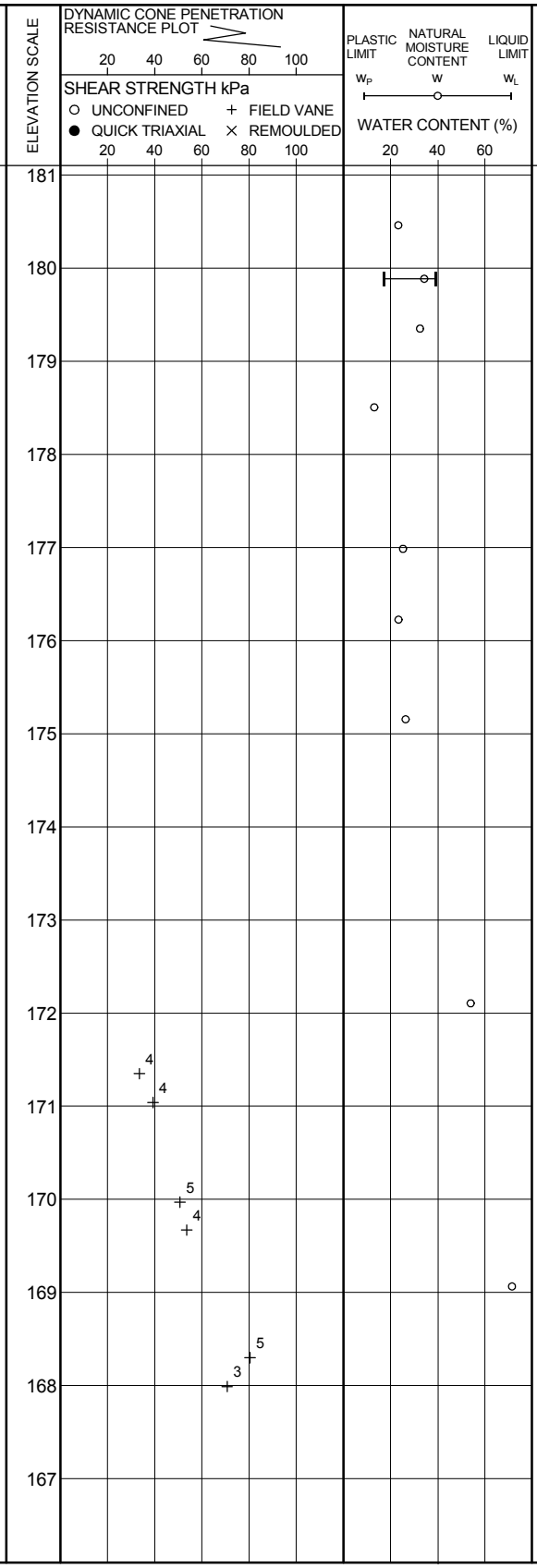
Golder Associates

RECORD OF BOREHOLE No S204-08

SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074786.1 ;E 225132.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Tricone, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 19 and 20, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
181.1	GROUND SURFACE							
0.0 / 180.7	TOPSOIL							
0.4	SILTY CLAY, containing rootlets and silty sand seams Firm to stiff Brown to grey Moist	1A						
		1B	SS	9				
		2	SS	4				
179.1		3A	SS	5				
2.0	SAND, some silt, trace clay Loose to compact Brown Wet	3B						
		4	SS	15				
		5	SS	19				
		6	SS	12				
		7	SS	6	0	85	12	3
175.7								
5.4	Sandy SILT, trace clay Very loose to loose Grey Wet	8	SS	5				
		9	SS	3				
172.9								
8.2	SILTY CLAY Firm to stiff Grey Moist	10	SS	2				
		11	TO	PM				
	Sandy silt interlayers encountered below a depth of 11.7 m	12	SS	1				
167.9								
13.2	Sandy SILT, trace to some clay Loose to compact Grey Wet	13	SS	4				



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-08

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074786.1 ;E 225132.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Tricone, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 19 and 20, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%) 20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	Sandy SILT, trace to some clay Loose to compact Grey Wet	14	SS	11	166					0 24 70 6
164.5					165					
16.6	SILTY CLAY Stiff Grey Moist				164					
		15	SS	5	163					
					162	3 3				
161.1					161					
20.0	SAND and SILT, trace to some clay Compact Grey Wet	16	SS	19	160					
158.4					159					
22.7	SILTY CLAY, trace sand Stiff to very stiff Grey Moist				158					
		17	SS	8	157					
					156	>119				
					155					
		18	SS	5	154					0 4 45 51
					153	3 2				
					152					

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-08

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074786.1 ;E 225132.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Tricone, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 19 and 20, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILTY CLAY, trace sand Stiff to very stiff Grey Moist		19	SS	10		151				
							150	>144			
							149				
	Silt interlayers encountered below a depth of 32.7 m		20	SS	7		148		○		
							147				
146.4 34.7	SAND and SILT, trace clay Compact Grey Wet						146				
			21	SS	12		145				
							144				
							143				
							142				
141.3			22	SS	19				○		0 57 41 2
39.8	END OF BOREHOLE										

NOTES:

1. Water level in open borehole at a depth of 2.9 m below ground surface (Elev. 178.2 m) upon completion of drilling.

2. Unable to push insitu vane test past a depth of 31.1 m below the ground surface (Elev. 150.0 m).

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

Golder Associates

RECORD OF BOREHOLE No S204-09

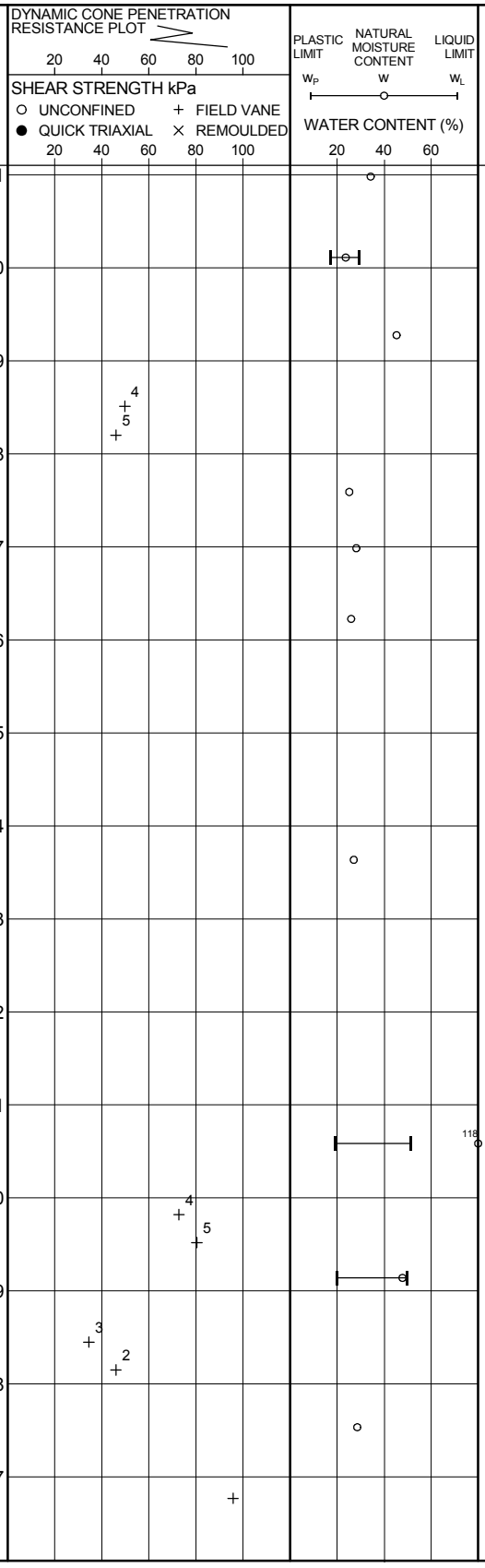
SHEET 1 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074804.5 ;E 225144.9
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 3 and 4, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
181.1	GROUND SURFACE										
0.0	TOPSOIL	1A	SS	5							
0.2	CLAYEY SILT, trace to some sand Firm Grey Moist	1B									
179.9		2A	SS	5							
1.2	SILTY CLAY Firm Grey Moist	2B									
		3	SS	3							
178.2											
177.8	SAND, trace silt, containing organics Compact Brown Moist	4A	SS	16	▽						
3.3		4B									
	Sandy SILT, trace to some clay Very loose to compact Brown to grey Wet	5	SS	3				0	21	73	6
		6	SS	3							
		7	SS	1							
		8	SS	2							
		9	SS	11							
171.4											
9.7	SILTY CLAY to CLAY, trace silt Firm to stiff Grey Moist	10	SS	1							
		11	TO	PH							
	Sandy silt interlayers encountered below a depth of 13.3 m	12	SS	3							
166.8											
14.3	Sandy SILT, trace clay Compact Grey Wet										



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

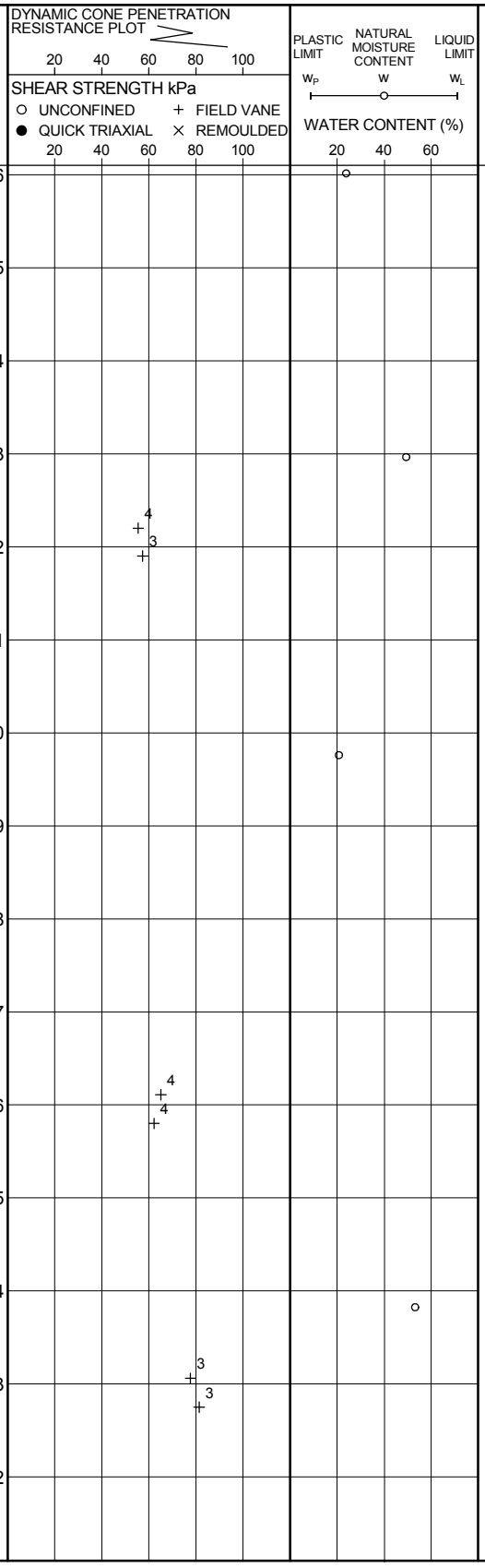
Golder Associates

RECORD OF BOREHOLE No S204-09

SHEET 2 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074804.5 ;E 225144.9
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 3 and 4, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---							
	Sandy SILT, trace clay Compact Grey Wet	13	SS	19	0	29	68	3
164.5								
16.6	SILTY CLAY Stiff Grey Moist	14	SS	7				
161.1								
20.0	SAND and SILT, trace clay Loose Grey Moist	15A 15B	SS	4				
158.4								
22.7	SILTY CLAY Stiff to very stiff Grey Moist	16	SS	5				
	Sandy silt interlayers encountered between depths of 27.0 m and 27.6 m	17	SS	5				



UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-09

SHEET 3 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074804.5 ;E 225144.9
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 3 and 4, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---							
	SILTY CLAY Stiff to very stiff Grey Moist	18	SS	6		151		
						150		
		19	SS	7		148		
						147		
		20	SS	7		145		
						144		
		21	SS	9		142		
						141		
138.7 42.4	SILT, trace to some clay, trace sand Dense Grey Wet	22	TO	PH		139		
		23	SS	42		138		0 2 92 6
136.8 44.3						137		

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-09

SHEET 4 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074804.5 ;E 225144.9
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 3 and 4, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Silty SAND, trace clay Compact Grey Wet		24	SS	27		136				
135.2											
45.9	END OF BOREHOLE										

NOTE:

1. Water level in open borehole at a depth of 3.4 m below ground surface (Elev. 177.7 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S204-10

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074702.1 ;E 225225.8
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE February 3, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P — w — w_L WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
184.8	GROUND SURFACE										
0.0	TOPSOIL										
0.2	END OF EXCAVATION PROBABLE BEDROCK										

NOTES:

1. Hand digging carried out at proposed location to expose bedrock.

2. Excavation dry upon completion.

3. Bedrock outcrop observed within the vicinity of Borehole S204-10.

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

Golder Associates

RECORD OF BOREHOLE No S204-11

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074707.9 ;E 225206.5	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers	COMPILED BY	OK
DATUM	Geodetic	DATE	February 16, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
183.6	GROUND SURFACE										
0.0	TOPSOIL										
0.2	Silty SAND, trace to some clay, containing rootlets Loose Brown Moist to wet		1A 1B	SS	4	▽	183				
182.7			2A 2B	SS	6						
0.9	Silt, some clay, trace sand Loose Grey Moist										
182.2			3	SS	13		182				
1.4	CLAYEY SILT, trace sand, trace gravel, containing rootlets Stiff Brown Moist										
181.5											
2.3	END OF BOREHOLE SPOON AND AUGER REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 182.8 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S204-11 to confirm depth to refusal; refusal encountered at a depth of 2.3 m below ground surface (Elev. 181.3 m).

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

Golder Associates

RECORD OF BOREHOLE No S204-12

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074725.4 ;E 225216.6	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	February 17, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
181.9	GROUND SURFACE							
0.0	Sand and gravel (FILL)	1A	AS	-				
	SNOW and ICE	1B						
181.3	Sand, trace to some silt, trace gravel (FILL) Brown Moist							
0.6	CLAYEY SILT, trace to some sand Firm Brown Moist	2	SS	5				
180.5	SILTY CLAY, trace sand Firm Grey Moist	3	SS	4				
1.4								
179.2	SILT, some clay, trace to some sand Loose Grey Wet	4	SS	6				
2.7	SILTY CLAY Soft Grey Wet	5	SS	1	0	0	50	50
178.2								
3.7		6	SS	WH				
175.9	Granite Gneiss (BEDROCK) Bedrock cored from depths of 6.0 m to 9.0 m For bedrock coring details, refer to Record of Drillhole S204-12	1	NQRC	REC 94%	RQD = 94%			
6.0		2	NQRC	REC 100%	RQD = 94%			
172.9								
9.0	END OF BOREHOLE							

NOTE:

1. Water level in open borehole at a depth of 2.4 m below ground surface (Elev. 179.5 m) upon completion of drilling.

GROUND WATER CONDITIONS: ▽

ELEVATION SCALE: 181, 180, 179, 178, 177, 176, 175, 174, 173

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

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

PROJECT: 09-1111-6014

RECORD OF DRILLHOLE: S204-12

SHEET 1 OF 1

LOCATION: N 5074725.4 ;E 225216.6

DRILLING DATE: February 17, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: D25 Bomb

DRILLING CONTRACTOR: Walker Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD - Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER Meter	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	NOTES
		Continued from Record of Borehole S204-12		175.90														
6		GRANITE GNEISS Fresh, medium crystalline, slightly porous, strong, foliated, pink, grey and black		6.00	1	100%												
7												CH,PL,RO	1.5	1				
												FE,PL,RO	1.5	1				
												CU,PL,RO	1.5	2				
												CU,PL,RO	1.5	1				
												HE,PL,SM	1	1				
8					2	100%						,PL,RO	1.5	1				
												SO,PL,SM	1.5	1				
												SO,PL,SM	1.5	1				
				172.94														
9		END OF DRILLHOLE		8.96														
10																		
11																		
12																		
13																		
14																		
15																		
16																		

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MR

CHECKED: TVA

GTA-RCK 030 09-1111-6014.GPJ GAL-MISS.GDT 7/24/12 SAC/DD

Golder Associates

RECORD OF BOREHOLE No S204-13

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074743.5 ;E 225228.6	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	February 18, 2010	CHECKED BY	TVA

SOIL PROFILE

ELEV / DEPTH	DESCRIPTION
181.5	GROUND SURFACE
0.0	TOPSOIL
181.0	Silty sand, some clay, containing rootlets (FILL) Loose Brown Moist
0.6	TOPSOIL
179.9	CLAYEY SILT, trace to some sand, containing rootlets to a depth of 0.8 m Firm Brown Moist
1.6	SILTY CLAY Firm to stiff Grey Moist
178.3	Silty SAND, trace clay Compact Brown Wet
3.2	SILT, trace to some sand, trace to some clay Very loose to loose Grey Wet
177.6	CLAY Firm Grey Moist
3.9	
174.8	
6.7	
167.4	END OF BOREHOLE SPOON AND CASING REFUSAL
14.1	

STRAT PLOT

SAMPLES

NUMBER	TYPE	"N" VALUES
1A 1B 1C	SS	6
2A 2B	SS	7
3	SS	4
4	SS	11
5	SS	6
6	SS	2
7	SS	1
8	SS	1
9	SS	WH
10	TO	PH
11	SS	WH
12	SS	2
13	SS	50/0.0

GROUND WATER CONDITIONS

ELEVATION SCALE: 181, 180, 179, 178, 177, 176, 175, 174, 173, 172, 171, 170, 169, 168

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	9	84	7

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-13

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074743.5 ;E 225228.6
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 18, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	NOTE: 1. Water level in open borehole at a depth of 3.2 m below ground surface (Elev. 178.3 m) upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-14

SHEET 1 OF 2 **METRIC**

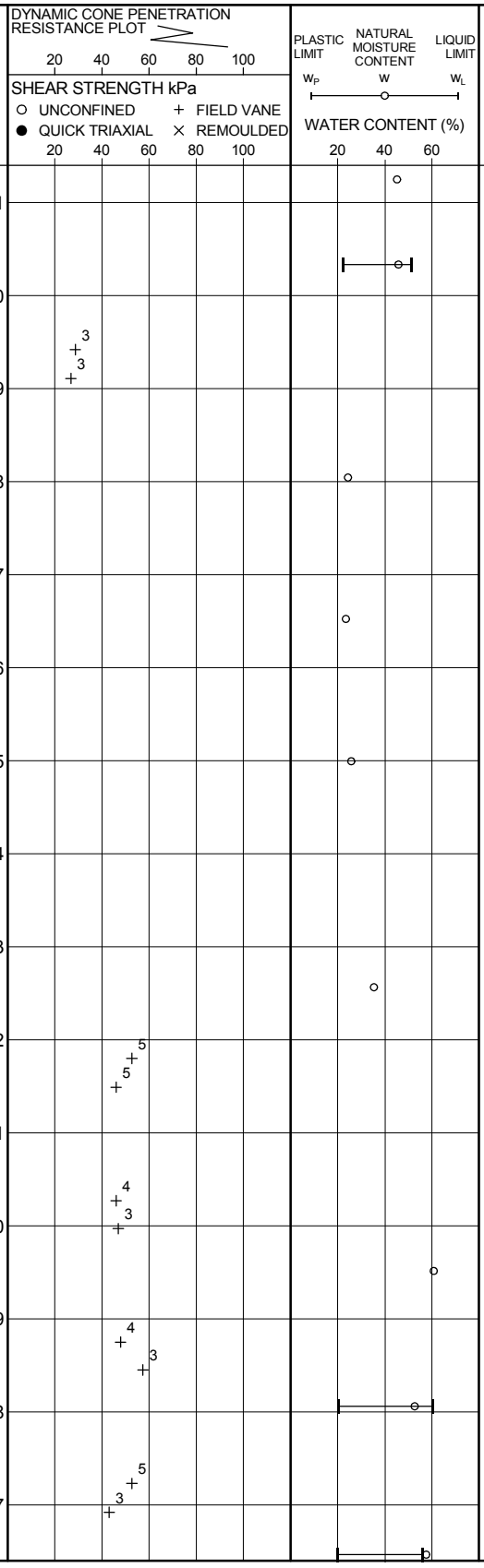
PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074748.3 ;E 225206.7
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 10, 2010

ORIGINATED BY RA
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION
181.4	GROUND SURFACE
0.0 / 181.1	TOPSOIL
0.3 / 180.6	SAND, trace to some silt, containing clayey silt pockets Loose Brown Moist
0.8 / 179.0	CLAY, trace to some silt, containing silt seams Firm Brown becoming grey at depth of 0.9 m Moist
2.4 / 178.4	SAND, trace to some silt, trace clay Compact Brown Moist
3.0 / 177.7	SILT, trace to some sand, trace clay Compact Brown Moist
3.7 / 173.3	SAND and SILT, trace clay Loose to compact Grey Wet
8.1	CLAY Firm to stiff Grey Moist Silty sand seams encountered between depths of 8.1 m and 12.2 m below ground surface

NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL	UNIT WEIGHT γ kN/m³
1	SS	9					
2	SS	6					
3	SS	24					
4	SS	22	0	12	84	4	
5	SS	11					
6	SS	5					
7	SS	4					
8	SS	7	0	31	66	3	
9	SS	5					
10	SS	3					
11	SS	WH					
12	SS	1					
13	TO	PH					16.7
14	SS	WH					



GROUND WATER CONDITIONS: ▽

REMARKS & GRAIN SIZE DISTRIBUTION (%)

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Continued Next Page

Golder Associates

RECORD OF BOREHOLE No S204-14

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074748.3 ;E 225206.7
ORIGINATED BY RA
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 10, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	CLAY Firm to stiff Grey Moist				166					
					165					
					164					
		15	SS	3						
					163					
					162					
					161					
		16	SS	4						
					160					
157.9					159					
23.5 157.5	BOULDER	17	RC	-	158					
23.9	SAND, some gravel, trace to some silt, trace clay Compact Grey Wet	18	SS	18	157		19	67	10	4
155.6					156					
155.3	BOULDER	19	RC	-						
154.9	Silty SAND, trace gravel Very dense Grey Wet	20	SS	154/0.20	155					
26.5	END OF BOREHOLE SPOON REFUSAL									

NOTE:

1. Water level in open borehole at a depth of 3.4 m below ground surface (Elev. 178.0 m) upon completion of drilling.

STRAT PLOT

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

REMARKS & GRAIN SIZE DISTRIBUTION (%)

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-15

SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074754.0 ;E 225187.0
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 18, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
181.4	GROUND SURFACE							
0.0	TOPSOIL	1A	SS	5				
180.9		1B						
0.7	SAND, containing pockets of clayey silt Loose Brown Moist	2	SS	6				
	SILTY CLAY Firm Grey Moist	3	SS	2				
178.7								
2.7	SAND, trace silt, trace clay Compact Brown Moist	4A	SS	12				
178.2		4B						
3.2	SAND and SILT, trace clay Very loose to compact Grey Wet	5	SS	7				
		6	SS	11	0	55	42	3
		7	SS	3				
174.7								
6.7	SILTY CLAY Firm Brown to grey Moist	8	SS	1				
172.7								
8.7	SILT, trace to some sand, trace to some clay Very loose to compact Grey Wet	9	TO	PM*				
		10	SS	2				
	Silty clay interlayers encountered between depths of 10.2 m and 10.8 m	11	SS	4				
		12	SS	10				
		13	SS	8				
		14A						

GROUND WATER CONDITIONS: ▽

ELEVATION SCALE: 181, 180, 179, 178, 177, 176, 175, 174, 173, 172, 171, 170, 169, 168, 167

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED (20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Continued Next Page

Golder Associates

RECORD OF BOREHOLE No S204-15

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074754.0 ;E 225187.0
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 18, 2010
CHECKED BY TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
166.3 / 15.1	SILTY CLAY Stiff Grey Wet		14B	SS	4		166				
	Silt interlayers encountered between depths of 15.1 m and 16.9 m		15	SS	4		165				
			16	TO	PH		164				
			17	SS	7		163				
			18	TO	PH		162				
152.3 / 29.1	SILT, trace to some clay, trace sand Compact Grey Wet						161				
							160				
							159				
							158				
							157				
							156				
							155				
							154				
							153				
							152				

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-15

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074754.0 ;E 225187.0
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 18, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	SILT, trace to some clay, trace sand Compact Grey Wet		19	SS	22		151 150		○		0 2 91 7
149.3 32.1	END OF BOREHOLE SPOON AND CASING REFUSAL		20	SS	25/0.0						

NOTES:

* Unable to recover a Shelby tube sample between depths of 9.3 m and 9.9 m (Elev. 172.1 m and 171.5 m) below ground surface.

1. Water level in open borehole at a depth of 3.2 m below ground surface (Elev. 178.2 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S204-16

SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074771.9 ;E 225198.2
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 1, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
181.0	GROUND SURFACE										
0.0 / 180.7	TOPSOIL										
0.3 / 180.2	CLAYEY SILT, some sand, containing silt seams and rootlets Firm Brown Moist	1A 1B	SS	5							
0.8	SILTY CLAY Firm Grey Moist	2	SS	3		180					
178.5		3A 3B	TO	PH		179					
2.5	SAND, trace to some silt, trace clay Compact Brown Moist to wet	4	SS	15		178					
177.3					▽						
3.7	SAND and SILT, trace clay Very loose to compact Grey Wet	5	SS	5		177					
		6	SS	3		176		0	66	32	2
		7	SS	5		175					
		8	SS	3		174					
		9	SS	11		173					
171.3						172					
9.8 / 170.6	SILT, some clay, trace sand Very loose Grey Wet	10A 10B	SS	2		171					
10.4 / 169.7	SILTY CLAY Stiff Grey Moist					170					
11.3	CLAYEY SILT, trace sand Stiff Grey Wet	11	SS	1		169					
167.9						168					
13.1	CLAY, some silt Firm to stiff Brown to grey Moist	12	SS	2		167					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
(20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20 40 60)

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-16

SHEET 2 OF 3 **METRIC**

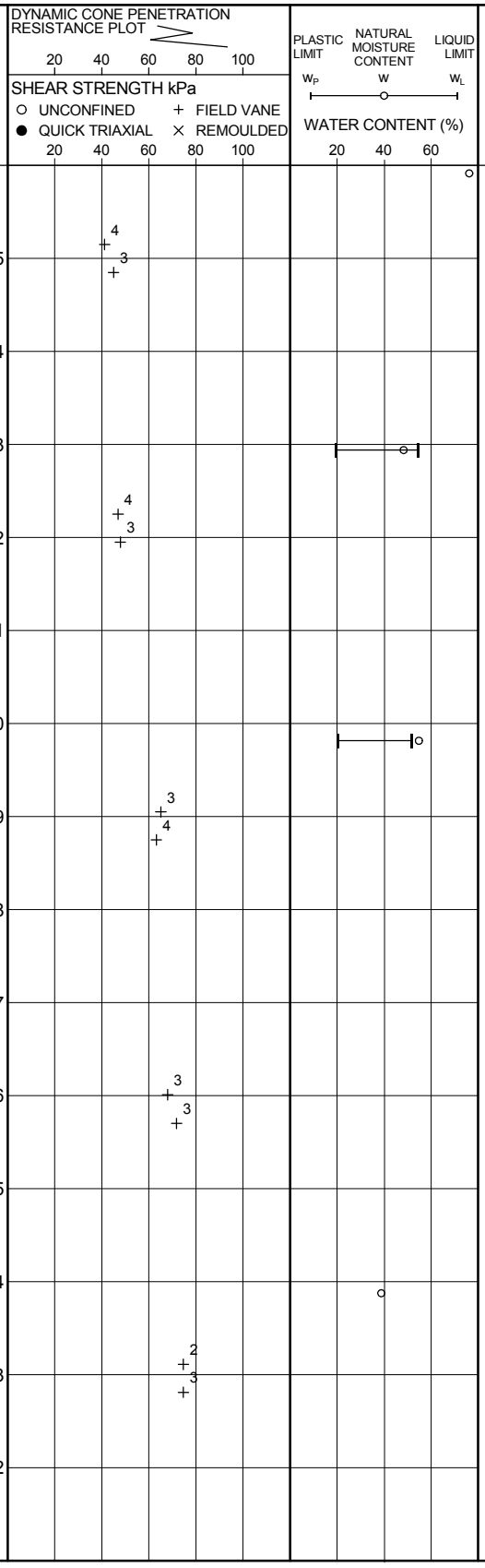
PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074771.9 ;E 225198.2
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE March 1, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	CLAY, some silt Firm to stiff Brown to grey Moist	13	SS	1						
	Becoming grey below a depth of 17.8 m	14	TO	PH						
		15	SS	4			0	0	46	54
		16	SS	5						
		17	SS	9						

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | ELEVATION SCALE | STRAT PLOT



Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-16

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074771.9 ;E 225198.2
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE March 1, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
150.7	Silt interlayers encountered at a depth of 29.9 m (Elev. 151.1 m)		18A	SS	14						
30.3	SILT, trace to some sand, trace clay Compact Grey Wet		18B				150 149 148		○		
147.5			19	SS	11				○		0 12 86 2
33.5	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 3.8 m below ground surface (Elev. 177.2 m) upon completion of drilling.										

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

Golder Associates

RECORD OF BOREHOLE No S204-17

SHEET 1 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

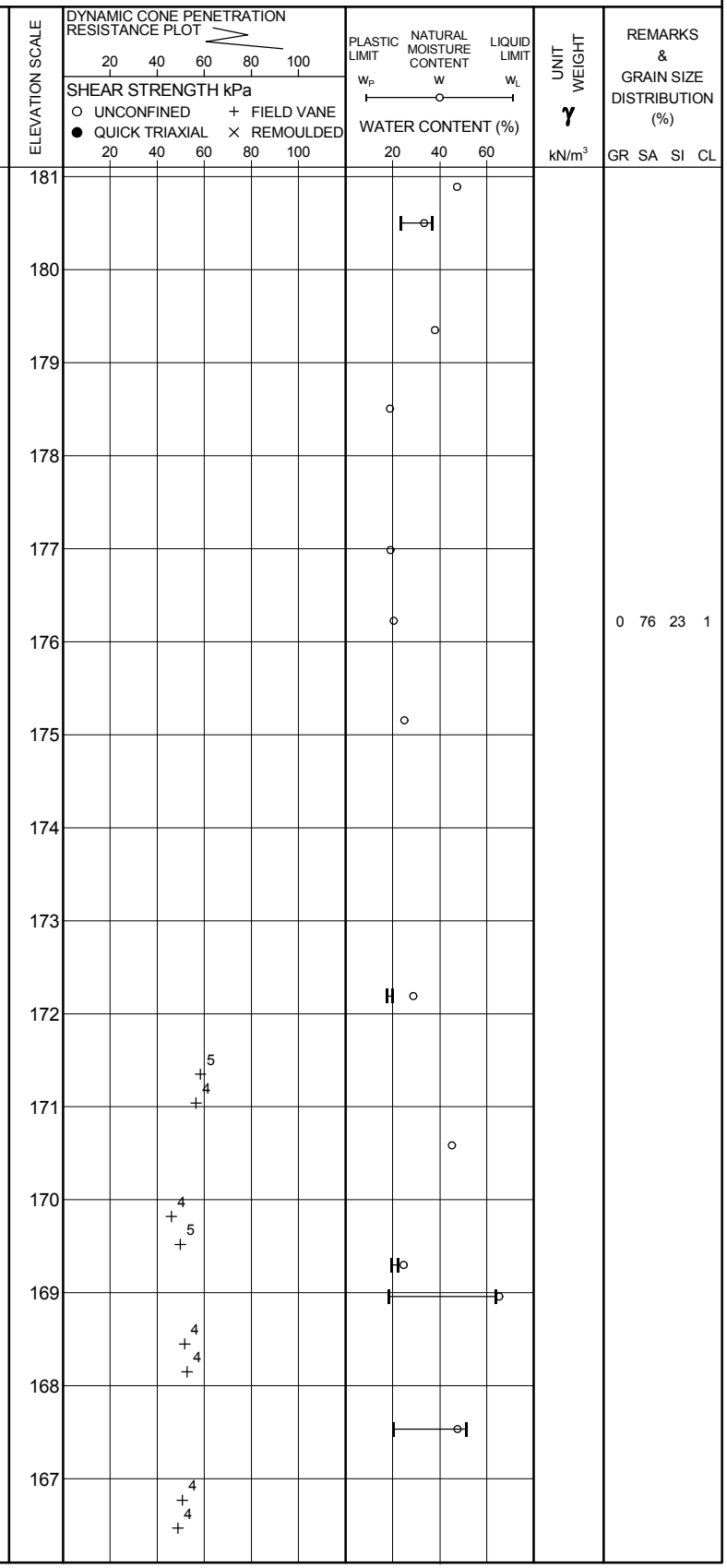
LOCATION N 5074790.3 ;E 225210.8
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 23 and 24, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION
181.1	GROUND SURFACE
0.0 / 180.8	TOPSOIL
0.5	Silty SAND, trace to some clay, containing rootlets Loose Dark brown Moist
	SILTY CLAY, trace to some sand, containing rootlets Firm Brown to grey Moist
179.1 / 2.0	Silty SAND, trace clay Very loose to compact Brown to grey Wet Clayey silt pockets encountered between depths of 2.3 m and 2.9 m
172.9 / 8.2	SILT, some clay, trace sand Very loose Grey Wet
172.0 / 9.1	CLAY Firm to stiff Grey Moist
169.5	SILT Grey Moist
169.1 / 12.0	CLAY Firm to stiff Grey Moist
166.3 / 14.8	

NUMBER	TYPE	"N" VALUES
1A 1B 1C	SS	6
2	SS	7
3A 3B	SS	4
4	SS	12
5	SS	15
6	SS	6
7	SS	3
8	SS	8
9	SS	5
10A 10B	SS	3
11	SS	3
12	TO	PH
13	SS	2

GROUND WATER CONDITIONS: ▽



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	76	23	1

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-17

SHEET 2 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074790.3 ;E 225210.8
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 23 and 24, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	SAND and SILT Loose Grey Wet	14	SS	5	166					
164.5 16.6	SILTY CLAY Firm to very stiff Grey Moist	15	SS	3	163					
		16	SS	6	160					
		17	SS	6	157		0	0	51	49
		18	SS	11	154					

SOIL PROFILE — STRAT PLOT — SAMPLES — GROUND WATER CONDITIONS — ELEVATION SCALE

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
(20 40 60 80 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20 40 60)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-17

SHEET 3 OF 3 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074790.3 ;E 225210.8
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 23 and 24, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	SILTY CLAY Firm to very stiff Grey Moist	19	TO	PH*	151					
		20	SS	9						
					150					
					149					
147.9		21A 21B	SS	4	148					
33.2	SILT, some clay, trace sand Loose Grey Wet									
					147					
146.4										
34.7	Silty SAND, trace clay Compact to dense Grey Wet				146					
		22	SS	24	145		0	73	24	3
					144					
					143					
		23	SS	34	142					
141.5										
39.6	END OF BOREHOLE									

NOTES:

* Unable to recover a Shelby tube sample between depths of 29.8 m and 30.3 m (Elev. 151.3 m and 150.8 m) below ground surface.

1. Water level in open borehole at a depth of 2.0 m below ground surface (Elev. 179.1 m) upon completion of drilling.

SOIL PROFILE — STRAT PLOT — SAMPLES — GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × REMOULDED
(20, 40, 60, 80, 100)

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (20, 40, 60)

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

Golder Associates

RECORD OF BOREHOLE No S204-18

SHEET 1 OF 4 **METRIC**

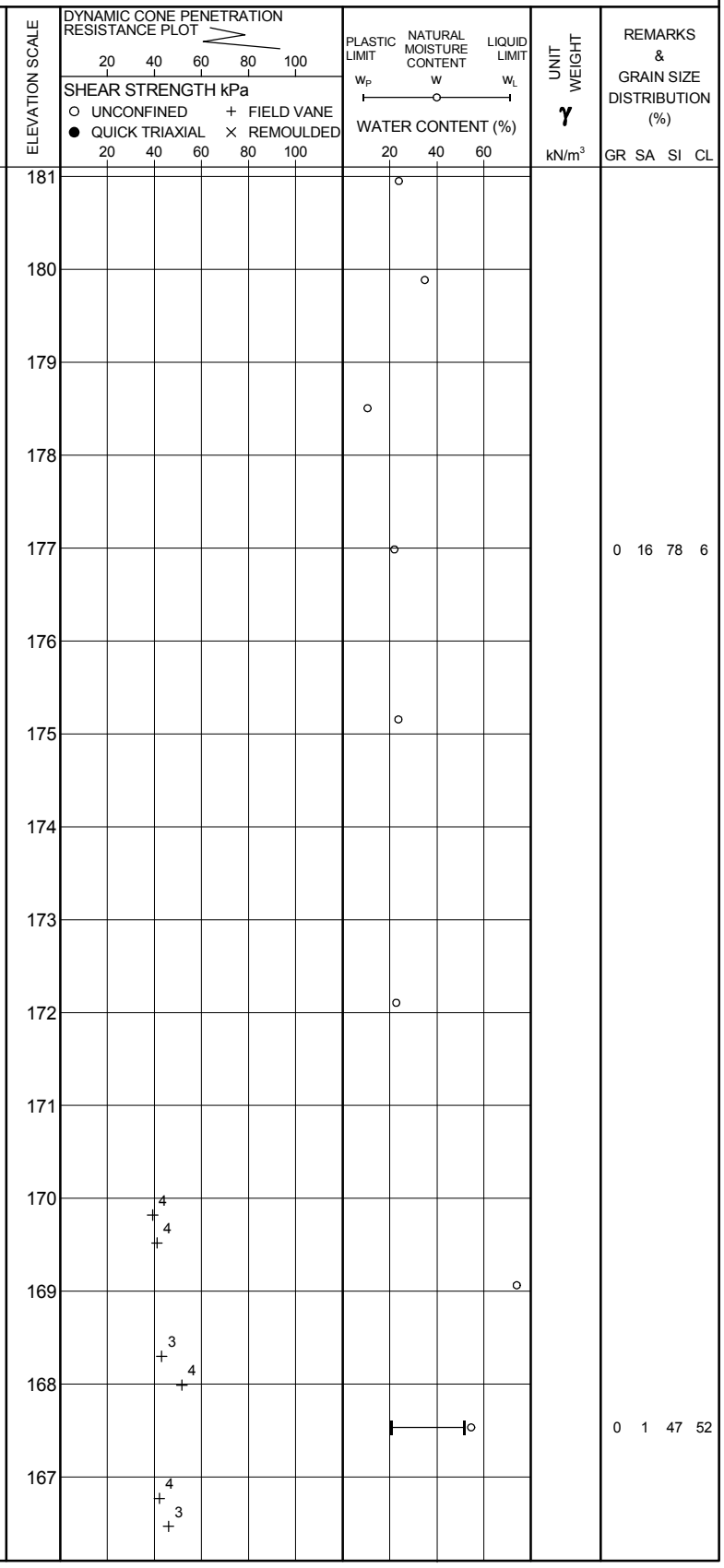
PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074795.1 ;E 225189.0
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 6 and 7, 2010

ORIGINATED BY MR/RA
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
181.1	GROUND SURFACE							
0.0 / 180.8	TOPSOIL							
0.3	SILTY CLAY, containing rootlets and silty sand layers to a depth of 0.8 m Firm Brown to grey Moist	1A 1B	SS	5				
		2	SS	6				
179.0		3A 3B	TO	PH				
2.1	Silty SAND, trace clay Loose to compact Brown Wet	4	SS	8				
177.4		5	SS	18				
3.7	SILT, some sand, trace to some clay Loose to compact Brown Wet	6	SS	13	0	16	78	6
		7	SS	4				
	Becoming grey below a depth of 5.5 m	8	SS	15				
		9	SS	5				
		10	SS	9				
171.4								
9.7	CLAY Firm to stiff Grey Moist	11	SS	2				
		12	SS	1				
		13	SS	2	0	1	47	52

GROUND WATER CONDITIONS: ▽



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S204-18

SHEET 2 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5074795.1 ;E 225189.0
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
DATE February 6 and 7, 2010

ORIGINATED BY MR/RA
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%) 20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---									
	CLAY Firm to stiff Grey Moist	14	SS	WH	166					
					165	3, 3				
					164					
		15	SS	3	163					
					162	3, 3				
161.3										
19.8	SILT, trace to some sand, trace clay Loose Grey Wet				161					
		16	TO	PH*	160					
		17	SS	7				○		0 8 88 4
					159					
158.2										
22.9	SILTY CLAY Stiff to very stiff Grey Moist				158					
		18	SS	5	157					
					156	4, 3				
					155					
		19	TO	PH	154					
					153	3, 4				
					152					

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-18

SHEET 3 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074795.1 ;E 225189.0
ORIGINATED BY MR/RA
DIST HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 6 and 7, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%))	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---								
	SILTY CLAY Stiff to very stiff Grey Moist	20	SS	7	151		○		0 1 54 45
					150	+ 4, + 3			
					149				
		21	SS	5	148		○		
					147	+ 3, + >96			
					146				
	Silt interlayers encountered below a depth of 36.1 m	22	SS	9	145				
143.2					144	>142, >122			
37.9	SAND and SILT, trace clay Compact Grey Wet				143				
		23	SS	21	142		○		0 35 65 0
					141				
					140				
					139				
138.3		24	SS	12					
42.8	END OF BOREHOLE								

Continued Next Page

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

Golder Associates

RECORD OF BOREHOLE No S204-18

SHEET 4 OF 4 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5074795.1 ;E 225189.0
ORIGINATED BY MR/RA
DIST
HWY 69
BOREHOLE TYPE 127 mm O.D. Continuous Flight Solid Stem Augers, NW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE February 6 and 7, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	NOTES: * Unable to recover a Shelby tube sample between depths of 20.9 m and 21.3 m (Elev. 160.2 m and 159.8 m) below ground surface. 1. Water level in open borehole at a depth of 3.7 m below ground surface (Elev. 177.4 m) upon completion of drilling.										

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

Golder Associates

RECORD OF DCPT No S204-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074717.5 ;E 225162.8	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Hand Excavation	COMPILED BY	OK
DATUM	Geodetic	DATE	February 2, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
186.4	GROUND SURFACE										
0.0	TOPSOIL										
0.1	END OF EXCAVATION PROBABLE BEDROCK NOTES: 1. Bedrock outcrop observed in the vicinity of the DCPT; bedrock confirmed by hand excavation at the DCPT location. 2. Excavation dry upon completion.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

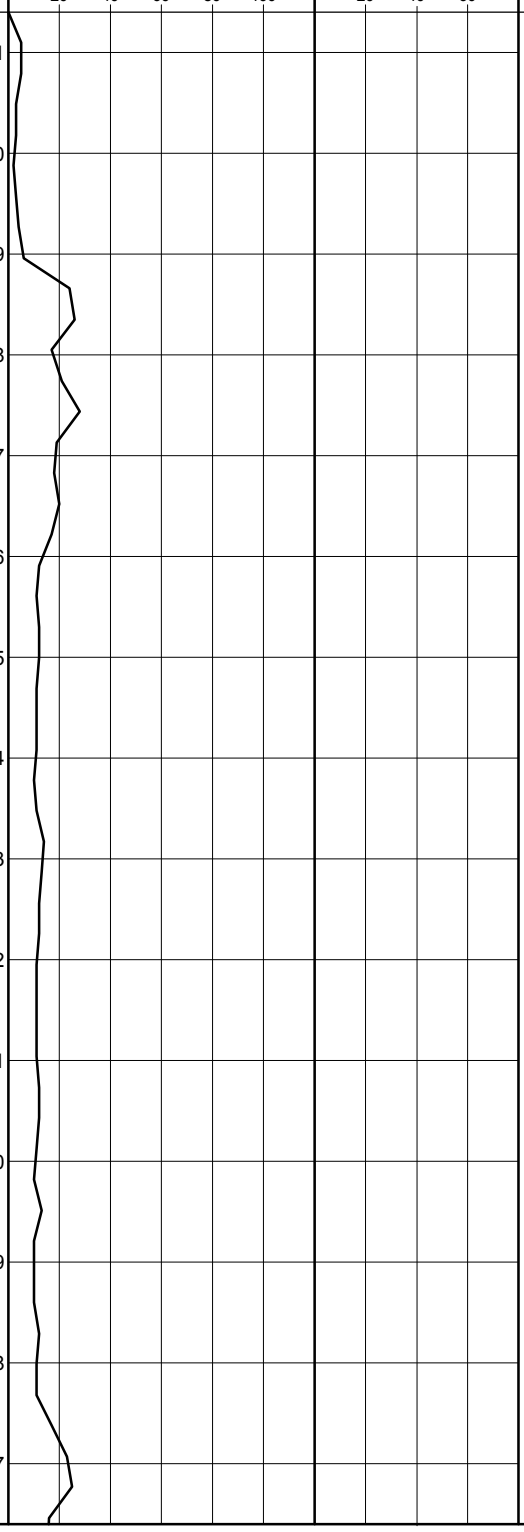
Golder Associates

RECORD OF DCPT No S204-DC02

SHEET 1 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074752.4 ;E 225183.1	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	March 1, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.4	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC02

SHEET 2 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074752.4 ;E 225183.1	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	March 1, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						166				
							165				
							164				
							163				
							162				
							161				
							160				
							159				
							158				
							157				
							156				
							155				
							154				
							153				
							152				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC02

SHEET 3 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074752.4 ;E 225183.1	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	March 1, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						151				
							150				
149.6 / 31.8	END OF DCPT Refusal to Further Penetration (100 Blows / 0.13 m)										

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

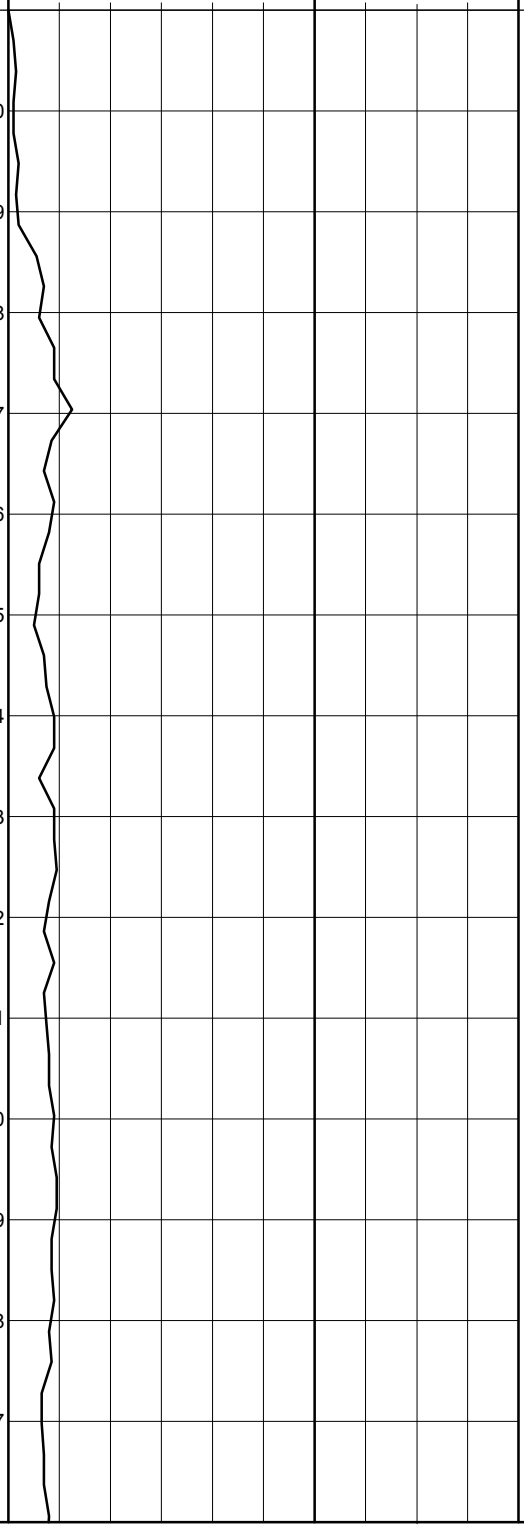
Golder Associates

RECORD OF DCPT No S204-DC03

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074762.9 ;E 225141.5	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 2, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
181.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC03

SHEET 2 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074762.9 ;E 225141.5	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 2, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						165				
							164				
							163				
							162				
							161				
							160				
							159				
							158				
							157				
							156				
							155				
							154				
							153				
152.7 / 28.3	END OF DCPT Refusal to Further Penetration (130 Blows / 0.30 m)							130			

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

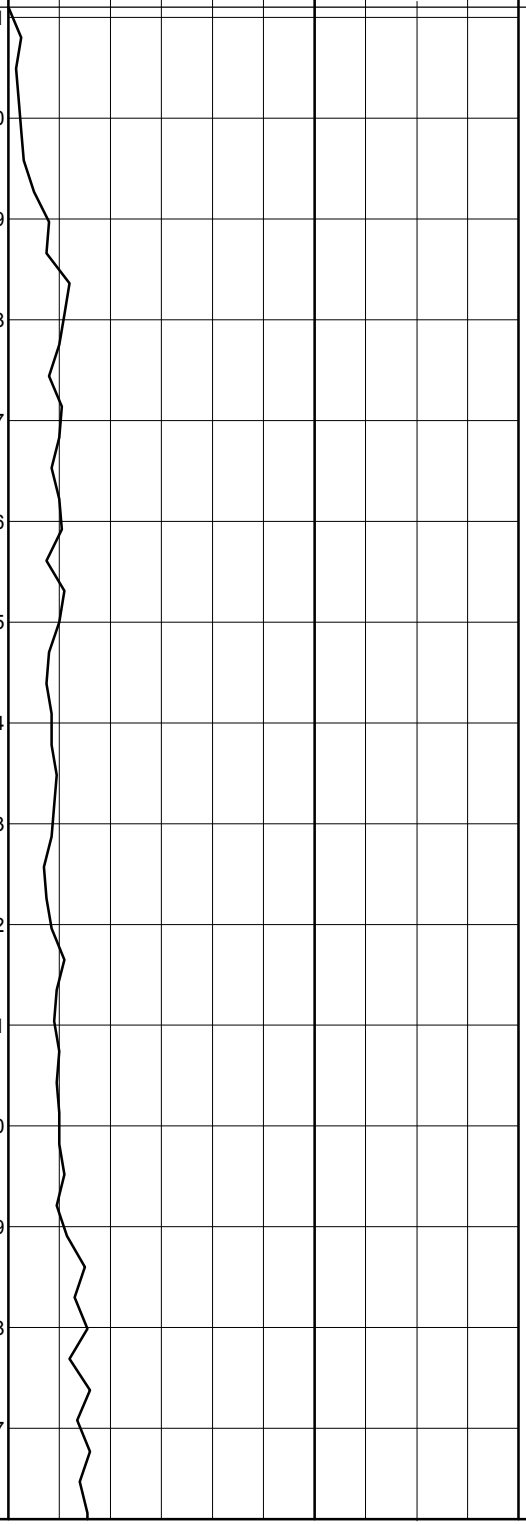
Golder Associates

RECORD OF DCPT No S204-DC04

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074799.2 ;E 225165.3	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 2, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.1	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



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+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC04

SHEET 2 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074799.2 ;E 225165.3	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 2, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						166				
							165				
							164				
							163				
							162				
							161				
							160				
							159				
							158				
							157				
							156				
155.2 / 25.9	END OF DCPT										

Legend: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED

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

Golder Associates

RECORD OF DCPT No S204-DC05

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074720.1 ;E 225237.2	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 16, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
182.1	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						182				
							181				
							180				
178.9							179				
3.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC06

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074730.3 ;E 225195.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 16, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
181.6	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						181 180 179 178 177				
176.0											
5.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

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

Golder Associates

RECORD OF DCPT No S204-DC07

SHEET 1 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074767.0 ;E 225220.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 25, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
181.4	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						181				
							180				
							179				
							178				
							177				
							176				
							175				
							174				
							173				
							172				
							171				
							170				
							169				
							168				
							167				

Continued Next Page

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

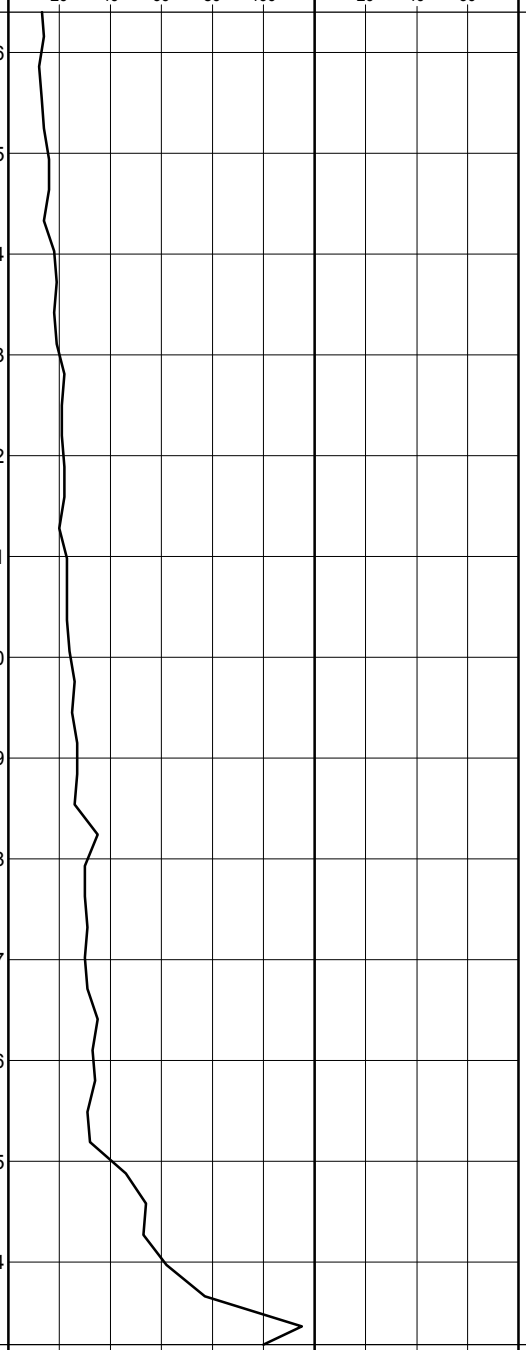
Golder Associates

RECORD OF DCPT No S204-DC07

SHEET 2 OF 2 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074767.0 ;E 225220.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 25, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)										
153.2 / 28.2	END OF DCPT Refusal to Further Penetration (100 Blows / 0.18 m)										



+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

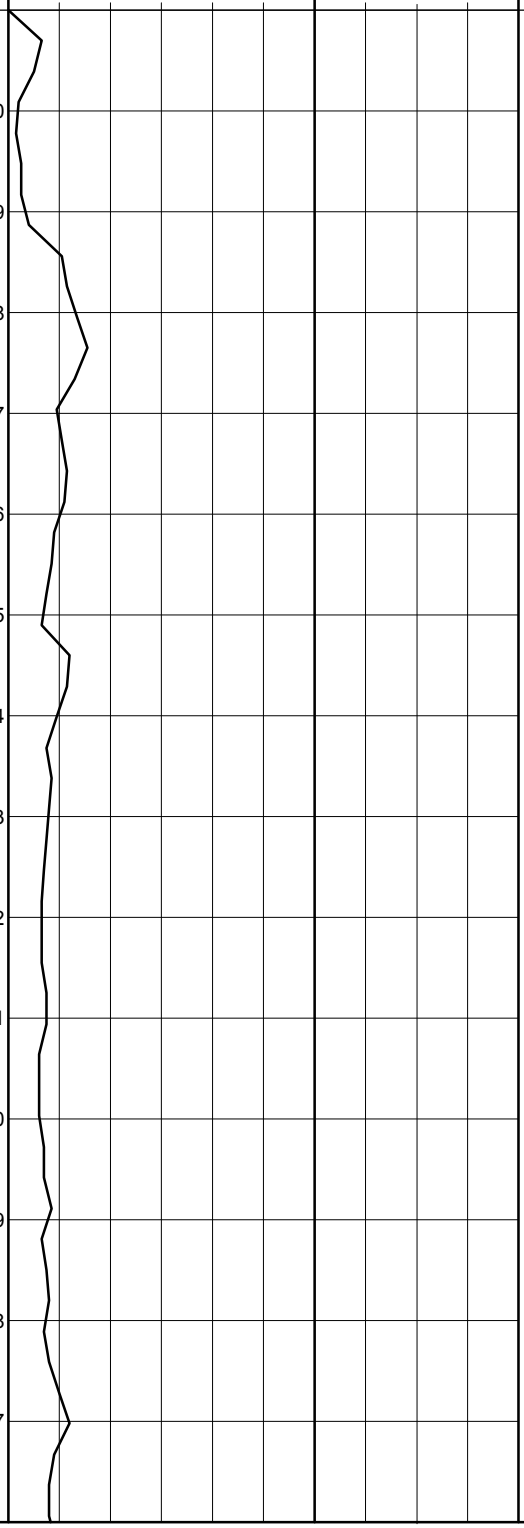
Golder Associates

RECORD OF DCPT No S204-DC08

SHEET 1 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074777.2 ;E 225177.8	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 21, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
181.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										



Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC08

SHEET 2 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074777.2 ;E 225177.8	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 21, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						165				
							164				
							163				
							162				
							161				
							160				
							159				
							158				
							157				
							156				
							155				
							154				
							153				
							152				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity

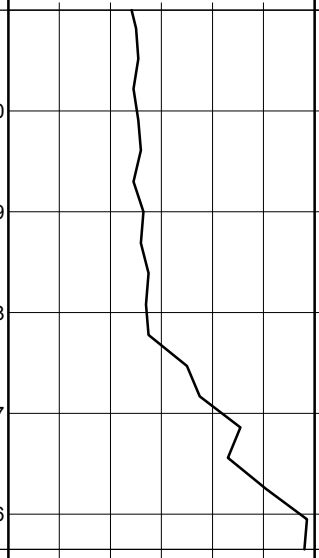
○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S204-DC08

SHEET 3 OF 3 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5074777.2 ;E 225177.8	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	February 21, 2010	CHECKED BY	TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Dynamic Cone Penetration Test (DCPT)						150 149 148 147 146				
145.7 35.4	END OF DCPT Refusal to Further Penetration (129 Blows / 0.30 m)										

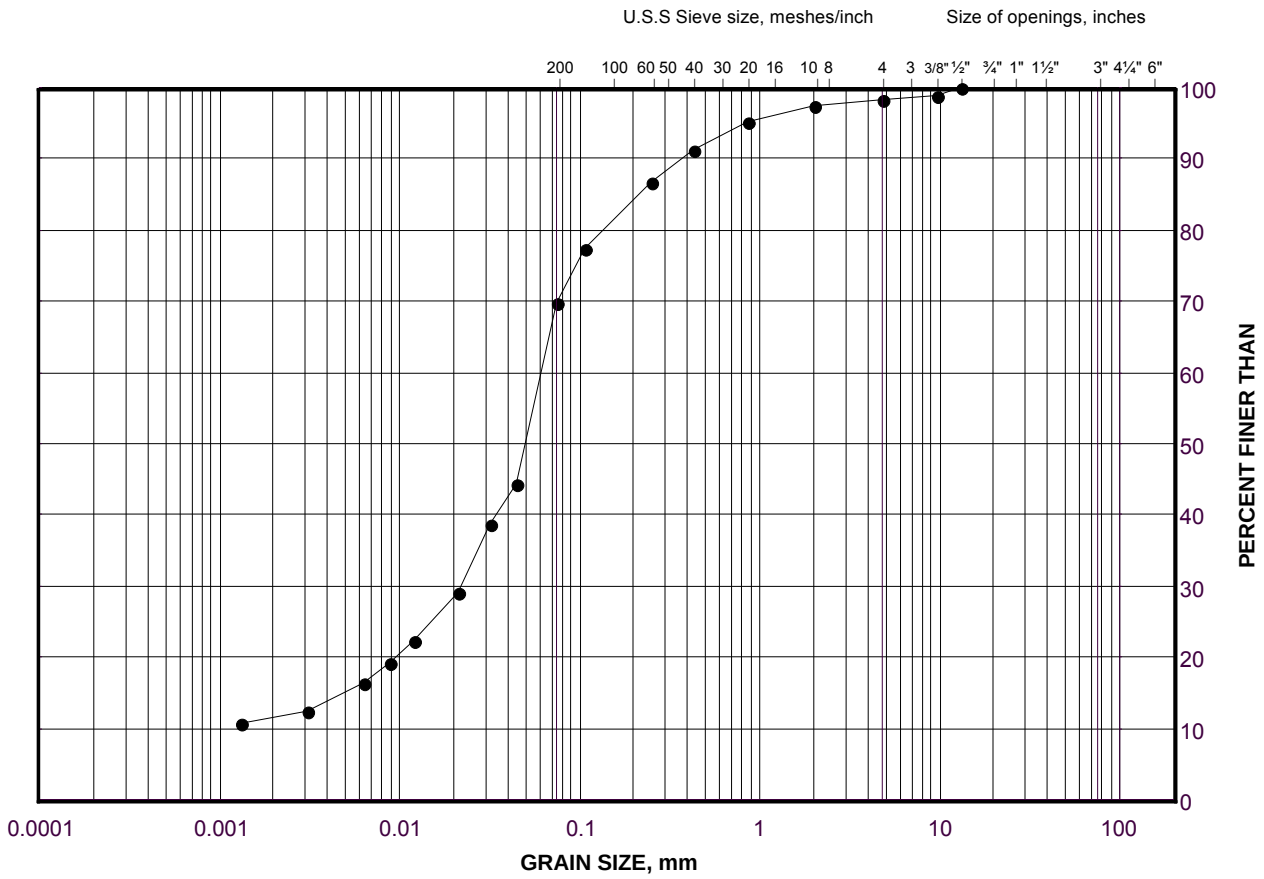
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Sandy Silt

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-01



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-01	1B	183.5

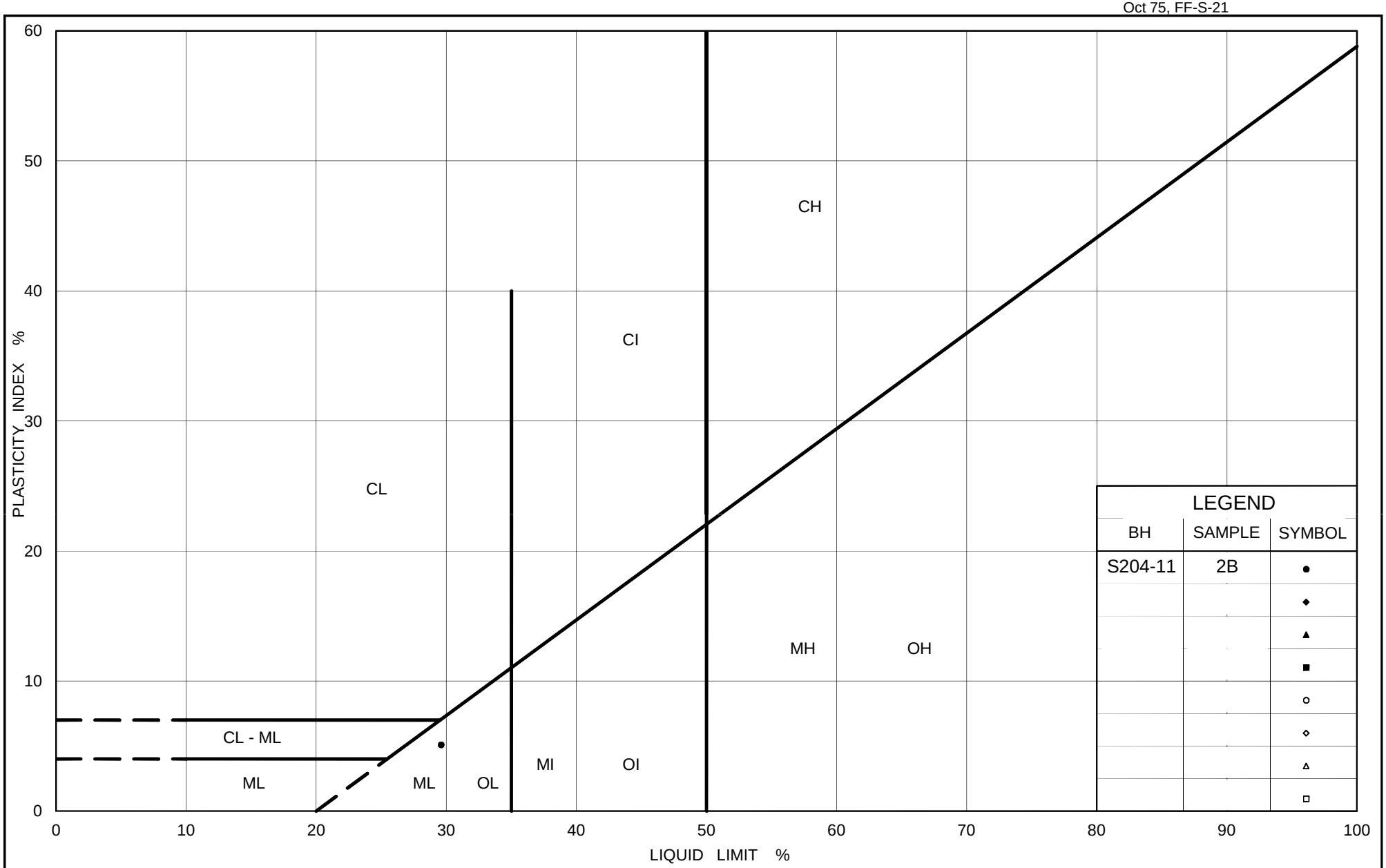
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Silt (Slight Plasticity)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-02

Project No. 09-1111-6014

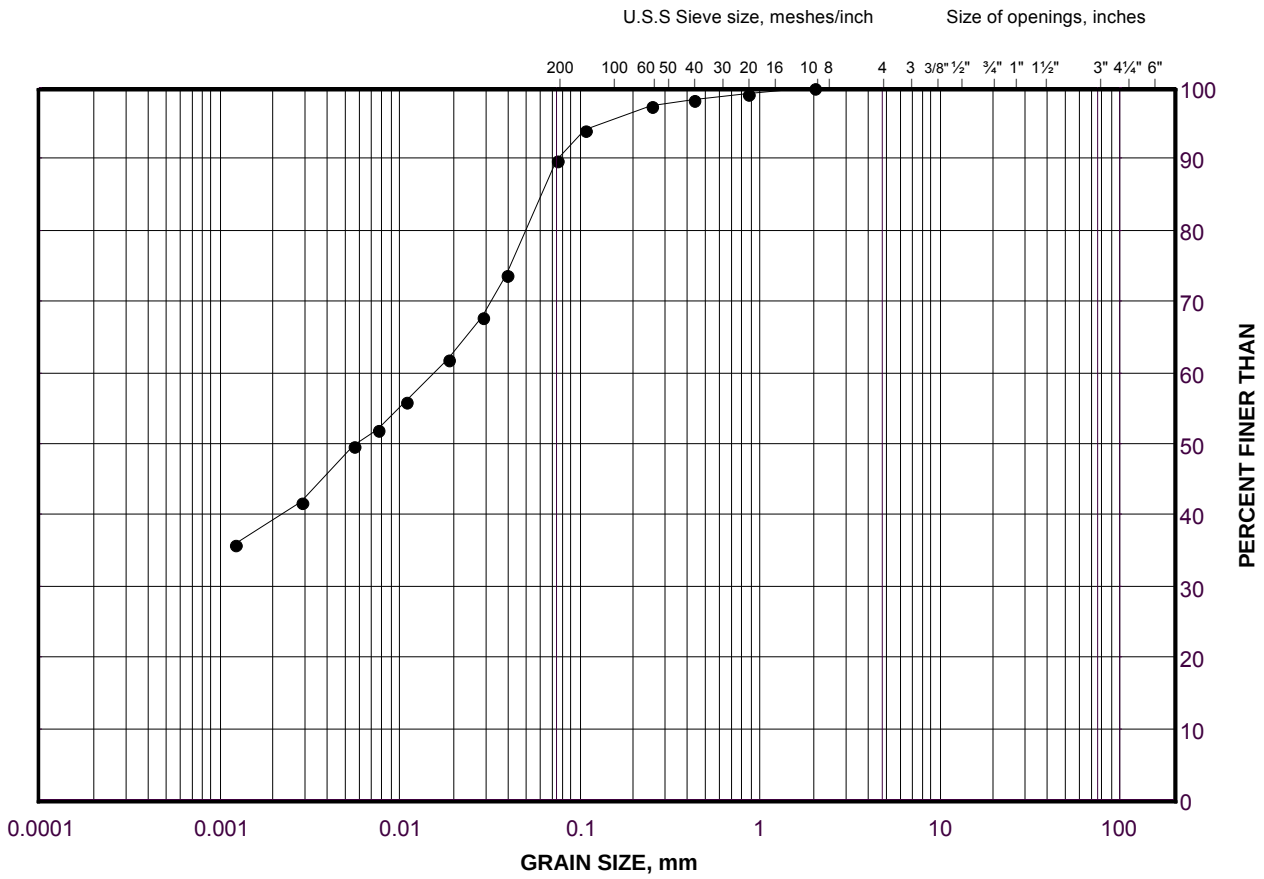
Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silty Clay (Near Surface)

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-03



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-03	3A	179.9

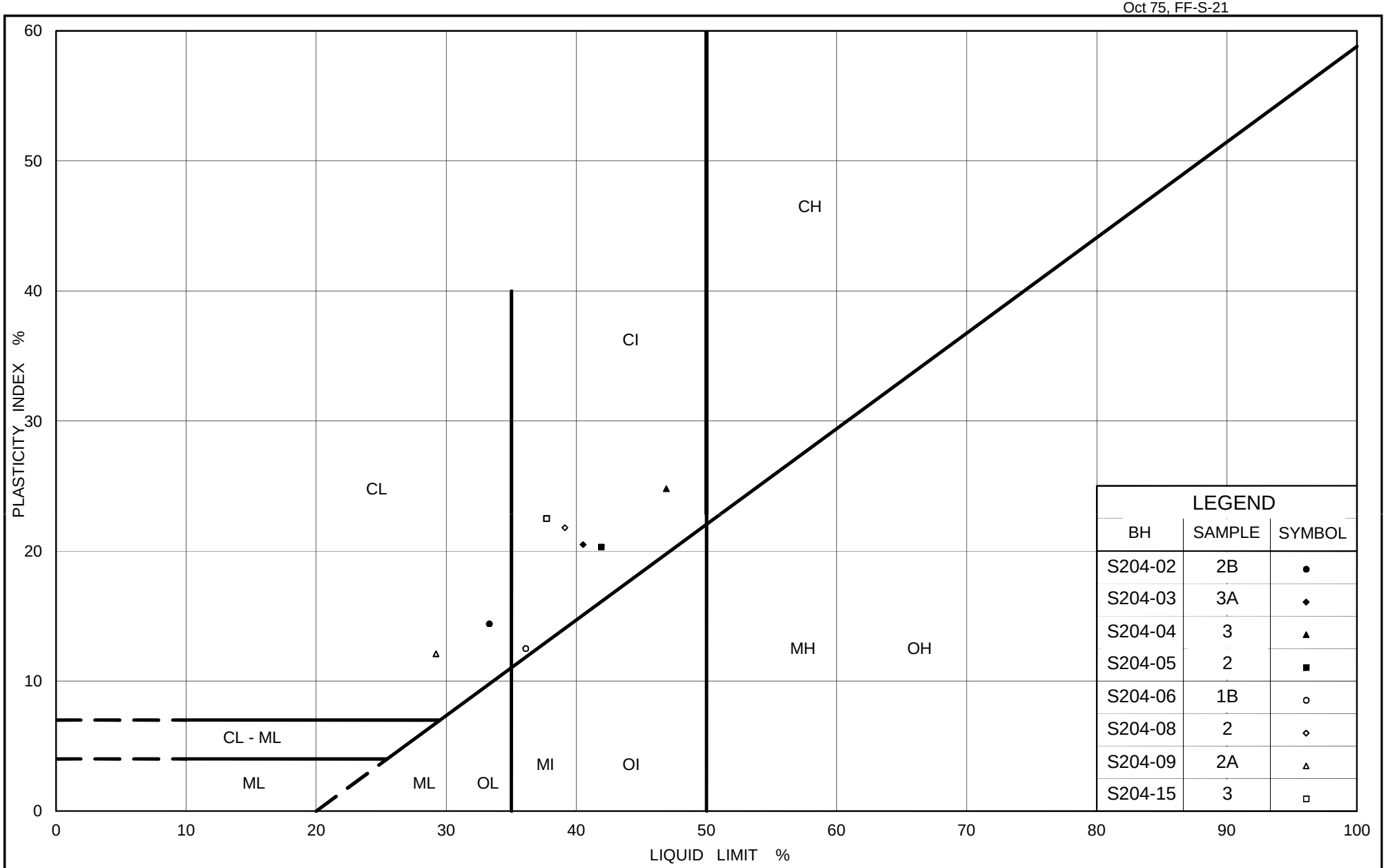
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 04-Aug-11

Oct 75, FF-S-21



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PLASTICITY CHART
Clayey Silt to Silty Clay
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-04

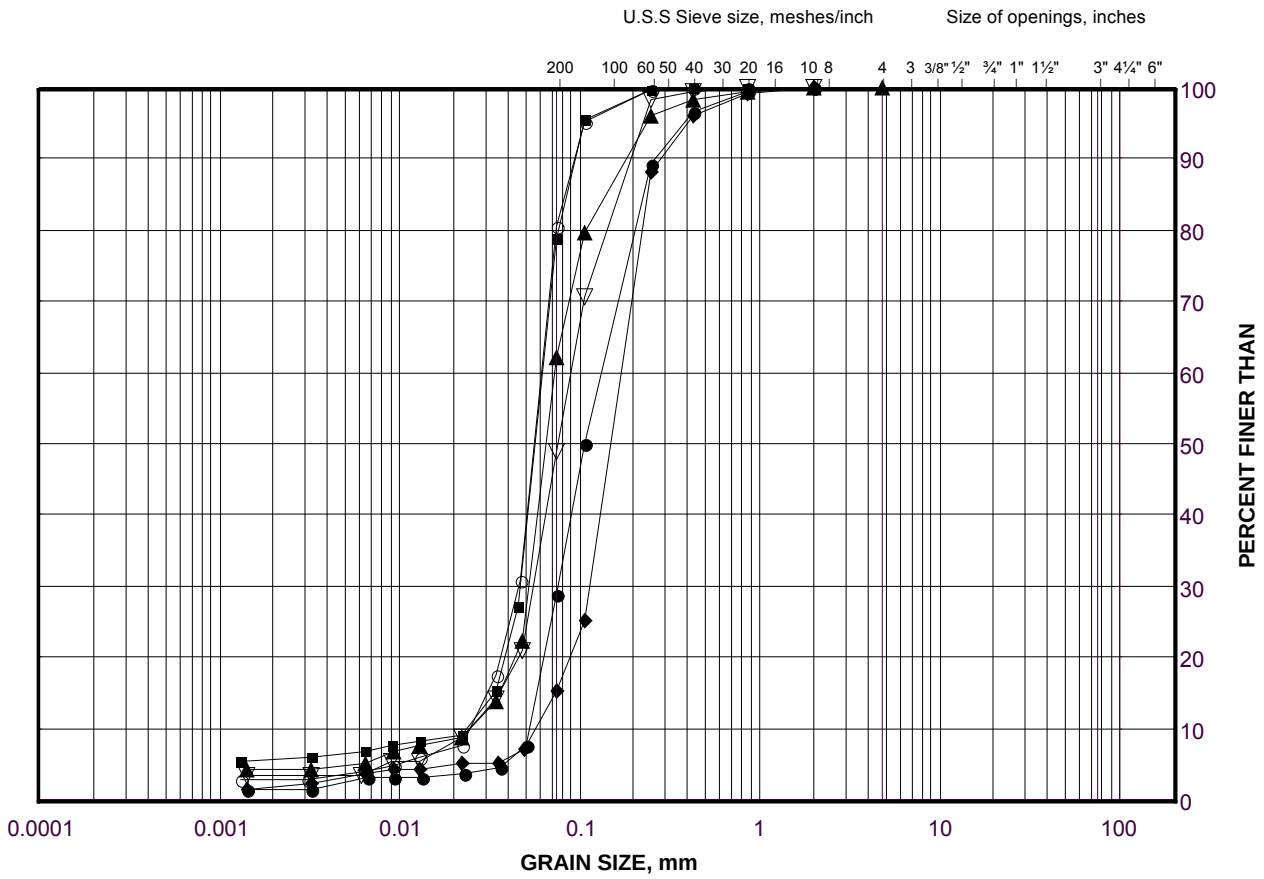
Project No. 09-1111-6014

Checked By: TVA

GRAIN SIZE DISTRIBUTION

Sand to Sandy Silt to Sand and Silt to Silty Sand (Upper)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-05



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-07	4	178.4
■	S204-09	5	177
◆	S204-08	7	176.2
▲	S204-06	7	176.2
▽	S204-05	7	176.3
❍	S204-07	9	173.5

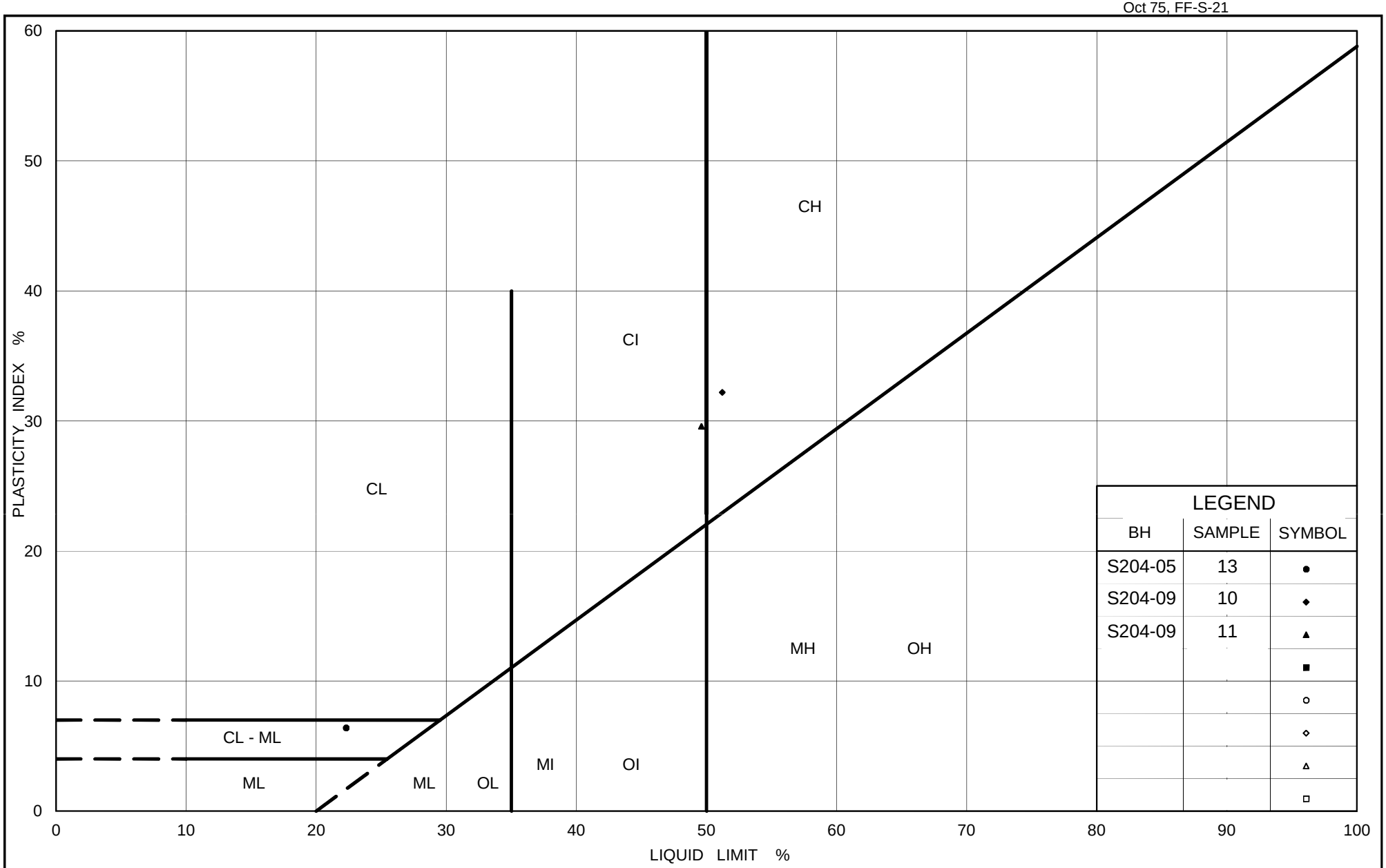
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 22-Dec-11

Oct 75, FF-S-21



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Ontario

PLASTICITY CHART
Clayey Silt to Clay (Upper)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-06

Project No. 09-1111-6014

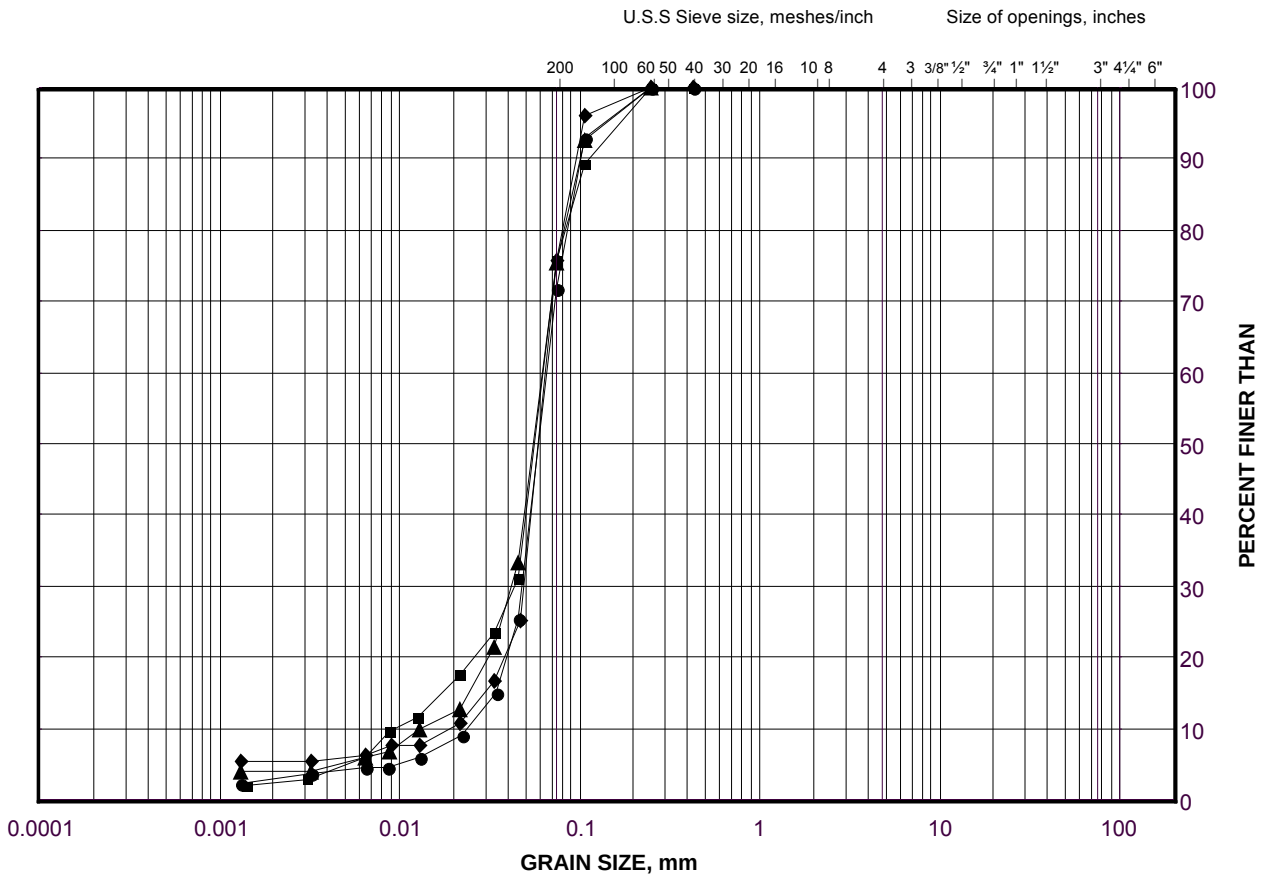
Checked By: TVA

GRAIN SIZE DISTRIBUTION

Sandy Silt (Lower)

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-07



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-09	13	166.0
■	S204-07	13	167.4
◆	S204-08	14	166.0
▲	S204-05	15	166.1

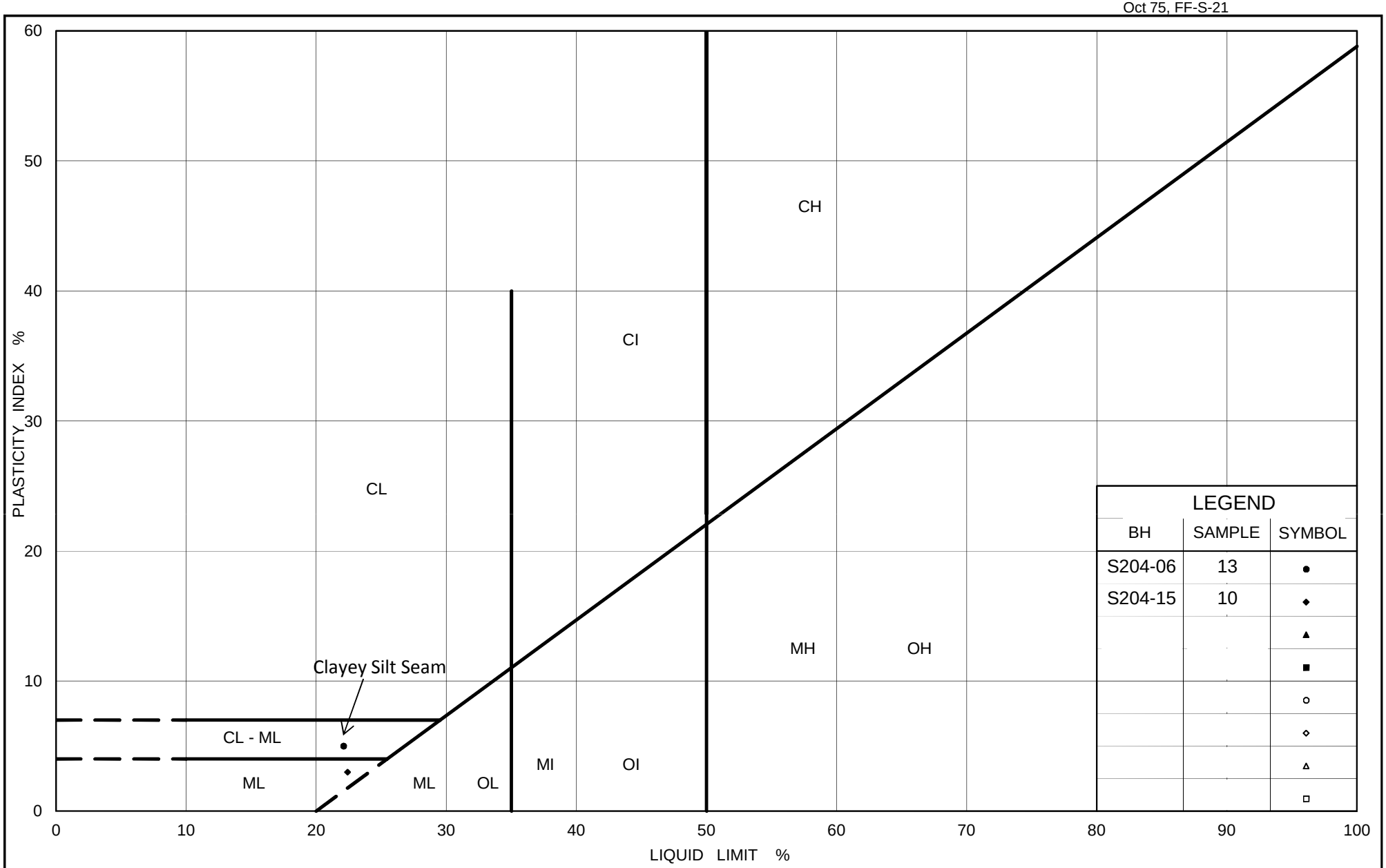
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Silt (Lower)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-08

Project No. 09-1111-6014

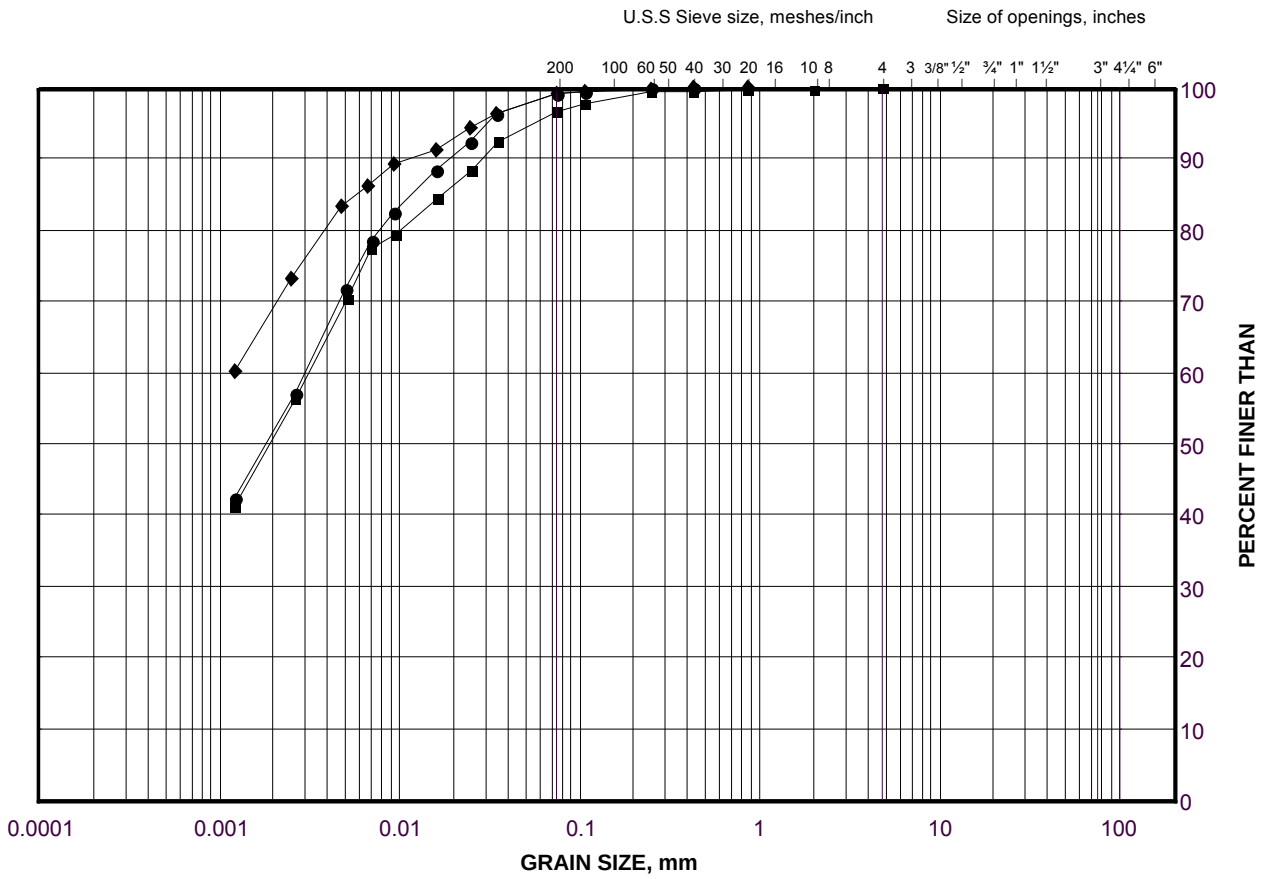
Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silty Clay to Clay (Lower)

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-09



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-06	17	159.6
■	S204-08	18	153.8
◆	S204-05	20	150.9

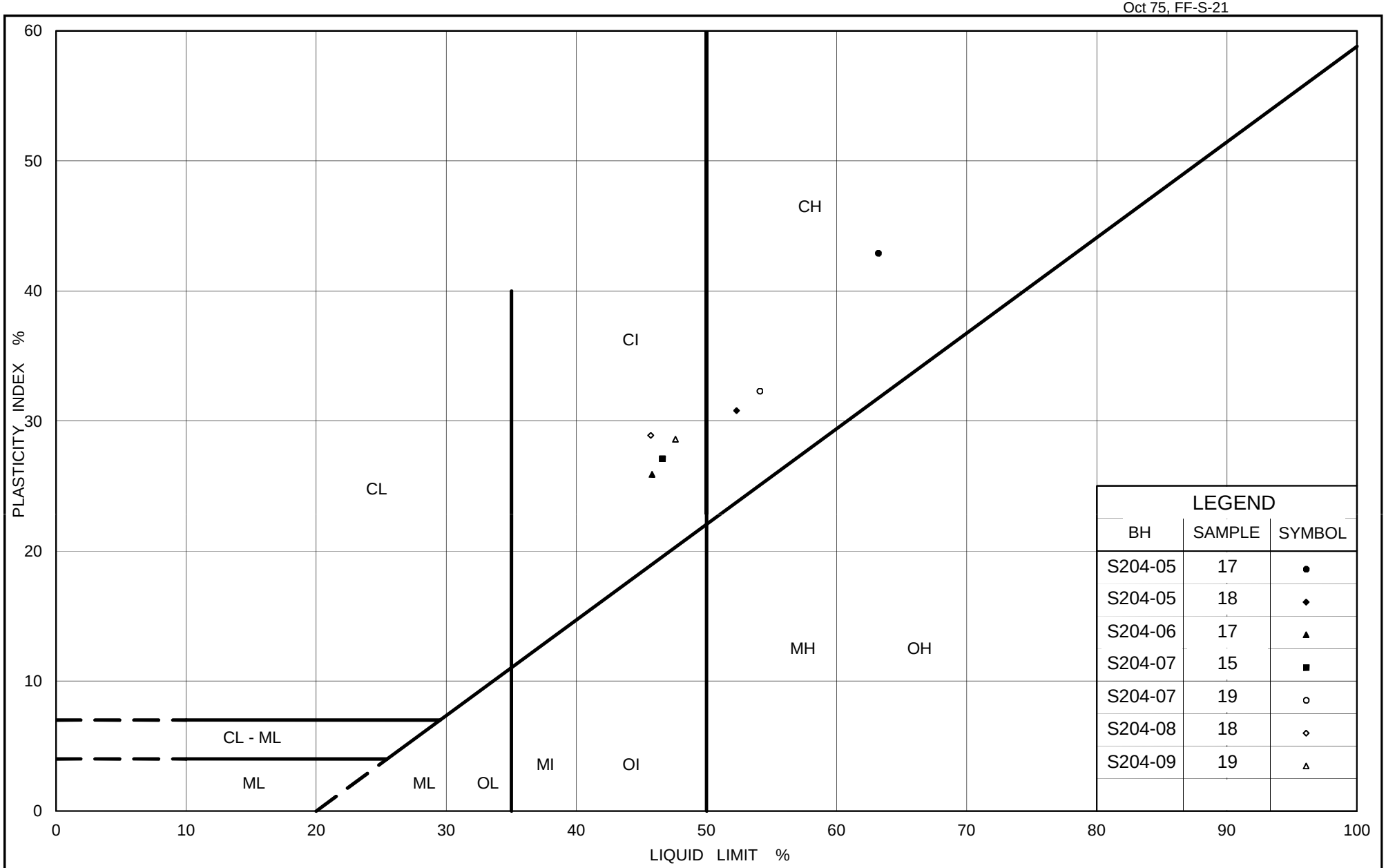
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

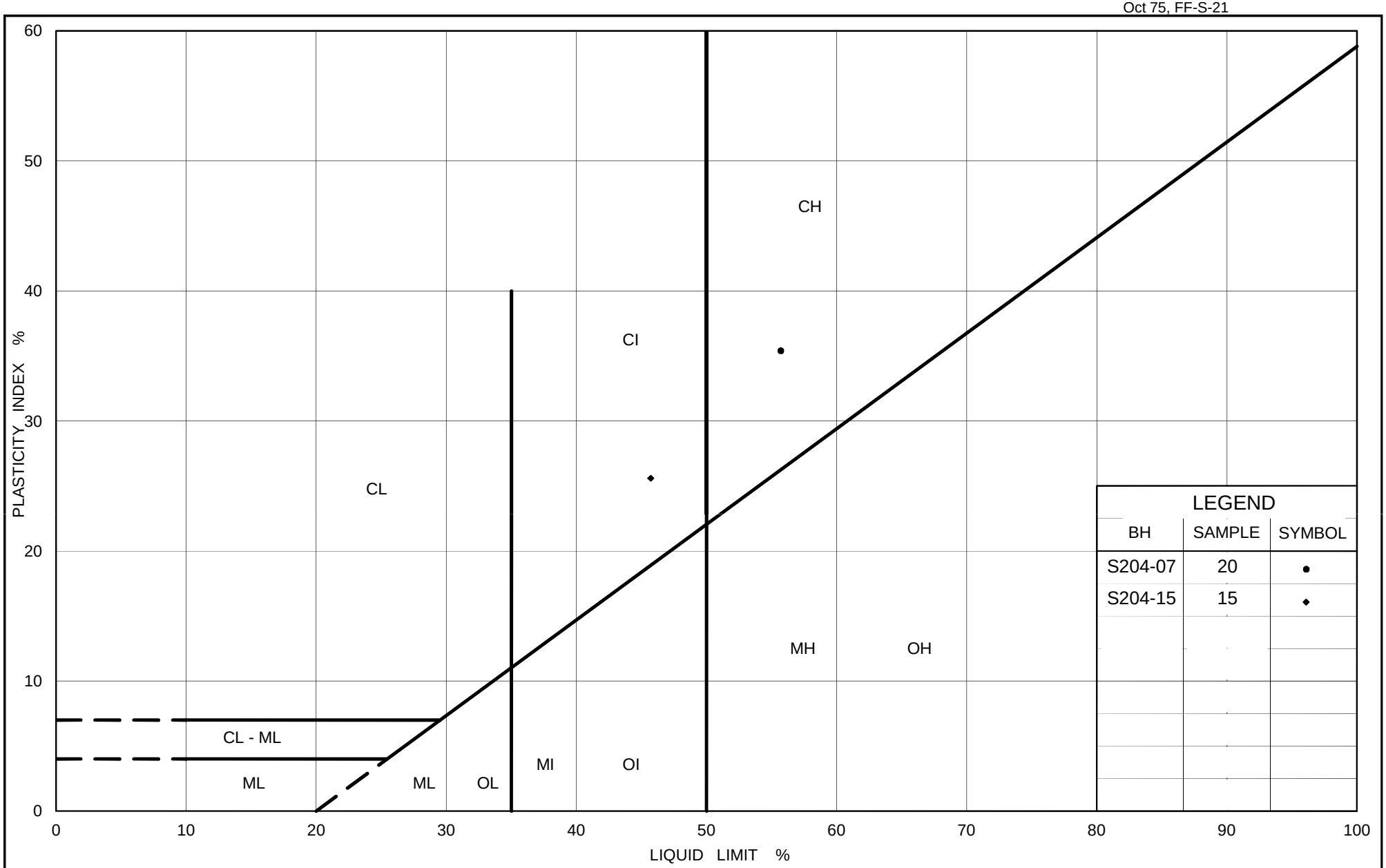
PLASTICITY CHART
Silty Clay to Clay (Lower)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-10A

Project No. 09-1111-6014

Checked By: TVA

Oct 75, FF-S-21



Ministry of Transportation

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PLASTICITY CHART
Clay (Lower)
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

Figure No. D.S204-10B

Project No. 09-1111-6014

Checked By: TVA

CONSOLIDATION TEST SUMMARY

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-11

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	17
Borehole Number	S204-05	Sample Depth, m	21.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	4		
Date Started	4/8/2010		
Date Completed	4/24/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	16.56
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	10.59
Area, cm^2	31.57	Specific Gravity, measured	2.77
Volume, cm^3	80.19	Solids Height, cm	0.990
Water Content, %	56.37	Volume of Solids, cm^3	31.25
Wet Mass, g	135.37	Volume of Voids, cm^3	48.93
Dry Mass, g	86.57	Degree of Saturation, %	99.7

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.540	1.566	2.540				
4.71	2.540	1.566	2.540	10	1.37E-01	8.36E-06	1.12E-07
9.53	2.537	1.563	2.538	856	1.60E-03	2.53E-04	3.96E-08
19.31	2.533	1.559	2.535	694	1.96E-03	1.49E-04	2.87E-08
38.76	2.526	1.552	2.530	487	2.79E-03	1.36E-04	3.70E-08
77.68	2.511	1.536	2.519	427	3.15E-03	1.57E-04	4.84E-08
155.14	2.483	1.508	2.497	470	2.81E-03	1.42E-04	3.91E-08
310.28	2.393	1.417	2.438	1185	1.06E-03	2.28E-04	2.38E-08
621.15	2.059	1.079	2.226	2579	4.07E-04	4.24E-04	1.69E-08
1241.95	1.857	0.876	1.958	1270	6.40E-04	1.28E-04	8.01E-09
2483.01	1.692	0.709	1.775	1156	5.78E-04	5.24E-05	2.97E-09
1241.95	1.708	0.725	1.700				
310.28	1.761	0.779	1.735				
77.68	1.825	0.844	1.793				
19.37	1.883	0.902	1.854				
4.71	1.912	0.931	1.897				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.91	Unit Weight, kN/m^3	18.98
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	14.07
Area, cm^2	31.57	Specific Gravity, measured	2.77
Volume, cm^3	60.35	Solids Height, cm	0.990
Water Content, %	34.94	Volume of Solids, cm^3	31.25
Wet Mass, g	116.82	Volume of Voids, cm^3	29.09
Dry Mass, g	86.57		

Prepared By: LFG

Golder Associates

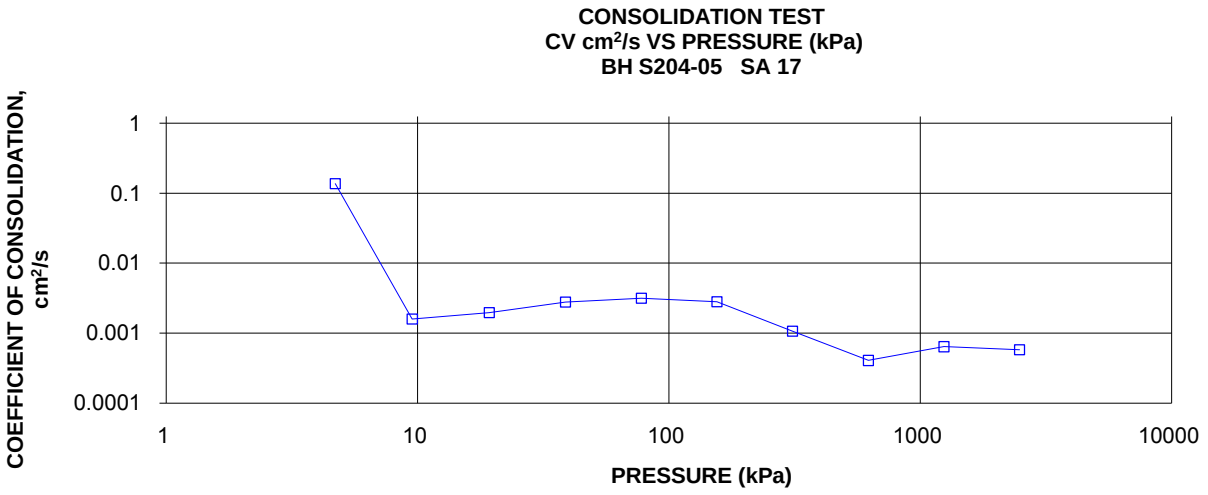
Checked By: TVA

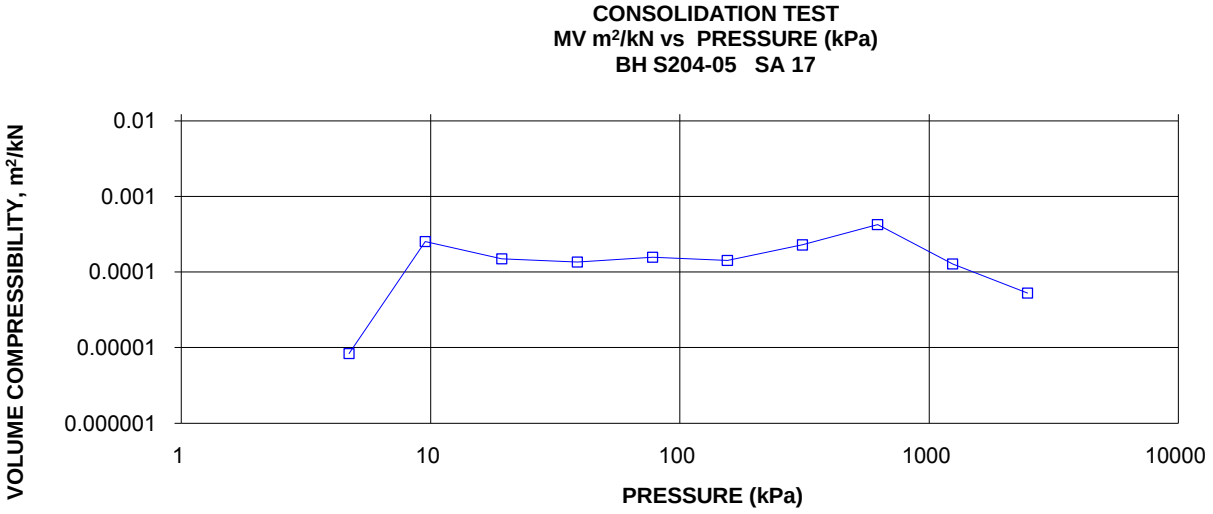
CONSOLIDATION TEST SUMMARY

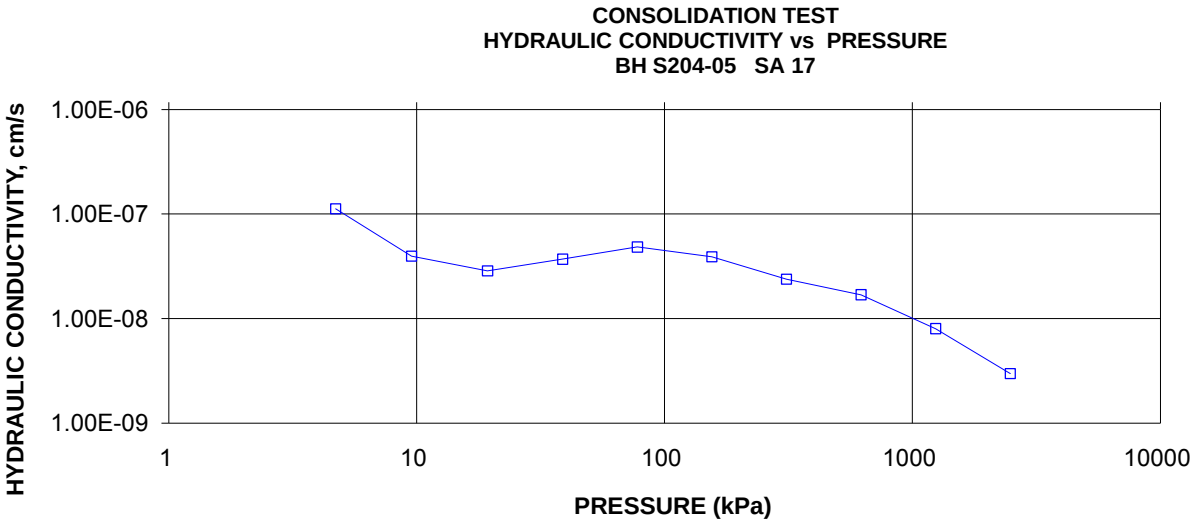
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-11

Sheet 2 of 4







Project No. 09-1111-6014

Prepared By: LFG

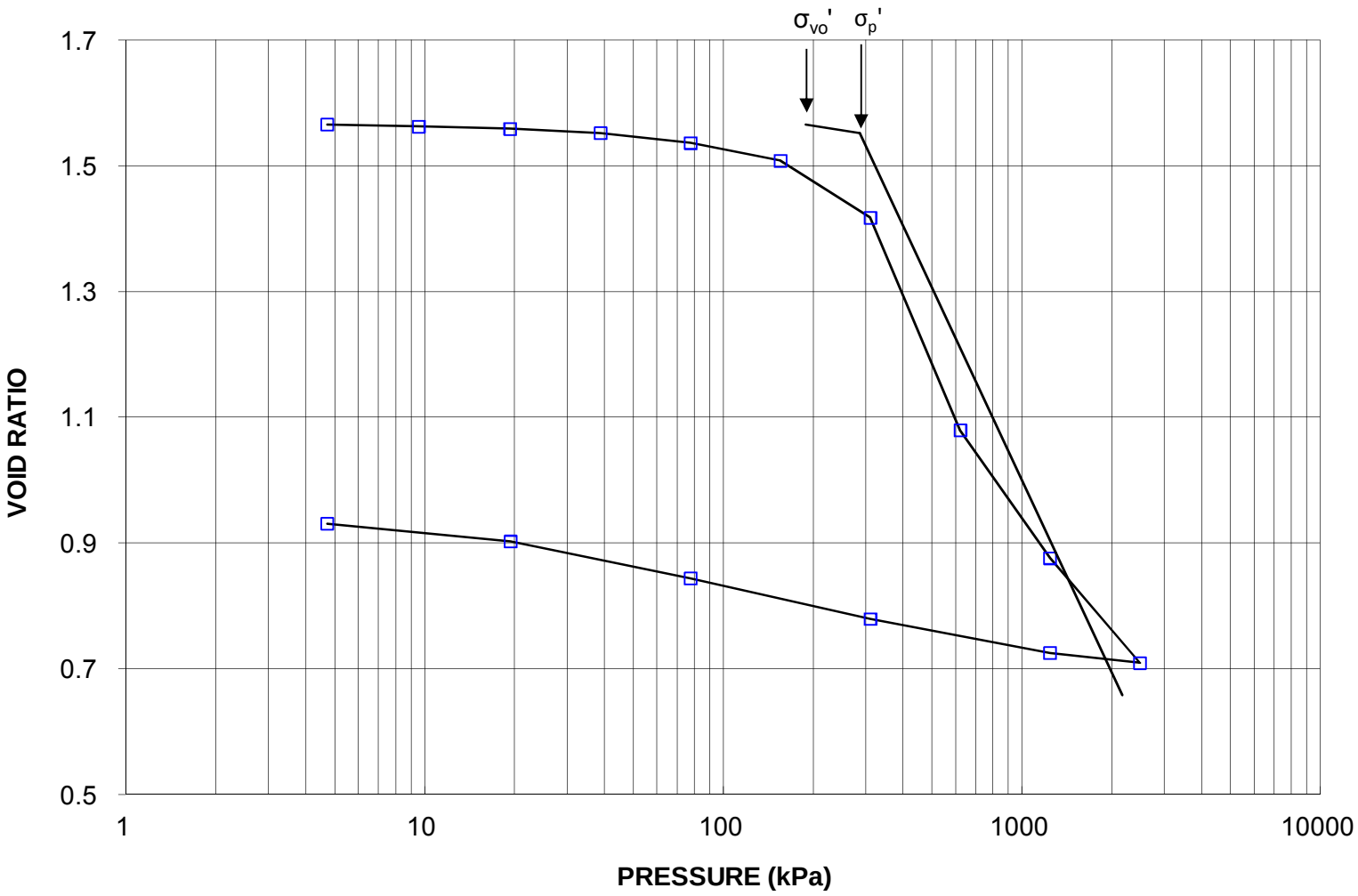
Golder Associates

Checked By: TVA

CONSOLIDATION TEST SUMMARY
VOID RATIO VS LOG PRESSURE

FIGURE D.S204-11
Sheet 3 of 4

CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH S204-05 SA 17



Project No. 09-1111-6014

Prepared By: LFG

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Project No. 09-1111-6014

Prepared By: LFG

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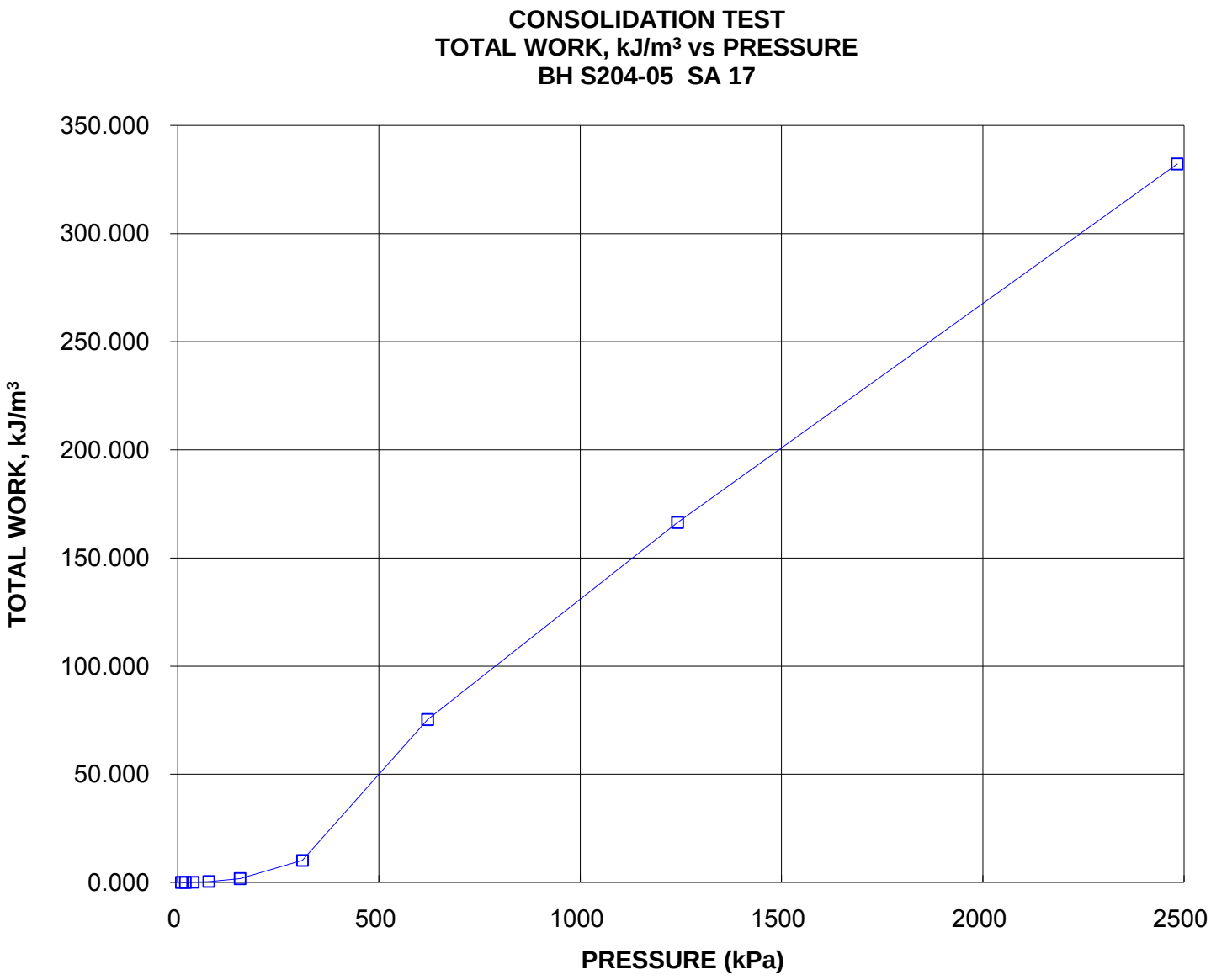

CONSOLIDATION TEST SUMMARY
TOTAL WORK VS PRESSURE

FIGURE D.S204-11
Sheet 4 of 4

CONSOLIDATION TEST SUMMARY

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-12

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	20
Borehole Number	S204-07	Sample Depth, m	30.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	11		
Date Started	4/8/2010		
Date Completed	4/21/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	17.57
Sample Diameter, cm	6.31	Dry Unit Weight, kN/m^3	12.08
Area, cm^2	31.27	Specific Gravity, measured	2.77
Volume, cm^3	79.43	Solids Height, cm	1.129
Water Content, %	45.49	Volume of Solids, cm^3	35.31
Wet Mass, g	142.32	Volume of Voids, cm^3	44.12
Dry Mass, g	97.82	Degree of Saturation, %	100.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.540	1.249	2.540				
4.89	2.539	1.248	2.540	1	1.37E+00	8.05E-05	1.08E-05
9.64	2.538	1.247	2.539	31	4.41E-02	8.29E-05	3.58E-07
19.74	2.535	1.245	2.537	362	3.77E-03	1.17E-04	4.32E-08
39.38	2.533	1.243	2.534	856	1.59E-03	4.21E-05	6.56E-09
78.50	2.521	1.232	2.527	501	2.70E-03	1.22E-04	3.22E-08
156.63	2.495	1.209	2.508	375	3.56E-03	1.32E-04	4.58E-08
313.38	2.448	1.168	2.471	482	2.69E-03	1.18E-04	3.10E-08
626.47	2.307	1.043	2.377	1778	6.74E-04	1.77E-04	1.17E-08
1252.49	2.051	0.816	2.179	1325	7.60E-04	1.61E-04	1.20E-08
2506.04	1.877	0.662	1.964	907	9.01E-04	5.46E-05	4.83E-09
1252.49	1.887	0.671	1.882				
313.38	1.936	0.714	1.911				
78.50	1.998	0.769	1.967				
19.74	2.053	0.818	2.025				
4.89	2.083	0.845	2.068				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.08	Unit Weight, kN/m^3	19.47
Sample Diameter, cm	6.31	Dry Unit Weight, kN/m^3	14.73
Area, cm^2	31.27	Specific Gravity, measured	2.77
Volume, cm^3	65.14	Solids Height, cm	1.129
Water Content, %	32.19	Volume of Solids, cm^3	35.31
Wet Mass, g	129.31	Volume of Voids, cm^3	29.82
Dry Mass, g	97.82		

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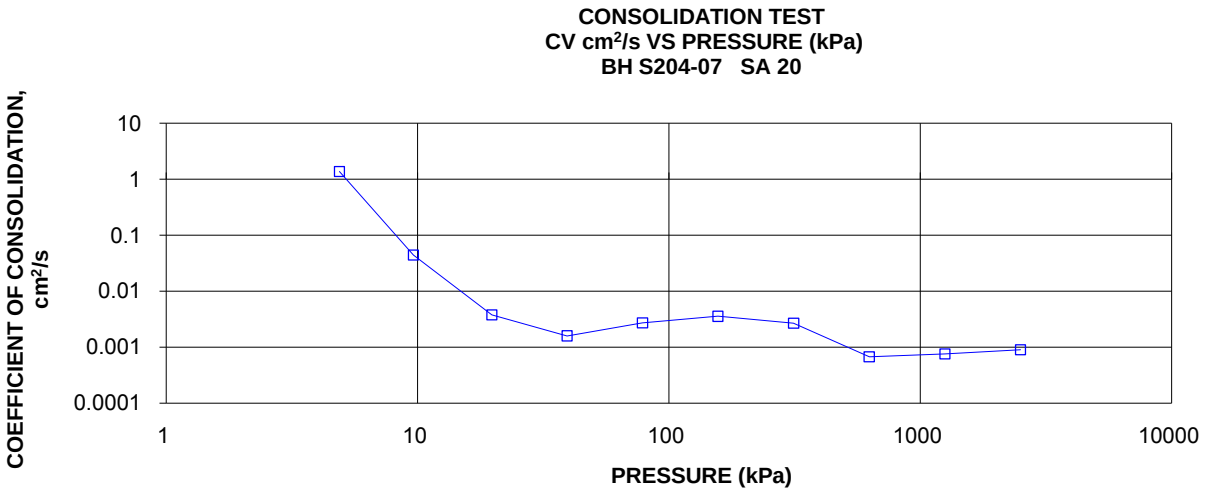
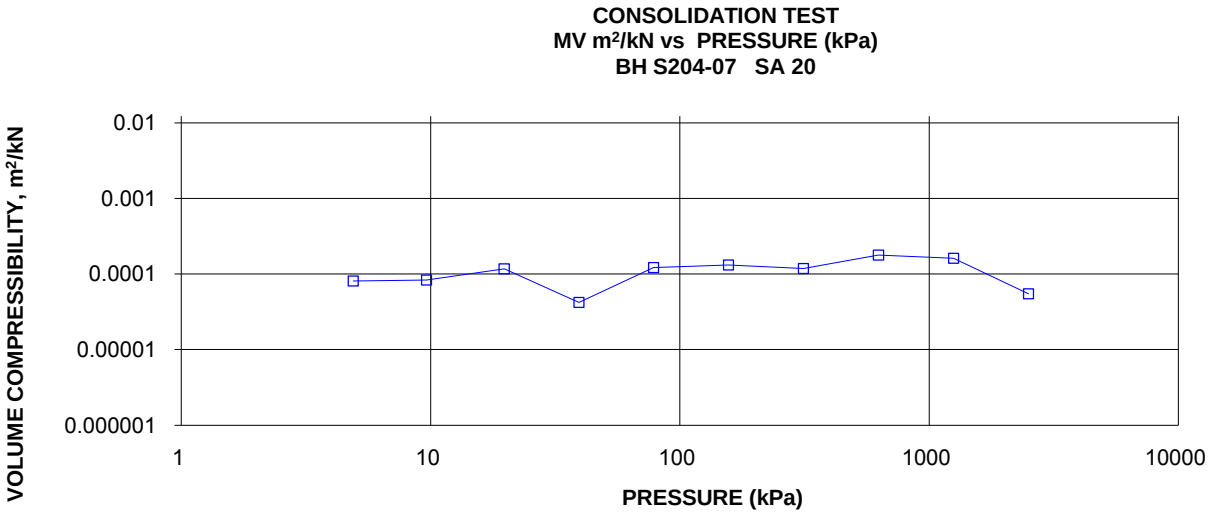
CONSOLIDATION TEST SUMMARY

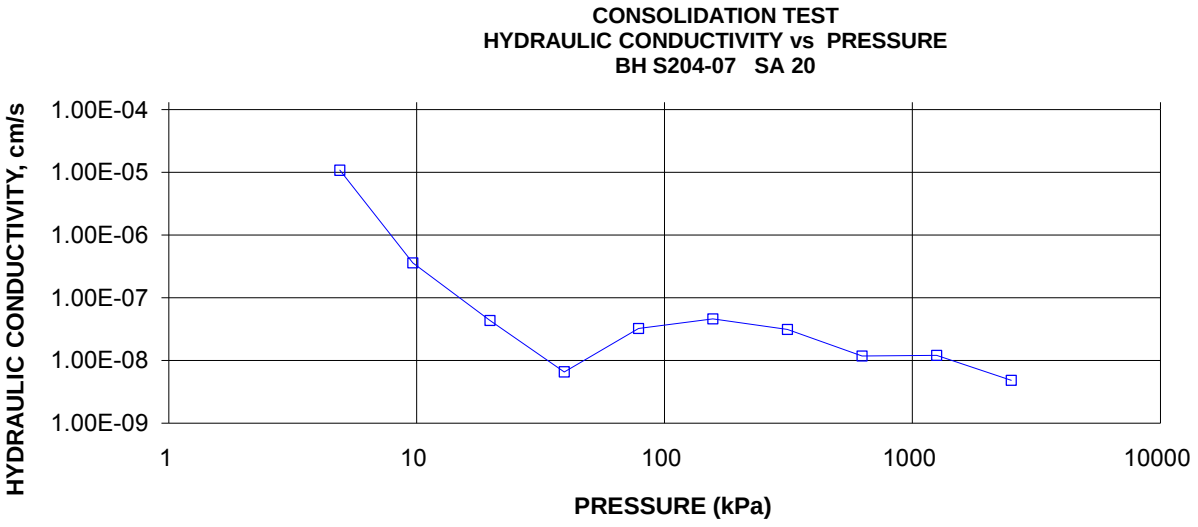
Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-12

Sheet 2 of 4







Project No. 09-1111-6014

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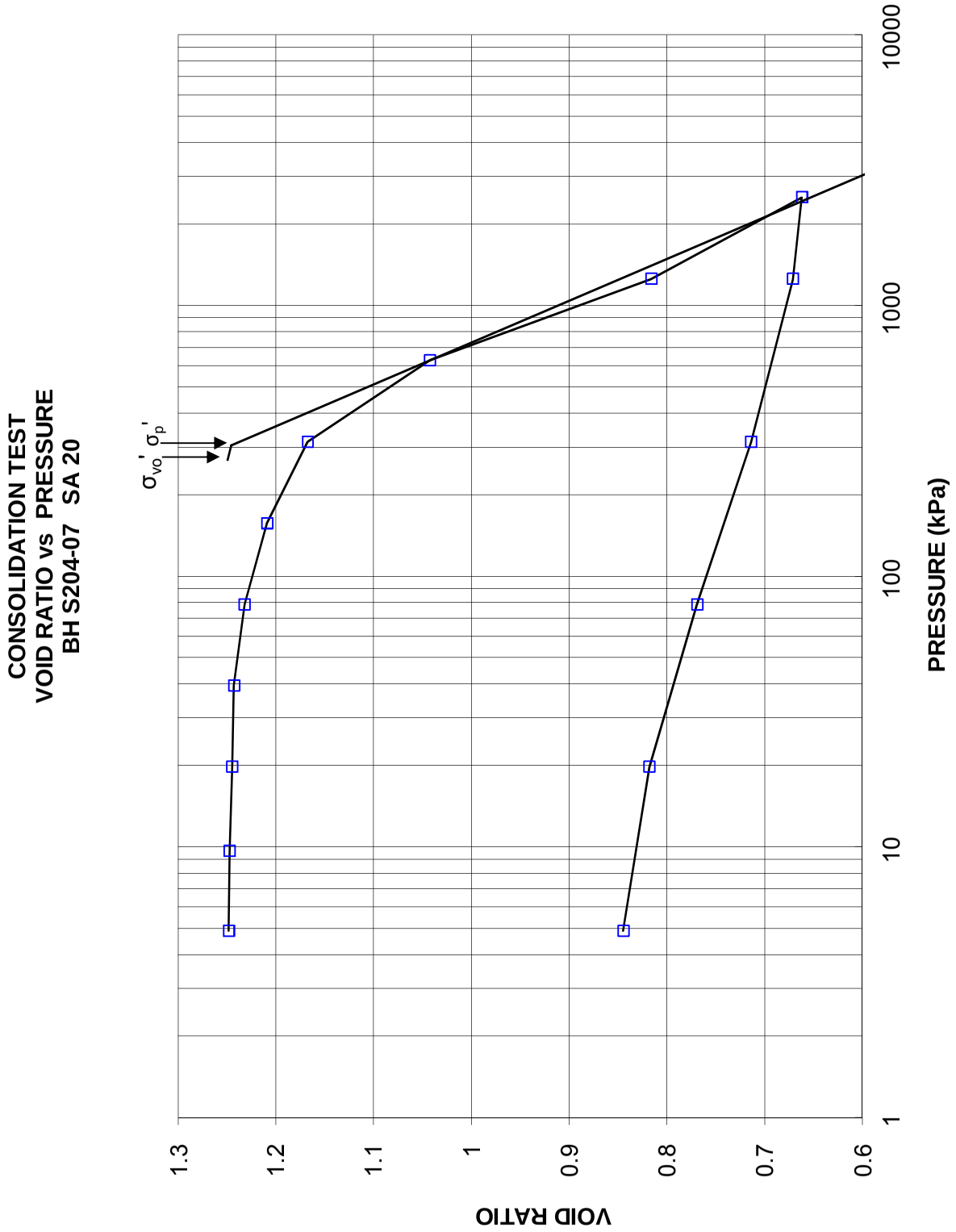
CONSOLIDATION TEST SUMMARY VOID RATIO VS LOG PRESSURE	FIGURE D.S204-12 Sheet 3 of 4



Project No. 09-1111-6014

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Prepared By: LFG

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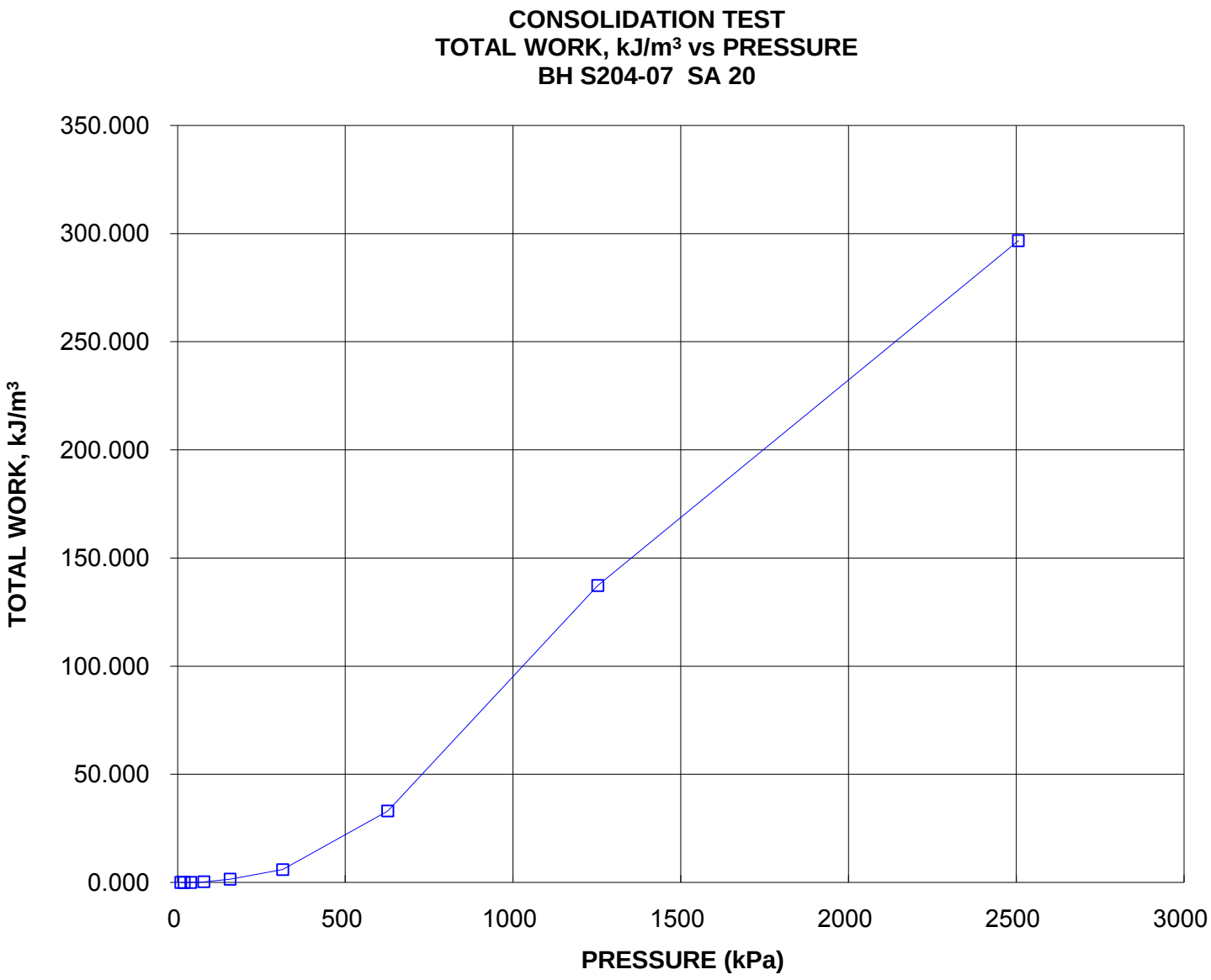
Checked By: TVA



CONSOLIDATION TEST SUMMARY
TOTAL WORK VS PRESSURE

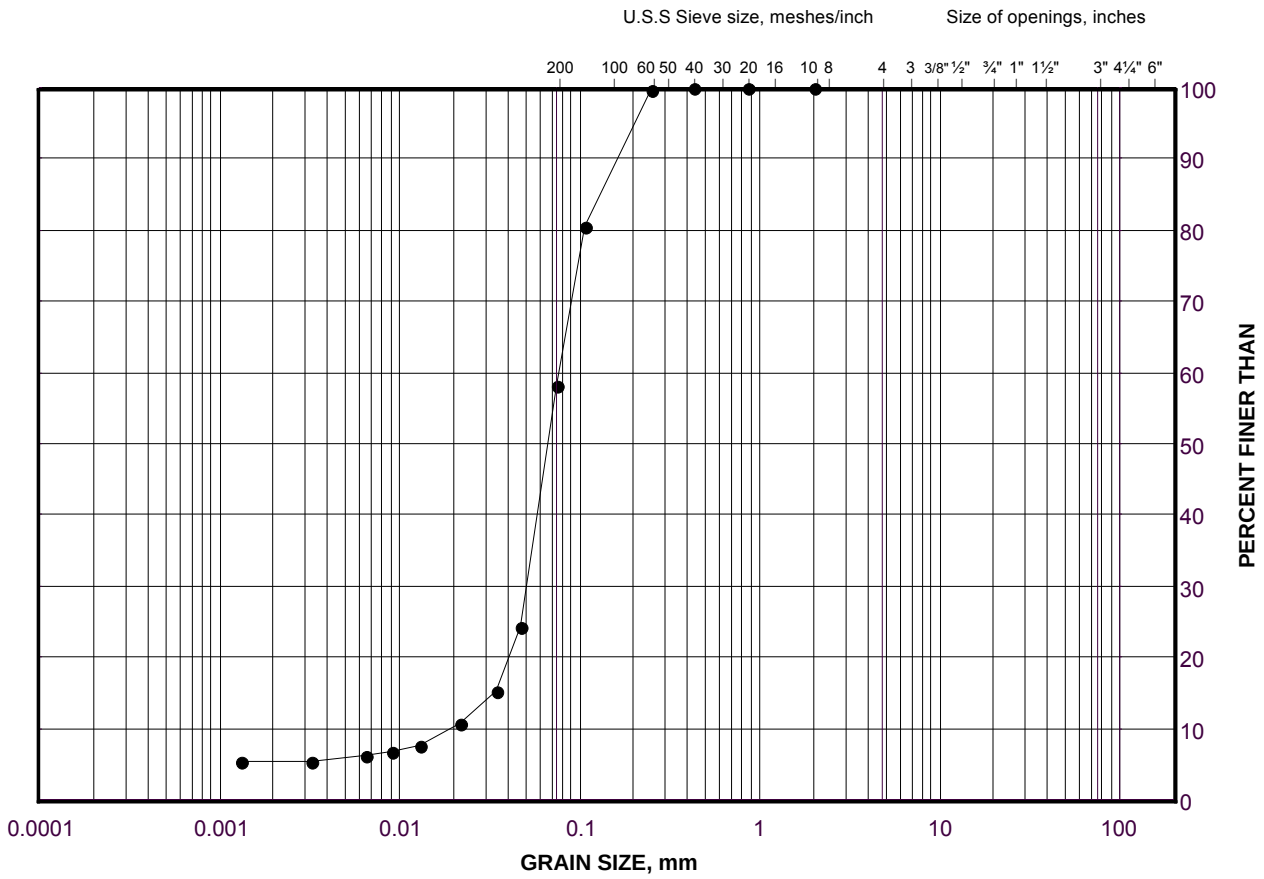
FIGURE D.S204-12
Sheet 4 of 4

GRAIN SIZE DISTRIBUTION

Sand and Silt (Interlayer)

Highway 69 (SBL) STA 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-13



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-07	17	159.4

Project Number: 09-1111-6014

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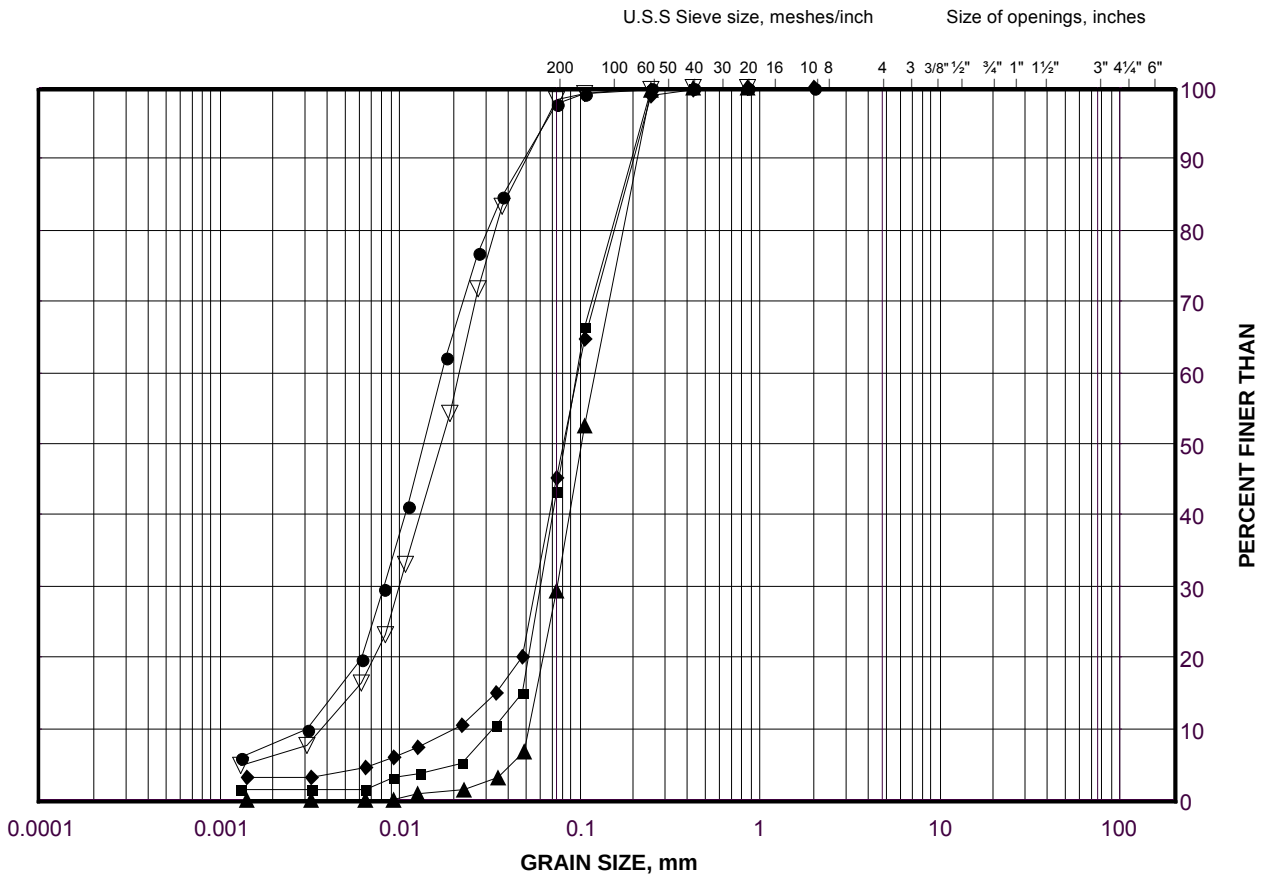
Date: 17-May-11

GRAIN SIZE DISTRIBUTION

Silt to Silty Sand to Sand and Silt

Highway 69 (SBL) 11+725 to 11+825 (Swamp 204)

FIGURE D.S204-14



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-15	19	151.1
■	S204-08	22	141.9
◆	S204-06	22	144.8
▲	S204-05	22	144.8
▽	S204-09	23	138.0

Project Number: 09-1111-6014

Checked By: TVA

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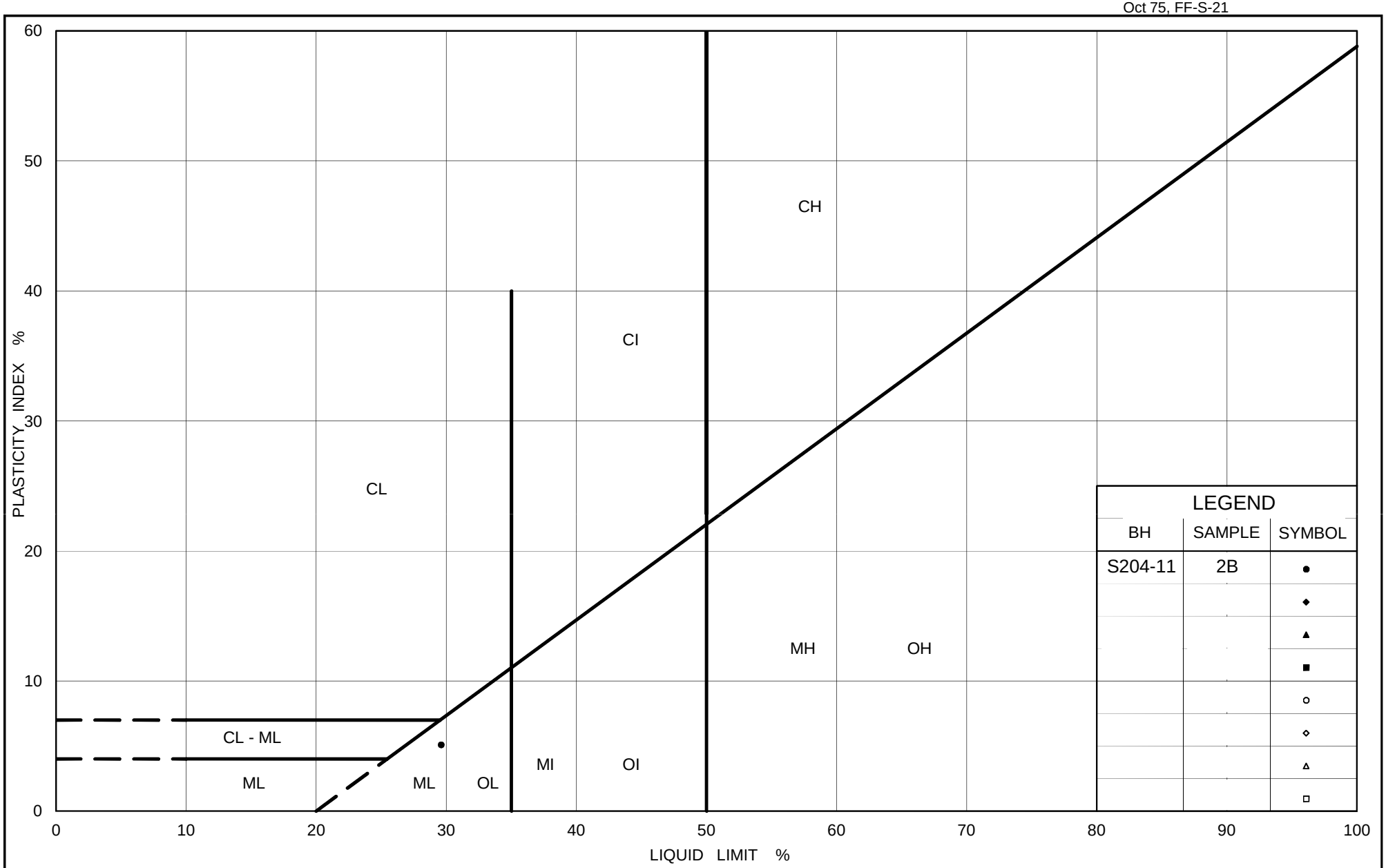
Date: 17-May-11

Oct 75, FF-S-21



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PLASTICITY CHART
Silt (Slight Plasticity)
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-15

Project No. 09-1111-6014

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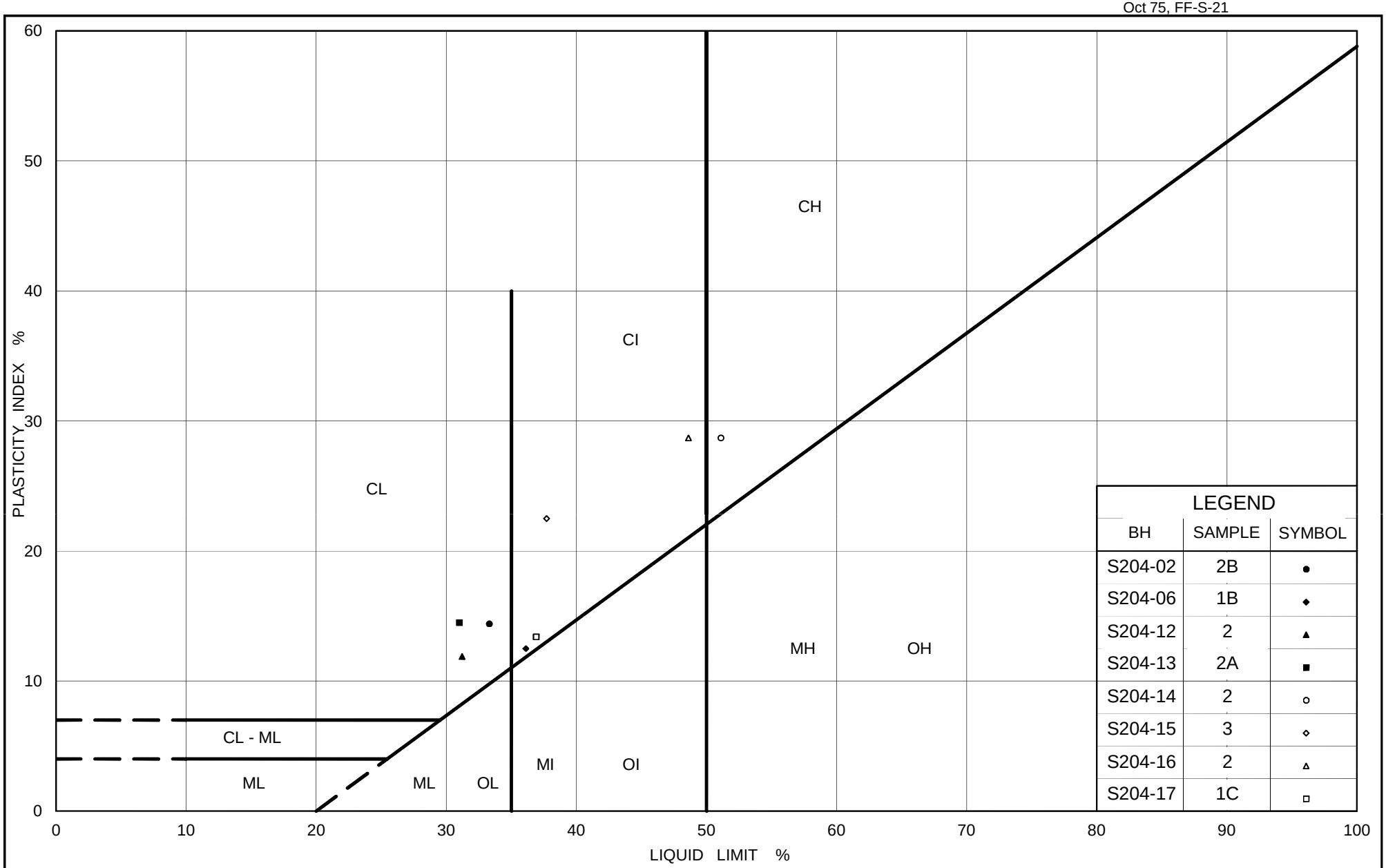

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PLASTICITY CHART
Clayey Silt to Clay (Near Surface)
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-16

Project No. 09-1111-6014

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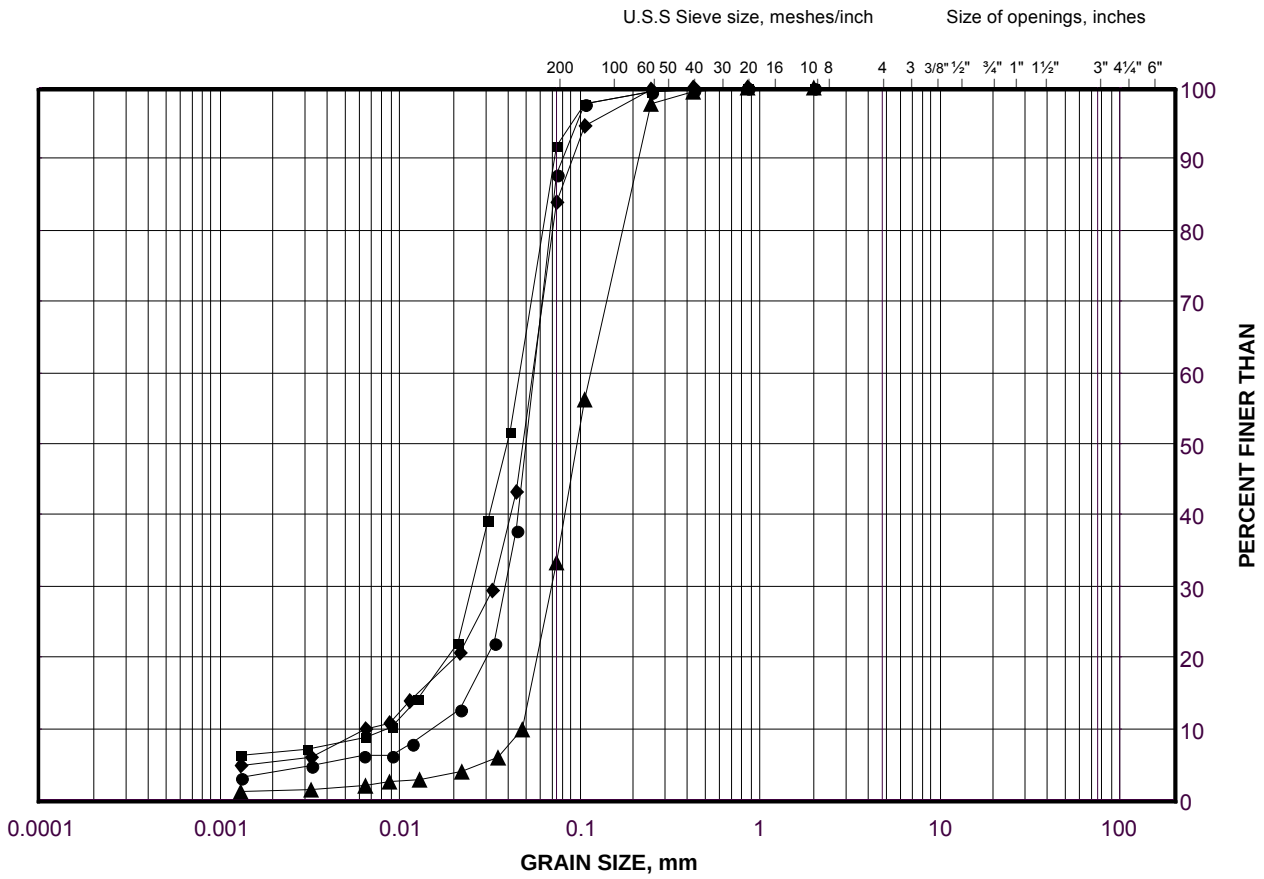
GRAIN SIZE DISTRIBUTION

Sand and Silt to Silt (Upper)

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-17A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-14	4	178.0
■	S204-13	5	177.2
◆	S204-18	6	177.0
▲	S204-16	6	176.1

Project Number: 09-1111-6014

Checked By: TVA

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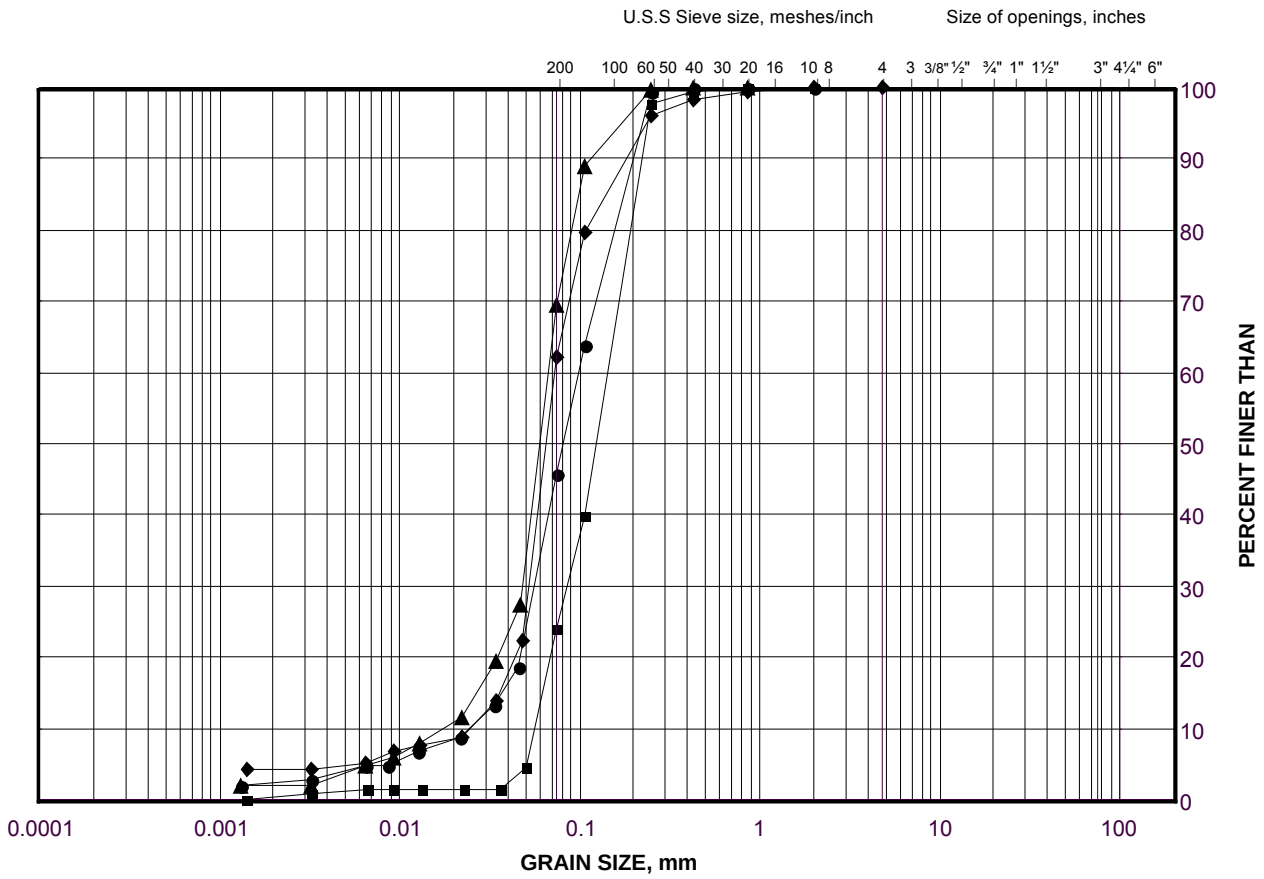
Date: 17-May-11

GRAIN SIZE DISTRIBUTION

Sand and Silt to Silt to Silty Sand (Upper)

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-17B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-15	6	176.5
■	S204-17	7	176.2
◆	S204-06	7	176.2
▲	S204-14	8	175.0

Project Number: 09-1111-6014

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Date: 17-May-11

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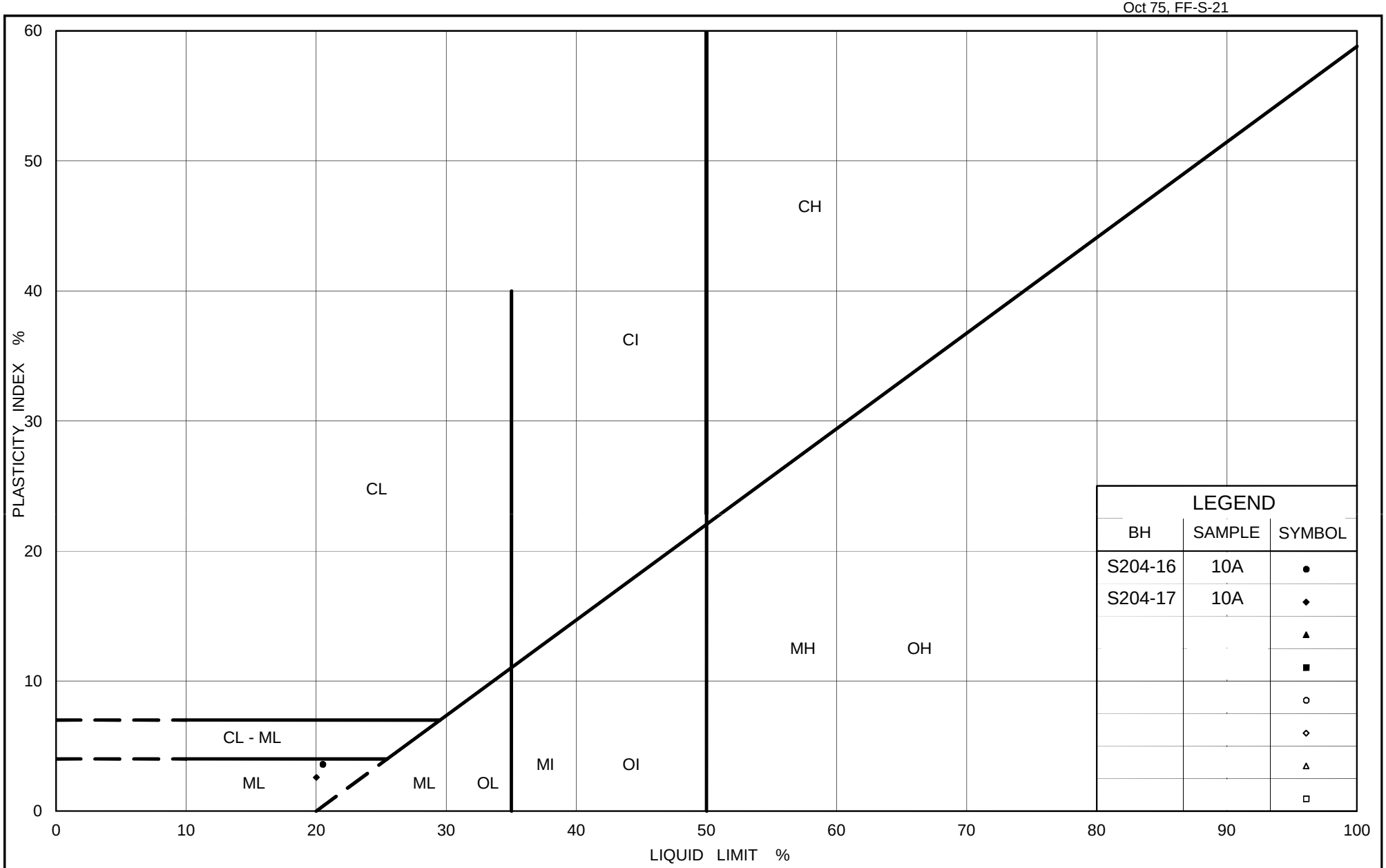

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PLASTICITY CHART
Silt (Upper)
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-18

Project No. 09-1111-6014

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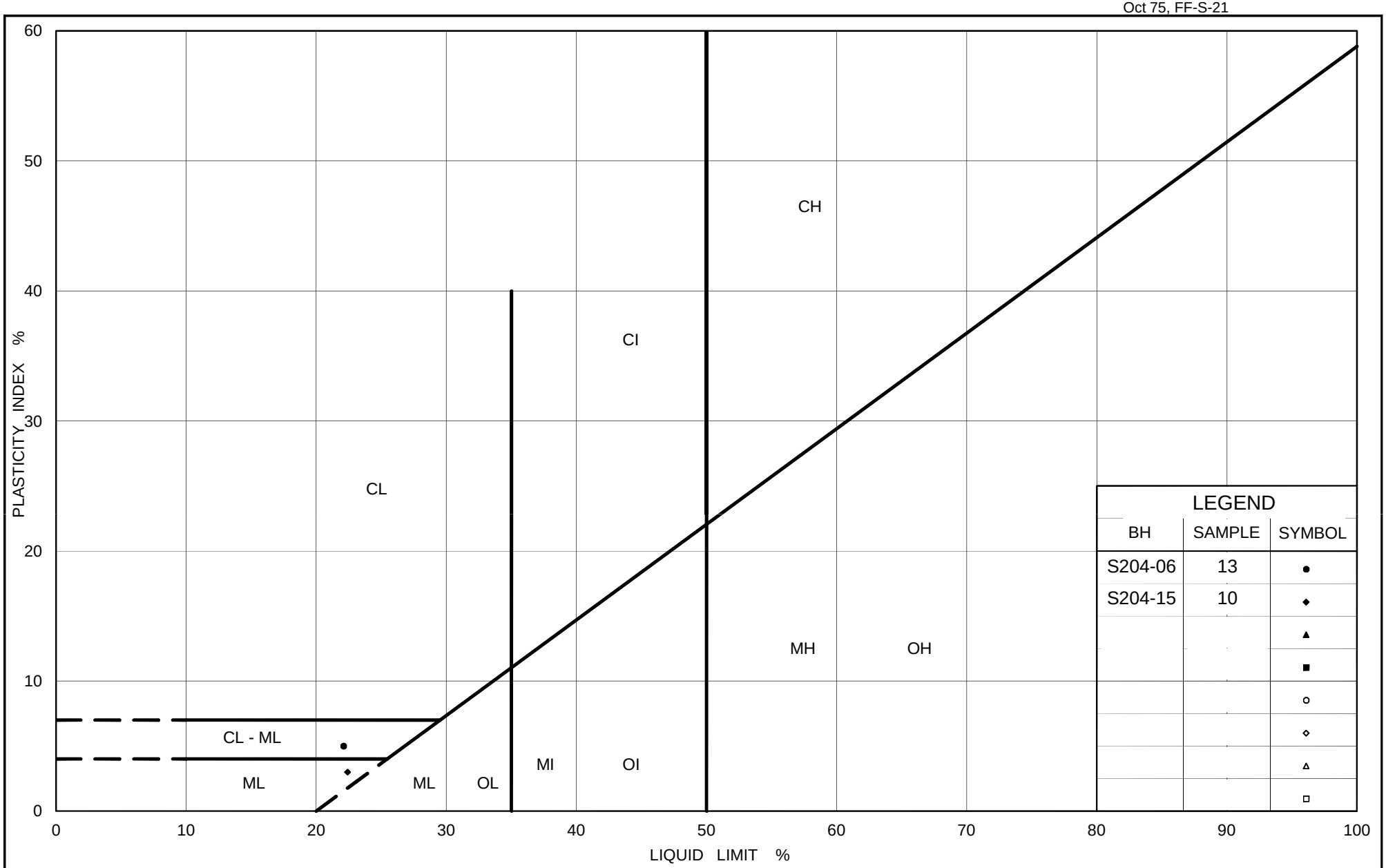

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PLASTICITY CHART
Silt (Lower)
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-19

Project No. 09-1111-6014

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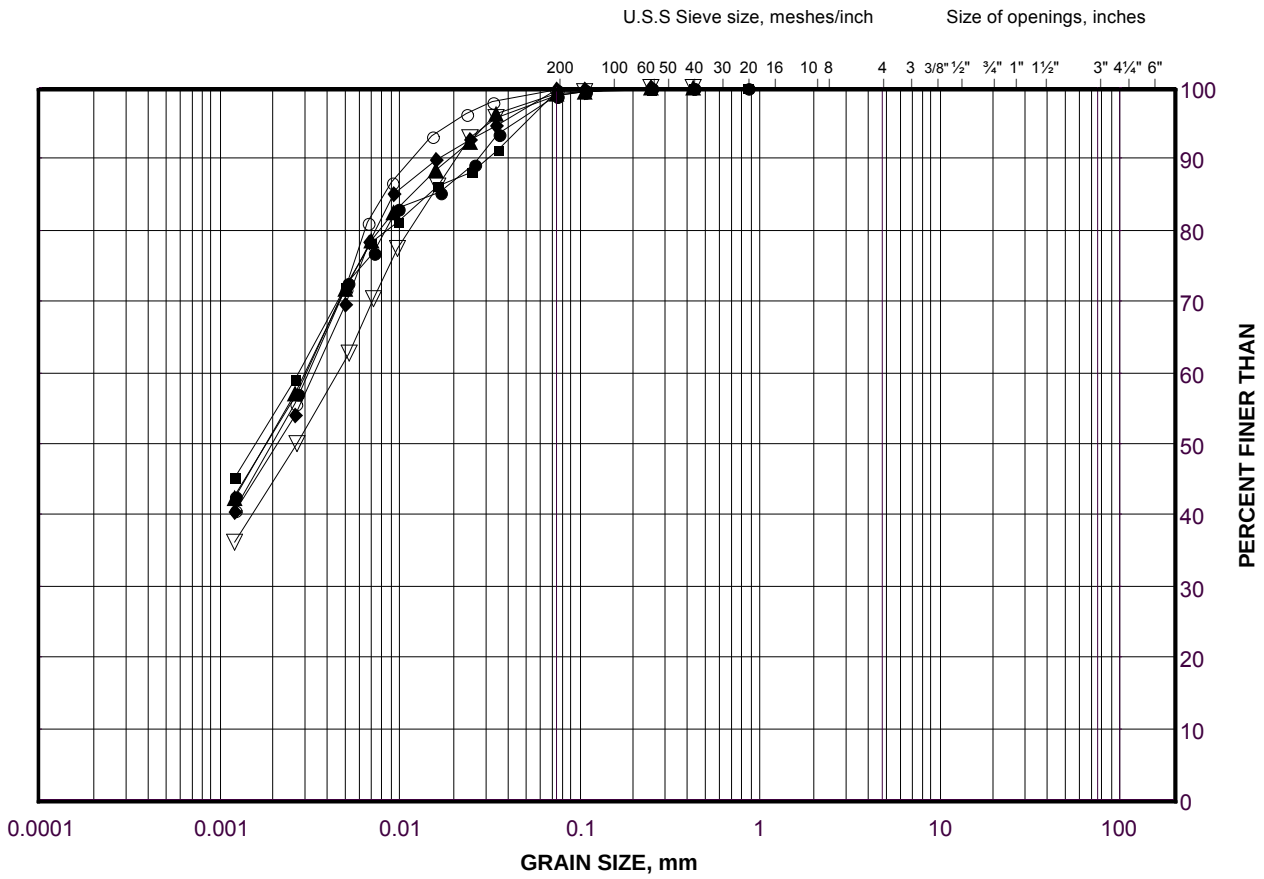
GRAIN SIZE DISTRIBUTION

Silty Clay to Clay

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-20



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-18	13	167.5
■	S204-16	15	159.8
◆	S204-17	17	157.1
▲	S204-06	17	159.6
▽	S204-18	20	150.8
❍	S204-12	5	177.8

Project Number: 09-1111-6014

Checked By: TVA

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Date: 17-May-11

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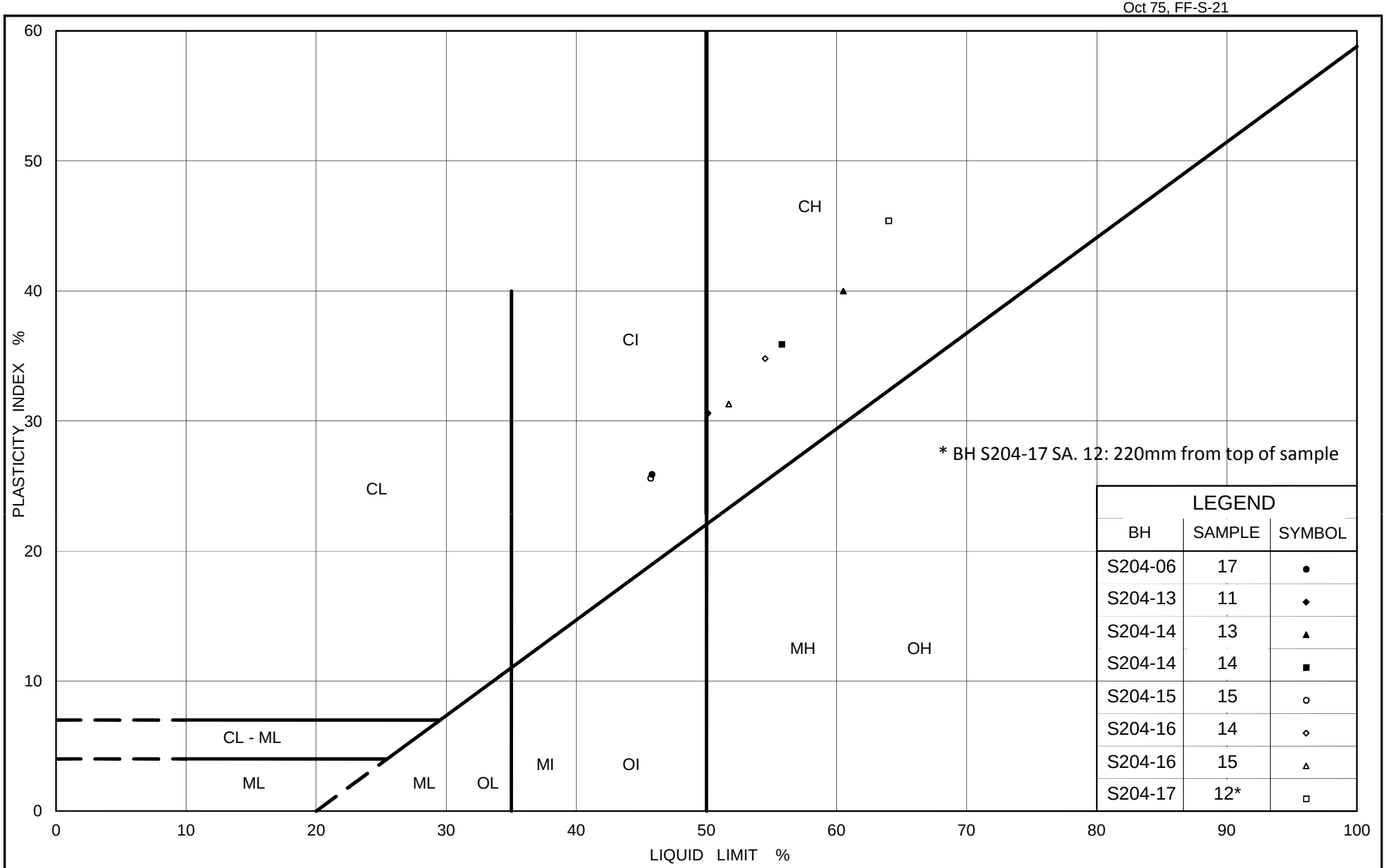

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PLASTICITY CHART
Silty Clay to Clay
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-21A

Project No. 09-1111-6014

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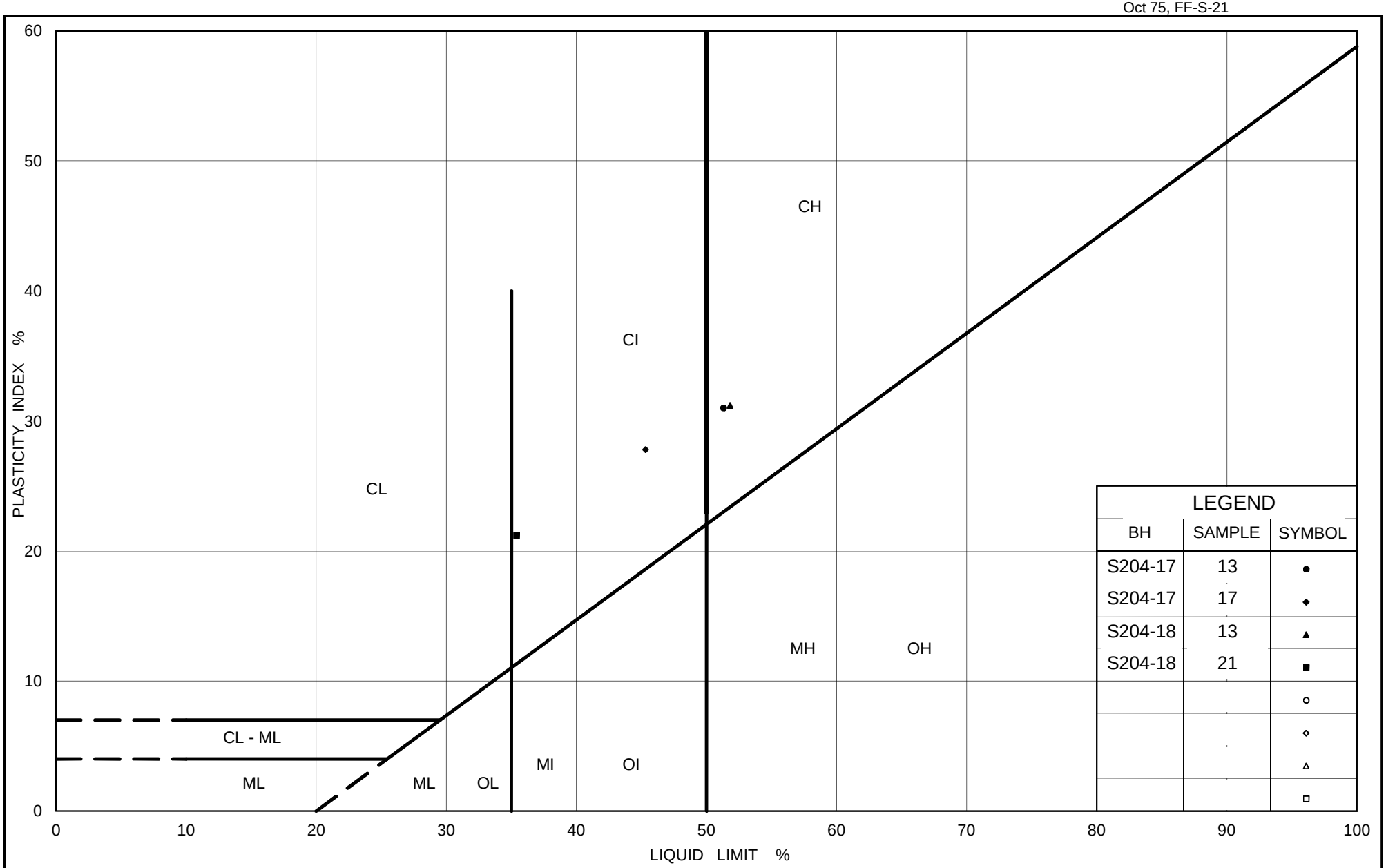

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PLASTICITY CHART
Silty Clay to Clay
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-21B

Project No. 09-1111-6014

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CONSOLIDATION TEST SUMMARY

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-22

Sheet 1 of 4

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	13
Borehole Number	S204-14	Sample Depth, m	13.4

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	12		
Date Started	4/8/2010		
Date Completed	4/21/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.55	Unit Weight, kN/m^3	16.74
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	10.96
Area, cm^2	31.57	Specific Gravity, measured	2.75
Volume, cm^3	80.50	Solids Height, cm	1.037
Water Content, %	52.70	Volume of Solids, cm^3	32.73
Wet Mass, g	137.43	Volume of Voids, cm^3	47.78
Dry Mass, g	90	Degree of Saturation, %	99.3

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	2.550	1.460	2.550				
4.84	2.550	1.460	2.550	2	6.89E-01	8.10E-06	5.47E-07
9.48	2.548	1.457	2.549	166	8.30E-03	1.94E-04	1.58E-07
19.55	2.545	1.454	2.546	187	7.35E-03	1.21E-04	8.69E-08
39.01	2.537	1.447	2.541	382	3.58E-03	1.55E-04	5.45E-08
77.76	2.526	1.437	2.532	148	9.18E-03	1.06E-04	9.56E-08
155.17	2.498	1.410	2.512	286	4.68E-03	1.43E-04	6.57E-08
313.71	2.233	1.154	2.365	1732	6.85E-04	6.56E-04	4.40E-08
624.24	2.006	0.935	2.120	1328	7.17E-04	2.86E-04	2.01E-08
1244.36	1.833	0.768	1.919	943	8.28E-04	1.10E-04	8.92E-09
2485.19	1.697	0.637	1.765	591	1.12E-03	4.29E-05	4.69E-09
1244.36	1.702	0.641	1.699				
313.71	1.748	0.686	1.725				
77.76	1.806	0.742	1.777				
19.55	1.849	0.784	1.827				
4.84	1.878	0.811	1.863				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.88	Unit Weight, kN/m^3	19.54
Sample Diameter, cm	6.34	Dry Unit Weight, kN/m^3	14.89
Area, cm^2	31.57	Specific Gravity, measured	2.75
Volume, cm^3	59.28	Solids Height, cm	1.037
Water Content, %	31.26	Volume of Solids, cm^3	32.73
Wet Mass, g	118.13	Volume of Voids, cm^3	26.55
Dry Mass, g	90		

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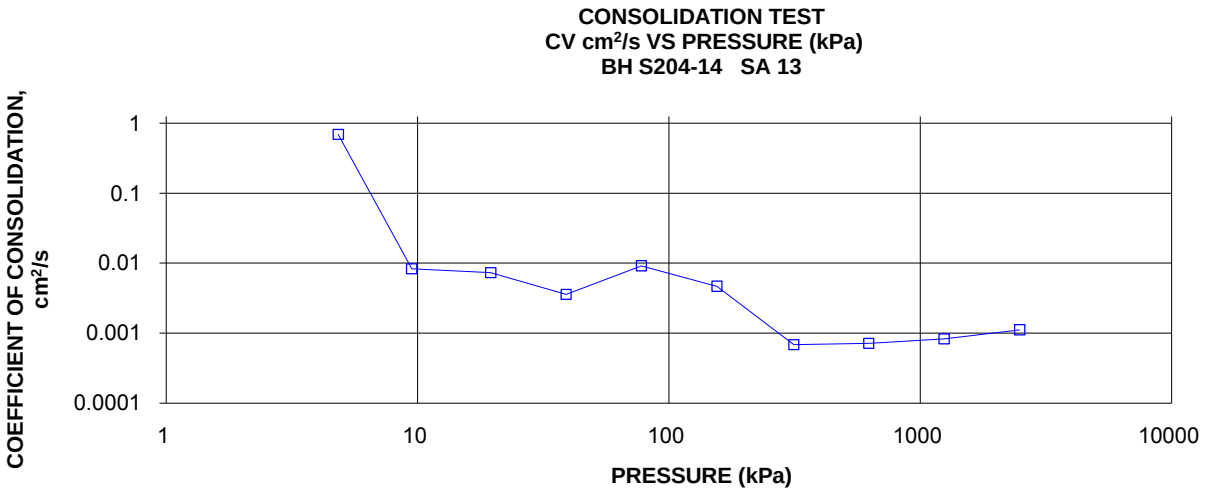
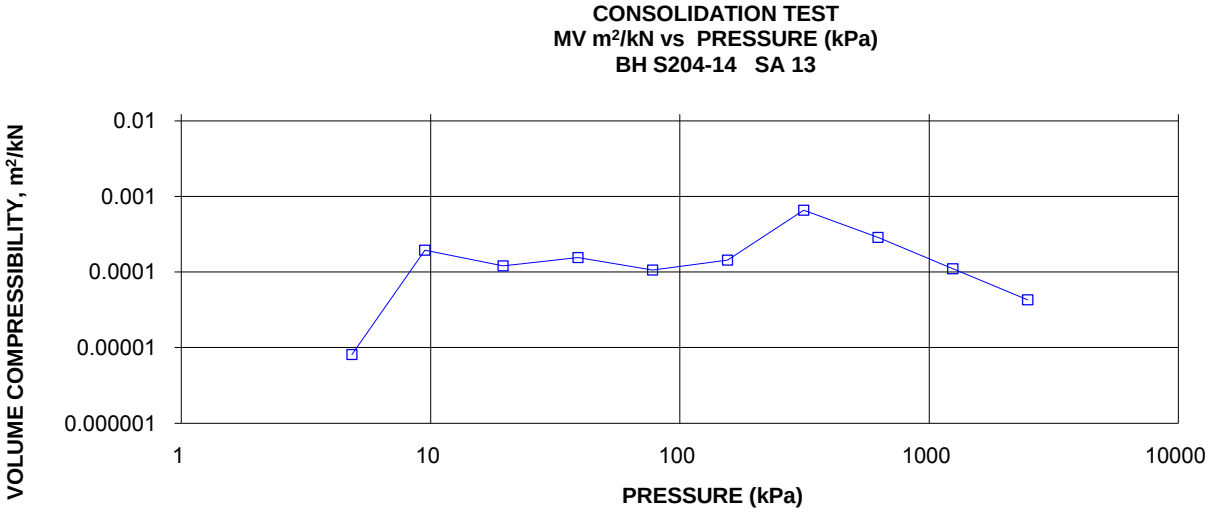
CONSOLIDATION TEST SUMMARY

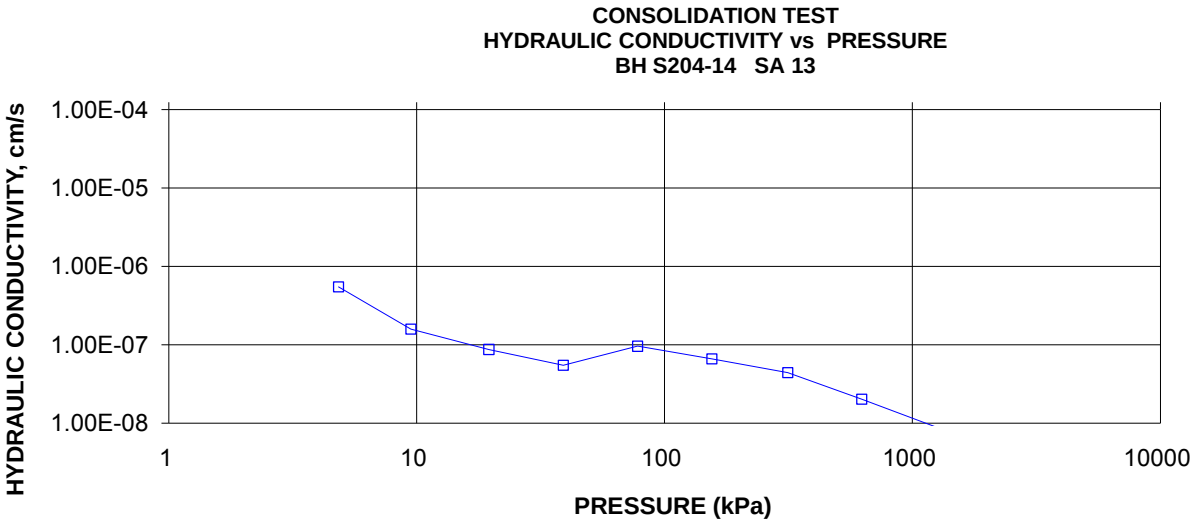
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-22

Sheet 2 of 4







Project No. 09-1111-6014

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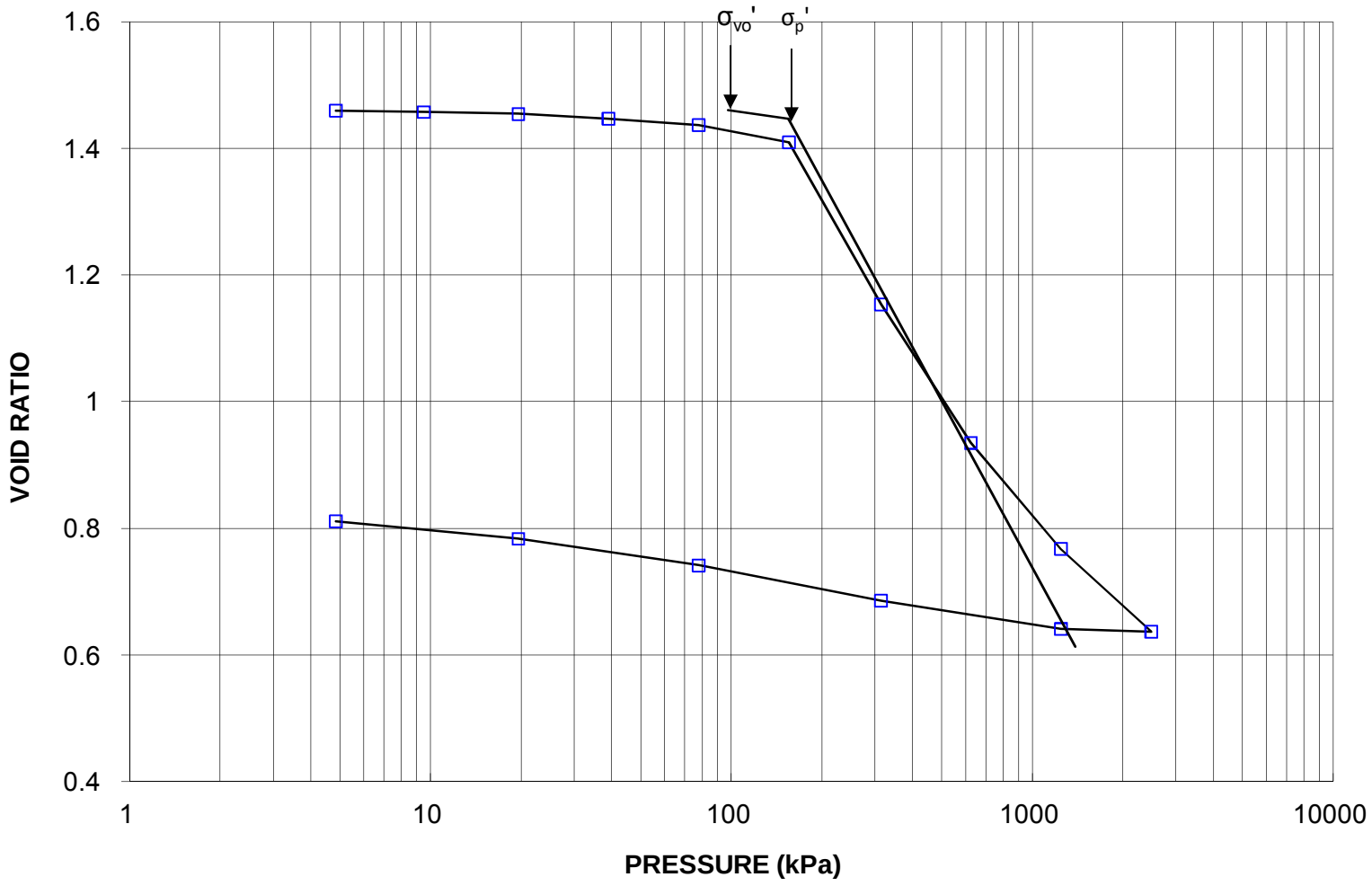
CONSOLIDATION TEST SUMMARY
VOID RATIO VS LOG PRESSURE

FIGURE D.S204-22
Sheet 3 of 4

CONSOLIDATION TEST
VOID RATIO vs PRESSURE
BH S204-14 SA 13



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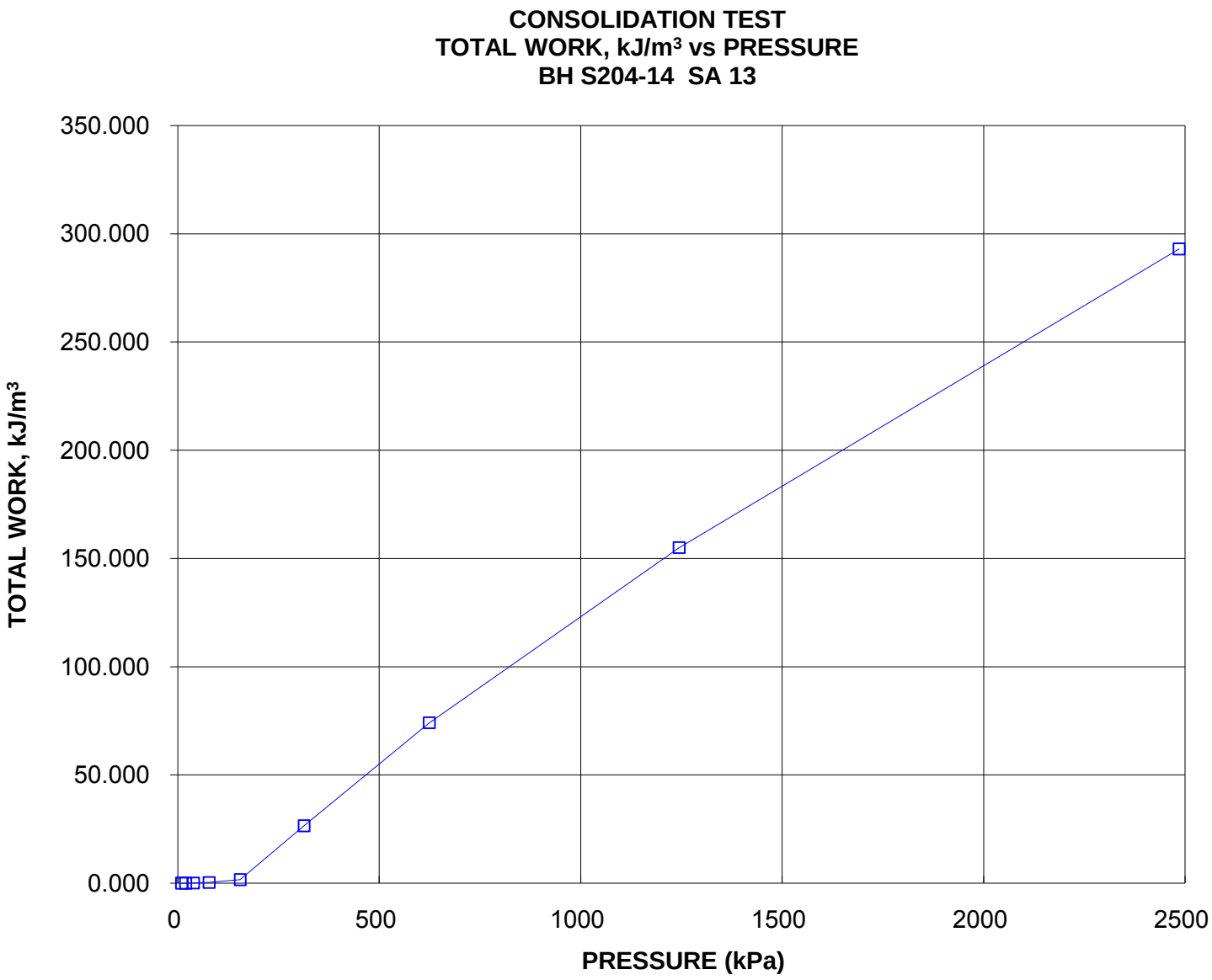


CONSOLIDATION TEST SUMMARY
TOTAL WORK VS PRESSURE

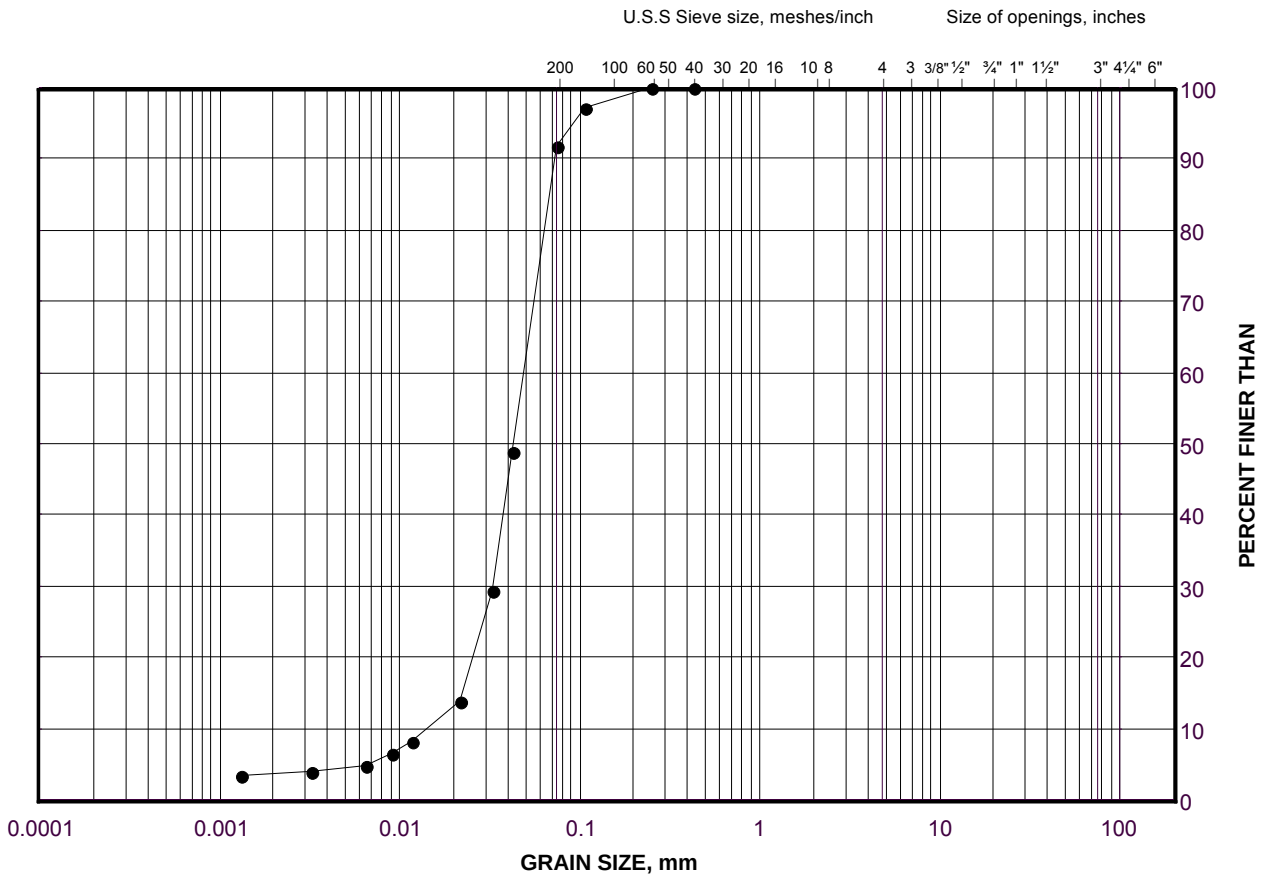
FIGURE D.S204-22
Sheet 4 of 4

GRAIN SIZE DISTRIBUTION

Silt (Interlayer)

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-23



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-18	17	159.5

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

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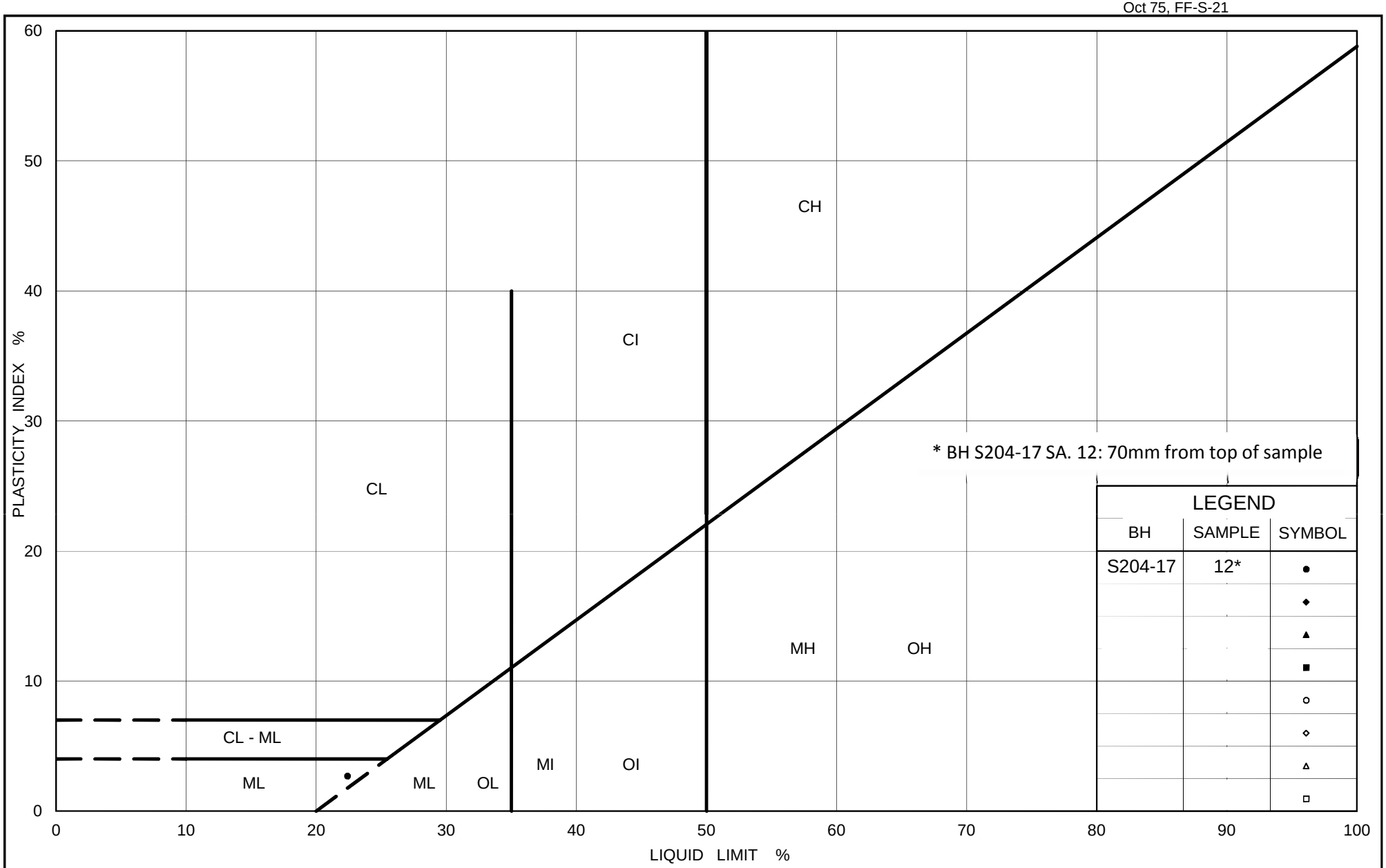

Ministry of Transportation

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PLASTICITY CHART
Silt (Slight Plasticity)
Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

Figure No. D.S204-24

Project No. 09-1111-6014

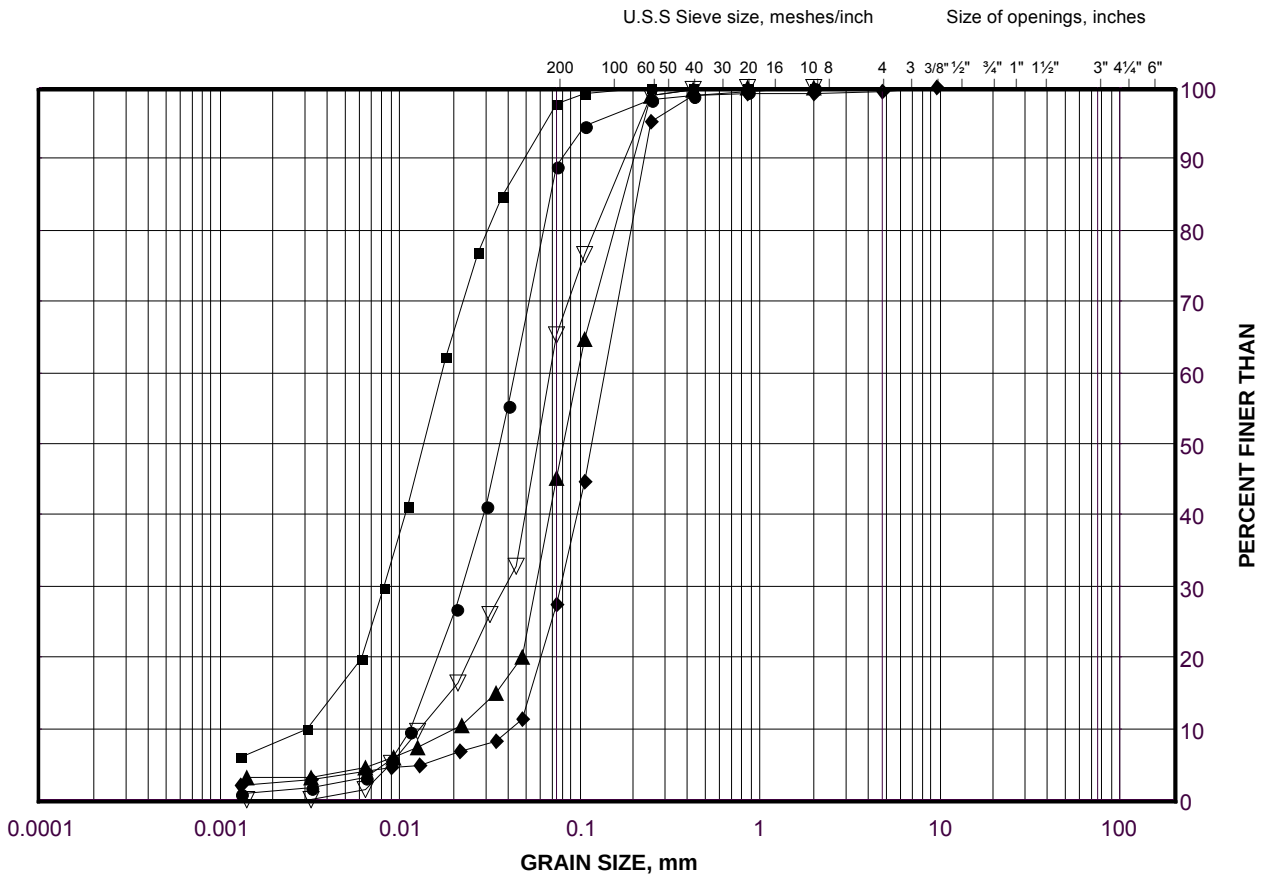
Checked By: TVA

GRAIN SIZE DISTRIBUTION

Silt to Sand and Silt to Silty Sand

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-25A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-16	19	147.8
■	S204-15	19	151.1
◆	S204-17	22	144.8
▲	S204-06	22	144.8
▽	S204-18	23	141.6

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

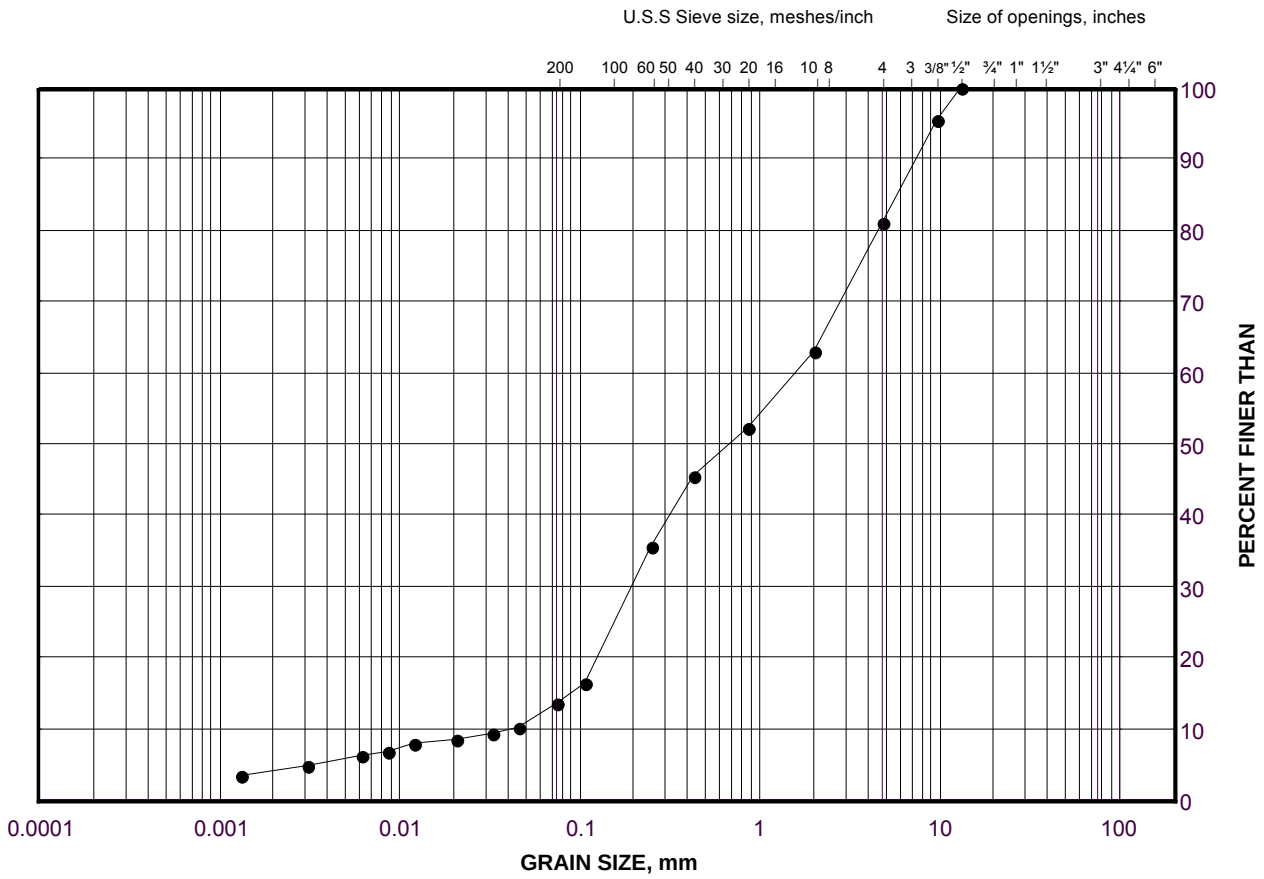
Date: 17-May-11

GRAIN SIZE DISTRIBUTION

Sand

Highway 69 (NBL) STA 11+700 to 11+800 (Swamp 204)

FIGURE D.S204-25B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S204-14	18	156.7

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Borehole S204-12

Box 1: 6.00 m – 8.96 m

0 m	0.25 m	0.5 m	0.75 m	1.0 m	1.25 m	1.5 m
0 ft	1 ft	2 ft	3 ft	4 ft	5 ft	

Scale

PROJECT
Swamp Crossings and High Fill Areas
Highway 69 Four-Laning
GWP 5404-05-00; WP 5404-05-01

TITLE
Core Photo – Swamp 204
Highway 69 (NBL) STA 11+700 to 11+800

Golder Associates

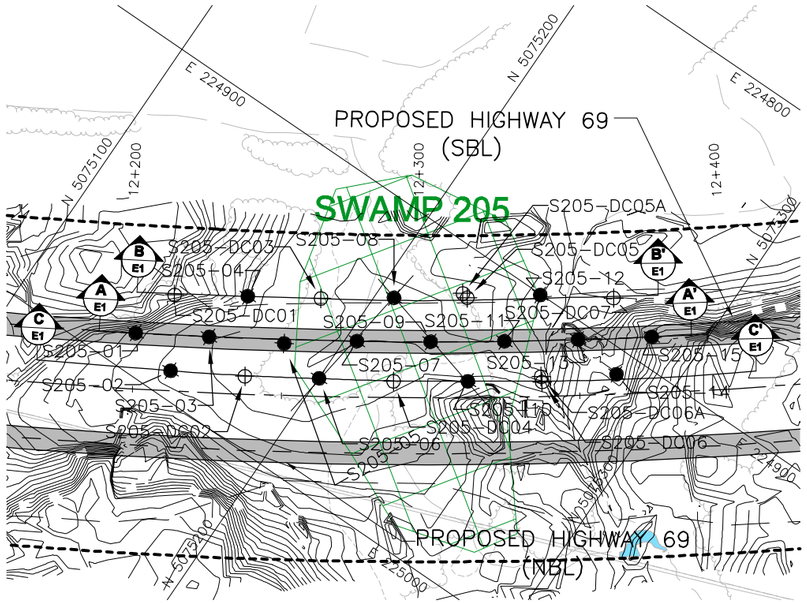
PROJECT No. 09-1111-6014			FILE No. ----	
DESIGN	AT		SCALE NTS	REV.
CADD	--		**FIGURE D.S204-26**	
CHECK	AT			
REVIEW	TVA			

REVISION DATE: April 13, 2011 BY: AT Project: 09-1111-6014

APPENDIX E

Highway 69 SBL – STA 12+200 to 12+375 (Swamp 205)

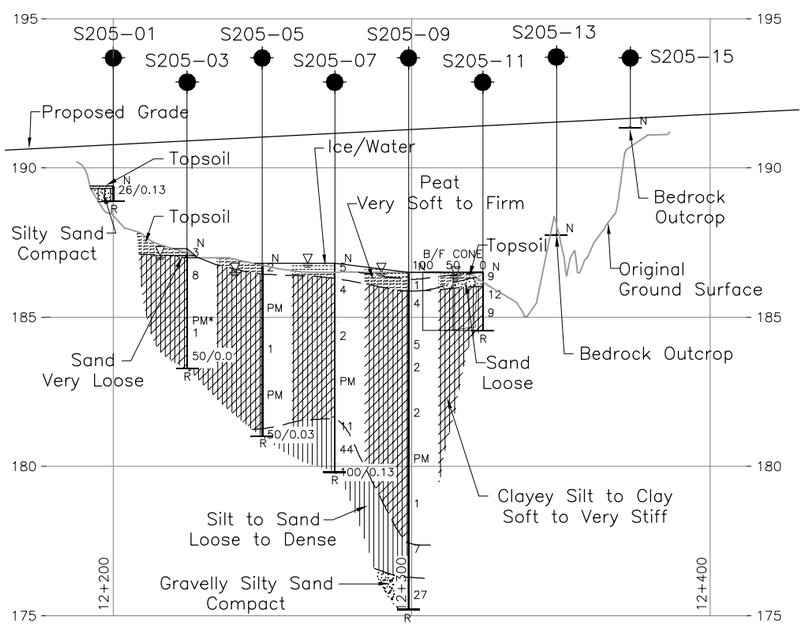
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE

20 0 20 40 m



CENTRELINE PROFILE
HIGHWAY 69 (SBL)

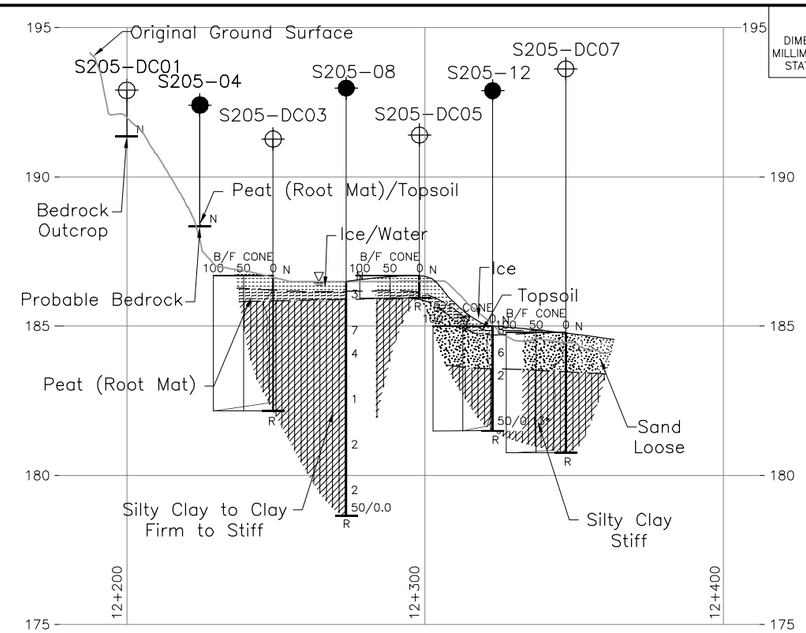
A-A' E1

HORIZONTAL SCALE

20 0 20 40 m

2 0 2 4 m

VERTICAL SCALE



EMBANKMENT TOE PROFILE
HIGHWAY 69 (SBL)

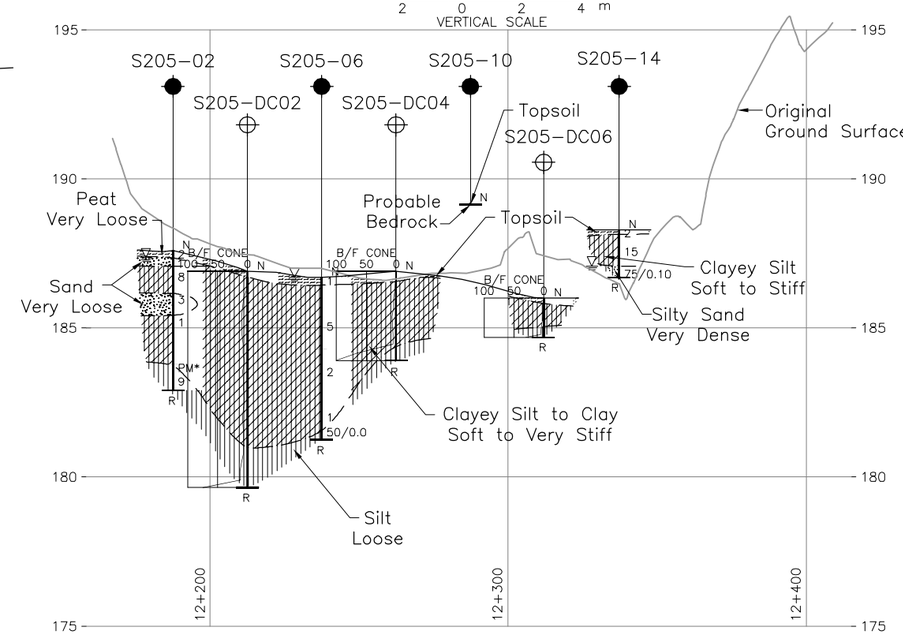
B-B' E1

HORIZONTAL SCALE

20 0 20 40 m

2 0 2 4 m

VERTICAL SCALE



EMBANKMENT TOE PROFILE
HIGHWAY 69 (SBL)

C-C' E2

HORIZONTAL SCALE

20 0 20 40 m

2 0 2 4 m

VERTICAL SCALE

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contours-Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile-nov-18-2011, received December 5, 2011.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.

WP No. 5404-05-01

SHEET

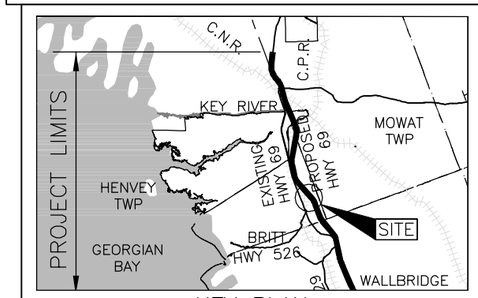
HIGHWAY 69

STA 12+200 TO 12+375 (SBL)

BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE

6 0 6 12 km

LEGEND

- Borehole – Current Investigation
- Dynamic Cone Penetration Test
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL upon completion of drilling
- R Refusal

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
S205-01	189.4	5075140.8	224987.3
S205-02	187.6	5075157.7	224991.2
S205-03	187.3	5075161.9	224974.5
S205-04	188.4	5075164.9	224956.0
S205-05	186.8	5075183.9	224962.1
S205-06	186.7	5075200.2	224965.2
S205-07	186.8	5075203.6	224947.8
S205-08	186.5	5075205.6	224928.7
S205-09	186.5	5075224.1	224934.0
S205-10	189.2	5075241.8	224937.9
S205-11	186.5	5075244.4	224919.9
S205-12	185.0	5075245.5	224900.3
S205-13	187.8	5075264.5	224905.5
S205-14	188.3	5075281.6	224907.8
S205-15	191.4	5075284.4	224890.8
S205-DC01	191.4	5075144.4	224969.4
S205-DC02	186.9	5075179.2	224978.6
S205-DC03	186.7	5075185.5	224942.7
S205-DC04	186.9	5075221.3	224951.9
S205-DC05	186.7	5075225.9	224914.9
S205-DC05A	186.7	5075223.8	224914.5
S205-DC06	186.0	5075262.6	224924.0
S205-DC06A	186.0	5075261.2	224922.7
S205-DC07	184.8	5075266.4	224887.3

NO.	DATE	BY	REVISION

Geocres No. 41H-115

HWY. 69	PROJECT NO. 09-1111-6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. E1

PLOT DATE: July 24, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\-Ca- CONTRACT 2 (SWAMP)\091111601404DE1.dwg

Golder Associates

RECORD OF BOREHOLE No S205-01

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5075140.8 ;E 224987.3
BOREHOLE TYPE Portable Equipment
DATE January 20, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.4	GROUND SURFACE										
0.0	TOPSOIL		1A 1B	SS	26/0.13						
	Silty SAND, trace gravel, containing rootlets Compact Brown Moist						189				
0.5	END OF BOREHOLE SPOON REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Open borehole dry upon completion of drilling.

2. Borehole advanced using portable drilling equipment with a half-weight hammer. SPT 'N' value shown has been adjusted to reflect value that would be obtained with a standard weight hammer.

3. Two Dynamic Cone Penetration Tests were advanced 1.5 m north and 1.5 m south of Borehole S205-01 to confirm depth to refusal; refusal encountered at a depth of 0.2 m and 0.5 m below ground surface (Elev. 189.2 m and Elev. 188.9 m), respectively.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S205-02

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075157.7 ;E 224991.2
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
DATE January 20, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
187.6	GROUND SURFACE			
0.0	PEAT containing rootlets (Fibrous) Very soft Black Wet	1A 1B 1C	SS	2
187.1 / 0.5	SAND, trace to some silt, slightly organic Very loose Brown Moist	2	SS	8
186.2 / 1.4	CLAYEY SILT, trace gravel, trace sand, containing rootlets Firm to stiff Brown to grey Moist	3	SS	3
185.4 / 2.2	SAND, trace gravel, trace silt, containing pockets of clayey silt Very loose Brown Wet	4	SS	1
183.8 / 3.8	CLAY, some silt, trace sand Soft Grey Wet	5	TO	PM*
182.9 / 4.7	SILT, trace to some sand, trace to some clay Loose Grey Wet	6	SS	9

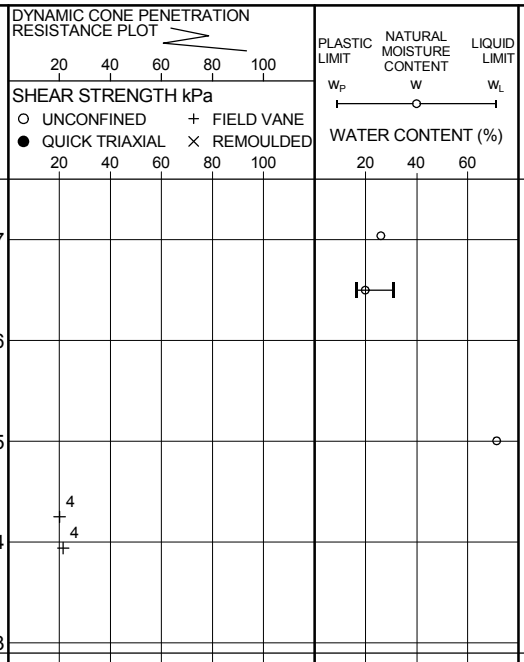
END OF BOREHOLE
SPOON REFUSAL

NOTES:

* Unable to recover a Shelby tube sample between depths of 3.8 m and 4.3 m (Elev. 183.8 m and 183.3 m) below ground surface.

1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 187.4 m) upon completion of drilling.

2. An additional borehole was drilled 1.0 m south of Borehole S205-02 to obtain a Shelby tube sample between depths of 2.3 m and 2.7 m below ground surface (Elev. 185.3 m and Elev. 184.9 m).



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S205-03

SHEET 1 OF 1 **METRIC**

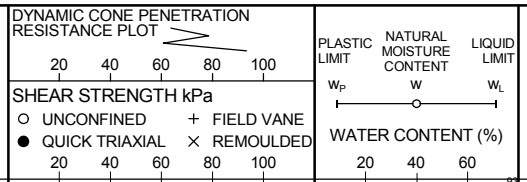
PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075161.9 ;E 224974.5
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
DATE January 21, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.3	GROUND SURFACE							
0.0	TOPSOIL	1A 1B 1C	SS	3	▽	187		
0.3	SAND, some silt Very loose Grey Moist							
	SILTY CLAY, trace sand, containing silt interlayers, rootlets and wood fragments to a depth of 0.6 m Firm to stiff Brown to grey Moist	2	SS	8		186		
		3	SS	PM*		185		
184.6								
2.7	CLAY, trace sand, trace silt, containing silt interlayers Soft Grey Moist	4	SS	1		184		
183.3		5	SS	50/0.0				
4.0	END OF BOREHOLE SPOON REFUSAL							

NOTES:

* Unable to recover a Shelby tube sample between depths of 2.3 m and 2.7 m (Elev. 187.0 m and 184.6 m) below ground surface.

1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 187.1 m) upon completion of drilling.



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

Golder Associates

RECORD OF BOREHOLE No S205-04

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5075164.9 ;E 224956.0
BOREHOLE TYPE Hand Excavation
DATE January 21, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE			kN/m³	GR SA SI CL
188.4	GROUND SURFACE										
0.0	PEAT (Root Mat)										
0.1	END OF EXCAVATION PROBABLE BEDROCK										

NOTES:

1. Hand digging carried out at proposed borehole location to expose bedrock; visible bedrock outcrop in the vicinity of borehole S205-04.

2. Excavation dry upon completion.

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

Golder Associates

RECORD OF BOREHOLE No S205-05

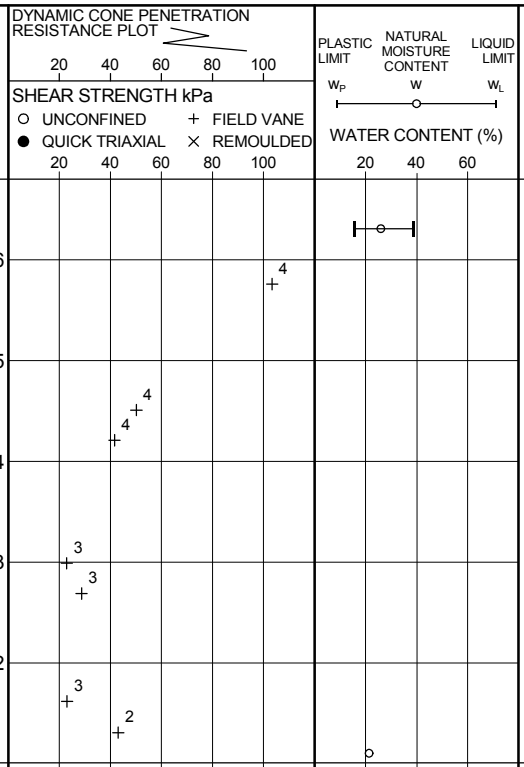
SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075183.9 ;E 224962.1
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
DATE January 21, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
186.8	GROUND SURFACE			
0.0 / 186.4	TOPSOIL	1A, 1B	SS	2
0.4 / 185.0	SILTY CLAY, trace sand, containing rootlets to a depth of 1.2 m Firm to very stiff Brown to grey Moist	2	TO	PM
1.9 / 181.3	CLAY, some silt Soft to firm Brown Moist	3	SS	1
		4	TO	PM
	SILT, trace to some sand, trace to some clay Loose Grey Wet	5	SS	50/0.03
5.8	END OF BOREHOLE SPOON REFUSAL			

NOTE:

1. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 186.5 m) upon completion of drilling.



GROUND WATER CONDITIONS

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S205-06

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075200.2 ;E 224965.2
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE January 22, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.7	GROUND SURFACE										
0.0 / 186.4	PEAT, (Fibrous) Very soft Dark brown Wet		1A 1B	SS	1				148		
0.3	SILTY CLAY, containing rootlets to a depth of 1.1 m Stiff to very stiff Brown Moist to wet						186	3 3			
			2	SS	5		185				
184.3 / 2.4	CLAY, some silt Firm Grey Wet						184	4 4			
			3	SS	2		183	3 3			
	Silt interlayers encountered at a depth of 4.6 m		4	SS	1		182				
181.2 / 5.5	END OF BOREHOLE SPOON REFUSAL		5	SS	50/0.0						

NOTE:

1. Water level in open borehole at ground surface (Elev. 186.7 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S205-07

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075203.6 ;E 224947.8
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE January 22, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	WATER CONTENT (%) (w_P, w, w_L)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.8	ICE SURFACE									
0.0	ICE									
	PEAT, containing wood fragments (Fibrous) Firm Brown Moist	1	SS	5				688		
0.5	SILTY CLAY, trace sand, containing rootlets Very stiff Brown and grey Moist	2	SS	4		186				
184.8						185	>126			
2.0	CLAY, trace sand, containing silt interlayers Soft Brown to grey Moist	3	SS	2		184				
						183	3, 3			
		4	TO	PM					15.3	
181.6						182	3, 3			
5.2	SILT, some sand, trace gravel, trace clay Compact to dense Grey Wet	5	SS	11		181				
180.1		6	SS	44						5 14 76 5
179.8	SAND, some silt, trace gravel Dense Grey Wet	7	SS	100/0.13		180				
7.0	END OF BOREHOLE SPOON REFUSAL									

NOTE:

1. Water level in open borehole at ice surface (Elev. 186.8 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S205-08

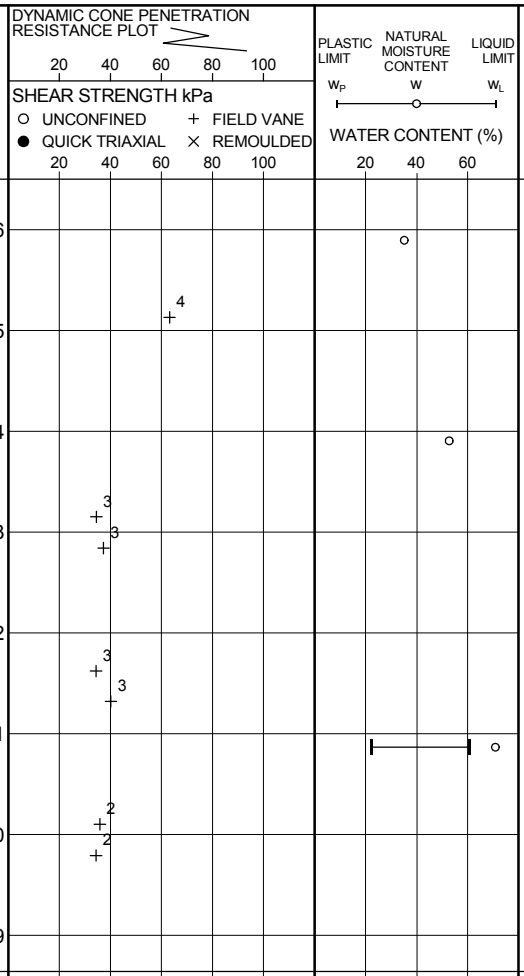
SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075205.6 ;E 224928.7
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE January 22, 2010
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
186.5	ICE SURFACE			
0.0	ICE			
	WATER			
185.9	PEAT			
0.6	Soft Brown Moist	1	SS	3
	SILTY CLAY, trace sand, containing rootlets to a depth of 2.1 m Stiff Brown and grey Moist	2	SS	7
	Silt interlayers encountered at a depth of 1.4 m	3	SS	4
183.3				
3.2	CLAY, trace sand Firm Grey Moist	4	SS	1
		5	SS	2
		6	SS	2
178.6		7	SS	50/0.0
7.9	END OF BOREHOLE SPOON REFUSAL			

NOTE:

1. Water level in open borehole at ice surface (Elev. 186.5 m) upon completion of drilling.



GROUND WATER CONDITIONS

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S205-09

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075224.1 ;E 224934.0	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, BW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	January 23, 2010	CHECKED BY	TVA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L (WATER CONTENT (%))	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.5	ICE SURFACE								
0.0	ICE								
	WATER								
185.9	PEAT, containing wood fragments (Fibrous) Very soft Dark brown Wet	1A 1B	SS	1	186				
0.6	SILTY CLAY, trace sand, containing wood fragments and rootlets to a depth of 0.9 m Very stiff Brown and grey Moist	2	SS	4	185	>132			
183.6	Silt interlayers encountered at a depth of 2.1 m (Elev. 184.4 m)	3	SS	5	184				
2.9	CLAY Firm Brown to grey Moist	4	SS	2	183	5, 4			
		5	SS	2	182				
		6	TO	PM	181	4, 3			
		7	SS	1	180	3, 2			
177.4					179				
9.1	SILT, trace to some sand, trace to some clay, trace gravel Loose Grey Wet	8	SS	7	178	3, 3			
176.3					177				
10.2	Gravelly Silty SAND, trace clay, containing silty sand interlayers Compact Grey Wet	9	SS	27	176				27 41 28 4
175.2									
11.3	END OF BOREHOLE SPOON AND CASING REFUSAL								

NOTE:

1. Water level in open borehole at ice surface (Elev. 186.5 m) upon completion of drilling.

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

Golder Associates

RECORD OF BOREHOLE No S205-10

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075241.8 ;E 224937.9
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 23, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
189.2	GROUND SURFACE												
0.0	TOPSOIL												
0.1	END OF BOREHOLE PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTE:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

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

Golder Associates

RECORD OF BOREHOLE No S205-11

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075244.4 ;E 224919.9	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, BW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	January 24, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.5	GROUND SURFACE										
0.0	TOPSOIL		1A								
186.0	SAND, trace silt, containing rootlets Loose Brown Moist		1B 1C	SS	9		186				
0.6	CLAYEY SILT, trace to some sand Stiff Brown and grey Moist		2	SS	12						
184.7	SILTY CLAY, trace sand, containing rootlets to a depth of 1.2 m Stiff Brown to grey Moist Silt interlayers encountered at a depth of 1.4 m (Elev. 185.1 m)		3A 3B	SS	9		185				
2.0	END OF BOREHOLE SPOON REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Water level in open borehole at a depth of 0.1 m below ground surface (Elev. 186.4 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S205-11 to confirm depth to refusal; refusal encountered at a depth of 2.0 m below ground surface (Elev. 184.5 m).

3. Attempted to push in situ vane test a depth of 1.7 m below ground surface (Elev. 184.8 m) but hit refusal.

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

Golder Associates

RECORD OF BOREHOLE No S205-12

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075245.5 ;E 224900.3	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring	COMPILED BY	OK
DATUM	Geodetic	DATE	January 23, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.0	ICE SURFACE										
0.0	ICE										
0.3	TOPSOIL		1	SS	8						
	SAND,trace to some silt, trace to some clay, containing organics and wood fragments up to a depth of 0.6 m Loose Brown		2	SS	6		184				0 82 11 7
183.6 1.4	Wet										
	SILTY CLAY, trace sand Stiff Grey Moist		3	SS	2		183				
							182	4 + 4 +			
181.7			4	SS	50/0.13						
	END OF BOREHOLE SPOON REFUSAL										
3.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Water level in open borehole at ice surface (Elev. 185.0 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m north of Borehole S205-12 to confirm depth to refusal; refusal encountered at a depth of 3.5 m below ground surface (Elev. 181.5 m).

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

Golder Associates

RECORD OF BOREHOLE No S205-13

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075264.5 ;E 224905.5
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 24, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P w w_L WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
187.8	GROUND SURFACE										
0.0	BEDROCK OUTCROP										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No S205-14

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075281.6 ;E 224907.8
ORIGINATED BY MR
DIST HWY 69
BOREHOLE TYPE Portable Equipment, BW Casing, Wash Boring
COMPILED BY OK
DATUM Geodetic
DATE January 24, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES									
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.3	GROUND SURFACE										
0.0	TOPSOIL		1A								
0.2	CLAYEY SILT, trace to some sand, containing rootlets and slightly organic Soft to stiff Grey Moist		1B	SS	2		188		○		
			2	SS	15	▽					
187.1	Silty SAND, some gravel, trace clay, containing rootlets and wood fragments Very dense Brown Wet						187				
186.7			3	SS	75/0.10				○		
1.6	END OF BOREHOLE SPOON REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 1.2 m below ground surface (Elev. 187.1 m) upon completion of drilling.

2. Bedrock outcrop noted within the vicinity of Borehole S205-14.

3. Upper 1.2 m of borehole advanced using portable drilling equipment with a half-weight hammer. SPT 'N' values shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

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

Golder Associates

RECORD OF BOREHOLE No S205-15

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075284.4 ;E 224890.8
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 20, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
191.4	GROUND SURFACE										
0.0	BEDROCK OUTCROP										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S205-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075144.4 ;E 224969.4	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Hand Excavation	COMPILED BY	OK
DATUM	Geodetic	DATE	January 20, 2010	CHECKED BY	TVA

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	SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	w_P	w	w_L	γ kN/m³	GR SA SI CL
191.4	BEDROCK OUTCROP												
0.0													

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

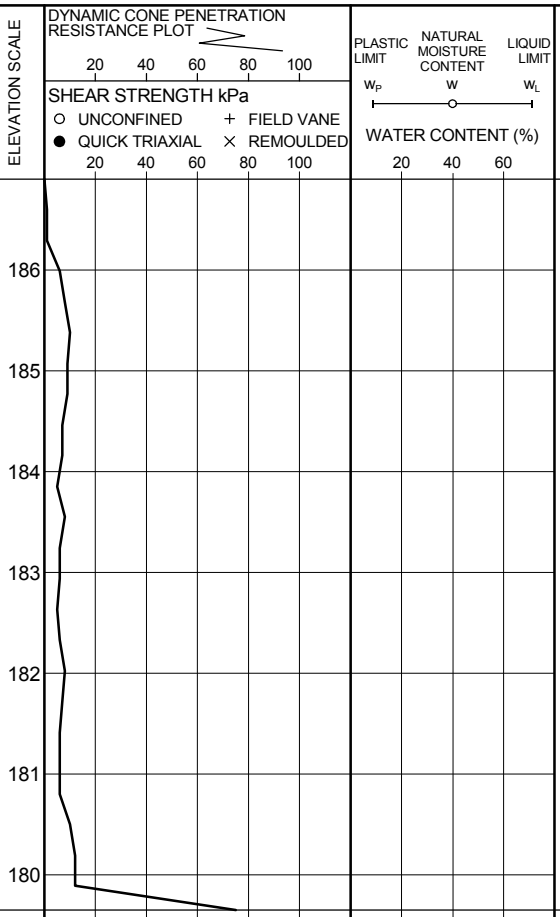
Golder Associates

RECORD OF DCPT No S205-DC02

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075179.2 ;E 224978.6	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 21, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.9	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
179.7											
7.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										



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

Golder Associates

RECORD OF DCPT No S205-DC03

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075185.5 ;E 224942.7	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 20, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						186, 185, 184, 183				
182.2											
4.5	END OF DCPT Refusal to Further Penetration (100 Blows / 0.28 m)										

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

Golder Associates

RECORD OF DCPT No S205-DC04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075221.3 ;E 224951.9	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 20, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.9	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						186				
							185				
183.9							184				
3.0	END OF DCPT Refusal to Further Penetration (100 Blows / 0.23 m)										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S205-DC05

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5075225.9 ;E 224914.9
BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test
DATE January 20, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
186.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
185.9							186				
0.8	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTES: 1. An additional Dynamic Cone Penetration Test was drilled 1.5 m south east of DCPT S205-DC05 to confirm depth to refusal; see Record of DCPT S205-DC05A for details. 2. Bedrock outcrop observed approximately 3.0 m west of DCPT S205-DC05.										

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

Golder Associates

RECORD OF DCPT No S205-DC05A

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic

LOCATION N 5075223.8 ;E 224914.5
BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test
DATE January 20, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	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 WATER CONTENT (%) 20 40 60	γ kN/m³	GR SA SI CL
186.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						186				
185.7											
1.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED

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

Golder Associates

RECORD OF DCPT No S205-DC06

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075262.6 ;E 224924.0	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY OK
DATUM	Geodetic	DATE	January 24, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
185.2											
0.8	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

2. An additional Dynamic Cone Penetration Test was drilled 1.5 m west of DCPT S205-DC06 to confirm depth to refusal; see Record of DCPT S205-DC06A for details.

3. Bedrock outcrop observed approximately 2.0 m west of DCPT S205-DC06.

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

Golder Associates

RECORD OF DCPT No S205-DC06A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014		
W.P.	5404-05-01	LOCATION	N 5075261.2 ;E 224922.7
DIST		HWY	69
DATUM	Geodetic	DATE	January 24, 2010
BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test		
ORIGINATED BY	MR	COMPILED BY	OK
CHECKED BY	TVA		

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						185				
184.7											
1.3	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.										

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

Golder Associates

RECORD OF DCPT No S205-DC07

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075266.4 ;E 224887.3	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 24, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.8	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						184 / 183 / 182 / 181				
180.8											
4.0	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Bedrock outcrop observed in the vicinity of DCPT S205-DC07.										

+ 3, × 3: Numbers refer to Sensitivity

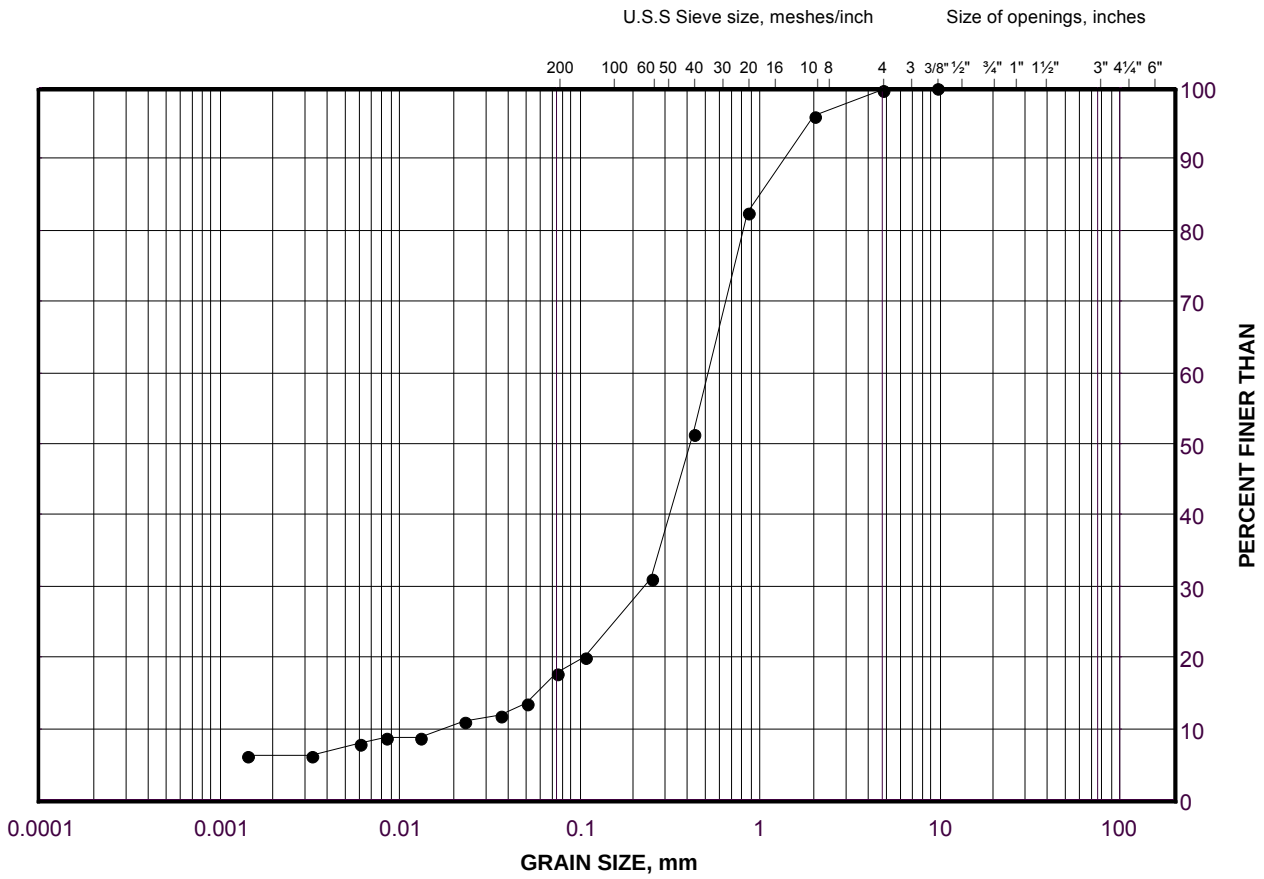
○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Sand

Highway 69 (SBL) STA 12+200 to 12+375 (Swamp 205)

FIGURE E.S205-01



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S205-12	2	183.9

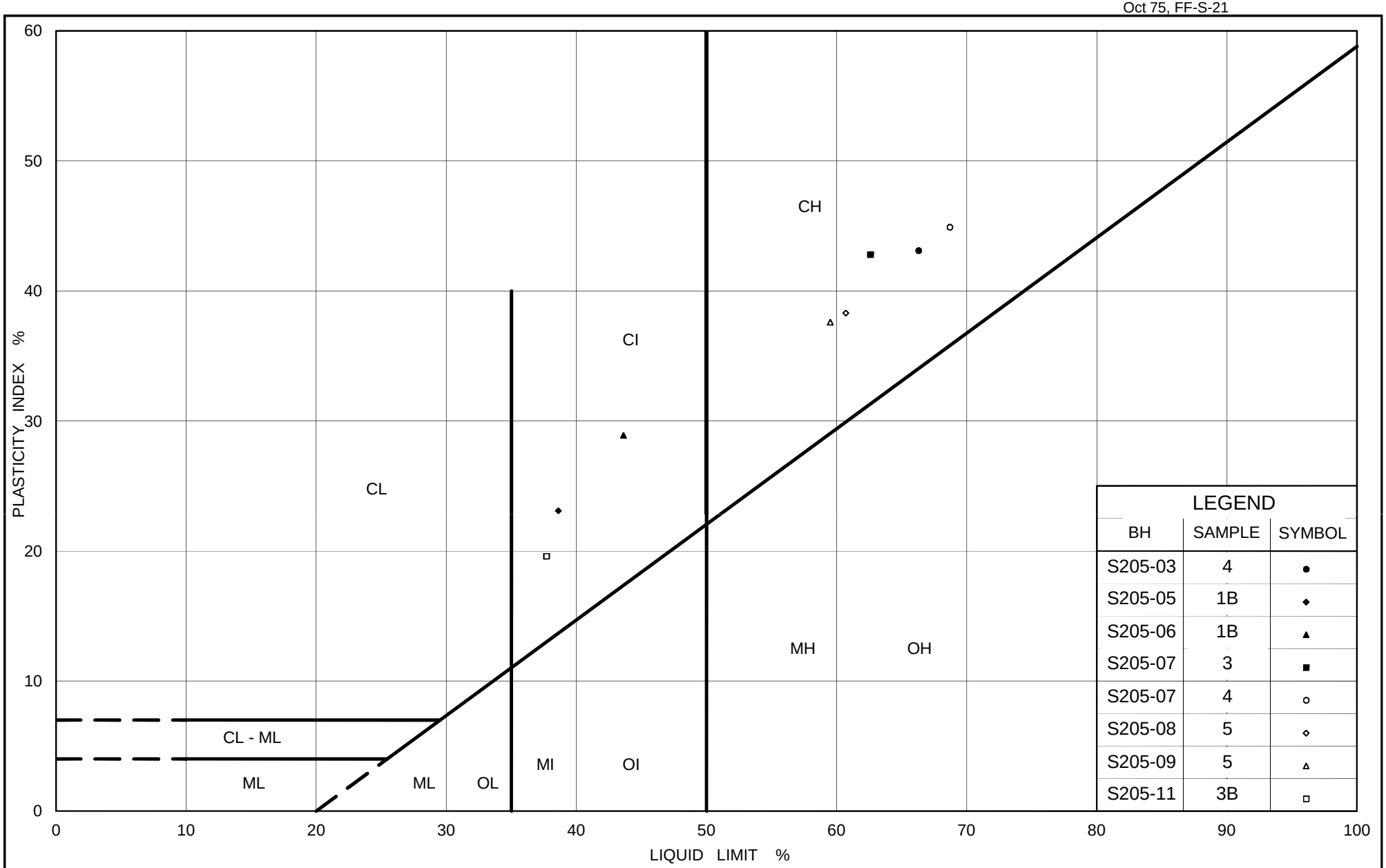
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

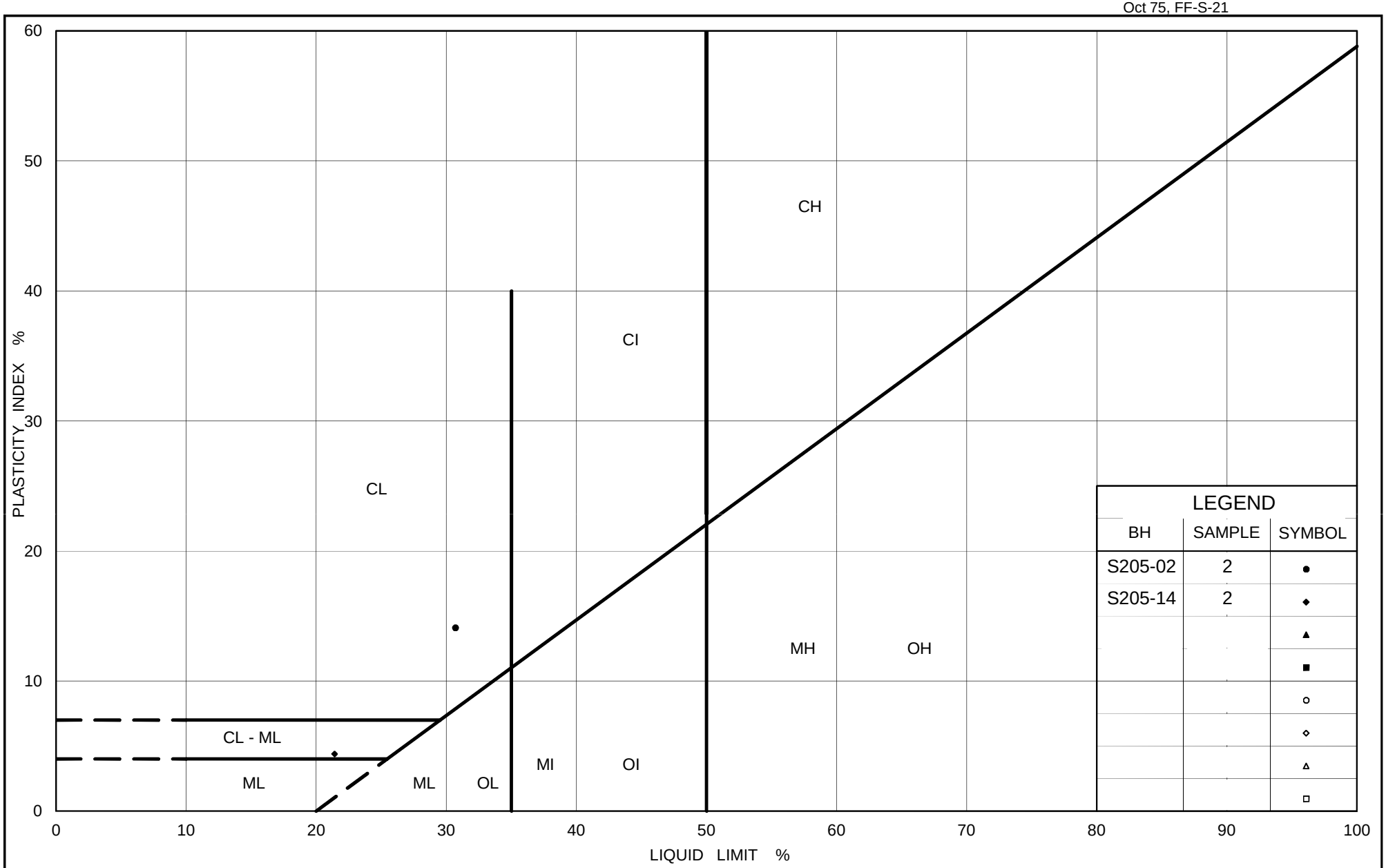
PLASTICITY CHART
Silty Clay to Clay
Highway 69 (SBL) STA 12+200 to 12+375 (Swamp 205)

Figure No. E.S205-02A

Project No. 09-1111-6014

Checked By: TVA

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Clayey Silt
Highway 69 (SBL) STA 12+200 to 12+375 (Swamp 205)

Figure No. E.S205-02B

Project No. 09-1111-6014

Checked By: TVA

CONSOLIDATION TEST SUMMARY

Highway 69 (SBL) STA 12+200 to 12+375 (Swamp 205)

FIGURE E.S205-03

SAMPLE IDENTIFICATION

Project Number	09-1111-6014	Sample Number	4
Borehole Number	S205-07	Sample Depth, m	4.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	8		
Date Started	4/9/2010		
Date Completed	4/22/2010		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.25	Unit Weight, kN/m^3	15.27
Sample Diameter, cm	4.97	Dry Unit Weight, kN/m^3	8.66
Area, cm^2	19.40	Specific Gravity, measured	2.74
Volume, cm^3	24.31	Solids Height, cm	0.404
Water Content, %	76.33	Volume of Solids, cm^3	7.83
Wet Mass, g	37.84	Volume of Voids, cm^3	16.48
Dry Mass, g	21.46	Degree of Saturation, %	99.4

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.253	2.104	1.253				
5.00	1.248	2.091	1.250	273	1.21E-03	8.14E-04	9.69E-08
10.00	1.239	2.068	1.243	577	5.68E-04	1.48E-03	8.26E-08
20.00	1.223	2.029	1.231	520	6.18E-04	1.25E-03	7.58E-08
40.08	1.187	1.941	1.205	437	7.05E-04	1.41E-03	9.77E-08
80.00	1.109	1.747	1.148	540	5.18E-04	1.56E-03	7.93E-08
160.00	0.992	1.457	1.051	602	3.89E-04	1.17E-03	4.45E-08
320.00	0.894	1.214	0.943	470	4.01E-04	4.89E-04	1.92E-08
640.89	0.812	1.010	0.853	392	3.93E-04	2.05E-04	7.90E-09
1280.00	0.743	0.840	0.777	252	5.08E-04	8.59E-05	4.28E-09
2560.00	0.682	0.689	0.712	118	9.12E-04	3.80E-05	3.40E-09
1280.00	0.690	0.710	0.686				
322.33	0.711	0.761	0.701				
80.01	0.746	0.849	0.729				
20.00	0.769	0.905	0.758				
5.00	0.788	0.951	0.778				

Note:
k calculated using cv based on t_{90} values.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

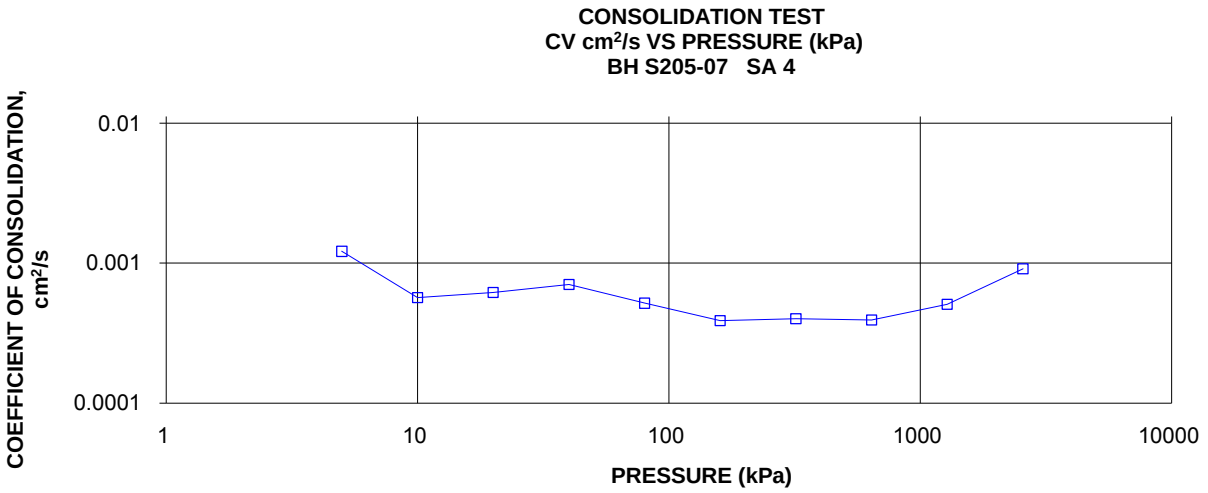
Sample Height, cm	0.79	Unit Weight, kN/m^3	18.85
Sample Diameter, cm	4.97	Dry Unit Weight, kN/m^3	13.78
Area, cm^2	19.40	Specific Gravity, measured	2.74
Volume, cm^3	15.28	Solids Height, cm	0.404
Water Content, %	36.81	Volume of Solids, cm^3	7.83
Wet Mass, g	29.36	Volume of Voids, cm^3	7.45
Dry Mass, g	21.46		

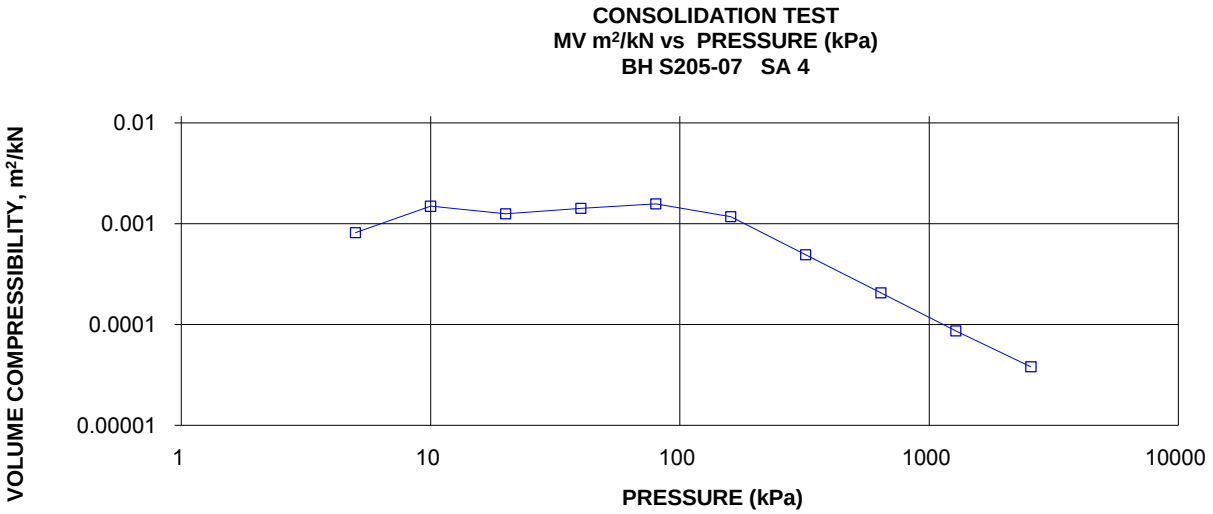
CONSOLIDATION TEST SUMMARY

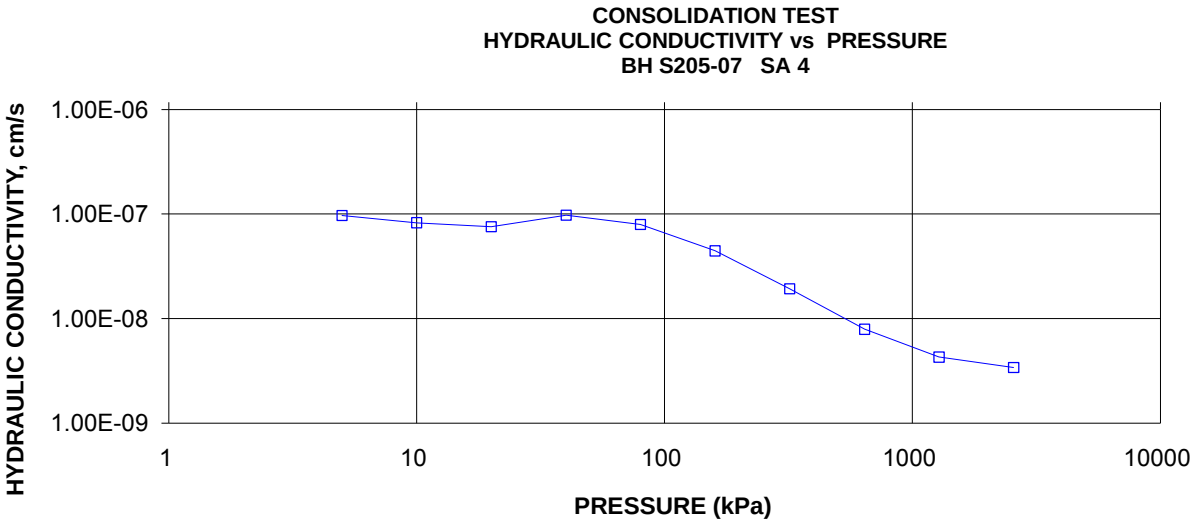
Highway 69 (SBL) STA 12+200 to 12+375 (Swamp 205)

FIGURE E.S205-03

Sheet 2 of 4







Project No. 09-1111-6014

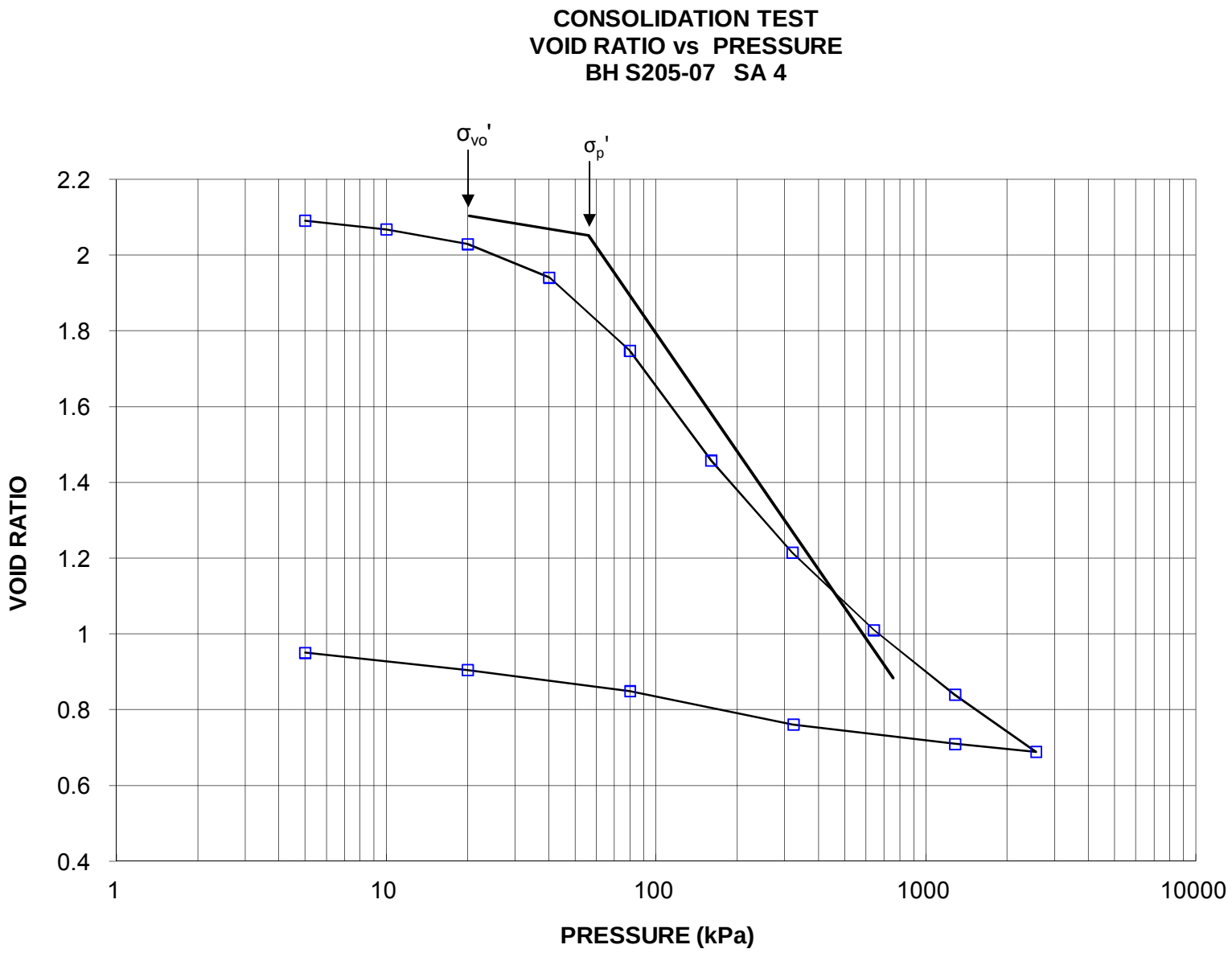
Prepared By: LFG

Golder Associates

Checked By: TVA

CONSOLIDATION TEST SUMMARY
VOID RATIO VS LOG PRESSURE

FIGURE E.S205-03
Sheet 3 of 4



Project No. 09-1111-6014

Prepared By: LFG

Golder Associates

Checked By: TVA

Project No. 09-1111-6014

Prepared By: LFG

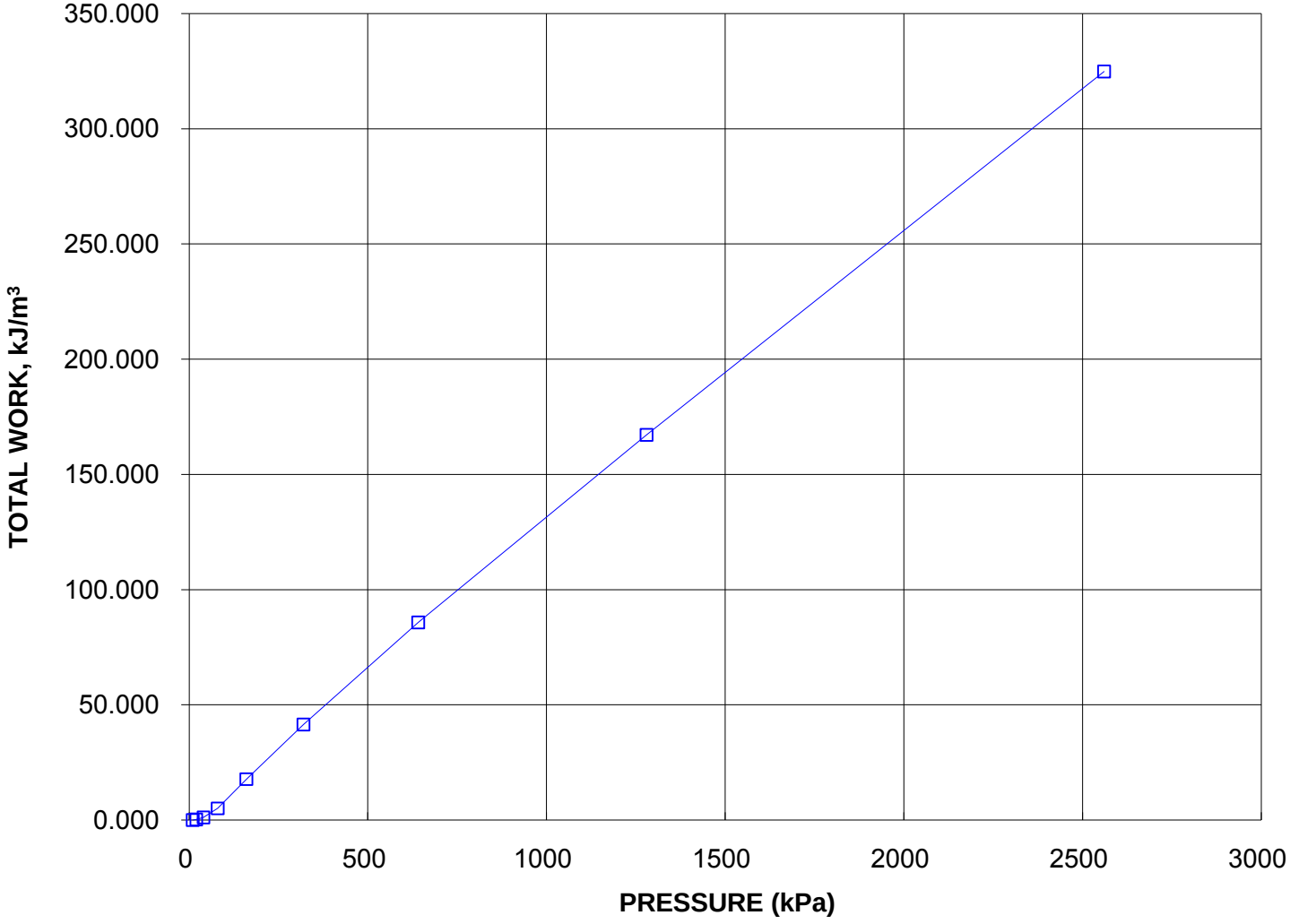
Golder Associates

Checked By: TVA

CONSOLIDATION TEST SUMMARY
TOTAL WORK VS PRESSURE

FIGURE E.S205-03
Sheet 4 of 4

CONSOLIDATION TEST
TOTAL WORK, kJ/m³ vs PRESSURE
BH S205-07 SA 4

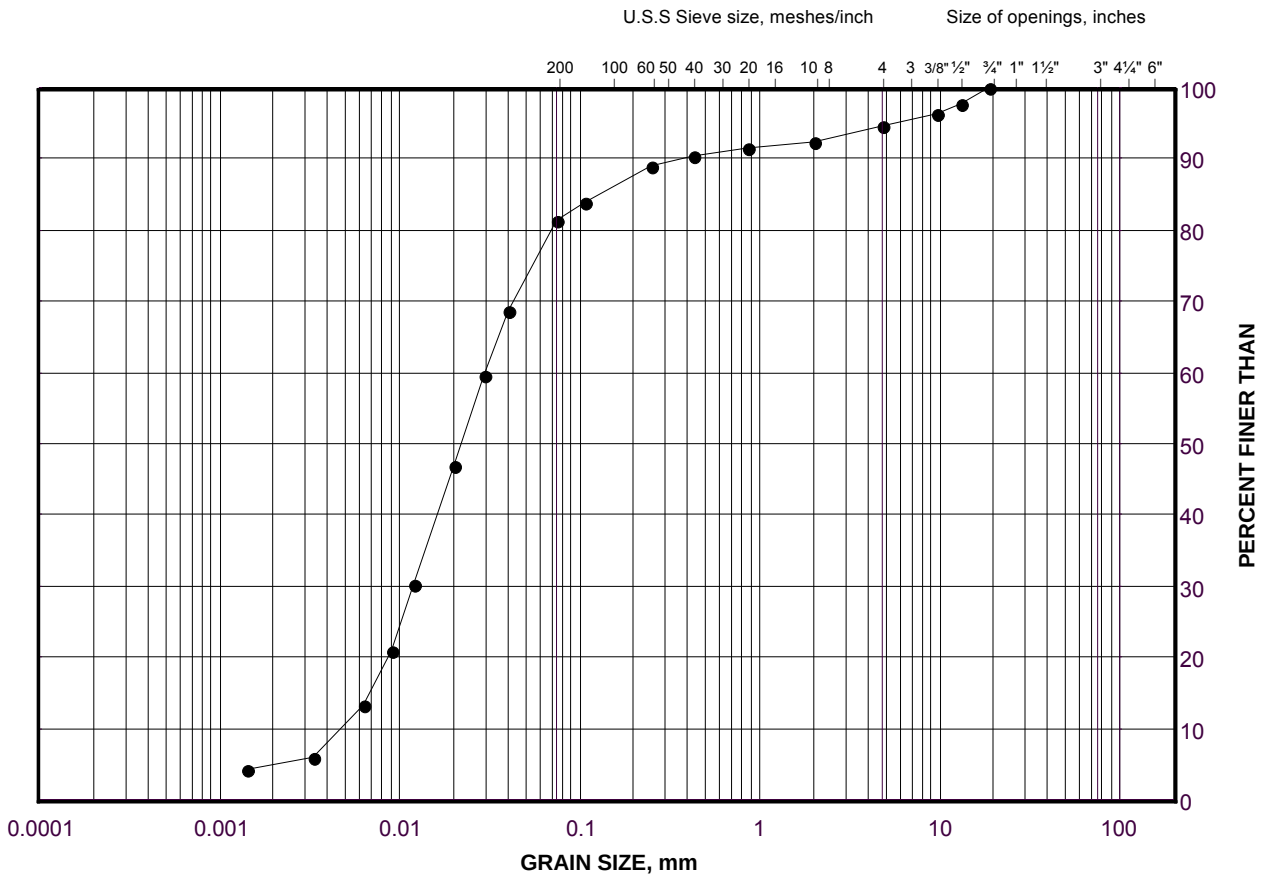


GRAIN SIZE DISTRIBUTION

Silt

Highway 69 (SBL) STA 12+200 to 12+375

FIGURE E.S205-04



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S205-07	6	179.6

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

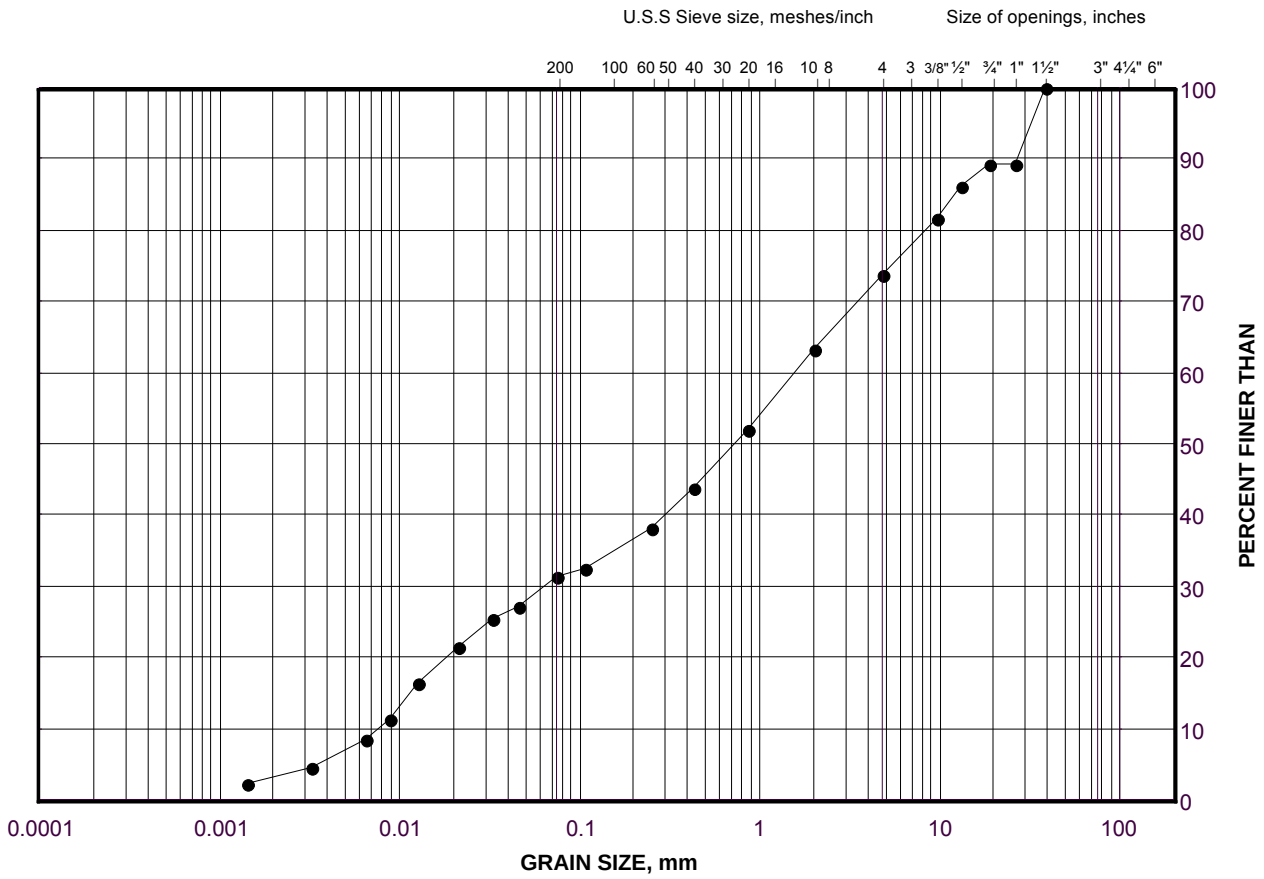
Date: 17-May-11

GRAIN SIZE DISTRIBUTION

Gravelly Silty Sand

Highway 69 (SBL) STA 12+200 to 12+375

FIGURE E.S205-05



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S205-09	9	175.5

Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

APPENDIX F

Highway 69 NBL – STA 12+750 to 12+825 (Swamp 206)

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 5404–05–01

SHEET

HIGHWAY 69
STA 12+750 TO 12+825 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

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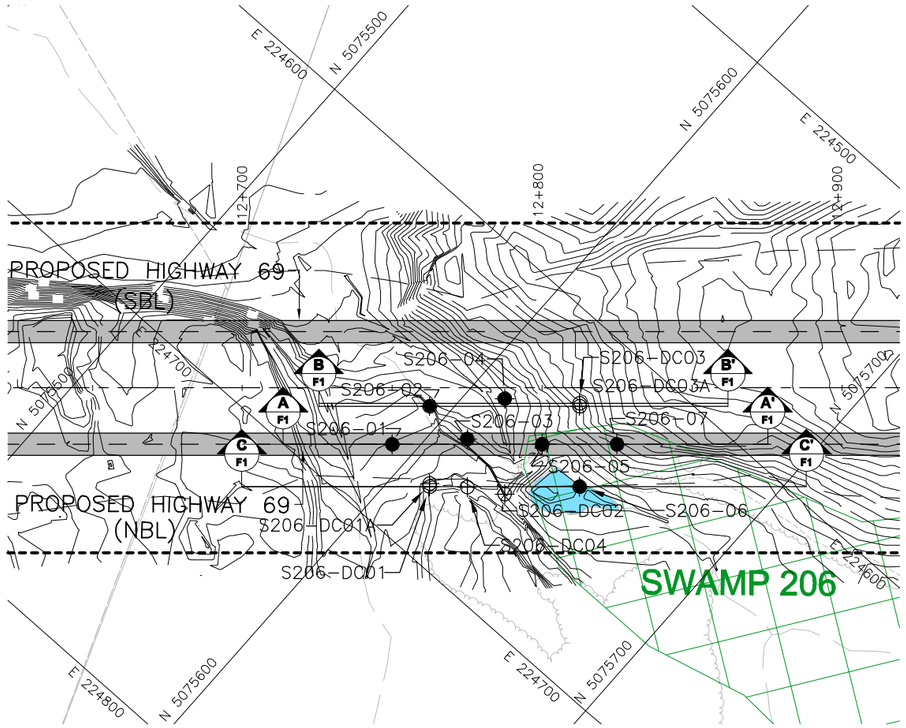
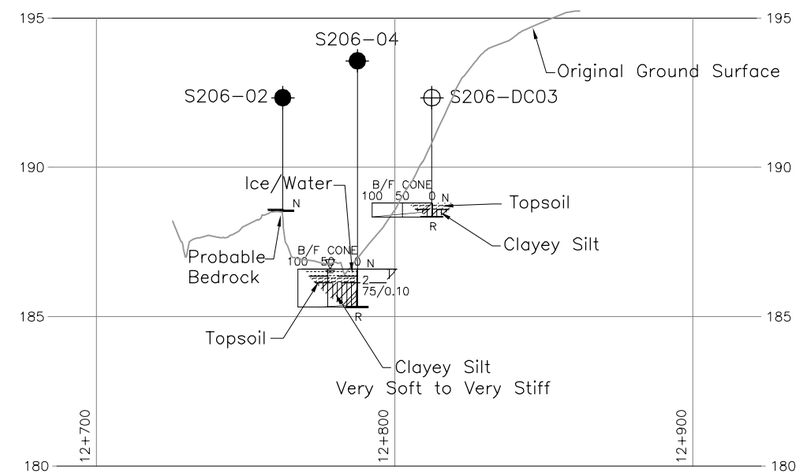
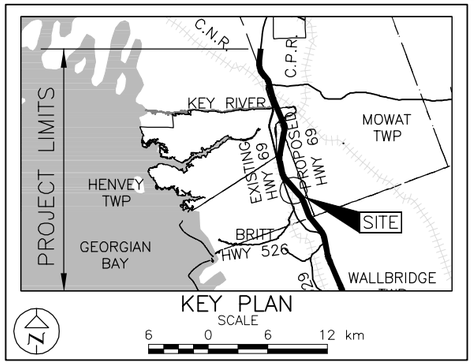
MISSISSAUGA, ONTARIO, CANADA



PLAN
SCALE
20 0 20 40 m



B-B' F1 EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)
HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



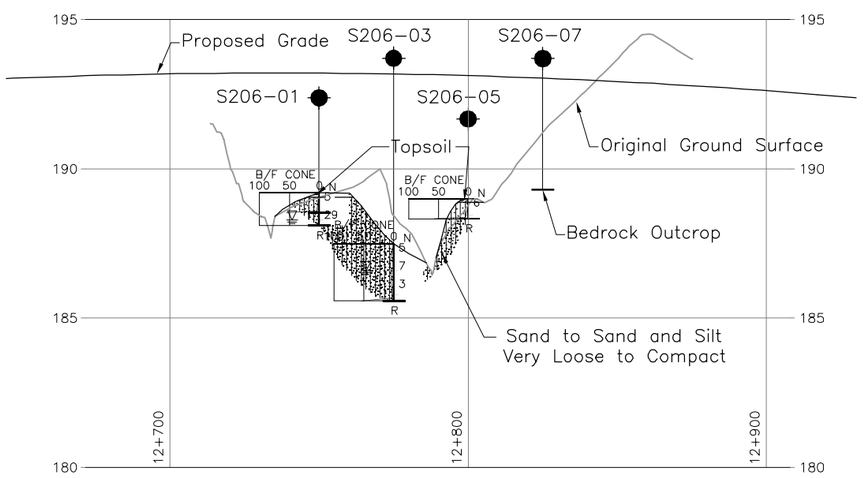
KEY PLAN
SCALE
6 0 6 12 km

LEGEND

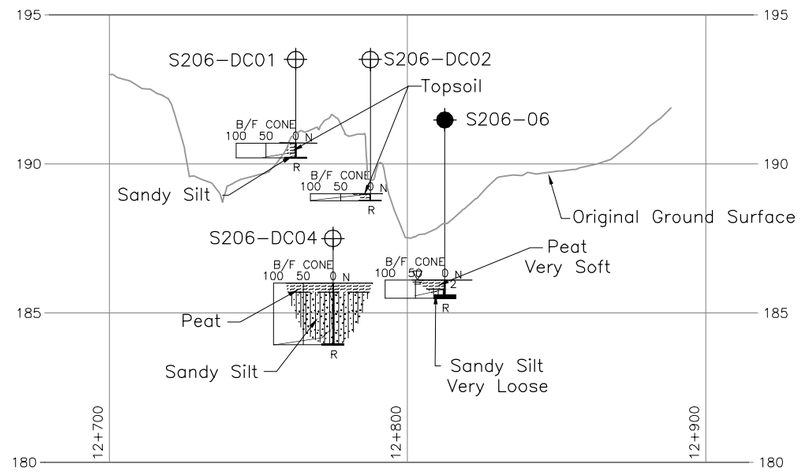
●	Borehole – Current Investigation
⊕	Dynamic Cone Penetration Test
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
▽	WL upon completion of drilling
R	Refusal

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
S206–01	189.2	5075592.8	224676.0
S206–02	188.6	5075593.8	224658.3
S206–03	187.5	5075610.4	224658.2
S206–04	186.6	5075610.9	224639.8
S206–05	189.0	5075630.3	224643.0
S206–06	186.1	5075649.0	224645.3
S206–07	189.3	5075649.1	224626.4
S206–DC01	190.7	5075611.5	224678.4
S206–DC01A	190.7	5075610.9	224677.6
S206–DC02	189.0	5075631.9	224663.7
S206–DC03	188.8	5075631.3	224625.2
S206–DC03A	188.8	5075630.6	224624.4
S206–DC04	186.0	5075621.0	224670.2



A-A' F1 CENTRELINE PROFILE
HIGHWAY 69 (NBL)
HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE



B-B' F1 EMBANKMENT TOE PROFILE
HIGHWAY 69 (NBL)
HORIZONTAL SCALE
20 0 20 40 m
2 0 2 4 m
VERTICAL SCALE

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

LICENSED PROFESSIONAL ENGINEER C.C. NG 100086170 July 23, 2012 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER J. M. A. COSTA July 23, 2012 PROVINCE OF ONTARIO

REFERENCE

Base plans provided in digital format by URS, drawing files Hwy69_base.dwg, Hwy69_plan.dwg, received December 16, 2009. Original Ground Surface cut from contour drawing file HWY69_Contours–Plan_C2_C3.dwg, received July 14, 2011 and the Proposed Grade obtained from drawing file Hwy69_profile–nov–18–2011.dwg, received December 5, 2011.

NO.	DATE	BY	REVISION

Geocres No. 41H–115

HWY. 69	PROJECT NO. 09–1111–6014		DIST.
SUBM'D. TVA	CHKD. TVA	DATE: July 2012	SITE:
DRAWN: JFC	CHKD. CN	APPD. JPD/JMAC	DWG. F1

PLOT DATE: July 25, 2012
FILENAME: T:\Projects\2009\09-1111-6014 (URS, Hwy 69, Henvey)\--CA- CONTRACT 2 (SWAMP)\GR1111601402ADF1.dwg

Golder Associates

RECORD OF BOREHOLE No S206-01

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075592.8 ;E 224676.0
BOREHOLE TYPE Portable Equipment
DATE January 18, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.2	GROUND SURFACE										
0.0	TOPSOIL		1A				189				
0.2	SAND, trace silt, containing rootlets		1B	SS	5						
188.6	Loose										
188.3	Brown		2A	SS	29	▽			○		2 34 54 10
	Moist		2B						○		
1.1	SAND and SILT, trace to some clay, trace gravel Compact Brown Moist										
	SAND, some gravel, trace silt Compact Brown Wet										
	END OF BOREHOLE SPOON REFUSAL										

NOTES:

1. Water level in open borehole at a depth of 0.9 m below ground surface (Elev. 188.3 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m east of Borehole S206-01 to confirm depth to refusal; refusal encountered at a depth of 0.8 m below ground surface (Elev. 188.4 m).

3. Bedrock outcrop observed in the vicinity of Borehole S206-01.

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

Golder Associates

RECORD OF BOREHOLE No S206-02

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075593.8 ;E 224658.3
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 19, 2010
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P	w	w_L	γ kN/m³	GR SA SI CL
188.6	GROUND SURFACE												
0.0 / 0.1	TOPSOIL												
	END OF EXCAVATION PROBABLE BEDROCK												

WATER CONTENT (%) 20 40 60

NOTE:

1. Hand digging carried out at proposed borehole location to expose bedrock.

2. Excavation dry upon completion.

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

Golder Associates

RECORD OF BOREHOLE No S206-03

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075610.4 ;E 224658.2
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Portable Equipment
COMPILED BY OK
DATUM Geodetic
DATE January 19, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR	SA	SI	CL
187.5	GROUND SURFACE													
0.0 / 0.1	TOPSOIL													
	SAND, trace gravel, trace silt, slightly organic and containing rootlets		1	SS	5		187		○	OC = 2.5%				
186.6	Loose		2A	SS	7	▽								
0.9	Brown Moist to wet		2B						○	OC = 2.4%	0	59	33	8
	SAND and SILT, trace to some clay, slightly organic Very loose to loose		3	SS	3		186							
185.8	Grey Wet													
1.9	END OF BOREHOLE SPOON REFUSAL													

END OF DCPT
Refusal to Further Penetration
(Hammer Bouncing)

NOTES:

1. Water level in open borehole at a depth of 1.0 m below ground surface (Elev. 186.5 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S206-03 to confirm depth to refusal; refusal encountered at a depth of 1.9 m below ground surface (Elev. 185.6 m).

3. Bedrock outcrop observed south of Borehole S206-03.

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

Golder Associates

RECORD OF BOREHOLE No S206-04

 METRIC

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075610.9 ;E 224639.8	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment	COMPILED BY	OK
DATUM	Geodetic	DATE	January 19, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.6	ICE SURFACE										
0.0	ICE										
	WATER		1A	SS	2						
186.1	TOPSOIL		1B				186				
185.8	CLAYEY SILT, trace sand, containing rootlets		2	SS	75/0.10						
0.9	Very soft to very stiff										
185.3	Brown and grey										
1.3	Wet to moist										
	END OF BOREHOLE										
	SPOON REFUSAL										
	END OF DCPT										
	Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Water level in open borehole at ice surface (Elev. 186.6 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S206-04 to confirm depth to refusal; refusal encountered at a depth of 1.3 m below ice surface (Elev. 185.3 m).

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

Golder Associates

RECORD OF BOREHOLE No S206-05

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075630.3 ;E 224643.0
BOREHOLE TYPE Portable Equipment
DATE January 19, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE: ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.0	GROUND SURFACE										
0.0	TOPSOIL		1A								
0.1	SAND, trace gravel, trace silt, containing rootlets		1B	SS	6				○		
188.5	Loose Brown Moist										
0.7	END OF BOREHOLE SPOON REFUSAL END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. Open borehole dry upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S206-05 to confirm depth to refusal; refusal encountered at a depth of 0.7 m below ground surface (Elev. 188.3 m).

3. Bedrock outcrop observed in the vicinity of Borehole S206-05.

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

Golder Associates

RECORD OF BOREHOLE No S206-06

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
DIST HWY 69
DATUM Geodetic
LOCATION N 5075649.0 ;E 224645.3
BOREHOLE TYPE Portable Equipment
DATE January 19, 2010
ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

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	SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	w_P — w — w_L; WATER CONTENT (%) (20 40 60)	γ kN/m³	GR SA SI CL
186.1	GROUND SURFACE										
0.0 / 185.8	PEAT, containing rootlets, (Fibrous) Very soft Grey Wet		1A	SS	2		186				
185.5 / 0.6	Sandy SILT, containing rootlets and topsoil Very loose Grey Wet		1B						○		

END OF BOREHOLE
SPOON REFUSAL

NOTES:

1. Water level in open borehole at ground surface (Elev. 186.1 m) upon completion of drilling.

2. A Dynamic Cone Penetration Test was advanced 1.5 m west of Borehole S206-06 to confirm depth to refusal; refusal encountered at a depth of 0.5 m below ground surface (Elev. 186.6 m).

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

Golder Associates

RECORD OF BOREHOLE No S206-07

 METRIC

PROJECT 09-1111-6014
W.P. 5404-05-01
LOCATION N 5075649.1 ;E 224626.4
ORIGINATED BY MR
DIST
HWY 69
BOREHOLE TYPE Hand Excavation
COMPILED BY OK
DATUM Geodetic
DATE January 19, 2010
CHECKED BY TVA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
189.3	GROUND SURFACE										
0.0	BEDROCK OUTCROP										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S206-DC01

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075611.5 ;E 224678.4	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 19, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.7	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
190.2											
0.5	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

NOTES:

1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.

2. An additional Dynamic Cone Penetration Test was advanced 1.0 m west of DCPT S206-DC01 to confirm depth to refusal; see Record of DCPT S206-DC01A for details.

3. Bedrock outcrop observed approximately 1.0 m west of DCPT S206-DC01.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S206-DC01A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014		
W.P.	5404-05-01	LOCATION	N 5075610.9 ;E 224677.6
DIST		HWY	69
DATUM	Geodetic	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test
		DATE	January 19, 2010

ORIGINATED BY MR
COMPILED BY OK
CHECKED BY TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.7	GROUND SURFACE										
0.0 / 190.3	Dynamic Cone Penetration Test (DCPT)										
0.4	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. DCPT advanced using portable drilling equipment with a half-weight hammer. Blows shown have been adjusted to reflect values that would be obtained with a standard weight hammer.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF DCPT No S206-DC02

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075631.9 ;E 224663.7	ORIGINATED BY	MR
DIST		HWY 69	BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 19, 2010	CHECKED BY	TVA

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.0	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
0.2	END OF DCPT Refusal to Further Penetration (Hammer Bouncing) NOTE: 1. Bedrock outcrop observed in the vicinity of DCPT S206-DC02.										

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

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RECORD OF DCPT No S206-DC03

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075631.3 ;E 224625.2	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 19, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.8	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
188.3											
0.5	END OF DCPT Refusal to Further Penetration (100 Blows / 0.15 m) NOTE: 1. An additional Dynamic Cone Penetration Test was drilled 1.5 m west of DCPT S206-DC03 to confirm depth to refusal; see Record of DCPT S206-DC03A for details.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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RECORD OF DCPT No S206-DC03A

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014		
W.P.	5404-05-01	LOCATION	N 5075630.6 ;E 224624.4
DIST		HWY	69
DATUM	Geodetic	DATE	January 19, 2010
BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test		
ORIGINATED BY	MR	COMPILED BY	OK
CHECKED BY	TVA		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
188.8	GROUND SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)										
188.2											
0.6	END OF DCPT Refusal to Further Penetration (Hammer Bouncing)										

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

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RECORD OF DCPT No S206-DC04

SHEET 1 OF 1 **METRIC**

PROJECT	09-1111-6014				
W.P.	5404-05-01	LOCATION	N 5075621.0 ;E 224670.2	ORIGINATED BY	MR
DIST		HWY	69	BOREHOLE TYPE	Portable Equipment, Dynamic Cone Penetration Test	COMPILED BY	OK
DATUM	Geodetic	DATE	January 19, 2010	CHECKED BY	TVA

SOIL PROFILE: ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.0	ICE SURFACE										
0.0	Dynamic Cone Penetration Test (DCPT)						185				
183.9							184				
2.1	END OF DCPT Refusal to Further Penetration (100 Blows / 0.23 m) NOTE: 1. Bedrock outcrop observed in the vicinity of DCPT S206-DC04.										

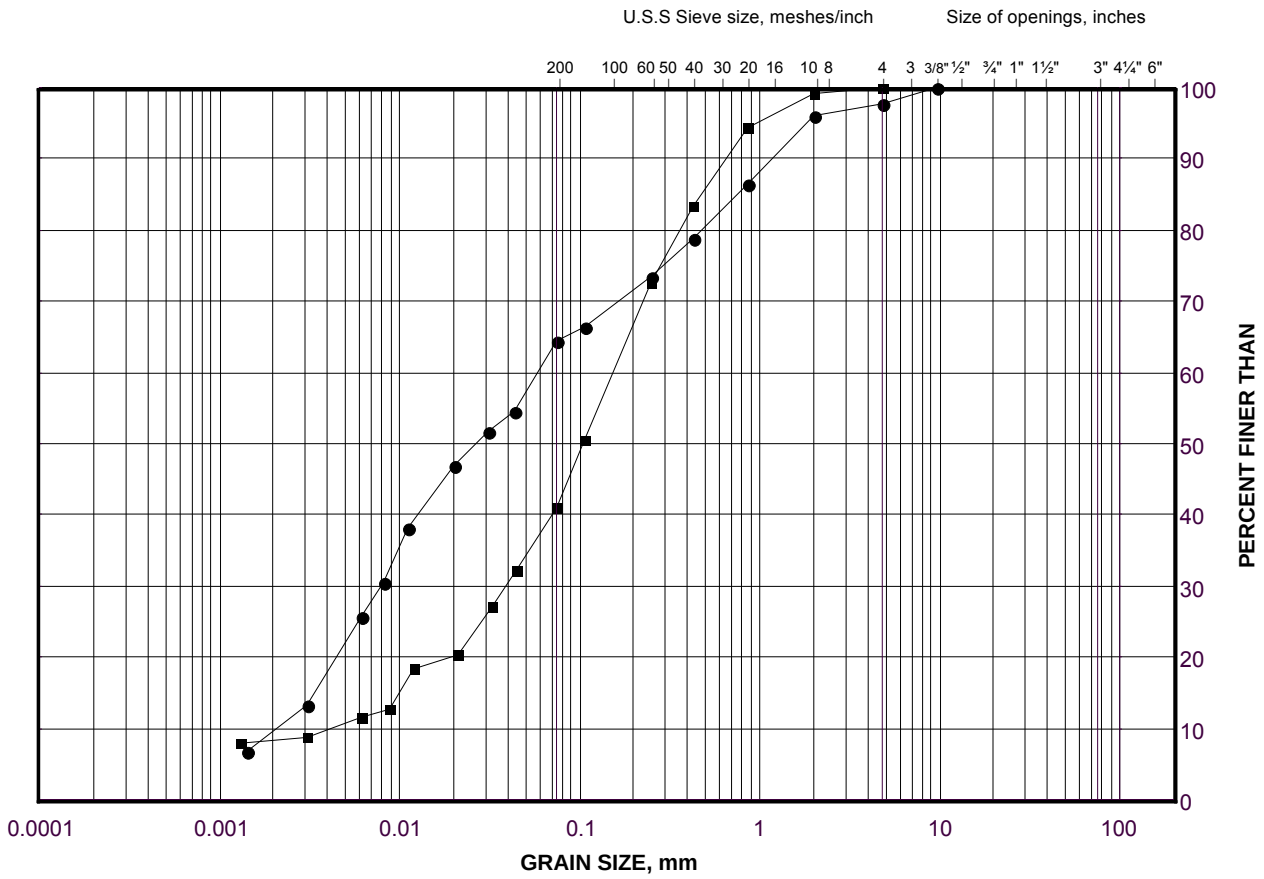
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

Sand and Silt

Highway 69 (NBL) STA 12+750 to 12+825 (Swamp 206)

FIGURE F.S206-01



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	S206-01	2A	188.4
■	S206-03	2B	186.4

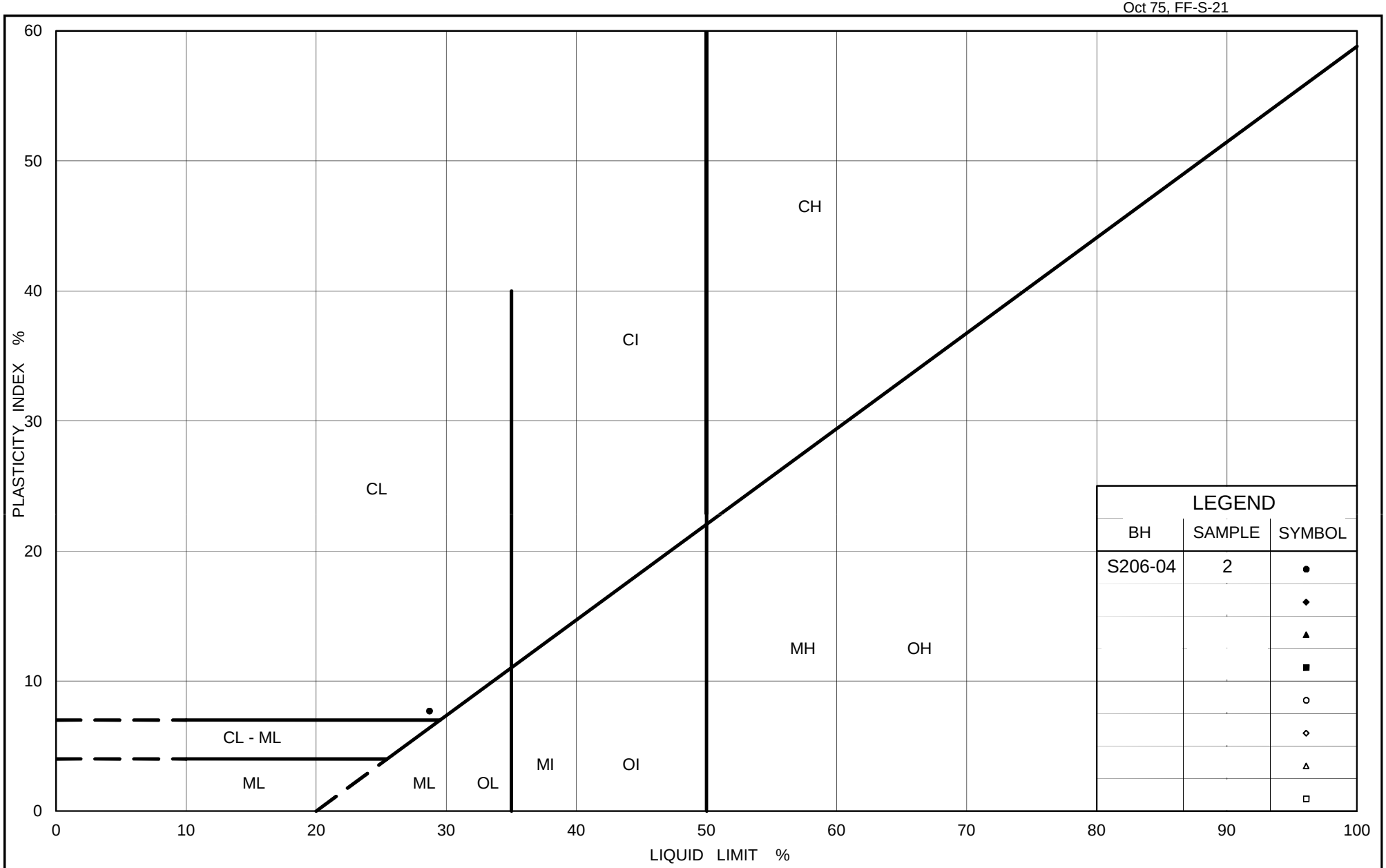
Project Number: 09-1111-6014

Checked By: TVA

Golder Associates

Date: 17-May-11

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Clayey Silt
Highway 69 (NBL) STA 12+750 to 12+825 (Swamp 206)

Figure No. F.S206-02

Project No. 09-1111-6014

Checked By: TVA

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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