



FINAL REPORT

FOUNDATION INVESTIGATION REPORT

New Storage Structure at Farley's Corner Patrol Yard, Hwy 524, Township of Pringle, North Bay Area

**Agreement No. 5013-E-0008
Assignment No. 7
WO 2015-11006**

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May 22, 2015

Ministry of Transportation

Foundation Investigation Report

Agreement No. 5013-E-0008
Assignment No. 7
WO 2015-11006
Geocres No. 31E-352

Type of Document:
FINAL

Project Name:
New Storage Structure at Farley's Corner Patrol Yard, Hwy 524, Township of Pringle, North Bay Area

Project Number:
ADM-00028245-H0

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Table of Contents

1	FOUNDATION INVESTIGATION REPORT	3
1.1	Introduction	3
1.2	Site Description and Geological Setting	3
1.2.1	Site Description	3
1.2.2	Geological Setting	3
1.3	Investigation Procedures	4
1.3.1	General	4
1.3.2	Laboratory Testing	5
1.3.3	Previous Investigation	5
1.4	Subsurface Conditions	5
1.4.1	Fill: Sand	6
1.4.2	Silty Sand	6
1.4.3	Bedrock	7
1.5	Groundwater Conditions	8
1.6	CLOSURE	9
	Appendix A – Photographs	10
	Appendix B – Drawings	14
	Appendix C – Borehole Logs	17
	Appendix D – Laboratory Data	26
	Appendix E – Rock Core Photographs	29
	Appendix F – Record of Historical Geotechnical Data	32

1 FOUNDATION INVESTIGATION REPORT

1.1 Introduction

This report presents the results of a geotechnical investigation carried out by **exp** Services Inc. (**exp**) for the proposed new storage structure located at Farley's Corners Patrol Yard, located on Hwy 524 in the Township of Pringle, North Bay area. The work was undertaken under Agreement # 5013-E-0008, Assignment No. 7 (WO 2015-11006). The terms of reference (TOR) were as presented in the Ministry of Transportation (MTO) letter received on March 02, 2015. The TOR noted that the proposed storage structure(s) at this petrol yard involved consideration of two replacement scenarios shown on the site map PLAN H-1062-524-1 provided by MTO: (i) replacement of existing sand dome storage structure in kind, and (ii) replacement of existing salt shed with a larger structure of 12.2 m x 21.3 m.

The purpose of the investigation is to establish the existing subsurface conditions at the proposed location of the patrol yard structures within the construction limits. The site specific geotechnical investigation consisted of field investigation including visual inspection, drilling, soil sampling, and laboratory testing. Factual results of the investigation and laboratory testing are included in this report. The report has been prepared specifically and solely for the projects described in the report.

1.2 Site Description and Geological Setting

1.2.1 Site Description

The Farley's Corners Patrol Yard is located on Hwy 524 in the Township of Pringle approximately 0.2 km north of Hwy 522 and Hwy 524 junction (see Key Map on Drawing 1, Appendix B). The terrain at the structure site is relatively flat as shown on photographs included in Appendix A.

In the proposed structure area, there are a sand dome and salt shed. The existing sand dome of about 38 m diameter is located approximately 55 m southeast of the existing MTO benchmark BM 758455 (Elev. 317.558 m) as marked on the site map, PLAN H-1062-524-1, and shown on Drawing 1 in Appendix B. The salt shed is about 9 m wide and 10 m long and is located approximately 5 m northwest of the sand dome.

1.2.2 Geological Setting

Map 2544 (Bedrock Geology of Ontario, Southern Sheet, 1991) of the Ministry of Northern Development and Mines indicates that the bedrock formation of the project area is known to be in the Central Gneiss Belt of the Mesoproterozoic Group, mainly of felsic igneous rocks comprised of tonalite, granodiorite and granite. Map 2556 (Quaternary Geology of Ontario, Southern Sheet, 1991) of the Ministry of Northern Development and Mines, indicates that the surface conditions in the vicinity of site consist of glaciofluvial outwash deposits consist of gravel and sand.

1.3 Investigation Procedures

1.3.1 General

The field investigation was performed during March 23 and March 24, 2015. The field program consisted of drilling four (4) sampled boreholes (BH F15-1, BH F15-2, BH F15-3, and BH F15-4) and one dynamic cone penetration test (DCPT) adjacent to BH F15-3.

The boreholes were strategically located at the patrol yard to provide the subsurface information for the design of replacement of existing sand dome storage structure in kind and replacement of existing salt shed with a larger structure of 12.2 m x 21.3 m. The borehole locations are shown on Drawing 1 in Appendix B.

The borehole locations (referenced to the MTM NAD83 coordinate system) and their ground surface elevations were surveyed by **exp** personnel, with reference to the benchmark at the northwest of the sand dome (MTO BM Elevation 317.56 m), as shown in the site map provided by MTO (PLAN H-1062-524-1).

The boreholes were advanced using a track mounted CME-55 drill rig, equipped with a hollow stem auger/ diamond drilling with NW casing. All borehole drilling/sampling were operated by a specialist drilling contractor, Marathon Drilling Co. Ltd. Boreholes F15-1 and F15-3 were advanced to depths of 3.7 m and 9.8 m respectively until auger/split spoon refusal (BH F15-1) or desired depth. DCPT test performed adjacent to BH F15-3 was advanced until refusal at depth of 10.7 m. Boreholes F15-2 was drilled up to a 6.0 m depth with 3.6 m of bedrock coring, and borehole F15-4 was drilled up to a 9.1 m depth with 2.1 m of bedrock coring.

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 D 1586), at intervals 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 of cohesive soils or relative density of non-cohesive soils. At BH F15-4 sand heaving was encountered at depth of 3.0 m, so a wash boring technique was utilized to facilitate taking representative samples at designated elevation with reasonable accuracy. When a hard stratum was reached sampling of rock was performed in two boreholes (BH F15-2 and BH F15-4) by diamond core drilling, using a 1.5 m long NQ double tube wireline core barrel. A dynamic cone penetration test (DCPT) was performed in the vicinity of BH F15-3 to identify a level of a hard stratum in that borehole. The results of the DCPT, recorded SPT "N" values, and relative consistency of the soil layers are shown on the borehole log sheets in Appendix C.

Upon completion of the boreholes, groundwater level measurements were carried out in the open holes. Since wash boring technique was used to advance borehole or to cored bedrock at BH F15-2, the stabilized ground water level could not be established by short term observation in these boreholes. The measured groundwater levels in BH F15 1, BH F15-3 and BH F15-4 were recorded in 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 staff who 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 were placed in labelled moisture-proof bags and returned to **exp's** Brampton laboratories for additional visual, textual and olfactory examination, and sampling for lab 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. 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.

1.3.3 Previous Investigation

The foundation report from August 1964 related to this site and named "Foundation Investigation Report for Proposed D.H.O. Patrol Yard, Hwy. # 524, District of Parry Sound, Township of Pringle, Con. 11, Lot 30, District # 13, North Bay (GEOCRE 31E00-047) is provided by MTO. The locations of the historical boreholes drilled in April 1964 are shown on Drawing 1 in Appendix B and the soil stratigraphy assessed during that investigation is shown on the attached drawing in Appendix F.

1.4 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, 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 along the proposed sand storage structure and salt shed are provided in Appendix B. It should be noted that the stratigraphic boundaries indicated on the borehole logs and stratigraphic section are inferred from non-continuous sampling, observations of drilling progress and results of Standard Penetration Tests. These boundaries typically represent transitions from one soil type to another and should not be regarded as exact planes of geological change. Further, subsurface conditions may vary between and beyond the borehole locations.

In general, the stratigraphic sequence at the proposed structure site consists of top sand fill, underlain by native silty sand deposits followed by bedrock. A brief summary of the soil and groundwater conditions encountered in the boreholes is provided below.

1.4.1 Fill: Sand

A sand fill layer was encountered below an approximately 25 mm thick layer of asphalt in all boreholes drilled. The thickness of sand fill layer is about 0.6 m extending from Elev. 317.7 m to 316.6 m.

This layer consists of sand with few to little gravel, few to little silt and clay size particles. The material is blackish brown to brown in color, and moist, frozen. Dynamic cone penetration resistance value within this layer is about 80 blows per 300 mm of penetration, suggesting very dense relative density of this layer.

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

Moisture Content:

- 2.3% to 9.2 %

Grain Size Distribution:

- 8% to 19% gravel;
- 66% to 82% sand; and
- 10% to 15% 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

1.4.2 Silty Sand

A layer of silty sand was encountered below the sand fill in all boreholes. The thickness of silty sand layer ranged from 1.8 m to 9.2 m extending from Elev. 317.1 m to 307.4 m. BH F15-1 and BH F15-3 were terminated within this layer upon split spoon refusal or achieving the proposed borehole depth.

This layer consists of sand with few to some silt, trace to little gravel and trace clay. The material is reddish brown to brown in color, and moist to wet. The SPT "N" values within this layer ranged from 3 to above 100 blows per 300 mm penetration, corresponding to very loose to very dense compactness condition, but more typically compact to very dense conditions.

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

Moisture Content:

- 5.3% to 22.2%

Grain Size Distribution:

- 0 to 19 % gravel;
- 63% to 89% sand;
- 5% to 25% silt; and
- 1% 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.

1.4.3 Bedrock

The presence of bedrock was found to be approximately between 2.4 m to 10.7 m below the ground surface. The bedrock was inferred from split spoon/DCPT refusal in BH F15-1 and BH F15-3, or confirmed using coring depth of 2.1 m (BH F15-4) to 3.6 m (BH F15-2). The elevation of the inferred or actual bedrock surface below this site ranges from Elev. 314.0 m to 307.4 m. The inferred or actual bedrock surface depth and elevation encountered at these borehole locations are listed in Table 1.1.

Based on the bedrock cores recovered, the bedrock consists of granite gneiss. In general, the bedrock samples are described as light grey/dark grey/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 61% to 100%, indicating a rock mass of fair to excellent quality. 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
BH F15-1	3.7	314.0	Inferred/ Spoon Refusal
BH F15-2	2.4	315.3	Bedrock Cored
BH F15-3	10.7	307.4	Inferred/ DCPT Refusal
BH F15-4	7.0	310.4	Bedrock Cored

1.5 Groundwater 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. Since wash boring technique was used for drilling BH F15-2, accurate groundwater levels at this borehole could not be measured in the open holes at the time of drilling operation. Water levels measured in open boreholes might not be stabilized due to short term observation.

Table 1.2 Groundwater levels recorded at the site

Borehole No.	Date of Measuring	Groundwater Level	
		Depth (m)	Elevation (m)
BH-1	03/24/2015	2.1	315.5
BH-3	03/23/2015	3.05	314.15
BH-4	03/24/2015	2.44	314.96

May 22, 2015

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 Silvana Micic, Ph.D., P.Eng. and Nimesh Tamrakar, M.Eng. and reviewed by TaeChul Kim, M.E.Sc., P.Eng. and Stan E. Gonsalves, M.Eng., P.Eng., Designated MTO Foundation Contact. The field investigation was conducted by Nimesh Tamrakar, M.Eng.

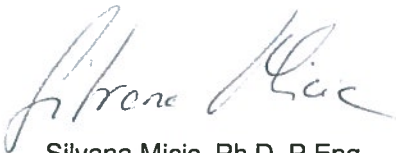
We trust that these comments provide you with sufficient information to proceed with design. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

exp Services Inc.



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Technical Specialist



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Stan E. Gonsalves, M.Eng., P.Eng.
Principal Engineer
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Appendix A – Photographs



Photo 1: Facing west from location of BH F15-4 (the existing salt shed)



Photo 2: Facing north from location of BH F15-4



Photo 3: Facing south from location of BH F15-2



Photo 4: Facing east from southwest corner of patrol yard (the existing sand dome structure on the left)

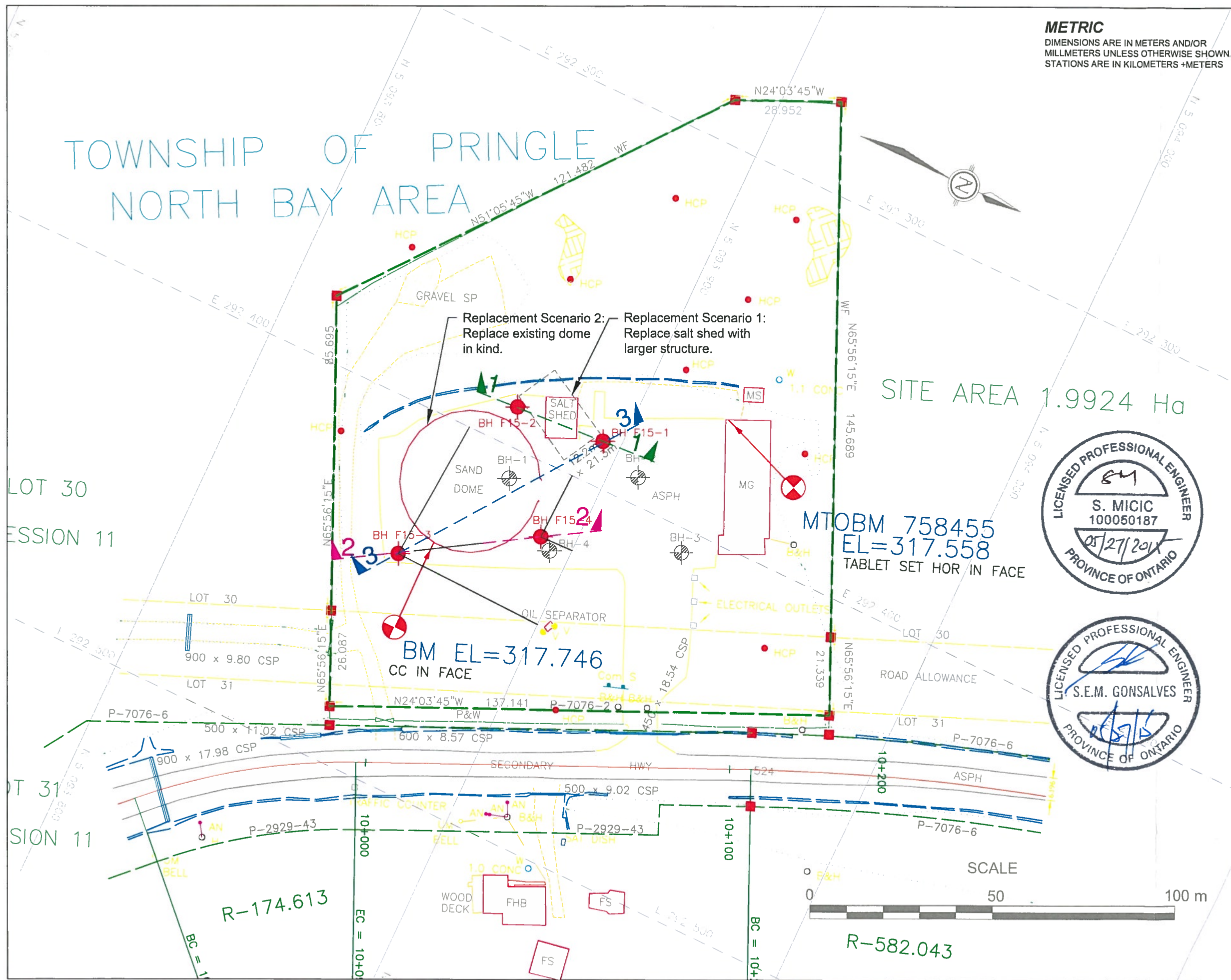


Photo 5: Facing north from location of BH F15-3



Photo 6: Facing east from location of BH F15-3

Appendix B – Drawings



Agreement No. 5013-E-0008
 Assignment No. 7
 WO 2015-11006
SAND AND SALT STORAGE STRUCTURES
 Farley's Corner Patrol Yard
 Site Plan

exp. **exp Services Inc.**
 KEY PLAN

LEGEND

BH No.	APPROX. ELEV.	MTM CO-ORDINATES	
		NORTH	EAST
MTOBM 758455	317.56	5093925	292370
BH F15-1	317.65	5093895	292388
BH F15-2	317.71	5093870	292389
BH F15-3	317.19	5093857	292439
BH F15-4	317.41	5093891	292419

NOTE
 Locations of the historical boreholes have been taken from the MTO Drawing No. 84-F-52 A and the base plan has been provided by MTO.
 This drawing is for site 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.

DATE	BY	DESCRIPTION
2015.05.22	SM	FINAL SUBMISSION
2015.04.30	SM	SUBMISSION FOR MTO REVIEW

SCALE		PROJECT NO. ADM-00028245-H0	
SUBM'D	SM	CHECKED	SM
DRAWN	NT	CHECKED	SG
DATE 2015.05.21		APPROVED SG	
DWG. 01			

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

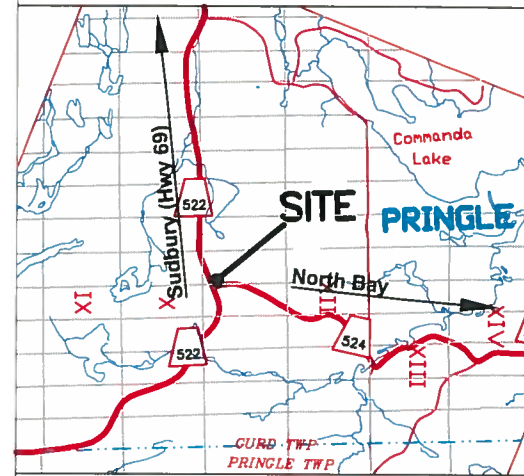


Agreement No. 5013-E-0008
Assignment No. 7
WO 2015-11006
**SAND AND SALT STORAGE
STRUCTURES**
Farley's Corner Patrol Yard
Soil Strata

SHEET
2

exp Services Inc.

KEY PLAN



LEGEND

- Borehole Locations (March, 2015)
- Approximate Historical Borehole/ DCPT Locations (July, 1964)
- N Standard Penetration Test (Blows/0.3 m)
- ▽ Groundwater Level Measured in the Open Hole

SOIL STRATA SYMBOLS



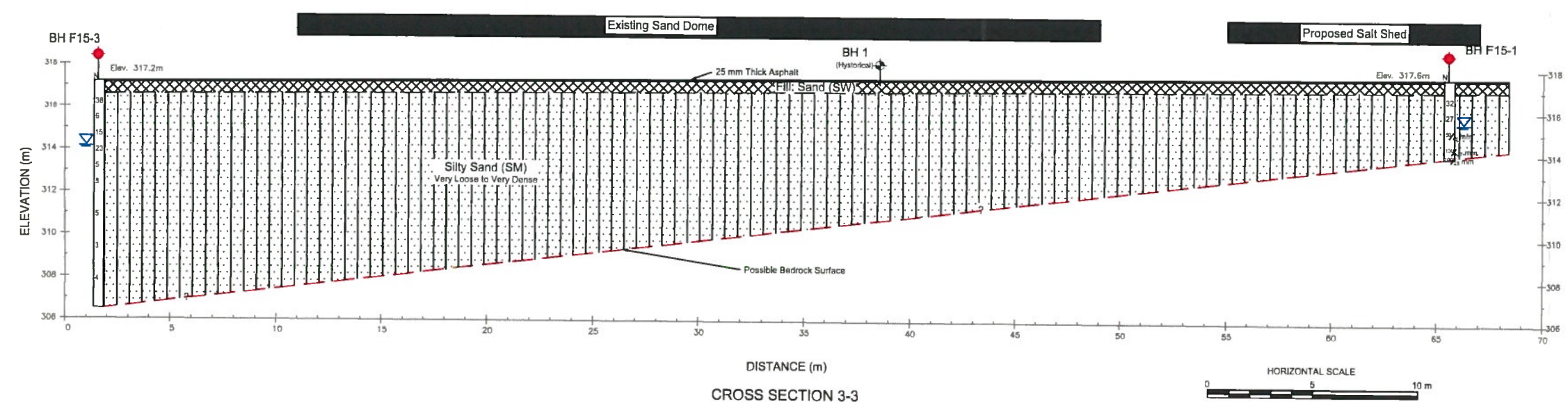
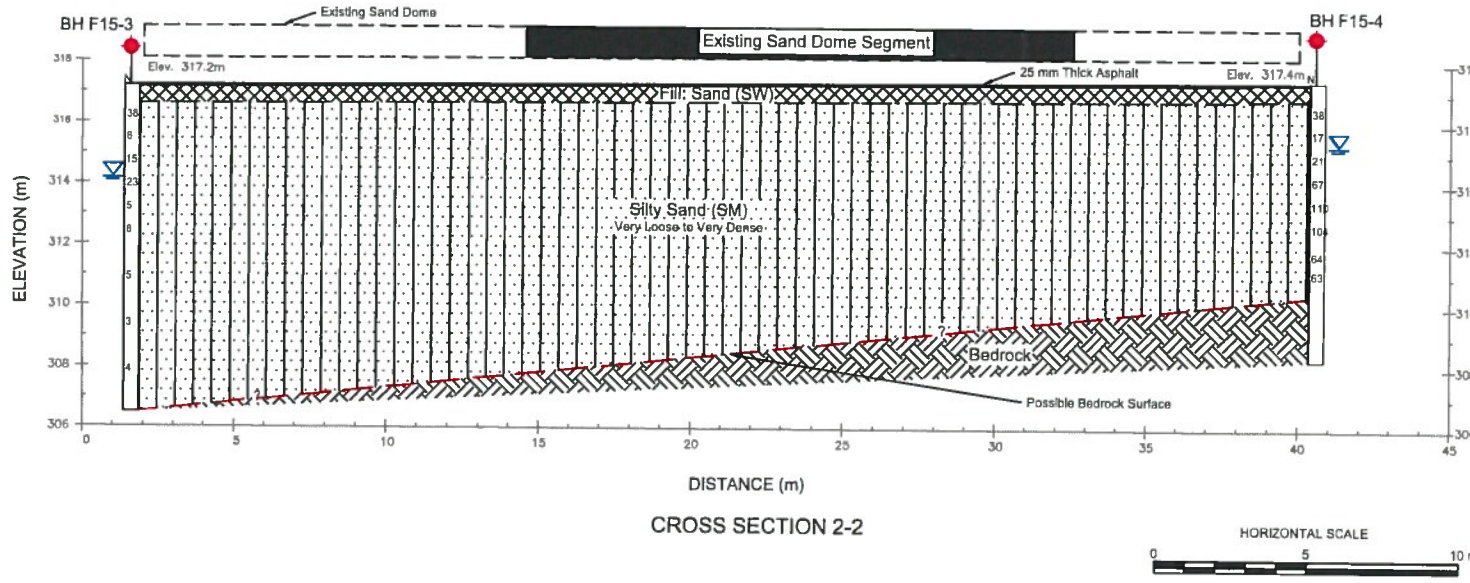
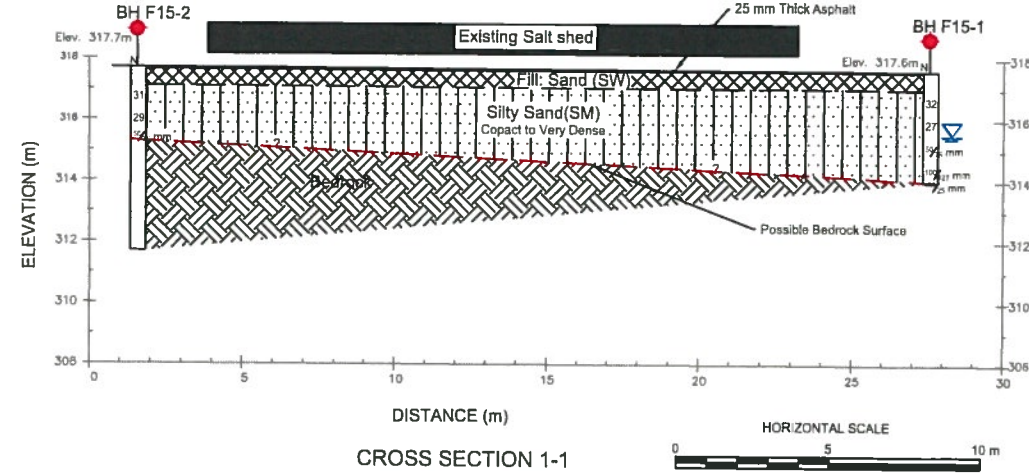
BH No.	APPROX. ELEV.	MTM CO-ORDINATES	
		NORTH	EAST
BH F15-1	317.65	5093895	292388
BH F15-2	317.71	5093870	292389
BH F15-3	317.19	5093857	292439
BH F15-4	317.41	5093891	292419

NOTE

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2015.05.22	SM	FINAL SUBMISSION
2015.04.30	SM	SUBMISSION FOR MTO REVIEW
DATE	BY	DESCRIPTION
		GEOCRE NO. 31E-352
SCALE	SEE SCALE BAR	PROJECT NO. ADM-00028245-H0
SUBM'D SM	CHECKED SM	DATE 2015.05.21
DRAWN NT	CHECKED SG	APPROVED SG DWG. 02



Appendix C – Borehole 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.

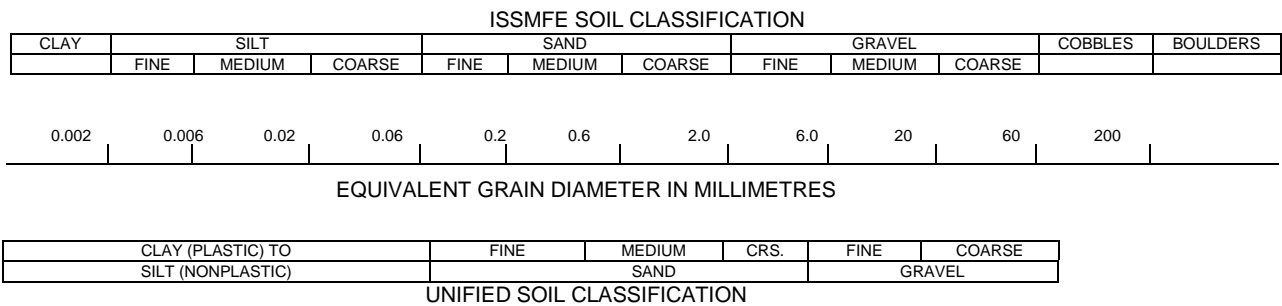
Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

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 the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). 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.



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:

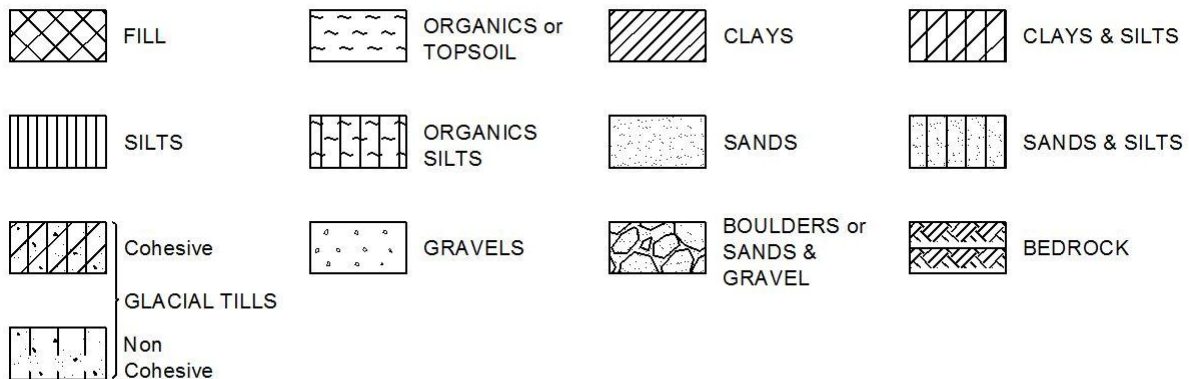
Table c: Consistency of Cohesive Soil

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



Open Borehole or Test Pit



Monitoring Well, Piezometer or Standpipe

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

	kPa	Pore water pressure
	1	Pore pressure ratio
	kPa	Total normal stress
	kPa	Effective normal stress
	kPa	Shear stress
	kPa	Principal stresses
	%	Linear strain
	%	Principal strains
E	kPa	Modulus of linear deformation
G	kPa	Modulus of shear deformation
	1	Coefficient of friction

MECHANICAL PROPERTIES OF SOIL

	kPa ⁻¹	Coefficient of volume change
	1	Compression index
	1	Swelling index
	1	Recompression index
	m ² /s	Coefficient of consolidation
H	m	Drainage path
T _v	1	Time factor
U	%	Degree of consolidation
	kPa	Effective overburden pressure
	kPa	Preconsolidation pressure
	kPa	Shear strength
	kPa	Effective cohesion intercept
		Effective angle of internal friction
	kPa	Apparent cohesion intercept
		Apparent angle of internal friction
	kPa	Residual shear strength
	kPa	Remoulded shear strength
	1	Sensitivity = c

PHYSICAL PROPERTIES OF SOIL

	kg/m ³	Density of solid particles
	kN/m ³	Unit weight of solid particles
	kg/m ³	Density of water
	kN/m ³	Unit weight of water
	kg/m ³	Density of soil
	kN/m ³	Unit weight of soil
	kg/m ³	Density of dry soil
	kN/m ³	Unit weight of dry soil
	kg/m ³	Density of saturated soil
	kN/m ³	Unit weight of saturated soil
	kg/m ³	Density of submerged soil
	kN/m ³	Unit weight of submerged soil
	1, %	Void ratio
	1, %	Porosity
		Water content
	%	Degree of saturation
	%	Liquid limit
	%	Plastic limit
	%	Shrinkage limit
	%	Plasticity index = $(W$
	%	Liquidity index = $(W$
	%	Consistency index = $(W$
	1, %	Void ratio in loosest state
	1, %	Void ratio in densest state
	1	Density index = $(e$
D	mm	Grain diameter
	mm	N percent - diameter
	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

RECORD OF BOREHOLE No BH F15-1

1 OF 1

METRIC

W. P. WO 2015-11006

LOCATION Farley's Corner Patrol Yard, MTM Z10 292388m E 5093895m N

ORIGINATED BY NT

DIST Hwy 524

BOREHOLE TYPE CME-55, Hollow stem auger drill, not cased

COMPILED BY ET

DATUM BM ELEV. 317.558m MTM Z10 292370m E 5093925m N

DATE 2015/03/24 - 2015/03/24

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									
								○ UNCONFINED	+	FIELD VANE	×	QUICK TRIAXIAL	LAB VANE				
317.6	Ground Surface						20	40	60	80	100						
317.0	ASPHALT 25 mm thickness		1	AS1													
317.0	FILL: SAND (SW) Sand with few silt, few gravel, blackish brown, moist																
0.6	SILTY SAND (SM) few gravel, few to little silt, brown, moist, compact to very dense		2	SS2	32												
			3	SS3	27												
			4	SS4	50/ 76mm												
			5	SS5	100/ 127mm												
314.0	Auger/split spoon refusal- Possible Bedrock END OF BOREHOLE		6	SS6	100/ 25mm												
3.7	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 was measured in the open hole																

OPG_EXP RECORD OF BOREHOLE 5013-E-0008 ASSIG. 7(FARLEY'S CORNER)- BH LOGS.GPJ ONTARIO MOT.GDT 5/20/15

Brampton, Ontario

RECORD OF BOREHOLE No BH F15-2

1 OF 1

METRIC

W. P. WO 2015-11006

LOCATION Farley's Corner Patrol Yard, MTM Z10 292389m E 5093870m N

ORIGINATED BY NT

DIST Hwy 524

BOREHOLE TYPE CME-55, Hollow stem auger/ diamond drill, cased hole

COMPILED BY ET

DATUM BM ELEV. 317.558m MTM Z10 292370m E 5093925m N

DATE 2015/03/23 - 2015/03/23

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					
317.7	Ground Surface																
317.0	ASPHALT 25 mm thickness		1	AS1													8 82 (10)
317.1	FILL: SAND (SW) few gravel, few silt, blackish brown, moist																
0.6			2	SS2	31		317										
	SILTY SAND (SM) few gravel, little silt, brown, moist, frozen, compact to very dense		3	SS3	29		316										8 67 (25)
			4	SS4	50/76.2mm												
315.3																	
2.4	BEDROCK - Granite Gneiss		5	NQ			315										
	Length (m) RQD (%)		6	NQ													
	Run 1 0.33 61.0																
	Run 2 0.64 72.0																
	Run 3 1.04 90.0		7	NQ			314										
	Run 4 1.52 93.0																
			8	NQ			313										
311.7							312										
6.0	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 level was measured since washboring techniques was used to advance borehole																

OPG_EXP RECORD OF BOREHOLE 5013-E-0008 ASSIG. 7(FARLEY'S CORNER)-BH LOGS.GPJ ONTARIO MOT.GDT 5/20/15

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

Brampton, Ontario

RECORD OF BOREHOLE No BH F15-3

1 OF 1

METRIC

W. P. WO 2015-11006

LOCATION Farley's Corner Patrol Yard, MTM Z10 292439m E 5093857m N

ORIGINATED BY NT

DIST Hwy 524

BOREHOLE TYPE CME-55, Hollow stem auger drill, not cased

COMPILED BY ET

DATUM BM ELEV. 317.558m MTM Z10 292370m E 5093925m N

DATE 2015/03/23 - 2015/03/23

CHECKED BY SM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
317.2	Ground Surface													
317.0	ASPHALT 25 mm thickness		1	AS1			317							
316.6	FILL: SAND (SW) Brown sand, with little silt and clay and gravel, moist to frozen						316							0 76 (24)
0.6	SILTY SAND (SM) trace to few gravel, few to little silt, trace clay, reddish to greyish brown, moist to wet, very loose to dense		2	SS2	38		315							7 84 (9)
			3	SS3	6		314							
			4	SS4	15		313							
	-Becoming fine		5	SS5	23		312							
			6	SS6	5		311							
			7	SS7	8		310							
			8	SS8	5		309							0 86 13 1
							308							
							307							
	-Becoming more silty		9	SS9	3									
			10	SS10	4									0 86 (14)
307.4	END OF SAMPLING													
9.8														
306.5	Refusal on DCPT (Possible Bedrock) END OF BOREHOLE													
10.7	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 was measured in open hole													

OPG_EXP RECORD OF BOREHOLE 5013-E-0008 ASS'G. 7(FARLEY'S CORNER)-BH LOGS.GPJ ONTARIO MOT.GDT 5/20/15

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

Brampton, Ontario

RECORD OF BOREHOLE No BH F15-4

1 OF 1

METRIC

W. P. WO 2015-11006

LOCATION Farley's Corner Patrol Yard, MTM Z10 292419m E 5093891m N

ORIGINATED BY NT

DIST Hwy 524

BOREHOLE TYPE CME-55, Hollow stem auger/ diamond drill, cased hole

COMPILED BY ET

DATUM BM ELEV. 317.558m MTM Z10 292370m E 5093925m N

DATE 2015/03/24 - 2015/03/24

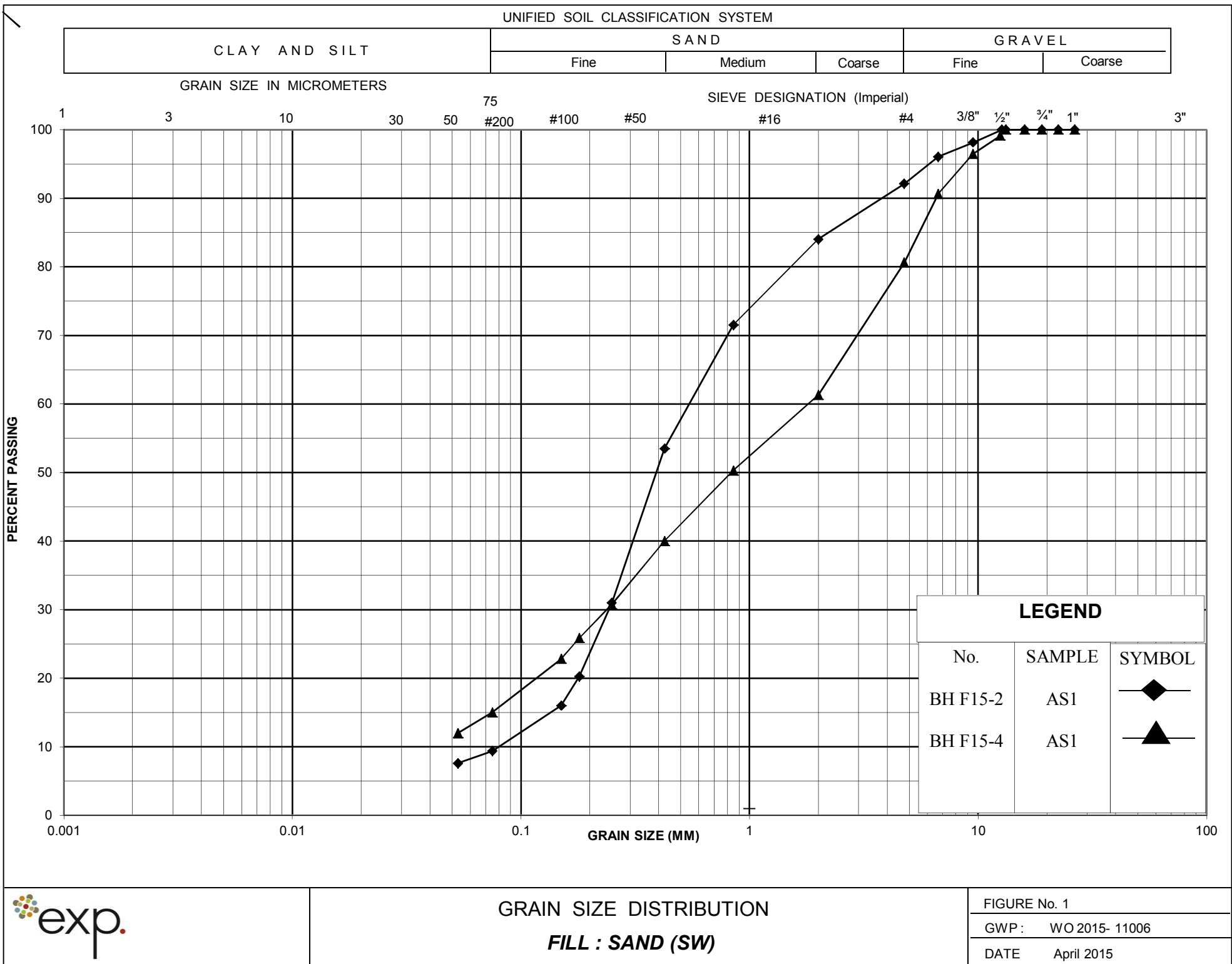
CHECKED BY SM

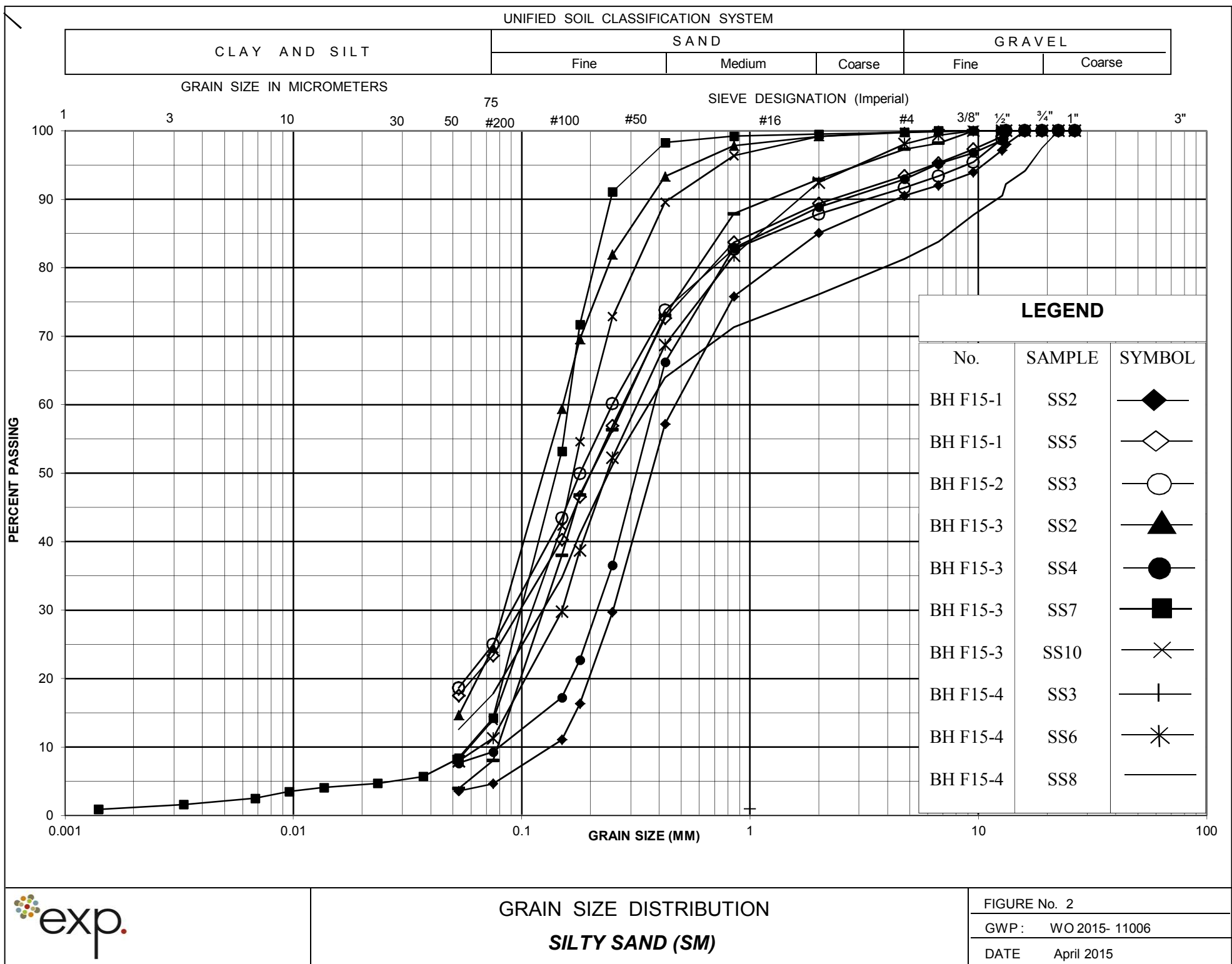
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
317.4	Ground Surface																
317.0	ASPHALT 25 mm thickness		1	AS1			317										19 66 (15)
316.8	FILL: SAND (SW) little gravel, little silt, brown, moist, frozen																
0.6	Silty Sand (SM) trace to little gravel, few to little silt, blackish brown to brown, moist to wet, compact to very dense		2	SS2	38		316										
			3	SS3	17												3 89 (8)
			4	SS4	21		315										
			5	SS5	67		314										
			6	SS6	110		313										2 87 (11)
			7	SS7	104												
							312										
	- Becoming gravelly and occasional cobbles		8	SS8	64												19 63 (18)
			9	SS9	63		311										
310.4																	
7.0	BEDROCK - Granite Gneiss		10	NQ			310										
	Length (m) RQD (%)																
	Run 1 0.58 96.0																
	Run 2 1.52 100.0																
			11	NQ			309										
308.3																	
9.1	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. Groundwater level was measured in the open auger hole																

OPG_EXP RECORD OF BOREHOLE 5013-E-0008 ASSIG. 7(FARLEY'S CORNER)- BH LOGS.GPJ ONTARIO MOT.GDT 5/20/15

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

Appendix D – Laboratory Data





Appendix E – Rock Core Photographs

Project NO: ADM 00028245-H0
BH NO: 2 Run No: 1, 2 & 3
Sample Depth: 2.4 m to 4.41 m
Elevation: 315.3 m to 313.3 m
Description: Granitic Gneiss
Date: March 23, 2015



Figure E1. Rock cores from BH F15-2 - from Elev. 315.3 m to 313.3 m

Project NO: ADM 00028245-H0
BH NO: 2 Run No: 4
Sample Depth: 4.41 m to 5.93 m
Elevation: 313.3 m to 311.7 m
Description: Granitic Gneiss
Date: March 23, 2015



Figure E2. Rock cores from BH F15-2 - from Elev. 313.3 m to 311.7 m

Project NO: ADM 00028245-H0
BH NO: 4 Run No: 1 & 2
Sample Depth: 7.0 m to 9.1 m
Elevation: 310.4 m to 308.3 m
Description: Granitic Gneiss
Date: March 24, 2015



Figure E3. Rock cores from BH F15-4 – from Elev. 310.4 m to 308.3 m

Appendix F – Record of Historical Geotechnical Data

