



FINAL REPORT

FOUNDATION INVESTIGATION REPORT Rosseau River Bridge Replacement, Highway 141, Rosseau, Ontario

**Agreement No. 5013-E-0008
Assignment No. 11
GWP 5394-15-00
Geocres No. 31E-361**

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exp Services Inc.
February 26, 2016

Ontario Ministry of Transportation

Northeastern Region Geotechnical Section

Foundation Investigation Report

Agreement No. 5013-E-0008

Assignment No. 11

GWP 5394-15-00

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Project Name:

Foundation Investigation and Design Report for Rosseau River Bridge Replacement, Hwy 141, Rosseau, Ontario

Project Number:

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February 26, 2016



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1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This foundation investigation report presents the results of a geotechnical investigation completed by **exp** Services Inc. for the rehabilitation/replacement of the Rosseau River Bridge located on Hwy 141, approximately 4.9 km east of the junction of Hwy 632, Rosseau, Ontario, the Ministry of Transportation (MTO) Northeastern Region. The work was undertaken under Agreement # 5013-E-0008, Assignment No. 11 (GWP 330-96-00). The terms of reference (TOR) were as presented in the MTO letter dated August 26, 2015.

Based on information included in the TOR it is understood that the existing Rossea River Bridge is a 13 m long single span bridge supported on shallow foundations. During the inspection of the bridge abutments in August 15 2015, it was noted that voids and scouring were present underneath the west abutment. Due to presence of these voids and scouring, the existing bridge was closed for traffic in September 2015, and both abutments of the existing bridge were initially considered to be rehabilitated. Consequently, the emergency temporary detour Acrow bridge was proposed and constructed north of existing bridge in September/October 2015. The geotechnical investigation for the temporary bridge (Phase I) was performed by **exp** on September 3 to 10, 2015, and it included drilling of BH1, BH7, BH8 and BH9 shown on Drawing 1 in Appendix B. The memorandum with foundation recommendations for the detour Acrow bridge was issued on September 10 2015 (Appendix H). Following this investigation and construction of the temporary bridge, MTO decided to demolish the existing bridge and build the new bridge. Based on our correspondences with MTO and the preliminary GA drawing provided by MTO, it is understood that the new bridge will be a 28 m long single span bridge at the similar location as the existing bridge with the west abutment at Sta. 14+100 and the east abutment at Sta. 14+128. Therefore, the new bridge will be about 15 m longer than the existing structure, and the new abutments will be set back relatively to existing as shown on Drawing 1 in Appendix B. It is proposed that the alignment of the new bridge will be shifted either approximately 0.5 m to the south to allow use of 2.0 m shoulders on the bridge or approximately 1.0 m to the south to allow standard 2.5 m shoulders on the bridge. Both options of the new alignment allow for approximately 1.15 m clearance between the new bridge and temporary detour bridge. It is further understood that semi-integral and/or integral abutment options are considered for the new bridge with a grade raise of approximately 0.25 m. In addition, an approximately 40 m long retaining wall is proposed along the south side of the bridge approach embankment at the west side of the river. The geotechnical investigation for the new bridge (Phase 2) was performed on November 18 to 23, 2015, and it included drilling of BH2, BH3, BH4, BH5 and BH6 shown on Drawing 1 in Appendix B.

The purposed of this geotechnical investigation is to examine the existing soil conditions within the construction limits for the new bridge replacement. The site specific geotechnical investigation consisted of borings, soil sampling, borehole logging, and field and laboratory testing.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of the investigation and the laboratory testing completed for this project.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The Rosseau River Bridge is located approximately 4.9 km east of the junction of Hwy 632, Rosseau, Ontario on Hwy 141. At the Rosseau River Bridge location, Hwy 141 is two-lane. The existing structure is single span steel girders concrete deck bridge, and is about 13.1 m in length and about 8.2 m wide double lanes. The approaches are about 10 m wide from shoulder to shoulder. The site plan and cross-section profiles for the Rosseau River Bridge are as shown on Drawings 1 to 3 in Appendix B. Photographs of the site/bridge are included in Appendix A.

At the site Hwy 141 runs in a generally east to west direction, and Rosseau River flows from north to south towards the Rosseau Lake. At the time of investigation, September 2015, approximate river water elevation was 254.9 m and the elevation of top of the existing bridge deck was approximately 258.8 m.

The banks of the river in the vicinity of the bridge contained gravel, cobbles and boulders. Vegetation in the area consists of deciduous and coniferous trees and smaller low lying shrubs and grass. Bedrock outcrops were observed in the vicinity of site and riverbed. The drainage in the area consists of roadside ditches which drain into the Rosseau River. Selected photographs of the site are provided in Appendix A.

1.2.2 Geological Setting

In accordance with the Ministry of Northern Development and Mines Map 2556, Quaternary Geology of Ontario, Southern Sheet, the site is generally undifferentiated igneous and metamorphic rock, exposed at surface or covered by a discontinuous, thin layer of drift.

In accordance with the Ministry of Northern Development and Mines Map 2544, Bedrock Geology of Ontario, Southern Sheet, the bedrock at the site consists of magmatic rocks and gneisses of undetermined protolith. Commonly layered biotite gneisses and migmatites; locally includes quartzofeldspathic gneisses, orthogneisses, and paragneisses.

1.3 Investigation Procedures

1.3.1 Site Investigation and Field Testing

The fieldwork for this project was carried out in two phases: Phase 1 - from September 3 to 10, 2015, and Phase 2 - from November 18 to 23, 2015. Prior to the field work commencement the clearances for existing utilities/services were provided by MTO. The investigation consisted of a total of 10 sampled boreholes (BH1, BH2, BH3, BH4, BH5, BH6, BH7, BH7A, BH8 and BH9). Boreholes BH1, BH7, BH7A, BH8 and BH9 were drilled during the geotechnical investigation for the detour Acrow bridge (Phase 1), while boreholes BH2, BH3, BH4, BH5 and BH6 were drilled during the geotechnical investigation for the new bridge (Phase 2).

Borehole BH1 was drilled through existing bridge deck close to the existing west abutment and was advanced to a depth of 20.5 m below the bridge deck. BH3, BH5 and BH6 were advanced at the abutment locations of new replacement bridge to depth between 7.3 m and 19.8 m below the

existing road surface. BH7, BH7A and BH8 were advanced at the abutment locations of temporary modular bridge to depths of 5.8 m, 8.8m and 16.5 m respectively below ground surface. BH7 was terminated at a depth of 5.8 m due to spoon broke off hitting hard surface. However, BH7A was drilled adjacent to BH7, approximately 3 m east from BH7, to confirm the bedrock. BH9 was advanced at west approach of temporary detour to depth of 4.4 m below ground surface. BH2 and BH4 were advanced at the locations of retaining wall to depths of 10.8 m and 6.3 m respectively below the existing road surface. The locations of the boreholes are shown on Drawing 1 in Appendix B.

Phase 1 boreholes were advanced using a CME-75 truck mounted drill rig operated by Canadian Soil Drilling, while Phase 2 boreholes were advanced using a CME-55 truck mounted drill rig operated by Marathon Drilling Co. Ltd. Both drills were equipped with continuous flight hollow stem augers and standard soil/bedrock sampling equipment.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were temporary surveyed by **exp** personnel using the Temporary Benchmark (TBM) on the nail in a temporary barrier (see Drawing 1 in Appendix B). Elevation of Temporary Benchmark (TBM) (Elev. 258.94 m) on the temporary barrier on the site (see Photograph 8, Appendix A) was provided by MTO Contract Administrator (CA).

During the drilling of the boreholes, soil samples were obtained using a 51 mm outside diameter (O.D.) split-spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586) at intervals ranging from 0.75 m to 1.5 m in depth as shown on the attached borehole logs (Appendix C). The original field (uncorrected) SPT "N" values were recorded on the borehole logs as recommended in the Canadian Foundation Engineering Manual (CFEM, pg. 40) and used to provide an assessment of in-situ consistency or relative density of non-cohesive soils. When a hard stratum was reached sampling of hard material was performed by diamond core drilling, using a 1.5 m long HQ3 (Phase 1) and NQ (Phase 2) double tube wireline core barrel.

Upon completion of the boreholes, ground water level measurements were carried out from the boreholes in accordance with the MTO guidelines. The measured ground water levels after completion of drilling boreholes were recorded on borehole log sheets in Appendix C. The boreholes were decommissioned by bentonite/cement mixtures in accordance with the Ministry of the Environment Regulation 903, as amended by Regulation 128/03 (the well regulation under the *Ontario Water Resources Act*).

The fieldwork was supervised by members of **exp's** engineering directed the drilling and sampling operation, logged borehole data in accordance with MTO and/or ASTM Standards for Soils Classification, and retrieved soil samples for subsequent laboratory testing and identification.

All of the recovered soil samples placed in labelled moisture-proof bags returned to **exp's** Brampton laboratory for additional visual, textual, olfactory examination and selective testing.

1.3.2 Laboratory Testing

All samples returned to the laboratory were subjected to visual examination and classification. The laboratory testing program included the determination of natural moisture content and particle size distribution for approximately 25% of the collected soil samples. Atterberg limits tests were also

performed, but all tested samples found non-plastic. All of the laboratory tests were carried out in accordance with MTO and/or ASTM Standards as appropriate.

The laboratory test results are provided on the attached borehole log sheets in Appendix C. The results of the grain size analyses are presented graphically in Appendix D.

1.4 Subsurface Conditions

The detailed subsurface conditions encountered in the boreholes advanced during this investigation are presented on the borehole log sheets in Appendix C. Laboratory test results are provided in Appendix D. The “Explanation of Terms Used in Report” preceding the borehole logs in Appendix C forms an integral part of and should be read in conjunction with this report.

A borehole location plan and stratigraphic section are provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole logs and stratigraphic sections are inferred from semi-continuous sampling, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent interpreted transitions from one soil type to another and should not be viewed as exact planes of geological change. Furthermore, subsurface conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions along the new bridge and temporary bridge location consist of a layer of sand and gravel to sand fill underlain by native deposits of silty sand to sand layer followed by sand layer and bedrock. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

1.4.1 Asphalt

Asphalt was encountered at the surface of all boreholes except boreholes drilled for temporary bridge investigation (BH7, BH8 and BH9). Thickness of the asphalt layer was between 80 mm to 90 mm. Asphalt thicknesses may further vary beyond the borehole location.

1.4.2 Fill: Sand and Gravel to Sand

Sand and gravel to sand fill was encountered below the asphalt in boreholes BH2, BH3, BH4, BH5 and BH6 and at the surface of boreholes BH7, BH8 and BH9. The thickness of this layer ranged from 1.4 m to 4.4 m extending from Elev. 258.9 m to Elev. 253.8 m. Borehole BH9 is terminated within this layer.

The composition of this fill layer is sand and gravel with occasional cobbles and boulders, and trace to little silt and clay size particles. The material is brown to grey in color, and moist. The SPT “N” values within this layer ranged from 2 blows per 300 mm penetration to 50 blows per 140 mm penetration, suggesting very loose to very dense compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 3.1% to 21.1%

Grain Size Distribution:

- 4% to 19 % gravel;
- 62% to 73% sand; and
- 12% to 34% silt and clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 1 in Appendix D.

1.4.3 Cobbles and Boulders

Cobbles and boulders layer was encountered below the sand and gravel to sand fill in borehole BH6 and below silty sand to sand in BH7A. The thickness of this layer is approximately 1.4 m to 1.7 m extending from Elev. 255.7 m to Elev. 254.1 m.

The composition of this layer is cobbles and boulders with some silt and coarse gravel. The combination of Standard Penetration Tests and coring was attempted to obtain their samples. Based on the recovered cored samples, the boulder size is estimated to be up to 240 mm in diameter (see Photographs 4 and 6 in Appendix E).

1.4.4 Sand and Gravel

Native sand and gravel layer was encountered below the sand and gravel to sand fill in boreholes BH4, BH5 and below the cobbles and boulders layer in borehole BH6. The thickness of this layer ranged from 0.8 m to 2.3 m extending from Elev. 256.4 m to Elev. 251.8 m.

The composition of this layer is sand and gravel with trace to little silt and clay size particles. The material is brown in color, and moist to wet. The SPT "N" values within this layer ranged from 21 blows per 300 mm penetration to 50 blows per 80 mm penetration, suggesting compact to very dense compactness condition.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 7.7% to 17.5%

Grain Size Distribution:

- 27% to 33 % gravel;
- 54% to 59% sand; and
- 13% to 14% silt and clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 2 in Appendix D.

1.4.5 Silty Sand to Sand

Native silty sand to sand layer was encountered below the sand and gravel to sand fill in boreholes BH2, BH7 and BH8, below the sand layer in borehole BH3, below the sand and gravel layer in BH4 and at the bottom of the river in BH1. The thickness of this layer ranged from 2.7 m to 7.7 m extending from Elev. 256.6 m to Elev. 246.9 m. Boreholes BH2 and BH7 are terminated within this layer.

The composition of this layer is sand trace to some silt, trace to some clay, trace gravel and occasional cobbles and boulders. The material is brown in color, and moist to wet. The SPT "N" values within this layer typically ranged from 4 to 77 blows per 300 mm penetration suggesting very loose to very dense compactness condition. Some SPT "N" value of 20 blows per 140 mm penetration (BH4) to 100 blows per 280 mm penetration (BH7) was encountered as well. It is suspected that the high SPT "N" values could be the influence of boulders or underlying bedrock.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 8.3% to 30.4%

Grain Size Distribution:

- 0% to 12 % gravel;
- 24% to 80% sand;
- 13% to 66% silt and
- 6% to 37% clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figures 3a and 3b in Appendix D.

1.4.6 Sand

Native sand layer was encountered below the silty sand to sand layer in boreholes BH1, BH3 and BH8. In BH3 sand layer is also encountered below the sand and gravel to sand fill layer at depth 1.5 m below ground surface extending from Elev. 257.2 m to Elev. 255.6 m. The thickness lower sand layer ranged from 4.6 m to 6.2 m extending from Elev. 248.0 m to Elev. 241.1 m. Borehole BH8 is terminated within this layer.

The composition of this layer is mostly sand with trace to some silt, trace clay and trace gravel. The material is brown to grey in color, and moist to wet. The SPT "N" values within this layer typically ranged from 1 to 50 blows per 300 mm penetration suggesting very loose to very dense compactness condition. One SPT "N" value of 40 blows per 80 mm penetration was encountered at BH3 at a depth of 12.2 m below the ground surface.

Laboratory testing performed on selected samples consisted of moisture content and grain size distribution tests. The test results are as follows:

Moisture Content:

- 9.3% to 21.2%

Grain Size Distribution:

- 1% to 10 % gravel;
- 54% to 88% sand;
- 2% to 43% silt and clay

The results of the moisture content and grain size distribution tests are provided on the record of borehole sheets in Appendix C. The results of the grain size distribution tests are also provided on Figure 4 in Appendix D.

1.4.7 Bedrock

The presence of bedrock, at approximately between 5.8 m to 17.5 m below the existing road surface was recorded. The bedrock was inferred from auger/split spoon refusal in BH2 and BH7, or confirmed using coring of 0.5 m to 4.6 m long. The elevation of the inferred or actual bedrock surface below Hwy 141 ranges from Elev. 253.1 m to Elev. 241.3 m. The inferred or actual bedrock surface depth and elevation encountered at these borehole locations are listed in Table 1.1. Photographs of rock cores are included in Appendix E.

Table 1.1 Depth and elevation of bedrock or possible bedrock surface

Borehole	Depth Below Ground Surface (m)	Elevation (m)	Comments
BH1	17.5	241.3	Bedrock Cored
BH2	10.8	247.7	Inferred/ Spoon Refusal
BH3	15.3	243.4	Bedrock Cored
BH4	5.8	252.9	Bedrock Cored
BH5	6.1	252.8	Bedrock Cored
BH6	7.1	251.8	Bedrock Cored
BH7	5.8	253.1	Inferred/ Spoon Refusal
BH7A	4.6	254.3	Bedrock Cored

Based on the bedrock cores recovered, the bedrock consists of granite gneiss. In general, the bedrock samples are described as light grey, black and pink in colour and have a fine crystalline structure, slightly weathered. The Rock Quality Designation (RQD) measured on the core samples

typically ranged from approximately 84% to 100%, indicating a rock mass of good to excellent quality.

1.5 Ground Water Conditions

Information regarding groundwater levels at the site was obtained by measuring the water levels in the open boreholes after completion of drilling. The groundwater levels measured in the boreholes are shown on Table 1.2 and borehole logs. Water levels measured in open boreholes might not be stabilized due to a short term observation.

At the time of investigations, the water level measured at the river was approximately at Elev. 254.9 m. Seasonal variations in the water table should be expected, with higher levels occurring during wetter periods of the year and lower levels during drier periods.

Table 1.2 Groundwater levels recorded at the site

Borehole	Location Relative to Existing Bridge	Date of Drilling	Groundwater Level (Elevation, m)
BH1	Bridge deck (near west abutment)	09/03/2015	254.9
BH2	West Approach/ Retaining Wall	11/21/2015	254.7
BH3	West Abutment	11/20/2015	253.5
BH4	Retaining Wall	11/19/2015	254.5
BH5	East Abutment (EBL)	11/19/2015	255.2
BH6	East Abutment (WBL)	11/18/2015	255.2
BH7	East Abutment (Temporary Bridge)	09/10/2015	255.8
BH7A	East Abutment (Temporary Bridge)	09/11/2015	-
BH8	West Abutment (Temporary Bridge)	09/09/2015	253.7
BH9	West Approach	09/10/2015	255.8

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1.6 Closure


The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.


This Foundation Investigation Report has been prepared by Mr. Nimesh Tamrakar, M.Eng, EIT., and Mrs. S. Micic, Ph.D., P. Eng. and reviewed by Mr. T.C. Kim, M.E.Sc., P.Eng. and Mr. S.E. Gonsalves, M.Eng., P.Eng. designated MTO foundation contact. The field investigation was conducted by Mr. Colin Schmidt, M.E.Sc.

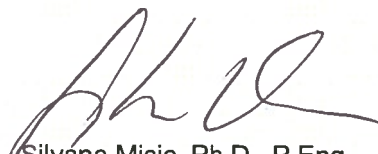
We trust that these comments provide you with sufficient information to for your present requirements. Should you have any questions, please do not hesitate to contact this office

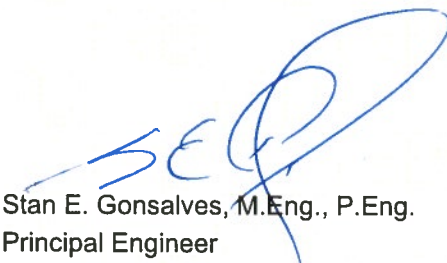
Yours truly,

exp Services Inc.


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Senior Geotechnical Engineer
Project Manager


Stan E. Gonsalves, M.Eng., P.Eng.
Principal Engineer
Designated MTO Foundation Contact



Appendix A – Photographs



Photo 1: East side of existing bridge facing west



Photo 2: Looking south from west approach

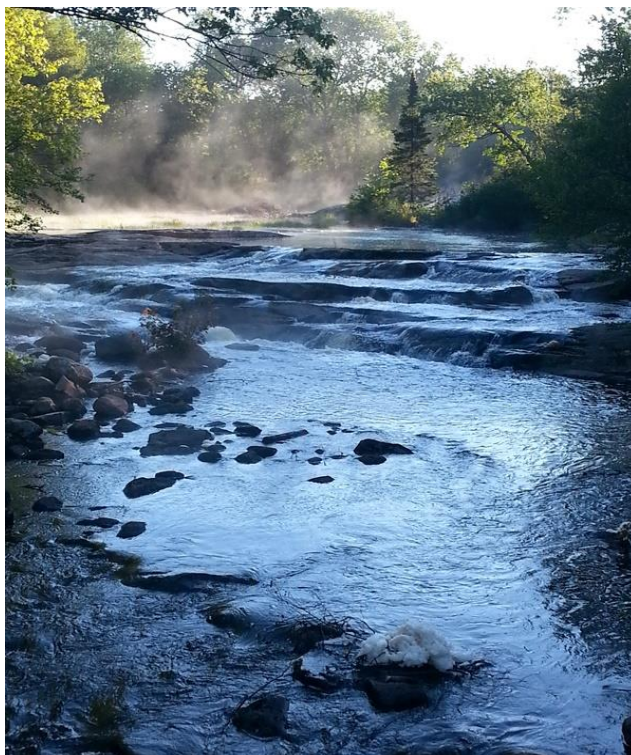


Photo 3: Looking north from existing bridge



Photo 4: Looking south from north side of existing bridge



Photo 5: Looking south from existing bridge



Photo 6: Temporary support under bridge



Photo 7: West approach of temporary detour looking east



Photo 8: Temporary benchmark on concrete barrier

Appendix B – Drawings

METRIC
DIMENSIONS ARE IN METERS AND/OR
MILLIMETERS UNLESS OTHERWISE SHOWN.
STATIONS ARE IN KILOMETERS +METERS

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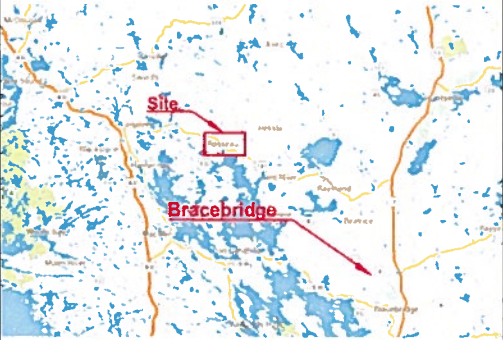
ROSSEAU RIVER BRIDGE REPLACEMENT
(SITE NO. 42-013, HWY 141)
SITE PLAN/ BOREHOLE LOCATIONS

SHEET
1



exp Services Inc.

KEY PLAN



LEGEND

- Temporary Bench Mark (TBM)
- Location of Drilled Boreholes (Phase 1)
- Location of Drilled Boreholes (Phase 2)

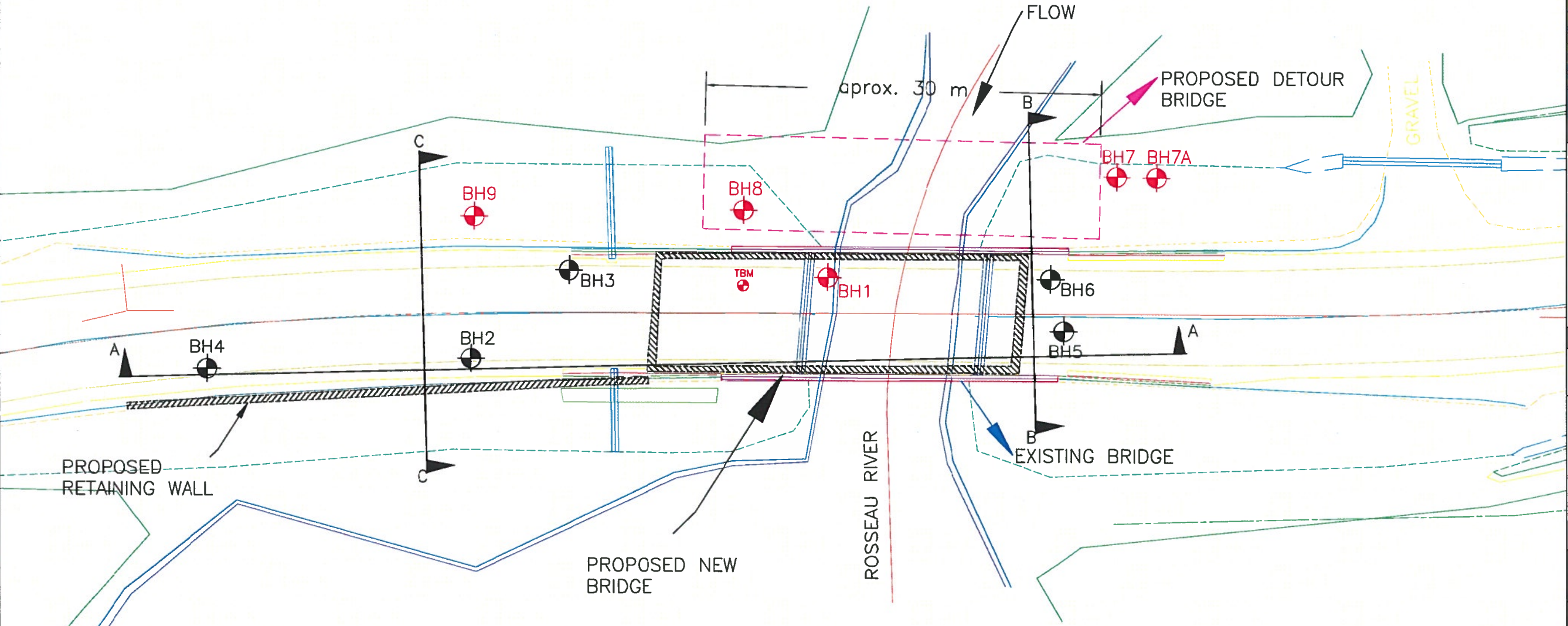
BH No.	APPROX ELEV. (m)	MTM CO-ORDINATES MTM ZONE 10	
		NORTH	EAST
TBM	258.9	5011014	298214
BH 1	258.8	5011010	298219
BH 2	258.5	5011025	298195
BH 3	258.7	5011024	298205
BH 4	258.7	5011038	298181
BH 5	258.9	5010998	298231
BH 6	258.9	5011000	298231
BH 7	258.9	5011000	298240
BH 7A	258.9	5011000	298243
BH 8	257.3	5011018	298218
BH 9	258.8	5011032	298203

NOTE

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 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 the report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

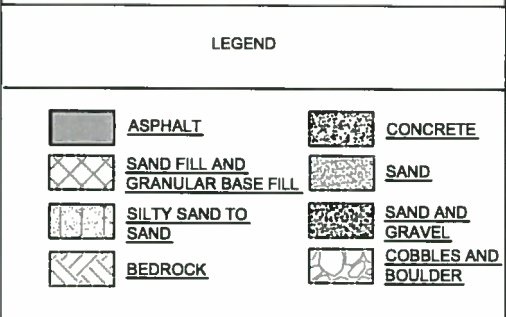
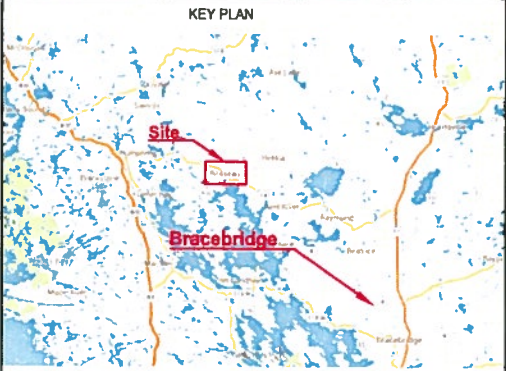
2016.01.05	SM	SUBMISSION FOR MTO REVIEW
2015.12.11	SM	SUBMISSION FOR MTO REVIEW
2015.11.05	SM	SUBMISSION FOR MTO REVIEW
2015.09.10	SM	SUBMISSION FOR MTO REVIEW
DATE	BY	DESCRIPTION
GEOCRE NO. 31E-361		
PROJECT NO. ADM-C0028245-M0		
SUBMD SM	CHECKED SM	DATE 2016.02.25
DRAWN SA	CHECKED SG	APPROVED DWG. 01



Note:
The plan with proposed structures was provided by MTO.



METRIC
DIMENSIONS ARE IN METERS AND/OR
MILLIMETERS UNLESS OTHERWISE SHOWN.
STATIONS ARE IN KILOMETERS +METERS



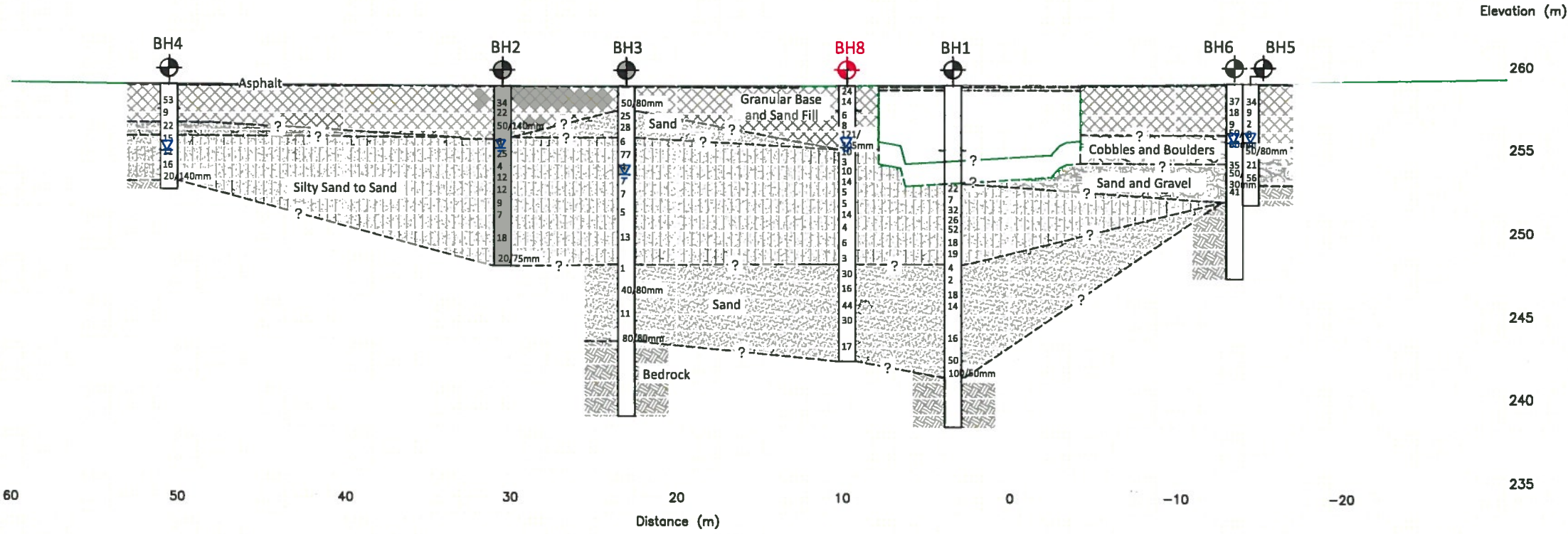
BH No.	APPROX. ELEV. (m)	MTM CO-ORDINATES MTM ZONE 10	
		NORTH	EAST
TBM	258.9	5011014	298214
BH 1	258.8	5011010	298219
BH 2	258.5	5011025	298195
BH 3	258.7	5011024	298205
BH 4	258.7	5011038	298181
BH 5	258.9	5010998	298231
BH 6	258.9	5011000	298231
BH 7	258.9	5011000	298240
BH 7A	258.9	5011000	298243
BH 8	257.3	5011018	298218
BH 9	258.8	5011032	298203

NOTE

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2016.01.05	SM	SUBMISSION FOR MTO REVIEW
2015.12.11	SM	SUBMISSION FOR MTO REVIEW
2015.11.05	SM	SUBMISSION FOR MTO REVIEW
2015.09.10	SM	SUBMISSION FOR MTO REVIEW
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MILLIMETERS UNLESS OTHERWISE SHOWN.
STATIONS ARE IN KILOMETERS +METERS

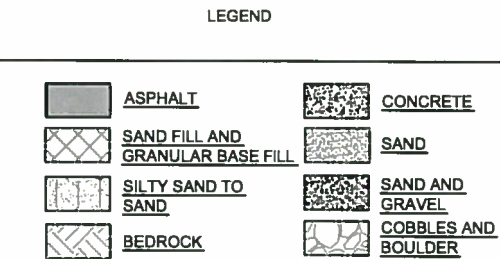
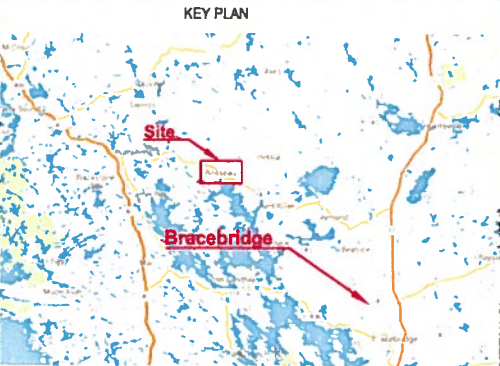
Agreement No. 5013-E-0008
Assignment No. 11
GWP No. 5394-15-00



ROSSEAU RIVER BRIDGE REPLACEMENT
(SITE NO. 42-013, HWY 141)
SOIL STRATA

SHEET
3

exp. exp Services Inc.



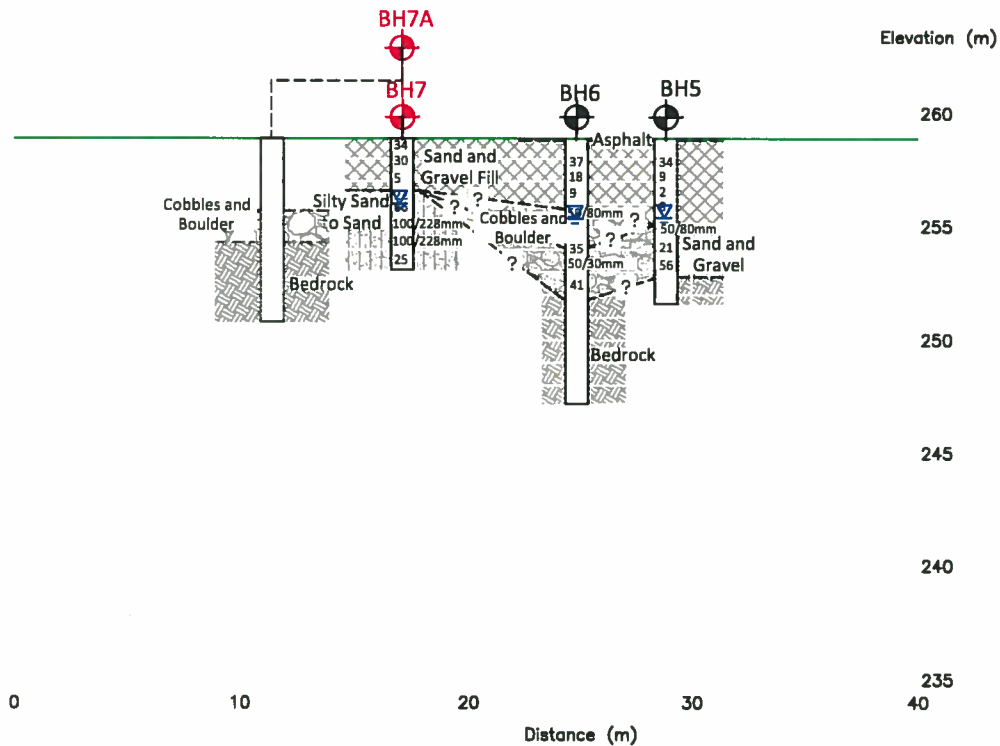
BH No.	APPROX. ELEV. (m)	MTM CO-ORDINATES MTM ZONE 10	
		NORTH	EAST
TBM	258.9	5011014	298214
BH 1	258.8	5011010	298219
BH 2	258.5	5011025	298195
BH 3	258.7	5011024	298205
BH 4	258.7	5011038	298181
BH 5	258.9	5010998	298231
BH 6	258.9	5011000	298231
BH 7	258.9	5011000	298240
BH 7A	258.9	5011000	298243
BH 8	257.3	5011018	298218
BH 9	258.8	5011032	298203

NOTE

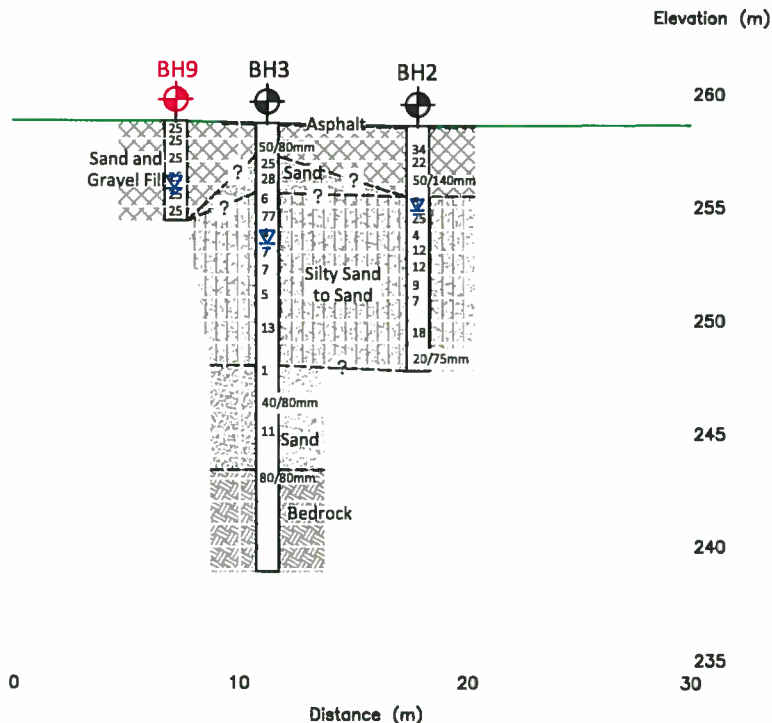
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

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 the report and related documents are specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

2018.01.05	SM	SUBMISSION FOR MTO REVIEW	
2015.12.11	SM	SUBMISSION FOR MTO REVIEW	
2015.11.05	SM	SUBMISSION FOR MTO REVIEW	
2015.09.10	SM	SUBMISSION FOR MTO REVIEW	
DATE	BY	DESCRIPTION	
		GEOCRE NO. 31E-361	
		PROJECT NO. ADM-00028245-M0	
SUBMD SM	CHECKED SM	DATE	2016.02.25
DRAWN SA	CHECKED SG	APPROVED	DWG. 03



SECTION B-B



SECTION C-C



Appendix C – Boreholes Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil: mixture of soil and humus capable of supporting good vegetative growth.

Peat: fibrous fragments of visible and invisible decayed organic matter.

Fill: where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

Till: the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report follow generally the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) with some modification to reflect current MTO practices. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.

ISSMFE SOIL CLASSIFICATION											
CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		
<div><div></div><div>0.002</div><div></div><div>0.006</div><div></div><div>0.02</div><div></div><div>0.06</div><div></div><div>0.2</div><div></div><div>0.6</div><div></div><div>2.0</div><div></div><div>6.0</div><div></div><div>20</div><div></div><div>60</div><div></div><div>200</div><div></div></div>											
EQUIVALENT GRAIN DIAMETER IN MILLIMETRES											
CLAY (PLASTIC) TO				FINE		MEDIUM		CRS.		FINE COARSE	
SILT (NONPLASTIC)				SAND				GRAVEL			
UNIFIED SOIL CLASSIFICATION											

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Note 16 in ASTM D2488-09a:

Table a: Percent or Proportion of Soil, Pp

	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	$5 \leq Pp \leq 10\%$
Little	$15 \leq Pp \leq 25\%$
Some	$30 \leq Pp \leq 45\%$
Mostly	$50 \leq Pp \leq 100\%$

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	$N < 5$
Loose	$5 \leq N < 10$
Compact	$10 \leq N < 30$
Dense	$30 \leq N < 50$
Very Dense	$50 \leq N$

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

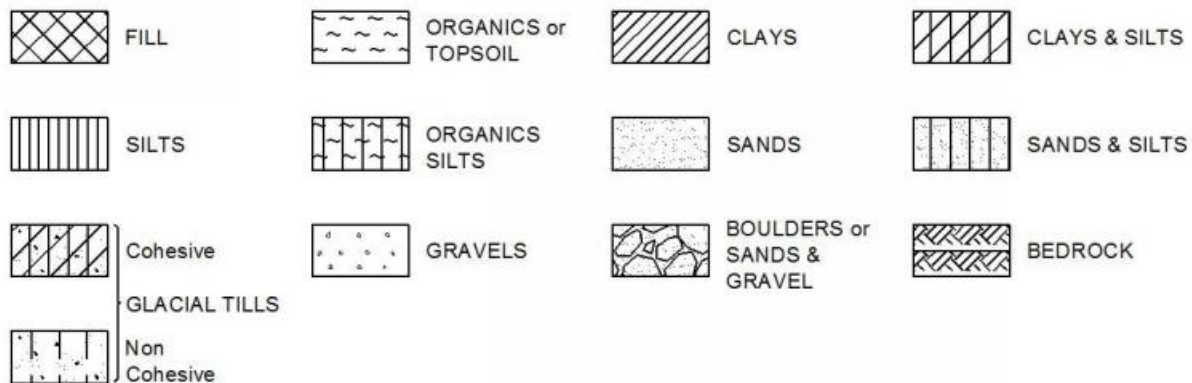
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	Split spoon sample (obtained from the Standard Penetration Test)
WS	Wash sample
BS	Bulk sample
TW	Thin wall sample or Shelby tube
PS	Piston sample
AS	Auger sample
VT	Vane test
GS	Grab sample
HQ, NQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits

STRESS AND STRAIN

u_w	kPa	Pore water pressure
r_u	1	Pore pressure ratio
σ	kPa	Total normal stress
σ'	kPa	Effective normal stress
τ	kPa	Shear stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal stresses
ε	%	Linear strain
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
μ	1	Coefficient of friction

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	Coefficient of volume change
c_c	1	Compression index
c_s	1	Swelling index
c_r	1	Recompression index
c_v	m^2/s	Coefficient of consolidation
H	m	Drainage path
T_v	1	Time factor
U	%	Degree of consolidation
σ'_{v0}	kPa	Effective overburden pressure
σ'_p	kPa	Preconsolidation pressure
τ_f	kPa	Shear strength
c'	kPa	Effective cohesion intercept
ϕ'	$-\circ$	Effective angle of internal friction
c_u	kPa	Apparent cohesion intercept
ϕ_u	$-\circ$	Apparent angle of internal friction
τ_R	kPa	Residual shear strength
τ_r	kPa	Remoulded shear strength
S_t	1	Sensitivity = c_u/τ_r

PHYSICAL PROPERTIES OF SOIL

P_s	kg/m^3	Density of solid particles
γ_s	kN/m^3	Unit weight of solid particles
ρ_w	kg/m^3	Density of water
γ_w	kN/m^3	Unit weight of water
ρ	kg/m^3	Density of soil
γ	kN/m^3	Unit weight of soil
ρ_d	kg/m^3	Density of dry soil
γ_d	kN/m^3	Unit weight of dry soil
ρ_{sat}	kg/m^3	Density of saturated soil
γ_{sat}	kN/m^3	Unit weight of saturated soil
ρ'	kg/m^3	Density of submerged soil
γ'	kN/m^3	Unit weight of submerged soil
e	1, %	Void ratio
n	1, %	Porosity
w	1, %	Water content
S_r	%	Degree of saturation
W_L	%	Liquid limit
W_P	%	Plastic limit
W_s	%	Shrinkage limit
I_p	%	Plasticity index = $(W_L - W_P)$
I_L	%	Liquidity index = $(W - W_P)/I_p$
I_C	%	Consistency index = $(W_L - W)/I_p$
e_{max}	1, %	Void ratio in loosest state
e_{min}	1, %	Void ratio in densest state
I_D	1	Density index = $(e_{max} - e)/(e_{max} - e_{min})$
D	mm	Grain diameter
D_n	mm	N percent - diameter
C_u	1	Uniformity coefficient
h	m	Hydraulic head or potential
q	m^3/s	Rate of discharge
v	m/s	Discharge velocity
i	1	Hydraulic gradient
k	m/s	Hydraulic conductivity
j	kN/m^3	Seepage force

Brampton, Ontario

METRIC

[illegible]

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

DPG EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH1

2 OF 2

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011010 E 298219) ORIGINATED BY CR
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/09/03 - 2015/09/03 CHECKED BY SM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
	SAND some silt, trace gravel, brown, very loose to very densewet (continued)		12	SS	16											
	-some gravel, dense below 16.76 m depth		13	SS	50											
241.3			14	NR	100/ 50mm											
17.5	BEDROCK HQ3 Coring															
	Lenght (m) RQD (%)															
	Run1 1.6 88.0		15	HQ3												
	Run2 1.4 97.0															
			16	HQ3												
238.3																
20.5	END OF BOREHOLE at ~20.5 m depth															
	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 3.9 m depth upon completion.															

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

Brampton, Ontario

1 OF 1

METRIC

ORIGINATED BY CS

COMPILED BY VP

CHECKED BY SM

DPG EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

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

Brampton, Ontario

METRIC

ORIGINATED BY CS

COMPILED BY VP

CHECKED BY SM

Continued Next Page

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

DPG EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16


Brampton, Ontario

RECORD OF BOREHOLE No BH3

2 OF 2

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011024 E 298205) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-55X, Hollow stem auger/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/11/20 - 2015/11/21 CHECKED BY SM

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: Cu, KPa									
								○ UNCONFINED + FIELD VANE									
								× QUICK TRIAXIAL LAB VANE									
							20	40	60	80	100						
243.4 15.3	-trace gravel below 15.2 m depth BEDROCK grey/black, pink granite NQ Coring Lenght (m) RQD (%) Run1 1.3 84.0 Run2 1.8 94.0 Run3 1.3 96.0		14	SS	50/ 80mm/										○		
			15	NQ													
			16	NQ													
			17	NQ													
238.9 19.8	END OF BOREHOLE at ~ 19.8 m depth NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 5.2 m depth upon completion.																

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH4

1 OF 1

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011038 E 298181) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/11/19 - 2015/11/19 CHECKED BY SM

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					
258.7	Ground Surface																
258.6	ASPHALT: 80mm																
	FILL: SAND AND GRAVEL very dense		1	SS	53		258										
	-Fill :Sand trace gravel, brown, loose, moist		2	SS	9		257										12 71 (17)
256.4																	
2.3	SAND AND GRAVEL trace gravel, trace organics, brown, compact, moist		3	SS	22		256										
255.6																	
3.1	SILTY SAND TO SAND trace silt, trace peat, brown, compact, moist		4	SS	15		255										0 64 (36)
	-some clay, brown, below 3.8 m depth		5	SS	11		254										0 36 (64)
			6	SS	16												
			7	SS	20/ 140mm												
252.9							253										
5.8	BEDROCK grey/black, pink granite		8	NQ													
252.4	NQ Coring																
6.3	Run1 Length (m) RQD (%) 0.5 100.0 END OF BOREHOLE at ~ 6.3 m depth																
	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 4.2 m depth upon completion.																

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

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH5

1 OF 1

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5010998 E 298231) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-55X, Hollow stem auger/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/11/19 - 2015/11/19 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
258.9	Ground Surface																
258.8	ASPHALT: 80mm																
	FILL: SAND AND GRAVEL TO SAND trace gravel, trace silt, brown, dense to loose, moist		1	SS	34		258										
			2	SS	9		257										18 70 (12)
			3	SS	2		256										
			4	SS	8		255										
255.1	SAND AND GRAVEL trace silt, brown, compact to very dense, wet		5	SS	50/ 80mm		255										
3.8			6	SS	21		254										
			7	SS	56		253										27 59 (14)
252.8	BEDROCK grey/black, pink granite						252										
6.1	NQ Coring		8	NQ													
	Length (m) RQD (%) Run1 1.2 100.0																
251.6	END OF BOREHOLE at ~ 7.3 m depth																
7.3	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 3.7 m depth upon completion.																

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

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH6

1 OF 1

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011000 E 298231) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-55X, Hollow stem auger/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/11/18 - 2015/11/18 CHECKED BY SM

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					
258.9	Ground Surface																
258.9	ASPHALT: 80mm																
258.9	FILL: SAND AND GRAVEL TO SAND brown, compact to loose, moist		1	SS	37		258							○			15 69 (16)
			2	SS	18		257							○			
	-silty sand, trace gravel, trace organics, brown, loose, moist at 2.3 m depth		3	SS	9		256							○			4 62 (34)
255.8	COBBLES AND BOULDERS some gravel, some silt, very dense, moist -black with pink/white granite and sample rock (112mm) recorded below 3.3 m depth -more boulders below 4.0 m depth		4	SS	50/30mm		255							○			
254.1	SAND AND GRAVEL trace silt, brown, dense to very dense, wet		5	SS	35		254							○			
			6	SS	50/80mm		253							○			33 54 (13)
			7	SS	41		252							○			
251.8	BEDROCK grey/black, pink granite NQ Coring		8	NQ			251										
	Lenght (m) RQD (%) Run1 0.7 100.0 Run2 1.5 100.0 Run3 1.5 98.0 Run4 0.9 100.0		9	NQ			250										
			10	NQ			249										
			11	NQ			248										
247.2	END OF BOREHOLE at ~ 11.7 m depth																
11.7	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 3.7 m depth upon completion.																

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

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH7

1 OF 1

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011000 E 298240) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers COMPILED BY VP
 DATUM Geodetic DATE 2015/09/10 - 2015/09/10 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
258.9	Ground Surface																
	FILL: SAND AND GRAVEL some cobbles, occasional boulder, grey loose to Dense		1	SS	34		258										
			2	SS	30												
			3	SS	5		257										
256.6																	
2.3	SILTY SAND TO SAND trace to some gravel, trace clay, trace cobbles and boulders, trace organics, trace rootlets, brown, moist to very moist, compact to very dense - Boulder @ 3.05 m - becoming clayey		4	SS	22		256										
			5	SS	66												
			6	SS	100/ 228mm		255										9 63 22 6
	- Bedrock @ 4.6 m on adjacent borehole BH-7A		7	SS	100/ 280mm		254										10 71 (19)
	- Boulder @ 5.2 m		8	SS	67												
253.1	- Spoon broke off																
5.8	END OF BOREHOLE Possible Bedrock, Spoon broke off																
	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 3.1 m depth upon completion.																

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

Brampton, Ontario

RECORD OF BOREHOLE No BH7A

1 OF 1

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011000 E298243) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers/ Diamond Drill, Cased Hole COMPILED BY NT
 DATUM Geodetic DATE 2015/09/11 - 2015/09/11 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH: Cu, KPa									WATER CONTENT (%)			GR
								○ UNCONFINED	+	FIELD VANE	×	QUICK TRIAXIAL	LAB VANE							
258.9	Ground Surface -Refer BH-7 for soil description, Auger flight upto boulder surface																			
255.7																				
3.2	COBBLES AND BOULDERS some sand, some gravel, dark grey with pink/white granite boulder and sample rock (242 mm) recorded -becoming more cobbles and sand and gravel @ 3.4 m		1	HQ3																
254.3																				
4.6	BEDROCK pink and grey granite HQ3 Coring Lenght (m) RQD (%) Run1 0.4 90 Run2 1.5 100 Run3 1.5 100		2	HQ3																
			3	HQ3																
			4	HQ3																
250.8																				
8.1	END OF BOREHOLE NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others 3. No Groundwater was measured																			

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

OPG_EXP.RECORD OF BOREHOLE HWY 141.GPJ ONTARIO.MOT.GDT 2/25/16





Brampton, Ontario

RECORD OF BOREHOLE No BH8

1 OF 2

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011018 E 298218) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/09/09 - 2015/09/09 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH: Cu, KPa										WATER CONTENT (%)			
								○ UNCONFINED		+ FIELD VANE								○			
								× QUICK TRIAXIAL		LAB VANE											
257.6	Ground Surface						20	40	60	80	100	10	20	30	GR	SA	SI	CL			
	NEW FILL: SAND AND GRAVEL some cobbles, brown, compact -grey to brown OLD FILL: SAND medium to fine grained sand, some bolders, trace gravel, trace silt, trace organics, brown, loose to compact, moist - dense below 3.1 m depth		1	SS	24																
			2	SS	14														257		
			3	SS	6														256		
			4	SS	8														255		
			5	SS	121/ 305mm														254		
253.8	SITLY SAND TO SAND fine grained sand, trace gravel, trace silt, trace organics, brown, very loose to very dense, wet -seam coarse grained sand below 6.1 m depth		6	SS	10														253		
7			SS	3	252																
8			SS	10	251																
9			SS	14	250																
10			SS	5	249																
11			SS	5	248																
12			SS	14	247																
13			SS	4	246																
14			SS	6	245																
246.9			SAND trace to some silt, trace clay, brown, very loose to compact, wet		15														SS	3	244
16					SS														30	243	
17					SS														16		
18					SS														44		
19					SS														30		

Continued Next Page

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

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

Brampton, Ontario

RECORD OF BOREHOLE No BH8

2 OF 2

METRIC

W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011018 E 298218) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers/ Diamond Drill, Cased Hole COMPILED BY VP
 DATUM Geodetic DATE 2015/09/09 - 2015/09/09 CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	SAND trace to some silt, trace clay, brown, very loose to compact, wet (continued) compact below 15.24 m depth		20	SS	17		242										
241.1 16.5	END OF BOREHOLE at ~ 16.5 m depth NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 4.0 m depth upon completion.																

OPG_EXP RECORD OF BOREHOLE HWY 141.GPJ ONTARIO MOT.GDT 2/25/16

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

Brampton, Ontario

RECORD OF BOREHOLE No BH9

1 OF 1

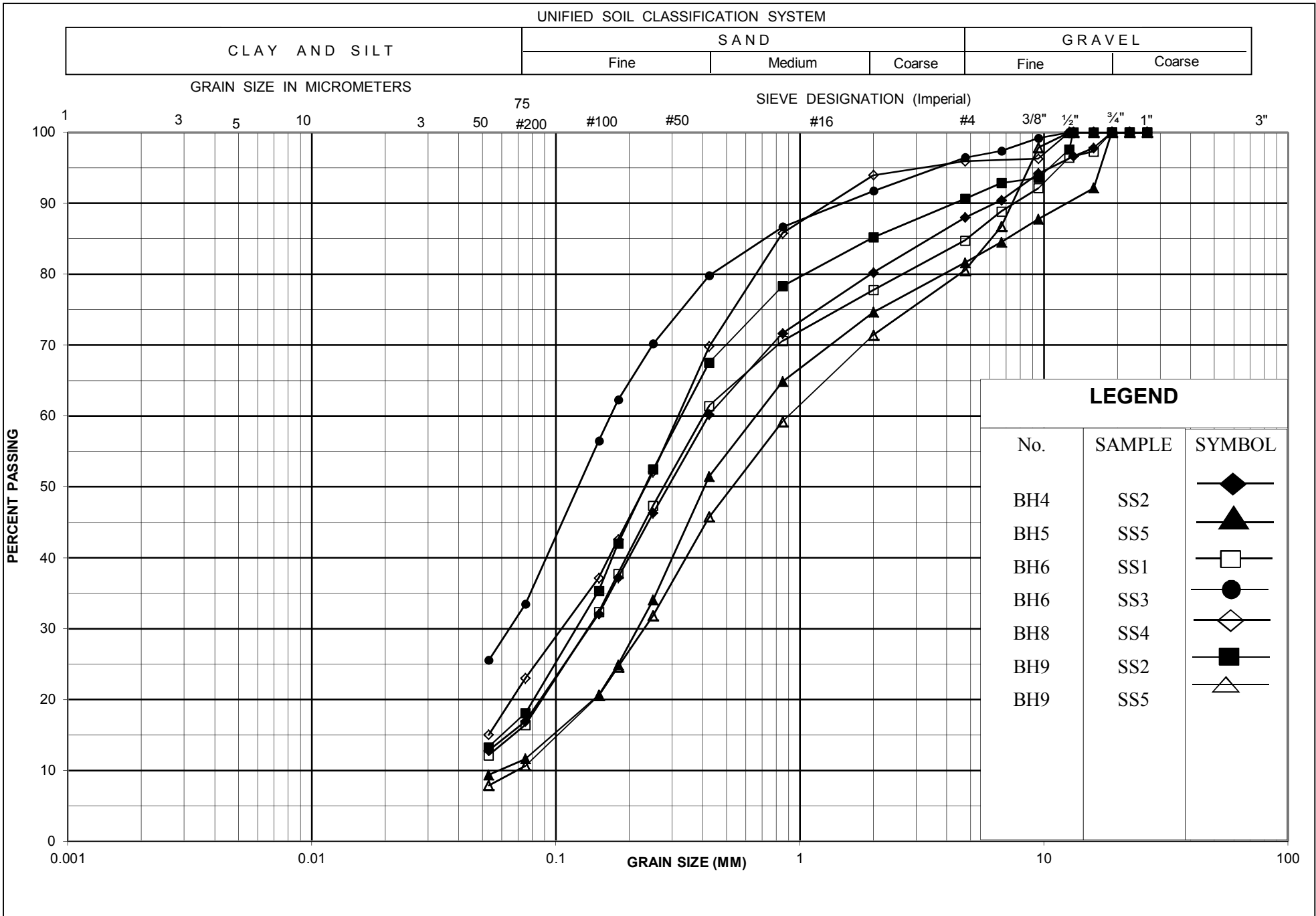
METRIC

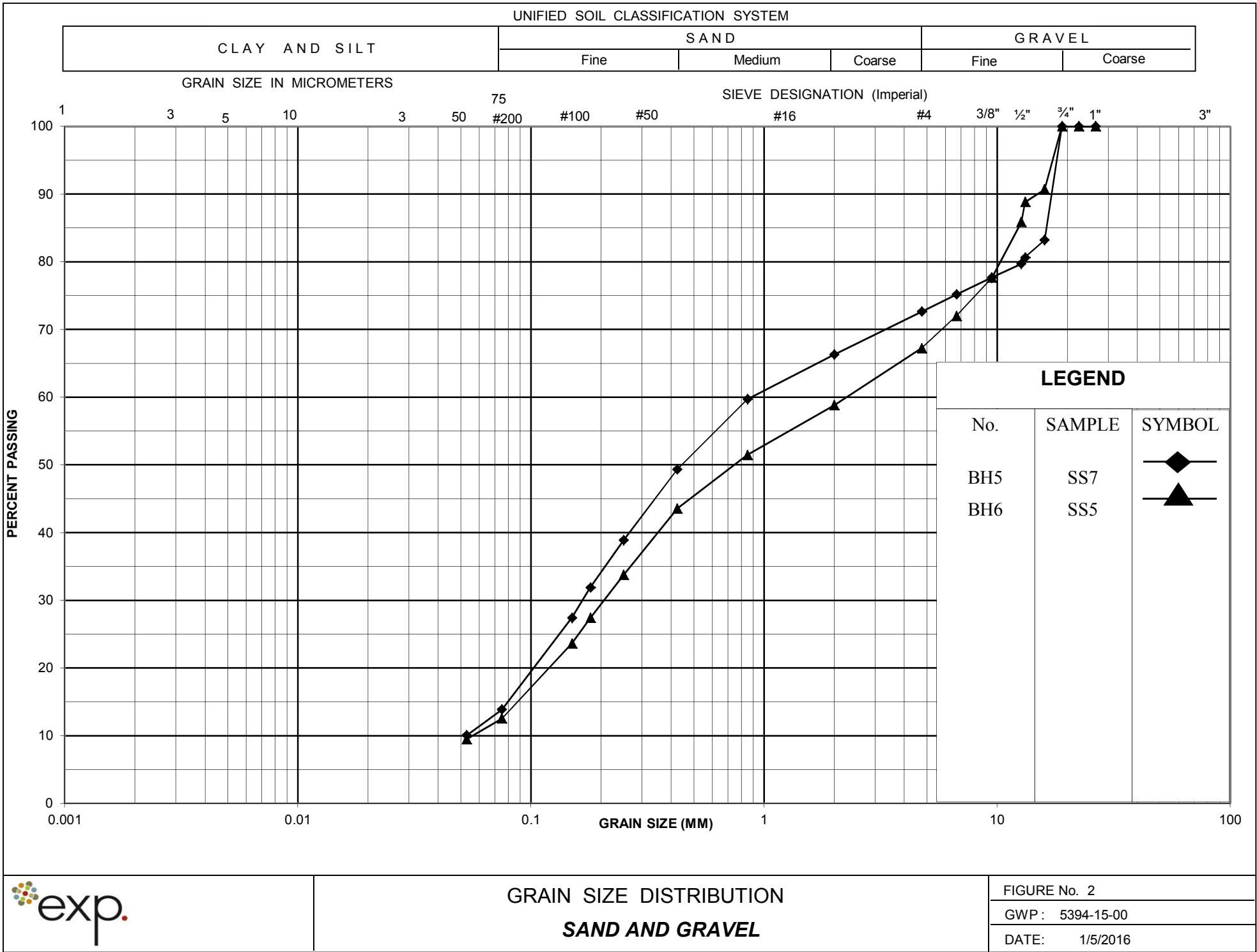
W. P. GWP 5394-15-00 LOCATION Rosseau River Bridge, Rosseau, Ontario, MTM Z10, (N 5011032 E 298203) ORIGINATED BY CS
 DIST HWY 141 BOREHOLE TYPE CME-75, Hollow Stem Augers COMPILED BY VP
 DATUM Geodetic DATE 2015/09/10 - 2015/09/10 CHECKED BY SM

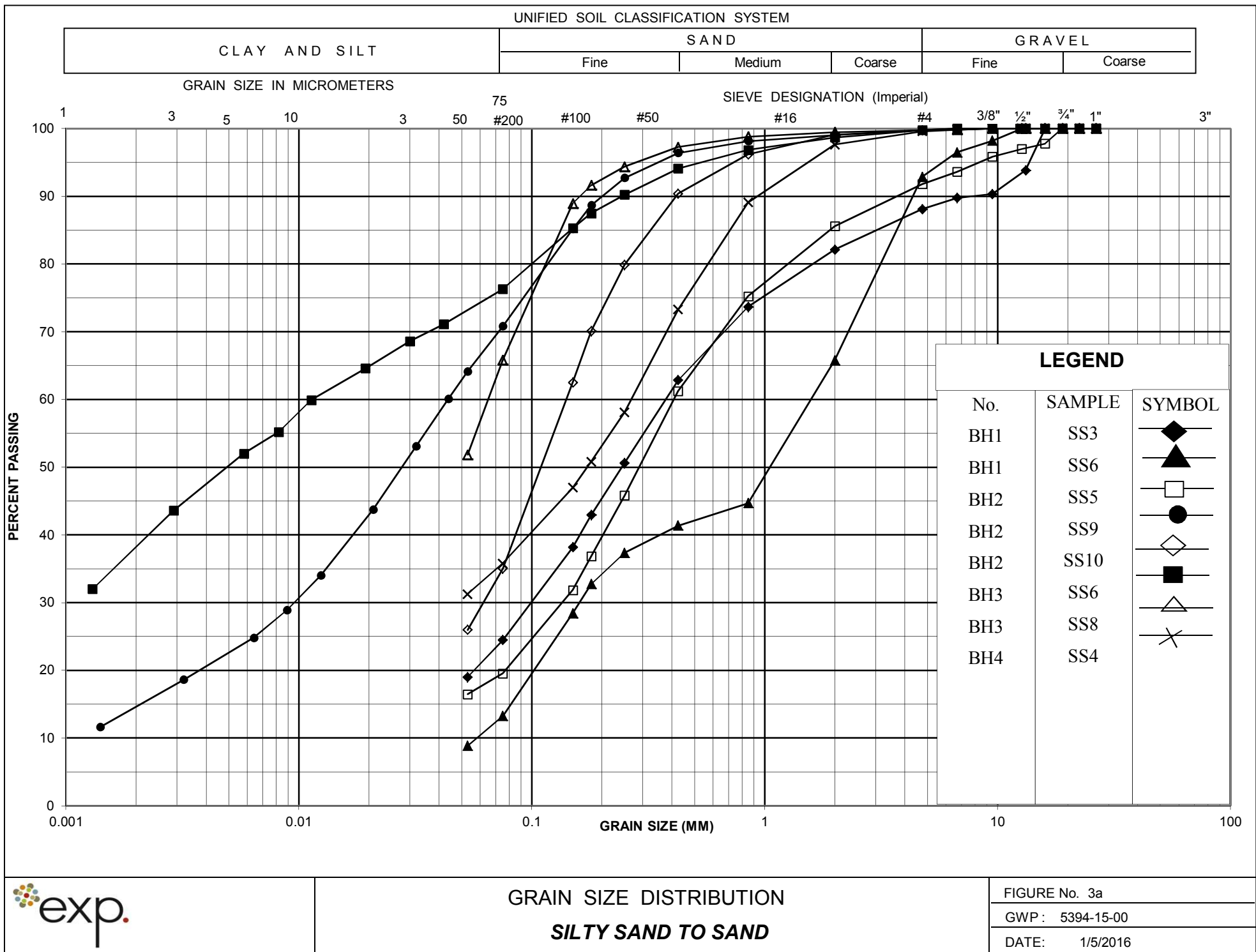
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH: Cu, KPa									WATER CONTENT (%)			GR
								○ UNCONFINED	+	FIELD VANE	×	QUICK TRIAXIAL	LAB VANE							
258.8	Ground Surface																			
	FILL: SAND AND GRAVEL grey, compact, moist		1	SS	23								○							
	-medium to fine grained sand, some gravel, brown, loose, moist below 0.8 m depth		2	SS	8								○					9	73 (18)	
			3	SS	5								○							
	-seam topsoil, trace rootlets 2.3 m depth		4	SS	6									○						
	-brown, compact, wet below 3.1 m depth		5	SS	29								○					19	70 (11)	
			6	SS	19								○							
254.4	END OF BOREHOLE at ~ 4.4 m depth																			
4.4	NOTES: 1. This drawing is to be read with the subject report and project numbers as presented above. 2. Interpretation assistance by exp is required before used by others. 3. Groundwater level at 3.1 m depth upon completion.																			

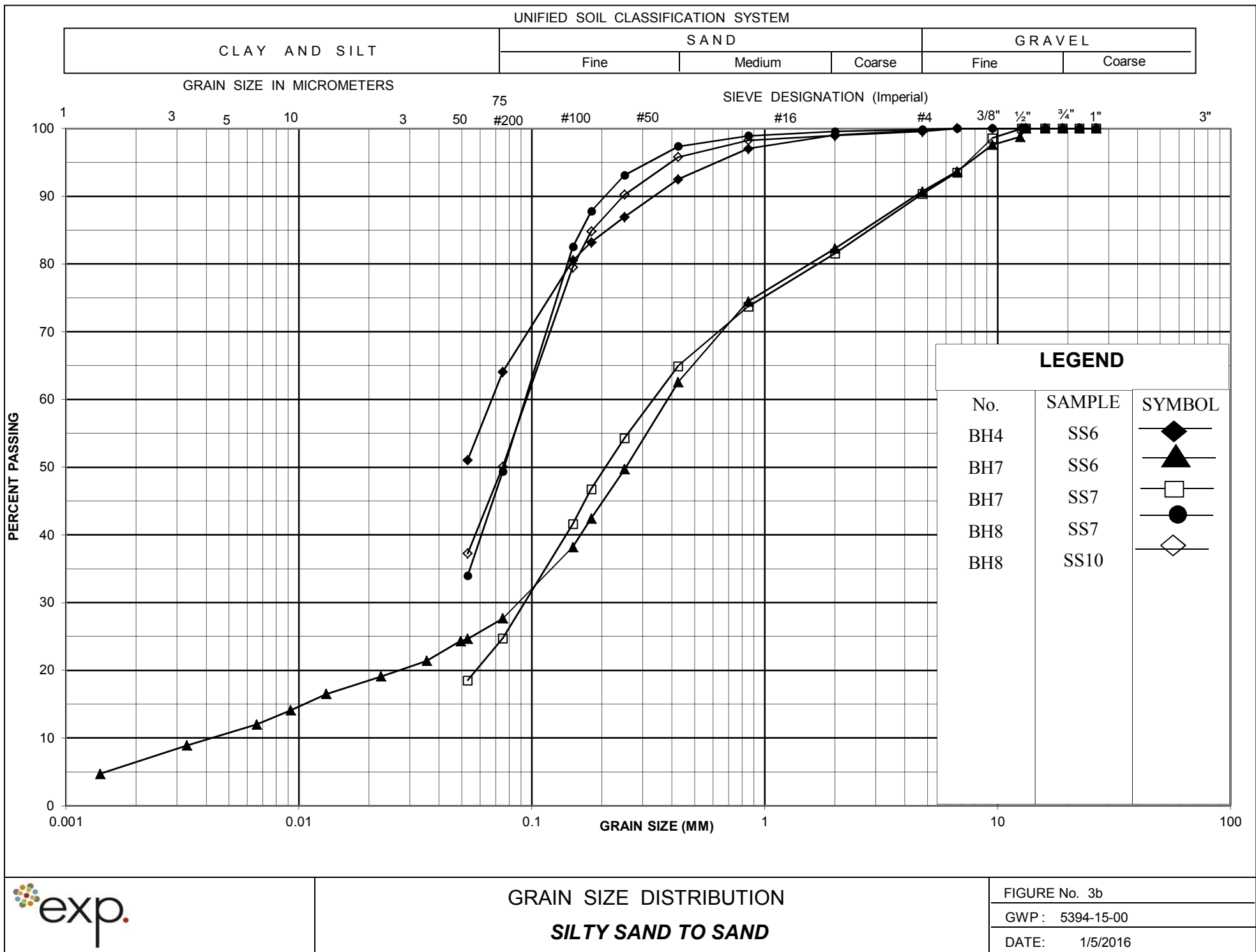
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

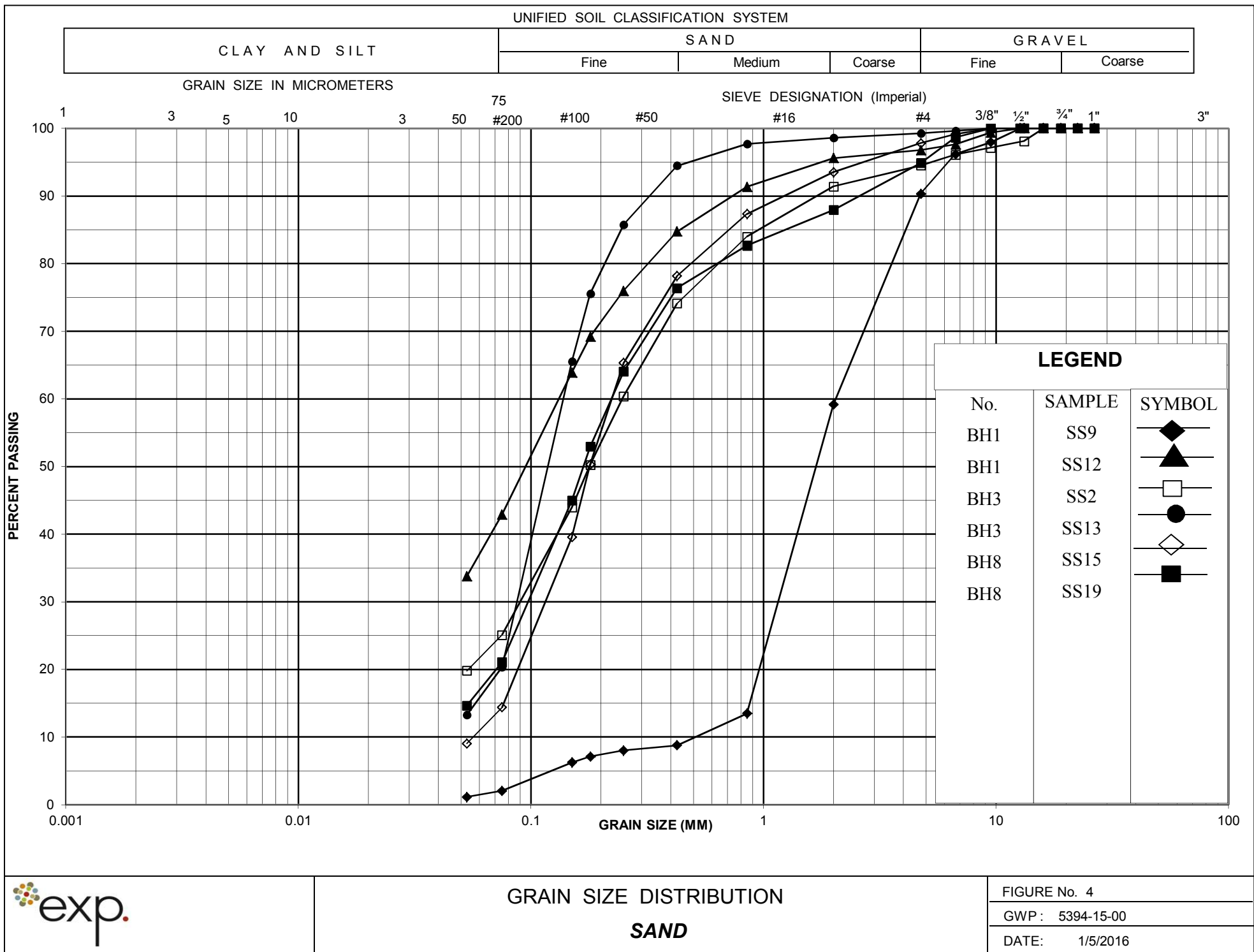
Appendix D – Laboratory Test Results











Appendix E – Bedrock Core Photographs

Project NO: ADM 00028245-M0
BH NO: 1
Run NO: 1 & 2
Sample Depth: 17.5 m to 20.5 m
Elevation: 241.3 m to 238.3 m
RQD: 88% to 97%
Date: September 03, 2015



Photo 1. Core Sample for BH1 from Elevation 241.3 m to 238.3 m

Project NO: ADM 00028245-M0
BH NO: 3
Run NO: 1, 2 & 3
Sample Depth: 15.3 m to 19.8 m
Elevation: 243.4 m to 238.9 m
RQD: 84% to 96%
Date: November 11, 2015



Photo 2. Core Sample for BH3 from Elevation 243.4 m to 238.9 m

Project NO: ADM 00028245-M0
BH NO: 4 and 5
Run NO: 1
Sample Depth: 5.8 m to 6.3m (BH4) 6.1 m to 7.3 m (BH5)
Elevation: 252.9 m to 252.4 m (BH4) 252.8 m to 251.6 m (BH5)
RQD: 100%
Date: November 19, 2015



Photo 3. Core Samples for BH4 and BH5

Project NO: ADM 00028245-M0
BH NO: 6
Cobbles and Boulders
Sample Depth: 4.0 m to 4.6m, 5.8 m to 6.2 m and 6.9 m to 7.1 m
Bedrock
Run NO: 1, 2 & 3 Sample Depth: 7.1 m to 10.0 m
Elevation: 251.8 m to 248.9 m RQD: 98% to 100%
Date: November 18, 2015



Photo 4. Core Samples BH6 Cobbles and Boulders from Elevation 255.8 m to 251.8 m and Bedrock from Elevation 251.8 m to 248.9 m

Project NO: ADM 00028245-M0
BH NO: 6
Run NO: 3 & 4
Sample Depth: 10.0 m to 11.7 m
Elevation: 248.9 m to 247.2 m
RQD: 98% to 100%
Date: November 18, 2015



Photo 5. Core Sample for BH6 from Elevation 248.9 m to 247.2 m

Project NO: ADM 00028245-M0
BH NO: 7A

Cobbles and Boulders

Sample Depth: 3.2 m to 3.5 m, 3.5 m to 4.6 m

Bedrock

Run NO: 1

Elevation: 254.3 m to 253.9 m

Date: September 11, 2015

Sample Depth: 4.6 m to 5.0 m

RQD: 90%



Photo 6. Core Sample for BH7A from Elevation 255.7 m to 253.9 m