



July 20, 2015

FOUNDATION INVESTIGATION REPORT

**SHEBESHEKONG ROAD UNDERPASS STRUCTURE
SITE NO. 44-442
HIGHWAY 69 FOUR-LANING FROM 1.0 KM NORTH OF
THE NEW HIGHWAY 559 INTERCHANGE NORTHERLY TO
1.5 KM NORTH OF HIGHWAY 7182 FOR 17 KM
MINISTRY OF TRANSPORTATION, ONTARIO
G.W.P. 5111-07-00, W.P. 5183-06-01 (Phase 2 of G.W.P. 5402-05-00)**

Submitted to:
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REPORT

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PART A

FOUNDATION INVESTIGATION REPORT

SHEBESHEKONG ROAD UNDERPASS STRUCTURE, SITE NO. 44-442

**HIGHWAY 69 FOUR-LANING FROM 1.0 KM NORTH OF THE NEW
HIGHWAY 559 INTERCHANGE NORTHERLY TO 1.5 KM NORTH OF
HIGHWAY 7182 (SHEBESHEKONG ROAD) FOR 17 KM**

MINISTRY OF TRANSPORTATION, ONTARIO

G.W.P. 5111-07-00, W.P. 5183-06-01 (Phase 2 of G.W.P. 5402-05-00)



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by McCormick Rankin, a member of MMM Group Limited on behalf of Ministry of Transportation, Ontario (MTO) to carry out detail foundation investigation services for the proposed Shebeshekong Road Interchange two-span underpass structure (Site No. 44-442) over the proposed new Highway 69 four-laning alignment. The proposed work is part of the detail design for the four-laning of Highway 69 from 1.0 km north of the new Highway 559 Interchange northerly to 1.5 km north of Highway 7182 (Shebeshekong Road), which involves high fill embankments and embankments over swamps, the New Woods Road and Shebeshekong Road interchanges and structures, the Shawanaga River and Site 9 Road bridge structures, as well as culvert crossings. The general location of this interchange structure along the new Highway 69 four-laning alignment is shown 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 July 2006. Golder's proposal for foundation engineering services associated with the Shebeshekong Road underpass structure is contained in Section 6.8 of MRC's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated July 4, 2007. The General Arrangement (GA) drawing for the proposed underpass structure of Highway 69 and Shebeshekong Road was provided to Golder by MRC on September 19, 2008.

This report addresses the investigation carried out for the Shebeshekong Road underpass structure and the immediately adjacent approach embankments only. Separate reports address the foundation investigations for the related swamp crossings and high fill areas for the associated interchange ramps and roadways, culverts and other bridge structures for the project.

The purpose of this investigation is to establish the subsurface conditions at the proposed structure, including the associated approach embankments, by borehole drilling, rock coring and laboratory testing on selected samples. The foundation units/limits for this investigation were located in the field by Callon Dietz Inc. (Callon Dietz), a professional surveying company retained by MRC. The investigation area is shown in plan on Drawing 2.

2.0 SITE DESCRIPTION

The proposed Shebeshekong Road underpass structure is located approximately 2 km south of the intersection of the existing Shebeshekong Road and Highway 69 and is approximately 18 km northwest of Nobel, Ontario. The existing Highway 69, which will be the future Site No. 9 Service Road in this area, runs generally in a southeast-northwest direction along the northeast side of the proposed new Highway 69 alignment.

In general, the topography in the area of the overall project limits consists of rolling terrain including densely treed areas and numerous bedrock outcrops separated by low-lying swamps. The proposed underpass structure and associated approach embankments are to be situated on a relatively flat, densely treed area. The ground surface within the limits of the proposed structure and approach embankments is between about Elevation 216.6 m and Elevation 214.2 m, referenced to geodetic datum, and is gently sloping downward from west to east.



3.0 INVESTIGATION PROCEDURES

3.1 Foundation Investigation

The field work for the Shebeshekong Road underpass structure investigation was carried out between October 27 and November 4, 2008 during which time a total of seventeen (17) boreholes were advanced: five (5) boreholes at the east abutment; five (5) boreholes at the centre pier; five (5) boreholes at the west abutment; and two (2) boreholes at the approach embankments (i.e. one borehole at each approach). The boreholes, designated as Boreholes B2-01 to B2-17, were advanced at approximately the locations shown in plan on Drawing 2.

The field investigation was carried out using a Diedrich D-50 Turbo track-mounted drill rig supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced through the overburden using 115 mm outside diameter solid stem augers and/or 'NW' casing and wash boring methods. Soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter (O.D.) split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586 Standard Test Method for Standard Penetration Test). Samples of the bedrock were obtained using an 'NQ' size rock core barrel.

The boreholes at the foundation elements were typically advanced to auger and/or sampler refusal (i.e. inferred bedrock) and bedrock was confirmed by coring in selected boreholes, while the boreholes at the approach embankments were advanced to sampler refusal (a depth less than the height of the proposed embankments at this site). The depths of the boreholes range from about 0.2 m to 9.7 m below existing ground surface, including coring of between about 1.5 m and 9.2 m into the bedrock, at Boreholes B2-01, B2-03, B2-05 to B2-11, B2-13 and B2-15 to B2-17.

The groundwater conditions in the open boreholes were observed during the drilling operations and piezometers were installed in Boreholes B2-01, B2-09, B2-10 and B2-15 to permit monitoring of the water level at these locations. The piezometers consist of 32 mm diameter PVC pipe, with a slotted screen sealed at a select depth within the borehole. The boreholes and annulus surrounding the piezometer pipe above the sand pack/screen were backfilled to the surface with bentonite pellets/grout. Piezometer installation details and water level readings are described on the Record of Borehole sheets presented in Appendix A. All boreholes in which standpipe piezometers were not installed were backfilled with bentonite to the ground surface upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The field work 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 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. Strength testing, such as unconfined compression and point load index tests were carried out on specimens of the rock core. The results of the laboratory testing are presented on the Record of Borehole sheets in Appendix A and detailed in Appendix B.

The perimeter limits of each foundation unit were located in the field by Callon Dietz prior to drilling. The as-drilled borehole locations and ground surface elevations were surveyed by a member of our technical staff, referenced to survey stakes installed by Callon Dietz. The borehole locations given in the Record of



FOUNDATION REPORT – SHEBESHEKONG ROAD UNDERPASS STRUCTURE – HIGHWAY 69 G.W.P. 5111-07-00

Borehole/Drillhole sheets and shown on Drawing 2 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum and are summarized below.

Borehole	Location (MTM NAD 83)		Ground Surface Elevation (m)	Depth Drilled (m)
	Northing	Easting		
B2-01	5043992.0	245158.5	215.7	5.3
B2-02	5043985.7	245166.2	216.4	0.9
B2-03	5043990.8	245164.0	216.5	6.1
B2-04	5043996.0	245161.8	216.3	1.0
B2-05	5043989.5	245169.4	216.6	4.9
B2-06	5044022.1	245183.3	215.7	9.7
B2-07	5044015.7	245191.1	215.8	3.0
B2-08	5044020.9	245188.8	215.9	3.4
B2-09	5044026.1	245186.6	216.6	3.2
B2-10	5044019.6	245194.2	215.4	9.3
B2-11	5044052.2	245208.2	214.6	6.3
B2-12	5044045.8	245215.9	214.2	3.0
B2-13	5044050.9	245213.6	214.9	6.0
B2-14	5044056.2	245211.4	215.2	0.2
B2-15	5044049.7	245219.1	214.6	2.4
B2-16	5043979.2	245154.4	215.3	3.7
B2-17	5044062.5	245223.2	214.9	1.7

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in The Physiography of Southern Ontario¹, this section of Highway 69 lies within the physiographic region known as the Georgian Bay Fringe, which extends along the east side of Georgian Bay through the

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



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 overlying 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, are present in valleys between the bedrock knobs and ridges.

The bedrock in the area consists typically of 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 4². Deposition of Palaeozoic strata and later erosion during glaciation left behind these Precambrian rocks.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced for this investigation, together with the results of the laboratory tests carried out on selected soil and bedrock core samples, are provided in Appendix A and B, respectively. The results of the in situ field tests (i.e. SPT 'N'-values) as presented on the Record of Borehole sheets and in Sections 4.2.1 to 4.2.6 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. It should be noted that the interpreted stratigraphy shown on Drawings 2 and 3 is a simplification of the subsurface conditions. Variation in the stratigraphic boundaries between and beyond the boreholes will exist and is to be expected.

In general, the subsurface conditions in the area of the proposed underpass consist of a surficial layer of topsoil up to about 0.3 m thick, underlain by a deposit of silty sand to sand and gravel between about 0.7 m and 2.8 m thick (where present). The topsoil or sand deposit is underlain by syenite/granite/biotite gneiss bedrock.

A detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Topsoil

Up to about 0.3 m of topsoil was encountered immediately below ground surface in all of the boreholes advanced at this site.

4.2.2 Silty Clay

A localized stratum of brown silty clay, trace gravel, containing fine sand seams and rootlets was encountered below the topsoil in Borehole B2-12. The top of this deposit is at about Elevation 214.0 m and its thickness is about 0.9 m.

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



The Standard Penetration Test (SPT) 'N'-values measured within the silty clay deposit are 4 blows and 26 blows per 0.3 m of penetration, indicating a firm to very stiff consistency.

The natural water content measured on one (1) sample of the silty clay is about 26 percent. The organic content measured on one (1) sample of the upper portion of this deposit is about 7 percent.

An Atterberg limit test was carried out on one (1) sample of the silty clay deposit. The liquid limit is about 36 percent and the plastic limit is about 20 percent, corresponding to plasticity index of about 16 percent. The results of the Atterberg limits test are shown on the plasticity chart on Figure B1 in Appendix B and indicate that this material is classified as silty clay of intermediate plasticity.

4.2.3 Sandy Silt to Silty Sand

A deposit of brown to mottled grey-brown sandy silt to silty sand, trace clay and containing rootlets was encountered below the topsoil in Boreholes B2-11, B2-13 and B2-15 and below the silty clay in Borehole B2-12. The top of this deposit varies from about Elevation 214.7 m to 213.1 m and the thickness of the deposit ranges from about 1.0 m to 2.2 m.

The SPT 'N'-values measured within the sand to silt deposit range from 4 blows to 38 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The natural water content measured on samples of this deposit range from about 17 percent to 24 percent and the organic content measured on one (1) sample of the upper portion this deposit is about 4 percent.

The grain size distributions of two (2) samples from the sandy silt to silty sand deposit are shown on Figure B2 in Appendix B.

An Atterberg limits test was carried out on one (1) sample of sandy silt to silty sand deposit which confirmed that it is non-plastic.

4.2.4 Silty Sand to Sand Till

A deposit of brown cohesionless till comprised of silty sand to sand with some silt, trace gravel and clay, containing cobbles, roots and rootlets was encountered below the topsoil in Boreholes B2-01, B2-02 and B2-16. The top of this deposit varies from about Elevation 216.2 m to 215.2 m and the thickness of the deposit ranges from about 0.4 m to 1.2 m.

The SPT 'N'-values measured within the silty sand to sand till deposit typically range from 3 blows to 34 blows per 0.3 m of penetration, indicating a loose to dense relative density. A SPT 'N'-value of 20 blows per 0.15 m of penetration was recorded in Borehole B2-01 prior to split-spoon refusal on bedrock.

The natural water content measured on samples of this deposit range from about 19 percent to 44 percent and the organic content measured on one (1) sample of the upper portion of this deposit is about 10 percent.

The grain size distributions of two (2) samples from the silty sand to sand till deposit are shown on Figure B3 in Appendix B.



4.2.5 Sand and Gravel Till

A deposit of brown cohesionless till comprised of sand and gravel with some silt to silty sand and gravel, trace clay and containing cobbles and boulders was encountered below the topsoil in Borehole B2-04, below the silty sand till deposit in Borehole B2-02, and below the sandy silt deposit in Boreholes B2-11 to B2-13. The top of this deposit varies from about Elevation 216.1 m and 212.1 m and its thickness ranges from 0.3 m to 0.9 m.

The SPT 'N'-values measured within the sand and gravel till deposit range from 35 blows per 0.3 m of penetration to 25 blows per 0.1 m of penetration, indicating a dense to very dense relative density. A SPT 'N'-value of 9 blows per 0.3 m of penetration was recorded within this layer in Borehole B2-04, indicating a very loose relative density at the top of the deposit immediately underlying the peat.

The natural water content measured on samples of this deposit range from about 9 percent to 32 percent.

The grain size distribution on one (1) sample of the sand and gravel till deposit is presented on Figure B4 in Appendix B.

4.2.6 Bedrock

Bedrock was encountered and core samples were recovered from Boreholes B2-01, B2-03, B2-05 to B2-11, B2-13 and B2-15 to B2-17 and the presence of bedrock was inferred from refusal to split-spoon and/or auger advance in Boreholes B2-02, B2-04 and B2-12 and from refusal to shovel penetration in Borehole B2-14. The depth to the bedrock surface is variable and ranges from about 0.1 m to 3.0 m below ground surface. Across the west abutment and centre pier, the bedrock surface elevation varies by up to about 1.8 m and 1.2 m, respectively. Across the east abutment, from the northeast corner to the southwest corner (a distance of about 11 m), the bedrock surface elevation varies by about 3.8 m (approximately 2.9H:1V slope or a dip of approximately 19° from the horizontal). The depth to bedrock below ground surface and corresponding bedrock surface elevation as encountered at the borehole locations is summarized below.

Foundation Element / Approach Embankment	Borehole No.	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	Refusal Type
West Approach Embankment	B2-16	1.3	214.0	Bedrock Cored
	B2-01	1.0	214.7	Bedrock Cored
West Abutment	B2-02	0.9	215.5	Spoon/Auger Refusal
	B2-03	0.0	216.5	Bedrock Cored
	B2-04	1.0	215.3	Auger Refusal
	B2-05	0.3	216.3	Bedrock Cored
	B2-06	0.1	215.6	Bedrock Cored
Centre Pier	B2-07	0.1	215.7	Bedrock Cored
	B2-08	0.3	215.6	Bedrock Cored
	B2-09	0.1	216.5	Bedrock Cored
	B2-10	0.1	215.3	Bedrock Cored
East Abutment	B2-11	2.0	212.6	Bedrock Cored
	B2-12	3.0	211.2	Spoon/Auger Refusal
	B2-13	1.7	213.2	Bedrock Cored
	B2-14	0.2	215.0	Shovel Refusal
East Approach Embankment	B2-15	2.4	212.2	Bedrock Cored
	B2-17	0.2	214.7	Bedrock Cored



Based on the samples of bedrock obtained from the boreholes, the bedrock generally consists of granite/syenite/biotite gneiss. In general, the bedrock samples are described as moderately weathered to fresh, fine to coarse crystalline, slightly foliated to foliated, black and white syenite gneiss. The Rock Quality Designation (RQD) measured on the core samples is typically between about 75 percent and 100 percent, indicating a rock mass of good to excellent quality, according to Table 3.10 in CFEM (2006)³. However, portions of core recovered from Boreholes B2-06 and B2-07 on the west side of the centre pier and B2-16 and B2-17 under the approach embankments, contain zones of moderately to highly weathered, fractured rock with RQD values between about 20 percent and 67 percent, indicating a rock mass of poor to fair quality. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are typically between about 89 percent and 100 percent and about 76 percent and 100 percent, respectively however, at Borehole B2-16 the SCR was noted to be as low as about 33 percent.

Point load strength tests were performed on selected samples of the rock core. The axial and diametral point load strength index values are shown on the Record of Drillhole sheets and in Table B1 in Appendix B. The point load index (Is_{50}) results from the axial laboratory tests carried out on seven (7) samples of the syenitic bedrock range from approximately 2.6 MPa to 8.4 MPa, with an average of about 6.8 MPa. The point load index (Is_{50}) results from the diametral laboratory tests carried out on three (3) samples of the syenitic bedrock range from approximately 6.1 MPa to 8.8 MPa, with an average of about 7.3 MPa.

Four (4) Unconfined Compression (UC) tests were carried out in accordance with ASTM D7102 (Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens) on selected samples of the syenite gneiss bedrock, that measured compressive strengths between about 78 MPa and 121 MPa with an average value of about 98 MPa, as summarized in Tables B2-1 to B2-4 in Appendix B.

Also presented in Table B1 are the estimated Uniaxial Compressive Strength (UCS) values for each sample tested for point load strength based on a relationship between Is_{50} and UCS which is given by a correlation factor (K) in accordance with ASTM D5731 (Standard Test Method for Determination of the Point Load Strength Index of Rock), which varies depending on the size of the core sample and the strength of the rock. For this site, the UCS values are based on an estimated average correlation factor (K) of 14 which was calculated based on a comparison of the UC test results and the point load strength test results. These values have been given for comparison only and should be interpreted together with the results of the UC tests.

Based on the laboratory UC tests and point load testing results in accordance with Table 3.5, CFEM 2006³, the the syenitic bedrock is classified as strong (R4, 50 MPa < UCS < 100 MPa) to very strong (R5, 100 MPa < UCS < 250 MPa).

4.2.7 Groundwater Conditions

The water level in the boreholes as noted during and upon completion of drilling operations was typically between about Elevation 215.9 m and Elevation 213.5 m, measured at ground surface to about 3.1 m below ground surface. In general, the samples taken in the overburden boreholes were noted to be moist to wet. Standpipe piezometers were installed in Boreholes B2-01, B2-09, B2-10 and B2-15 to permit monitoring of the water levels at this site. Details of the piezometer installations are shown the Record of Borehole and Drillhole sheets in Appendix A. The groundwater levels measured in the piezometer installations are summarized below.

³ Canadian Geotechnical Society. 2006. *Canadian Foundation Engineering Manual*, 4th Edition. The Canadian Geotechnical Society c/o BiTech Publisher Ltd., British Columbia.



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Foundation Element	Borehole No.	Ground Surface Elevation (m)	Groundwater Elevation (m)	Date of Measurement
West Abutment	B2-01	215.7	215.3	November 5, 2008
			215.5	April 12, 2009
			215.3	June 10, 2009
Centre Pier	B2-09	216.6	215.6	November 5, 2008
			214.8	April 12, 2009
			213.5	June 10, 2009
Centre Pier	B2-10	215.4	213.6	November 5, 2008
			213.7	April 12, 2009
			213.6	June 10, 2009
East Abutment	B2-15	214.6	214.2	November 5, 2008
			214.2	April 12, 2009
			214.2	June 10, 2009

It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.

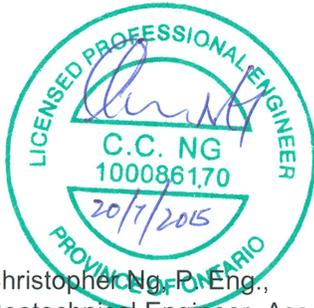
5.0 CLOSURE

The field technician directing the drilling and sampling program was Mr. Chris Radway. This report was prepared by Mr. Matthew Kelly, P. Eng., and Mr. Christopher Ng, 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.



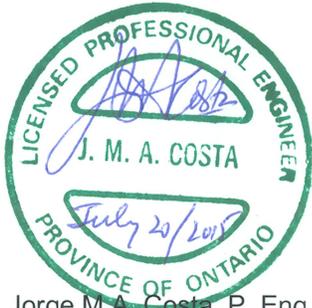
Report Signature Page

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TVA/MWK/CN/JPD/JMAC/jl

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DRAWINGS

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

CONT No.
 WP No. 5183-06-01



HIGHWAY 69
 SITE LOCATION PLAN

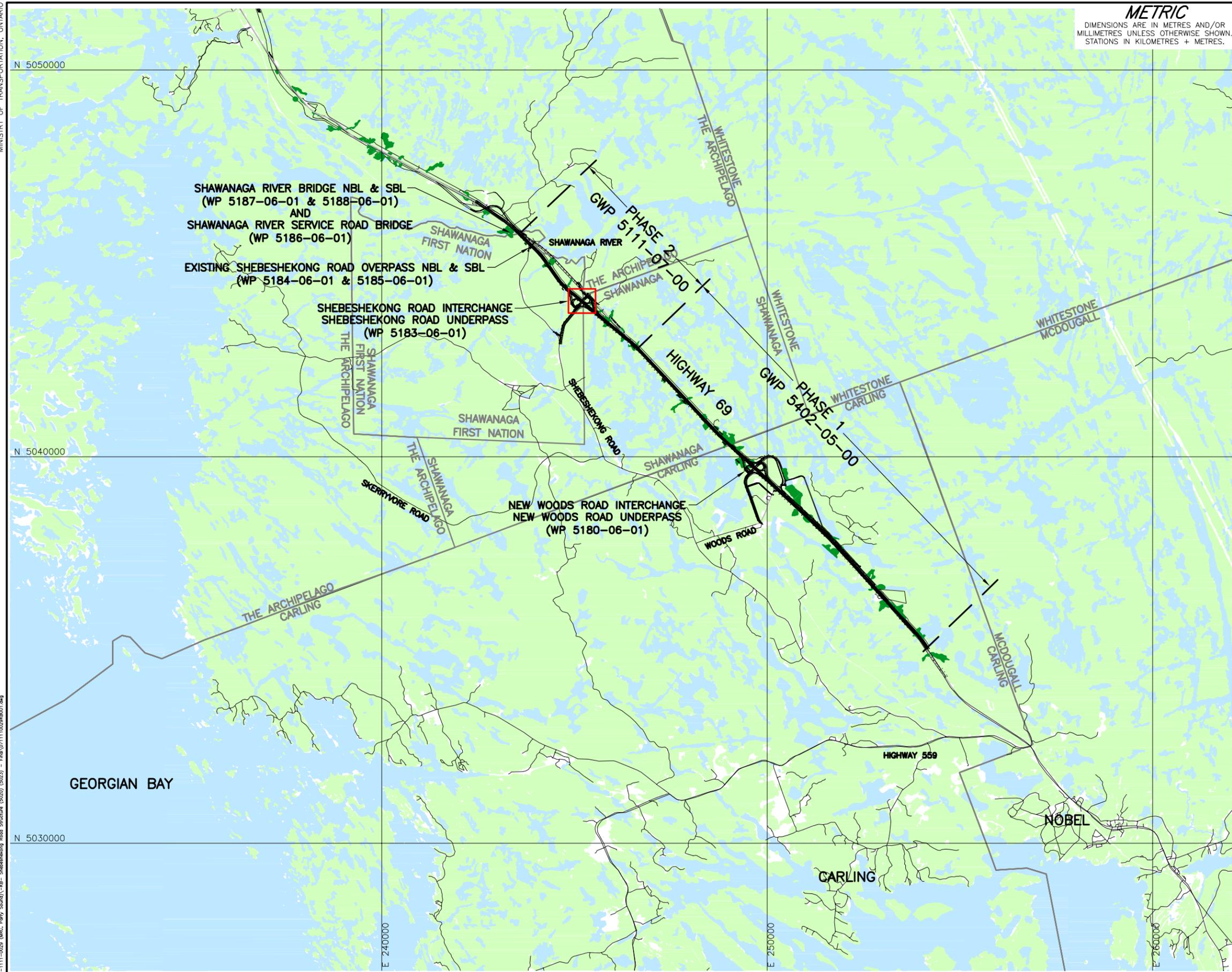
SHEET



Golder Associates Ltd.
 MISSISSAUGA, ONTARIO, CANADA



KEY PLAN
 NOT TO SCALE



PLAN



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REFERENCE
 Base Data - MNR NRVIS, obtained 2004, CANMAP v2006.4
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 Datum : NAD 83 Projection : MTM Zone 10

NO.	DATE	BY	REVISION

Geocres No. 41H-140

HWY. 69	PROJECT NO. 07-1111-0029	DIST.
SUBM'D. VA	CHKD. VA	DATE: Jul. 2015
DRAWN: DD/CD	CHKD. CN	APPD. JPD/JMAC
		SITE: 44-442
		DWG. 1

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

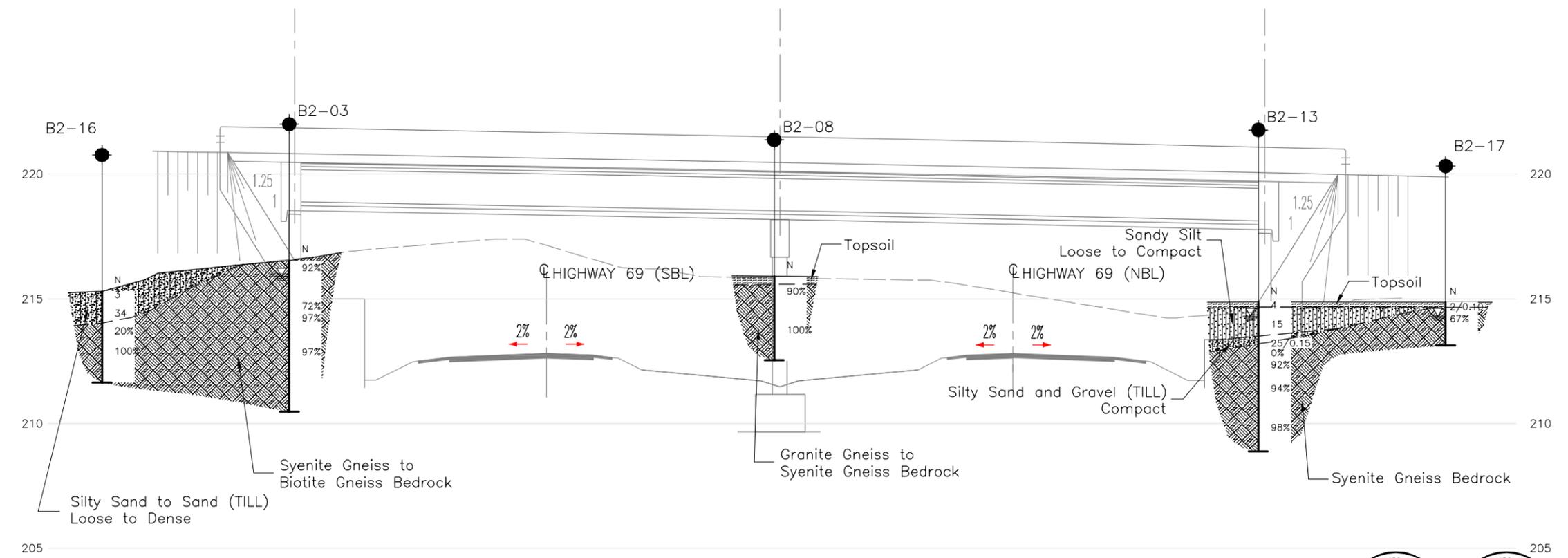
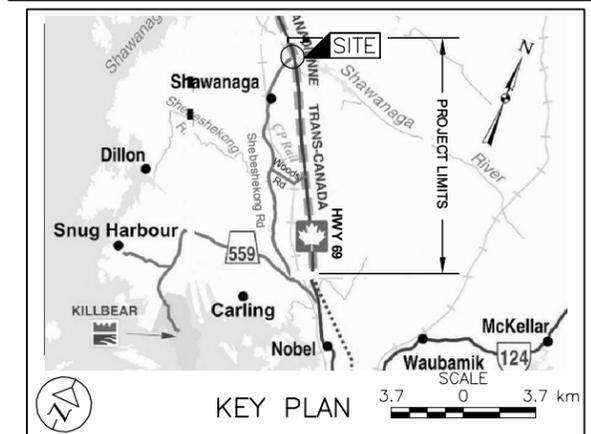
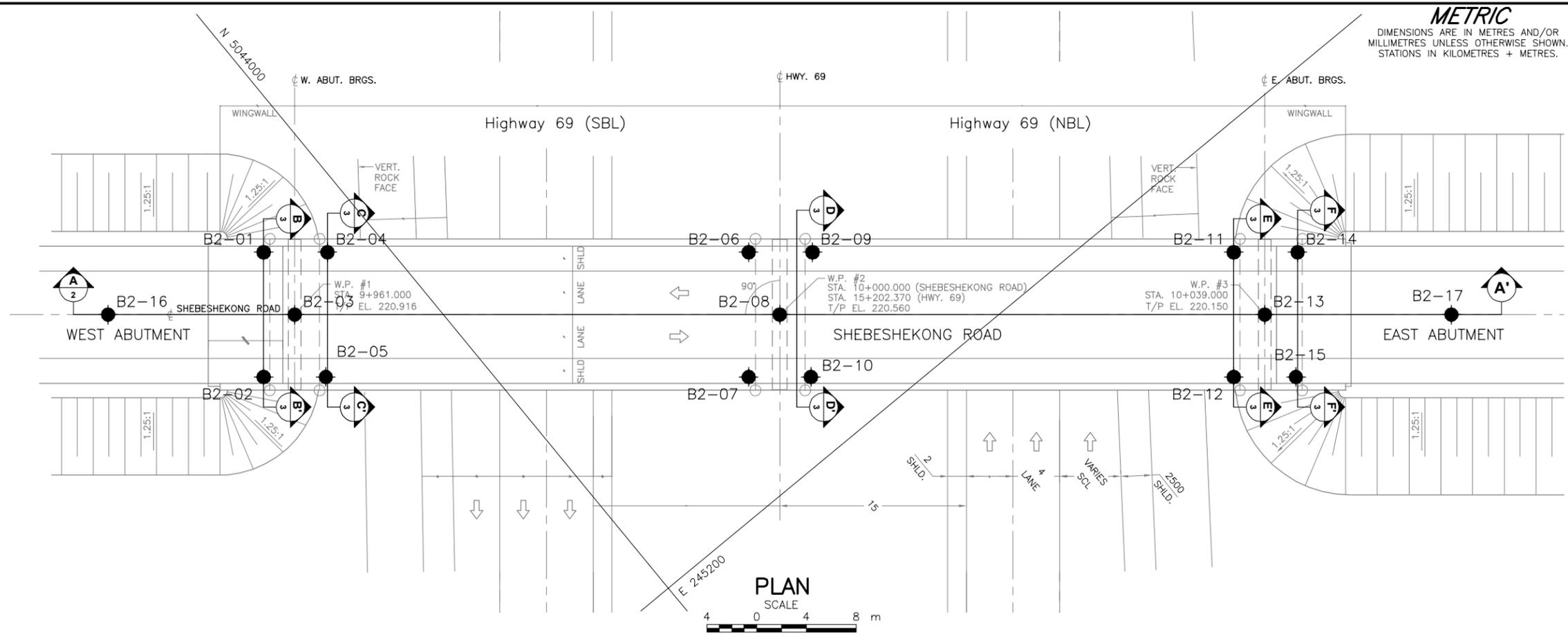
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WP No. 5183-06-01



HIGHWAY 69
SHEBESHEKONG ROAD UNDERPASS
BOREHOLE LOCATION
AND SOIL STRATA

SHEET

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- ⊥ Seal
- ⊏ Piezometer
- 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

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
B2-01	215.7	5043992.0	245158.5
B2-02	216.4	5043985.7	245166.2
B2-03	216.5	5043990.8	245164.0
B2-04	216.3	5043996.0	245161.8
B2-05	216.6	5043989.5	245169.4
B2-06	215.7	5044022.1	245183.3
B2-07	215.8	5044015.7	245191.1
B2-08	215.9	5044020.9	245188.8
B2-09	216.6	5044026.1	245186.6
B2-10	215.4	5044019.6	245194.2
B2-11	214.6	5044052.2	245208.2
B2-12	214.2	5044045.8	245215.9
B2-13	214.9	5044050.9	245213.6
B2-14	215.2	5044056.2	245211.4
B2-15	214.6	5044049.7	245219.1
B2-16	215.3	5043979.2	245154.4
B2-17	214.7	5044062.5	245223.2

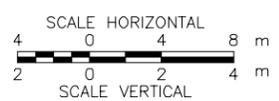
NOTES

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.

A-A'
2 CENTRELINE PROFILE SHEBESHEKONG ROAD UNDERPASS



PROFESSIONAL ENGINEER
J. M. A. COSTA
June 03, 2015
PROVINCE OF ONTARIO

PROFESSIONAL ENGINEER
J.P. DITTRICH
June 03, 2015
PROVINCE OF ONTARIO

REFERENCE
Base plans provided in digital format by MRC, drawing file no. S6878-325-001GA.dwg, received on September 19, 2008.

NO.	DATE	BY	REVISION

Geocres No. 41H-140

HWY. 69	PROJECT NO. 07-1111-0029	DIST.
SUBM'D. MWK	CHKD. MWK	DATE: JUL. 2015
DRAWN: DD/RJ	CHKD. CN	APPD. JPD/JMAC
		DWG. 2

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

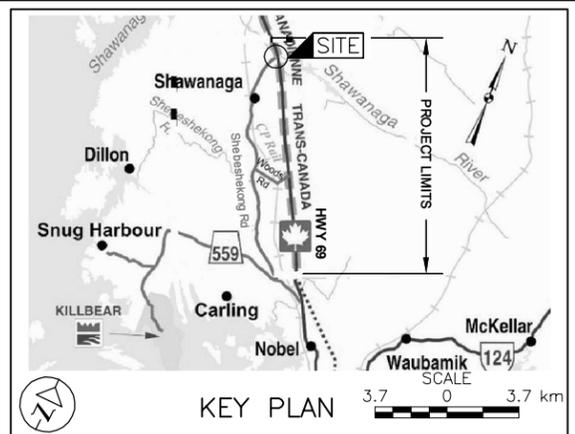
CONT No.
WP No. 5183-06-01

HIGHWAY 69
SHEBESHEKONG ROAD UNDERPASS
SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- ≡ WL in piezometer, measured on June 10, 2009
- ≡ WL upon completion of drilling
- R Refusal

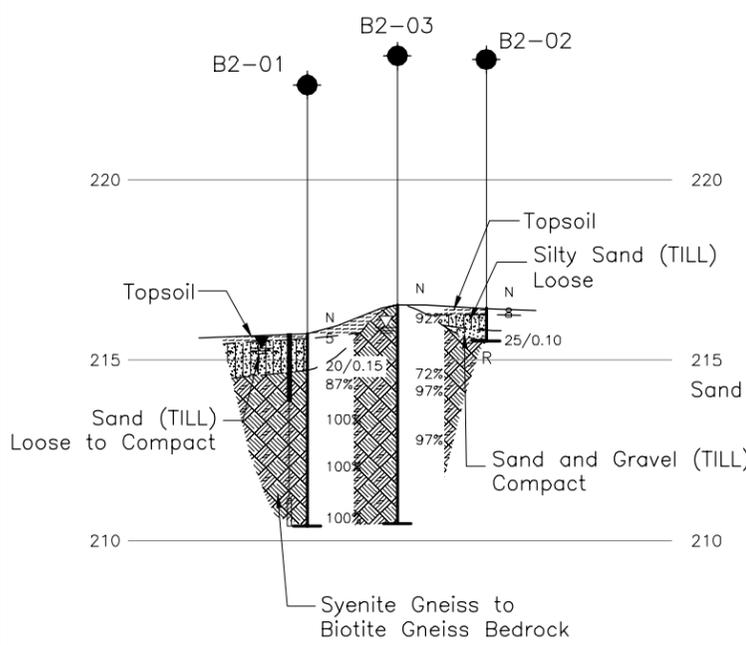
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
B2-01	215.7	5043992.0	245158.5
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B2-10	215.4	5044019.6	245194.2
B2-11	214.6	5044052.2	245208.2
B2-12	214.2	5044045.8	245215.9
B2-13	214.9	5044050.9	245213.6
B2-14	215.2	5044056.2	245211.4
B2-15	214.6	5044049.7	245219.1

NOTES

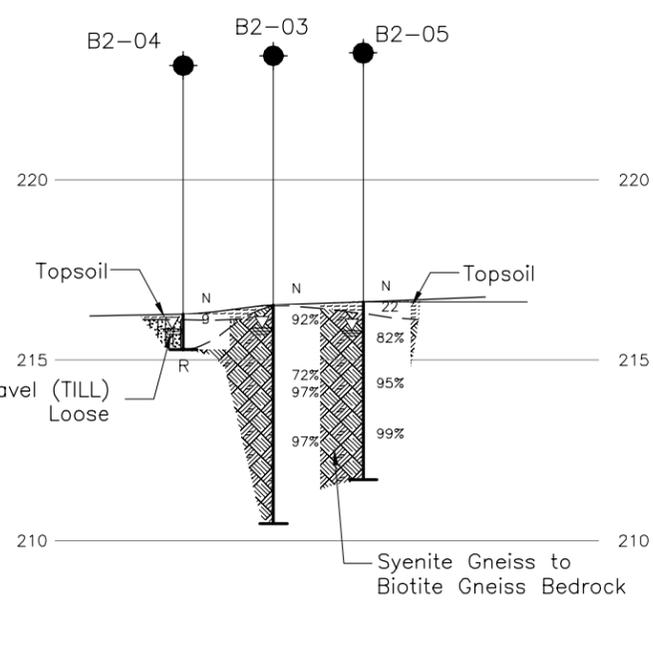
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The boundaries between soil strata have been established only at borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

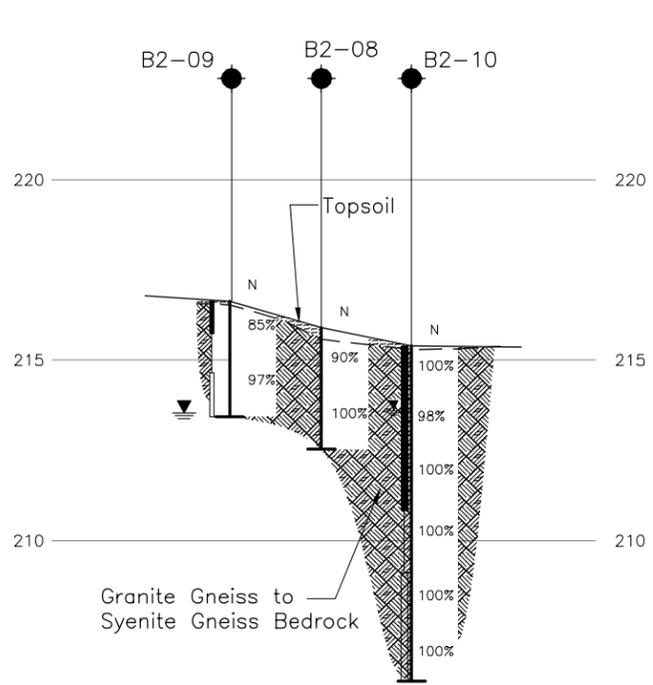
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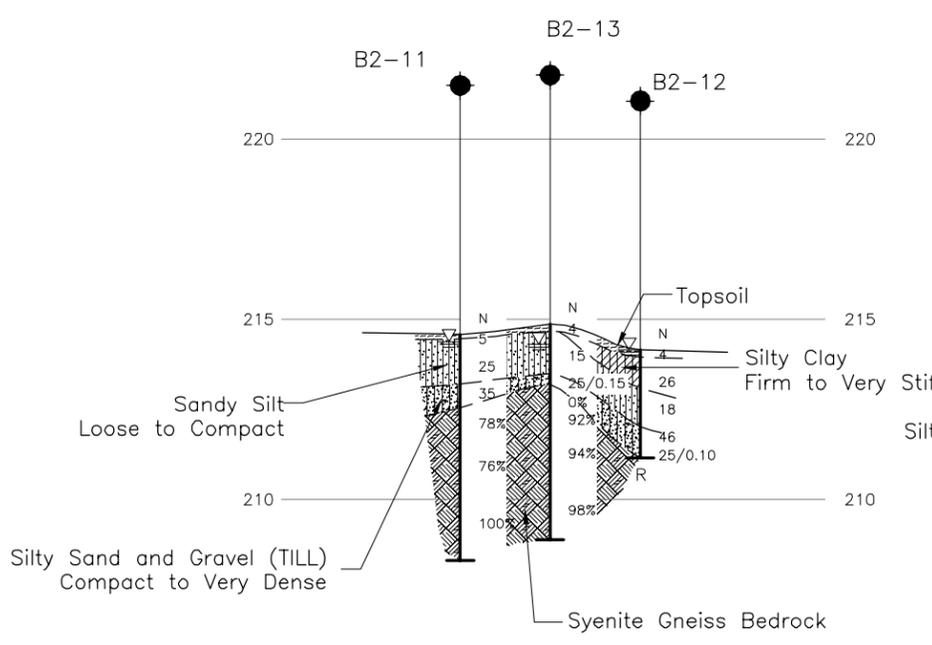
(B-B') 2 WEST ABUTMENT (BACK)



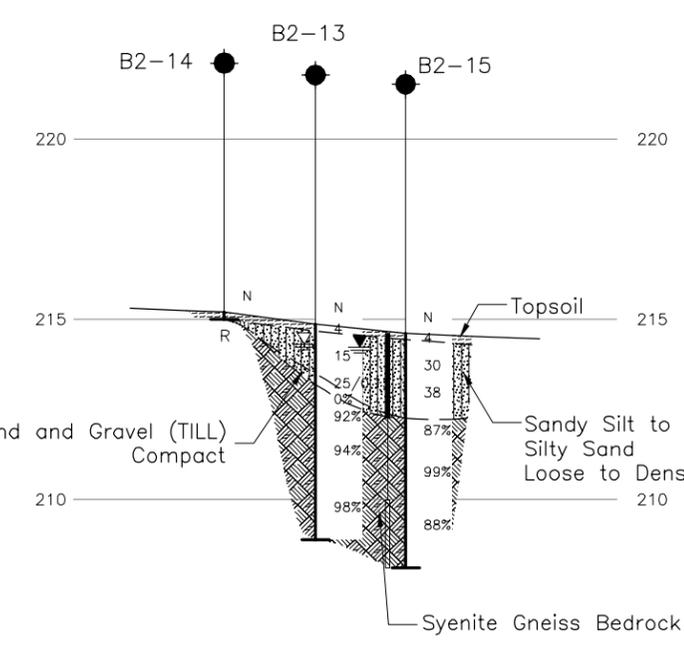
(C-C') 2 WEST ABUTMENT (FRONT)



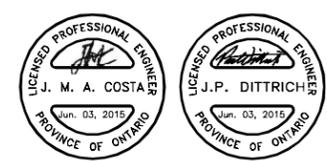
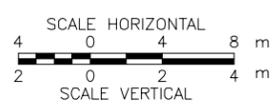
(D-D') 2 CENTRE PIER



(E-E') 2 EAST ABUTMENT (FRONT)



(F-F') 2 EAST ABUTMENT (BACK)



NO.	DATE	BY	REVISION

Geocres No. 41H-140

HWY. 69	PROJECT NO. 07-1111-0029	DIST.
SUBM'D. MWK	CHKD. MWK	DATE: Jul. 2015
SITE: 44-442	APPD. JPD/JMAC	DWG. 3



APPENDIX A

Record of Boreholes and Drillholes



LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

* 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 = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
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, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

V. MINOR SOIL CONSTITUENTS

Percent 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 With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index	N
Relative Density	<u>Blows/300 mm or Blows/ft</u>
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

	<u>kPa</u>	<u>Cu, Su</u>	<u>psf</u>
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.



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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

<u>Description</u>	<u>Bedding Plane Spacing</u>
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

<u>Description</u>	<u>Spacing</u>
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

<u>Term</u>	<u>Size*</u>
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	

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-01	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5043992.0 ; E 245158.5</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 27 and 30, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
215.7	GROUND SURFACE															
0.0	TOPSOIL															
214.7	SAND, some silt, trace gravel, trace clay, containing roots and rootlets (TILL) Loose to compact Brown Wet		1	SS	5									44.2		OC = 9.7%
1.0	Syenite Gneiss to Biotite Gneiss (BEDROCK) Bedrock cored from depths of 1.0 m to 5.3 m For bedrock coring details, refer to Record of Drillhole B2-01		2	SS	20/0.15											4 78 16 2
			1	RC	REC 100%											RQD = 87%
			2	RC	REC 98%											RQD = 100%
			3	RC	REC 100%											RQD = 100%
			4	RC	REC 100%											RQD = 100%
210.4	END OF BOREHOLE															
5.3	NOTE: 1. Water level measured in piezometer: Date Depth (m) Elev (m) 05/11/08 0.4 215.3 12/04/09 0.2 215.5 10/06/09 0.4 215.3															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-01

SHEET 1 OF 1

LOCATION: N 5043992.0 ;E 245158.5

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRALLIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES		
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION						
							80-90	80-90			0-90	0-90	0-90						
1	NO RC October 27 and 30, 2008	Continued from Record of Borehole B2-01		214.70															
		SYENITE GNEISS Slightly weathered to fresh, fine to medium grained, foliated, black and white		1.00															
1		0.3		Light brown 80 - 90															
2		0.3		Light brown 80 - 90															
2		0.3		Light brown 80 - 90															
3		BIOTITE GNEISS Fresh, fine to medium, crystalline, foliated, black and white		212.20															
3.50																			
3	0.3	Light brown 80 - 90																	
4	0.3	Light brown 80 - 90																	
4	0.3	Light brown 80 - 90																	
5		END OF BOREHOLE		210.40															
5.30																			

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC



PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-02	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5043985.7 ; E 245166.2</u>	ORIGINATED BY <u>CR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>115 mm O.D. Solid Stem Augers</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 30, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
216.4 0.0	GROUND SURFACE TOPSOIL		1	SS	8		216										
215.8	Silty SAND, some gravel, trace clay, containing cobbles and rootlets (TILL)		2	SS	25/0.10	▽											
215.5 0.9	Loose Brown Moist SAND and GRAVEL, some silt, trace clay, containing cobbles (TILL) Compact Brown Moist END OF BOREHOLE SPOON AND AUGER REFUSAL																

NOTE:
1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 215.6 m) upon completion of drilling.

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-03	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5043990.8 ; E 245164.0</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 29, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L	GR	SA	SI	CL	
216.5	GROUND SURFACE																		
0.0	TOPSOIL																		
	Syenite Gneiss to Biotite Gneiss (BEDROCK)					▽													
	Bedrock cored from depths of 0.03 m to 6.1 m		1	RC	REC 100%		216												RQD = 92%
	For bedrock coring details, refer to Record of Drillhole B2-03		2	RC	REC 96%		215												RQD = 72%
			3	RC	REC 100%		214												RQD = 97%
			4	RC	REC 99%		212												RQD = 97%
210.4	END OF BOREHOLE						211												
6.1	NOTE: 1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 215.9 m) upon completion of drilling.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-03

SHEET 1 OF 1

LOCATION: N 5043990.8 ;E 245164.0

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRALLIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES					
							FLUSH	TOTAL CORE %			SOLID CORE %	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION					Jr	Ja	Jn		
														IR								ST	CO
		Continued from Record of Borehole B2-03		216.48																			
		SYENITE GNEISS Slightly weathered, fine to medium, crystalline, foliated, black and white		0.02																			
1					1	Light brown 80 - 90																	
					2	Light brown to light grey 80 - 90																	
2																							
					3	Light brown 80 - 90																	
3																							
		BIOTITE GNEISS Slightly weathered to fresh, fine to medium, crystalline, foliated, black and white		213.20																			
4				3.30																			
					4	Light brown 80 - 90																	
5																							
6		END OF DRILLHOLE		210.40																			
				6.10																			
7																							
8																							
9																							
10																							

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

DEPTH SCALE
1 : 50



LOGGED: CR
CHECKED: CN

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-04	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5043996.0; E 245161.8</u>	ORIGINATED BY <u>CR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>115 mm O.D. Solid Stem Augers</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 30, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	GR
216.3	GROUND SURFACE																	
0.0	TOPSOIL		1A	SS	9	▽	216											
0.2	SAND and GRAVEL, some silt, trace clay, containing cobbles (TILL)		1B															50 38 11 1
215.3	Loose Brown Wet																	
1.0	END OF BOREHOLE AUGER REFUSAL																	
	NOTE: 1. Water level in open borehole at a depth of 0.4 m below ground surface (Elev. 215.9 m) upon completion of drilling.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-05	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5043989.5 ; E 245169.4</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 29, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W			W _L	20	40	60	80
216.6	GROUND SURFACE																				
0.0	TOPSOIL	[Hatched]	1	SS	22/0.05																
216.3	Syenite Gneiss (BEDROCK)	[Diagonal]				▽															
0.3	Bedrock cored from depths of 0.3 m to 4.9 m For bedrock coring details, refer to Record of Drillhole B2-05	[Diagonal]	1	RC	REC 99%															RQD = 82%	
		[Diagonal]	2	RC	REC 100%																RQD = 95%
		[Diagonal]	3	RC	REC 99%																RQD = 99%
211.7	END OF BOREHOLE																				
4.9	NOTE: 1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 215.8 m) upon completion of drilling.																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No B2-06** SHEET 1 OF 1 **METRIC**
 W.P. 5186-06-01 LOCATION N 5044022.1 ; E 245183.3 ORIGINATED BY CR
 DIST HWY 69 BOREHOLE TYPE NW Casing, Wash Boring COMPILED BY MWK
 DATUM Geodetic DATE November 5, 2008 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
											○ UNCONFINED	+ FIELD VANE				
											● QUICK TRIAXIAL	× REMOULDED				
											WATER CONTENT (%)					
											20	40	60	80	100	
											10	20	30			
215.7	GROUND SURFACE															
0.0	TOPSOIL															
	Weathered syenite gneiss (BEDROCK)															
214.7	Syenite Gneiss (BEDROCK)															
1.0	Bedrock cored from depths of 1.0 m to 9.7 m		1	RC	REC 89%											RQD = 51%
	For bedrock coring details, refer to Record of Drillhole B2-06		2	RC	REC 100%											RQD = 100%
			3	RC	REC 100%											RQD = 97%
			4	RC	REC 100%											RQD = 99%
			5	RC	REC 99%											RQD = 100%
			6	RC	REC 100%											RQD = 100%
206.0	END OF BOREHOLE															
9.7	NOTE: 1. Water level in open borehole at a depth of 1.2 m below ground surface (Elev. 214.5 m) upon completion of drilling.															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-06

SHEET 1 OF 1

LOCATION: N 5044022.1 ;E 245183.3

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRALLIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES			
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION					Jr	Ja	Js
							FLUSH													
		Continued from Record of Borehole B2-06		214.70																
1		SYENITE GNEISS Moderately weathered to fresh, fine to medium crystalline, foliated, black and white, contains nepheline veins and pink eudialyte grains		1.00																
				1	0.4	Brown to light brown 80 - 90														
2				2	0.3	Light brown 80 - 90														
3				3	0.3	Light brown 90 - 100														
4				4	0.3	Light brown 90 - 100														
5				5	0.3	Light brown to grey 90 - 100														
6				206.00																
7				9.70																
8		END OF DRILLHOLE																		
9																				
10																				
11																				

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

NO RC
November 05, 2008

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: CN

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-07	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044015.7 ; E 245191.1</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 28, 2008</u>	CHECKED BY <u>MWK/CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	80
215.8	GROUND SURFACE																				
0.0	TOPSOIL																				
0.1	Granite Gneiss (BEDROCK)					▽															
	Bedrock cored from depths of 0.1 m to 3.0 m		1	RC	REC 98%		215														RQD = 35%
	For bedrock coring details, refer to Record of Drillhole B2-07		2	RC	REC 100%		214														RQD = 77%
212.8	END OF BOREHOLE						213														
3.0	NOTE: 1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 215.2 m) upon completion of drilling.																				

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-07

SHEET 1 OF 1

LOCATION: N 5044015.7 ;E 245191.1

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA	HYDRALLIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES	
							TOTAL CORE %	SOLID CORE %				K, cm/sec	10 ⁰	10 ¹				10 ²
							FLUSH	FLUSH				B Angle	DIP w.r.t. CORE AXIS	Jr				Ja
		Continued from Record of Borehole B2-07		215.70														
1	NQ RC October 28, 2008	GRANITE GNEISS Slightly weathered, fine crystalline, foliated, black and white		0.10							JN,PL,VR FO,PL,Ro JN,PL,Ro FR,PL,Ro FO,PL,Ro JN,PL,Ro FR,IR,Ro FR,PL,Ro JN,PL,IR,Ro FO,PL,Ro JN,PL,Ro FO-JN,PL,Ro FR,PL,Ro FR,PL,Ro FO,PL,Ro FO,PL,Ro							
2				0.4	Light brown 90 - 100													
3		END OF DRILLHOLE		212.80 3.00														
4																		
5																		
6																		
7																		
8																		
9																		
10																		

GTA-RCK 018 T:\PROJECTS\2007-07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED: MWK/CN

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-08	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044020.9; E 245188.8</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 28, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
215.9	GROUND SURFACE																	
0.0	TOPSOIL																	
215.6	Granite Gneiss to Syenite Gneiss (BEDROCK) Bedrock cored from depths of 0.3 m to 3.4 m For bedrock coring details, refer to Record of Drillhole B2-08		1	RC	REC 97%		215										RQD = 90%	
0.3								214										RQD = 100%
					2	RC	REC 100%		213									
212.5	END OF BOREHOLE																	
3.4	NOTE: 1. Water level in open borehole not noted upon completion of drilling/coring.																	

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-09	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044026.1 ; E 245186.6</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 28, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
216.6	GROUND SURFACE															
0.0	TOPSOIL															
	Granite Gneiss to Syenite Gneiss (BEDROCK)															
	Bedrock cored from depths of 0.1 m to 3.2 m		1	RC	REC 100%											RQD = 85%
	For bedrock coring details, refer to Record of Drillhole B2-09															
			2	RC	REC 100%											RQD = 97%
213.4	END OF BOREHOLE															
3.2	NOTE: 1. Water level measured in piezometer: Date Depth (m) Elev (m) 05/11/08 1.0 215.6 12/04/09 1.8 214.8 10/06/09 3.1 213.5															

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-09

SHEET 1 OF 1

LOCATION: N 5044026.1 ;E 245186.6

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	FLUSH										DISCONTINUITY DATA	HYDRALLIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC - Q AVG.	NOTES	
							RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn						
							TOTAL CORE %	SOLID CORE %														
		Continued from Record of Borehole B2-09		216.50																		
1	NQ RC October 28, 2008	GRANITE GNEISS Slightly weathered, fine crystalline, foliated, black and white		0.10																		
		SYENITE GNEISS Slightly weathered to fresh, fine to medium grained, black and white, contains pink porphyry			215.69	1	0.4	Light brown 80 - 90														
2				0.91																		
3					2	0.3	Light brown 80 - 90															
		END OF DRILLHOLE		213.40																		
				3.20																		
4																						
5																						
6																						
7																						
8																						
9																						
10																						

GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC



PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-10

SHEET 1 OF 1

LOCATION: N 5044019.6 ;E 245194.2

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY			FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA			HYDRALLIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES			
							TOTAL CORE %	SOLID CORE %	R.Q.D. %		B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja				K, cm/sec	10 [°]	10 [°]
							FLUSH														
		Continued from Record of Borehole B2-10		215.30																	
		SYENITE GNEISS Slightly weathered, fine to medium crystalline, foliated, black and white, contains red porphyr		0.10																	
1					1	0.5	Light brown 90 - 80														
2					2	0.3	Light brown 90 - 100														
3					3	0.3	Light brown to brown 90 - 100														
4					4	0.2	Light brown 90 - 100														
5					5	0.3	Light brown 90 - 100														
6					6	0.4	Light brown 90 - 100														
7																					
8																					
9																					
10		END OF DRILLHOLE		206.10 9.30																	

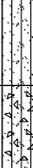
GTA-RCK 018 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC

DEPTH SCALE
1 : 50



LOGGED: CR
CHECKED: CN

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-12	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044045.8 ; E 245215.9</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>115 mm O.D. Solid Stem Augers</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 4, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
214.2	GROUND SURFACE																			
0.0	TOPSOIL																			
0.2	SILTY CLAY, trace gravel, containing rootlets and some sand seams Firm to very stiff Brown Wet		1	SS	4		214										OC = 6.7%			
213.1	Sandy SILT, trace clay Compact Mottled grey-brown Wet		2A	SS	26		213													
1.1			2B																	
212.1	Silty SAND and GRAVEL, trace clay, containing cobbles (TILL) Dense to very dense Brown Wet		3	SS	18		212										0 26 71 3			
2.1			4			SS		46												
211.2			5						SS	25/0/10										
3.0	END OF BOREHOLE SPOON AND AUGER REFUSAL																			
	NOTE: 1. Water level in open borehole at ground surface (Elev. 214.2 m) upon completion of drilling.																			

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT 07-1111-0029 **RECORD OF BOREHOLE No B2-13** SHEET 1 OF 1 **METRIC**
 W.P. 5186-06-01 LOCATION N 5044050.9; E 245213.6 ORIGINATED BY CR
 DIST HWY 69 BOREHOLE TYPE 115 mm O.D. Solid Stem Augers and NW Casing, Wash Boring COMPILED BY MWK
 DATUM Geodetic DATE October 31 and November 3, 2008 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa	
											○ UNCONFINED	+ FIELD VANE							
											● QUICK TRIAXIAL	× REMOULDED							
											WATER CONTENT (%)								
											20	40	60	80	100	10	20	30	
214.9	GROUND SURFACE																		
0.0	TOPSOIL																		
0.2	Sandy SILT, trace clay, containing silty sand seams, roots and rootlets Loose to compact Brown Moist to wet		1	SS	4														
213.5			2	SS	15														
213.2	Silty SAND and GRAVEL, trace clay (TILL) Compact Brown Wet		3	SS	25														
1.7	Syenite Gneiss (BEDROCK) Bedrock cored from depths of 1.7 m to 6.0 m For bedrock coring details, refer to Record of Drillhole B2-13		2	RC	REC 94%														RQD = 0%
			3	RC	REC 100%														RQD = 92%
			4	RC	REC 100%														RQD = 94%
																			RQD = 98%
208.9	END OF BOREHOLE																		
6.0	NOTE: 1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 214.3 m) upon completion of drilling.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-14	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044056.2 ; E 245211.4</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>Hand Excavation</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>October 30, 2008</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
215.2	GROUND SURFACE															
0.0	TOPSOIL															
0.2	END OF EXCAVATION (Refusal To Shovel Advance)					215										

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-15	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044049.7 ; E 245219.1</u>	ORIGINATED BY <u>CR</u>	
DIST <u>HWY 69</u>	BOREHOLE TYPE <u>115 mm O.D. Solid Stem Augers and NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 3, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × REMOULDED									
								20	40	60	80	100	10	20	30		
214.6	GROUND SURFACE																
0.0	TOPSOIL																
0.2	Silty SAND, trace clay Loose to dense Brown to mottled grey-brown Moist to wet		1	SS	4		214										Non-Plastic
			2	SS	30												
			3	SS	38		213										
212.2	Syenite Gneiss (BEDROCK)						212										RQD = 87%
2.4	Bedrock cored from depths of 2.4 m to 6.5 m For bedrock coring details, refer to Record of Drillhole B2-15		1	RC	REC 89%		211										RQD = 99%
			2	RC	REC 100%		210										
			3	RC	REC 100%		209										RQD = 88%
208.1	END OF BOREHOLE																
6.5	NOTE: 1. Water level measured in piezometer: Date Depth (m) Elev (m) 05/11/08 0.4 214.2 12/04/09 0.4 214.2 10/06/09 0.4 214.2																

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT: 07-1111-0029

RECORD OF DRILLHOLE: B2-15

SHEET 1 OF 1

LOCATION: N 5044049.7 ;E 245219.1

DRILLING DATE:

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-50 Turbo (Track-Mounted)

DRILLING CONTRACTOR: Walker Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT INDEX PER 0.3 m	DISCONTINUITY DATA		HYDRALLIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES		
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	K, cm/sec	T					
							FLUSH											Jr	Ja
		Continued from Record of Borehole B2-15		212.20															
3	NQ RC November 03, 2008	SYENITE GNEISS Slightly weathered to fresh, fine to medium crystalline, slightly foliated, black and white	[Symbolic Log Pattern]	2.40	1	0.4	Light brown 80 - 90												
4				2	0.4	Light brown 90 - 80													
5				3	0.3	Light brown 80 - 90													
6		END OF DRILLHOLE		208.10															
7				6.50															
8																			
9																			
10																			
11																			
12																			

GTA-RCK 018 T:\PROJECTS\2007-07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ GAL-MISS.GDT 07/09/15 DD/SAC



PROJECT 07-1111-0029 **RECORD OF BOREHOLE No B2-16** SHEET 1 OF 1 **METRIC**
 W.P. 5186-06-01 LOCATION N 5043979.2 ; E 245154.4 ORIGINATED BY CR
 DIST HWY 69 BOREHOLE TYPE 115 mm O.D. Solid Stem Augers and NW Casing, Wash Boring COMPILED BY MWK
 DATUM Geodetic DATE October 30, 2008 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	SHEAR STRENGTH kPa	
215.3	GROUND SURFACE																		
0.0	TOPSOIL																		
0.1	Silty SAND to SAND, some silt, trace gravel, trace clay, containing roots and rootlets to a depth of 0.6 m (TILL)		1	SS	3														
	Loose to dense Brown Moist to wet		2	SS	34														7 64 27 2
214.0	Syenite gneiss (BEDROCK)																		
1.3	Bedrock cored from depths of 1.3 m to 3.7 m		1	RC	REC 94%														RQD = 20%
	For bedrock coring details, refer to Record of Drillhole B2-16		2	RC	REC 99%														RQD = 100%
211.6	END OF BOREHOLE																		
3.7	NOTE: 1. Open borehole dry upon completion of drilling.																		

GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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

PROJECT <u>07-1111-0029</u>	RECORD OF BOREHOLE No B2-17	SHEET 1 OF 1	METRIC
W.P. <u>5186-06-01</u>	LOCATION <u>N 5044062.5 ; E 245223.2</u>	ORIGINATED BY <u>CR</u>	
DIST <u> </u> HWY <u>69</u>	BOREHOLE TYPE <u>115 mm O.D. Solid Stem Augers and NW Casing, Wash Boring</u>	COMPILED BY <u>MWK</u>	
DATUM <u>Geodetic</u>	DATE <u>November 4, 2008</u>	CHECKED BY <u>CN</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
214.9	GROUND SURFACE																
0.0	TOPSOIL		1	SS	2/0.10												
0.2	Syenite Gneiss (BEDROCK)					▽											
	Bedrock cored from depths of 1.3 m to 3.7 m		1	RC	REC 97%		214										RQD = 67%
	For bedrock coring details, refer to Record of Drillhole B2-16																
213.2	END OF BOREHOLE																
1.7	NOTE: 1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 214.3 m) upon completion of drilling.																

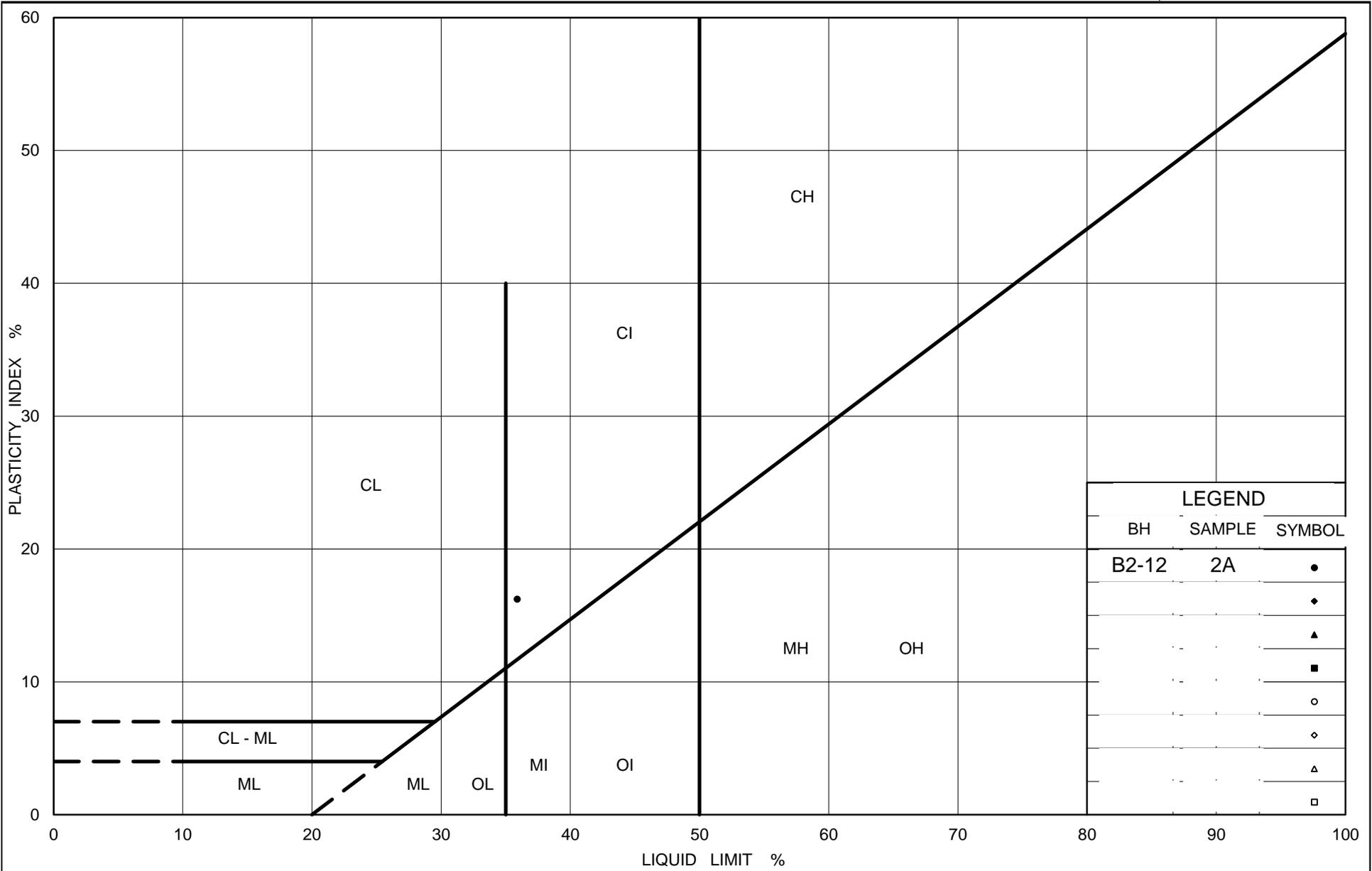
GTA-MTO 001 T:\PROJECTS\2007\07-1111-0029 (MRC, PARRY SOUND)\LOG\07-1111-0029-SHEBESHEKONG RD-PHASE II.GPJ CAL-GTA.GDT 07/09/15 DD/SAC

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



APPENDIX B

Laboratory Test Results



Ministry of Transportation

Ontario

PLASTICITY CHART Silty Clay

Figure No. B1

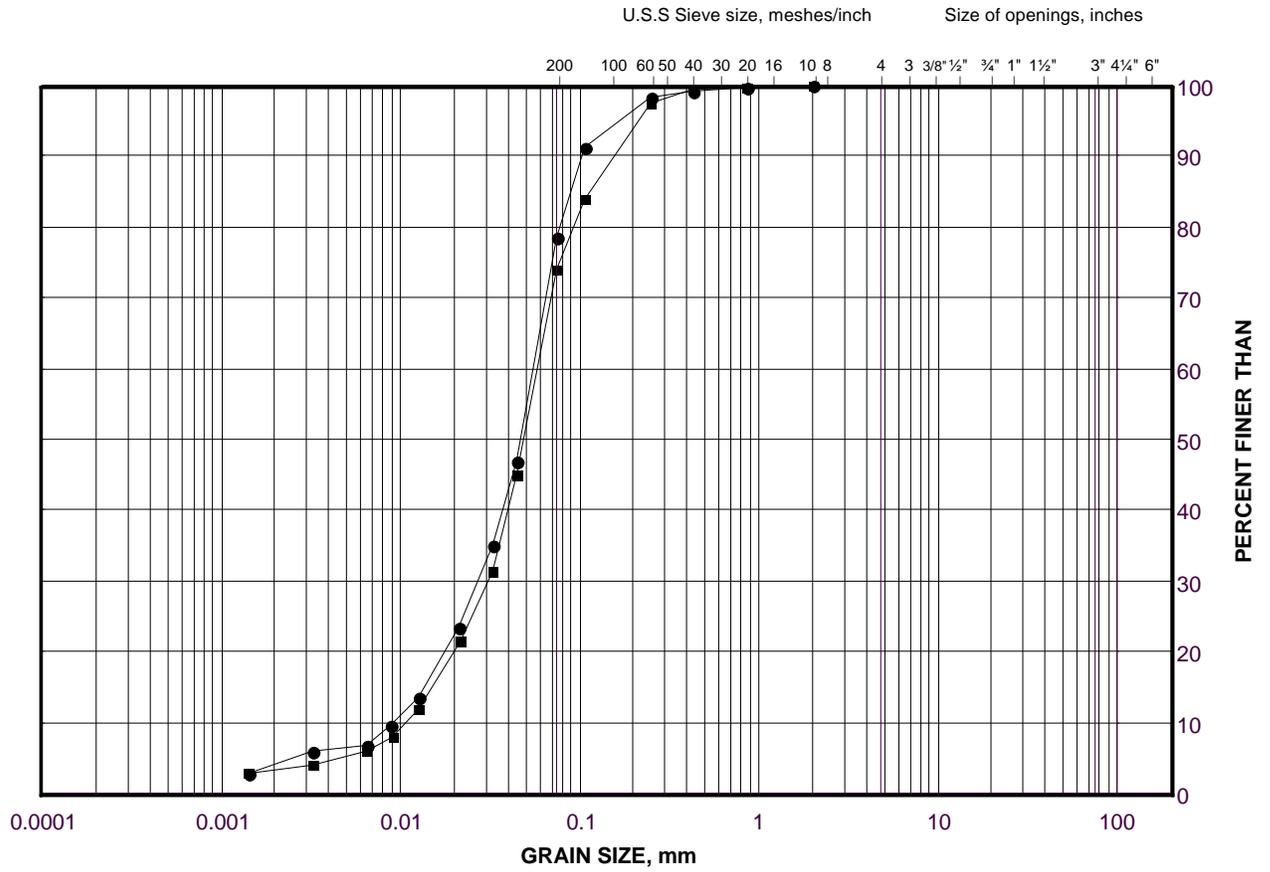
Project No. 07-1111-0029

Checked By: CN

GRAIN SIZE DISTRIBUTION

Sandy Silt

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	B2-11	2	213.5
■	B2-12	3	212.5

Project Number: 07-1111-0029

Checked By: CN

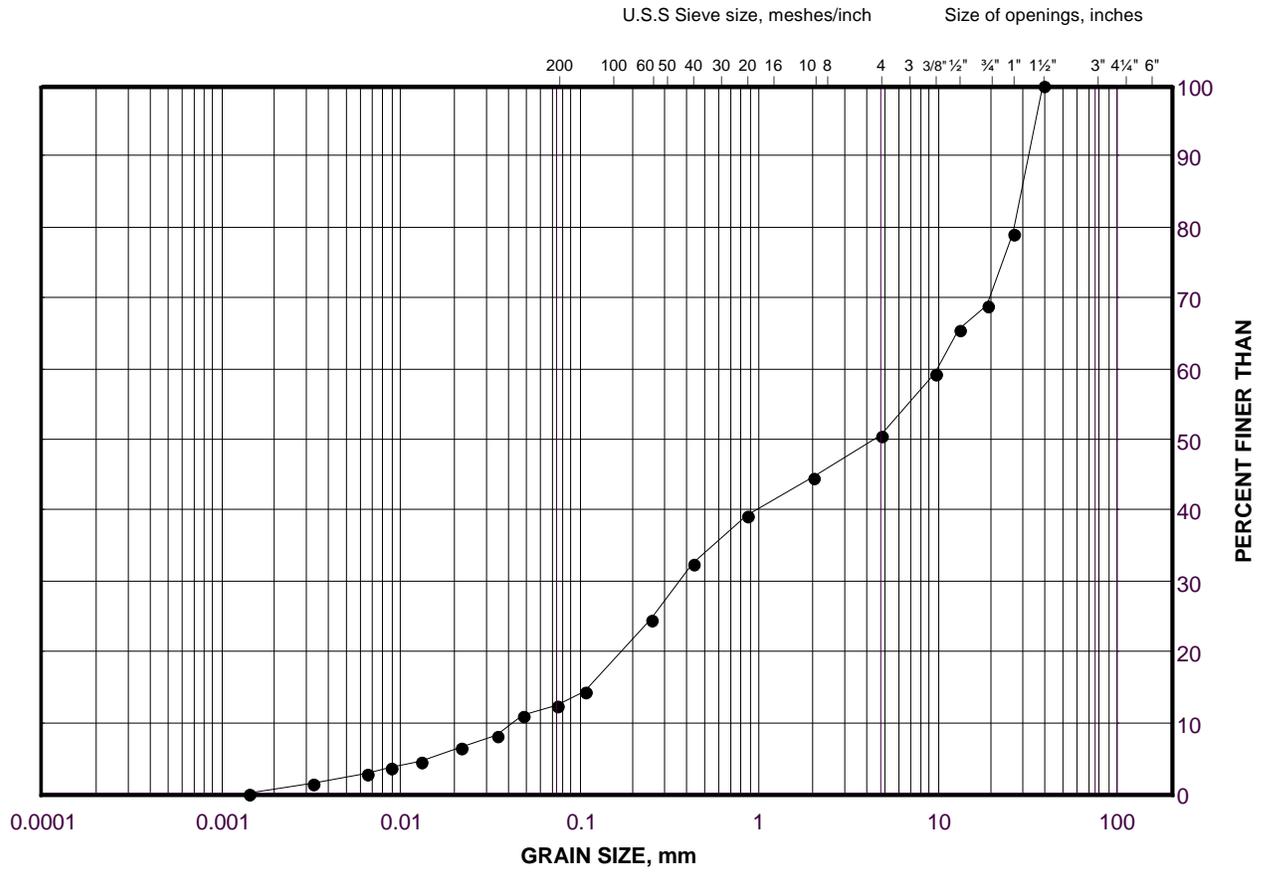
Golder Associates

Date: 30-Sep-09

GRAIN SIZE DISTRIBUTION

Sand and Gravel (Till)

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	B2-04	1B	216.0

Project Number: 07-1111-0029

Checked By: CN

Golder Associates

Date: 30-Sep-09

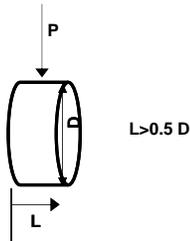
**TABLE B1
POINT LOAD TEST ON ROCK SAMPLES**

Borehole Number	Run Number	Sample Depth (m)	Sample Elevation (m)	Bedrock Description	Test Type	Is (50mm) (MPa)	Approx. ⁽¹⁾ UCS Range (MPa)
B2-03	1	1.2	215.3	Syenite Gneiss	Axial	7.662	107
B2-03	1	1.2	215.3	Syenite Gneiss	Diametral	8.778	123
B2-06	3	4.9	210.8	Syenite Gneiss	Axial	8.279	116
B2-06	4	5.2	210.5	Syenite Gneiss	Axial	8.437	118
B2-06	4	5.2	210.5	Syenite Gneiss	Diametral	7.111	100
B2-06	5	6.7	209.0	Syenite Gneiss	Axial	6.194	87
B2-10	3	3.7	211.7	Syenite Gneiss	Axial	7.597	106
B2-10	3	3.7	211.7	Syenite Gneiss	Axial	2.582	36
B2-10	4	5.8	209.6	Syenite Gneiss	Diametral	6.109	86
B2-13	2	2.4	212.5	Syenite Gneiss	Axial	7.220	101

⁽¹⁾ $I_{s50} \times K$ could from ASTM D5731-08. A value of $K = 14$ has been estimated for this site based on the results of the UCS testing.

DIAMETRAL SPECIMEN SHAPE REQUIREMENTS

note: Diametral tests are perpendicular to core axis
(planes of weakness)



AXIAL SPECIMEN SHAPE REQUIREMENTS

note: Axial tests are parallel to core axis
(planes of weakness)

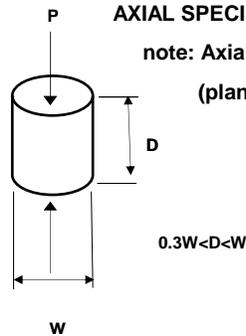


TABLE B2-1
UNCONFINED COMPRESSION (UC) TEST
ASTM D 7012-07

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	-
BOREHOLE NUMBER	B2-03	SAMPLE DEPTH, m	1.83

TEST CONDITIONS

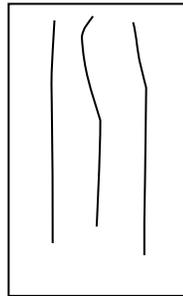
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.25

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.70	WATER CONTENT, (specimen) %	0.07
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m ³	27.06
SAMPLE AREA, cm ²	17.72	DRY UNIT WT., kN/m ³	27.04
SAMPLE VOLUME, cm ³	189.61	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	523.35	VOID RATIO	-0.02
DRY WEIGHT, g	522.98		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	95.4
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REMARKS: _____ DATE: 12/29/2008

TABLE B2-2
UNCONFINED COMPRESSION (UC) TEST
ASTM D 7012-07

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	-
BOREHOLE NUMBER	B2-06	SAMPLE DEPTH, m	4.88

TEST CONDITIONS

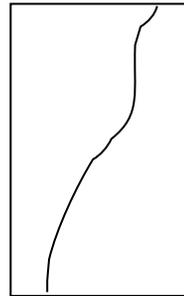
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.25

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.70	WATER CONTENT, (specimen) %	0.08
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m ³	27.01
SAMPLE AREA, cm ²	17.72	DRY UNIT WT., kN/m ³	26.99
SAMPLE VOLUME, cm ³	189.61	SPECIFIC GRAVITY, assumed	2.70
WET WEIGHT, g	522.45	VOID RATIO	-0.02
DRY WEIGHT, g	522.03		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	120.5
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REMARKS:

DATE:

12/29/2008

TABLE B2-3
UNCONFINED COMPRESSION (UC) TEST
ASTM D 7012-07

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	-
BOREHOLE NUMBER	B2-10	SAMPLE DEPTH, m	5.79

TEST CONDITIONS

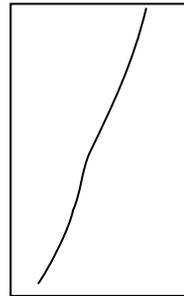
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.28

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.90	WATER CONTENT, (specimen) %	0.08
SAMPLE DIAMETER, cm	4.79	UNIT WEIGHT, kN/m ³	26.69
SAMPLE AREA, cm ²	18.02	DRY UNIT WT., kN/m ³	26.66
SAMPLE VOLUME, cm ³	196.42	SPECIFIC GRAVITY, assumed	2.80
WET WEIGHT, g	534.70	VOID RATIO	0.03
DRY WEIGHT, g	534.27		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	98.7
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REMARKS: _____ DATE: 12/29/2008

TABLE B2-4
UNCONFINED COMPRESSION (UC) TEST
ASTM D 7012-07

SAMPLE IDENTIFICATION

PROJECT NUMBER	07-1111-0029	SAMPLE NUMBER	-
BOREHOLE NUMBER	B2-13	SAMPLE DEPTH, m	2.44

TEST CONDITIONS

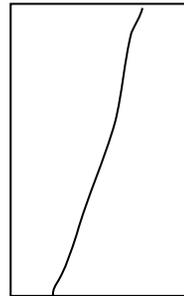
MACHINE SPEED, mm/min	-	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST, min	>2 <15	L/D	2.34

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	11.00	WATER CONTENT, (specimen) %	0.09
SAMPLE DIAMETER, cm	4.70	UNIT WEIGHT, kN/m ³	27.21
SAMPLE AREA, cm ²	17.35	DRY UNIT WT., kN/m ³	27.19
SAMPLE VOLUME, cm ³	190.84	SPECIFIC GRAVITY, assumed	2.80
WET WEIGHT, g	529.75	VOID RATIO	0.01
DRY WEIGHT, g	529.27		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	-	COMPRESSIVE STRESS, MPa	77.9
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REMARKS:

DATE:

12/29/2008

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. 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 now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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