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SNC Lavalin

Geotechnical Investigation
BIO Site Underground Infrastructure Upgrades, Dartmouth, Nova Scotia

Final Report

Date: May 17, 2017
Ref. N°: B-0017022-1

Englobe

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BIO Site Underground Infrastructure Upgrades, Dartmouth, Nova Scotia

Final Report | B-0017022-1

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REVISION AND PUBLICATION REGISTER		
Revision N°	**Date**	**Modification And/Or Publication Details**
00	2017-05-02	Draft Report
1	2017-05-17	Final Report

1 INTRODUCTION

At the request of SNC Lavalin, EnGlobe Corp., has carried out a geotechnical investigation for the proposed upgrades of underground infrastructure at the BIO Site in Dartmouth, Nova Scotia. The purpose of the work was to assess the subsurface conditions at select areas of the site and to make recommendations for design and costing of earthworks.

This report presents the observations and engineering recommendations associated with the geotechnical investigation of the site. Included herein are the factual results of the field investigation including discussion of field procedures, subsurface conditions, laboratory analysis and recommendations for site development.

2 SITE AND PROJECT DESCRIPTION

Public Works and Government Services Canada (PWGSC) is planning to upgrade portions of the water, wastewater and storm water collection systems at the BIO Site in Dartmouth, NS. The upgrade will include the installation of new pipelines, manholes and a sanitary sewer force main adjacent to the harbour. Reinstatement of asphalt, sidewalks and curb and gutter will be required to facilitate the placement of the new underground infrastructure.

3 INVESTIGATION PROCEDURE

The fieldwork for the investigation was carried out on April 21 and 24, 2017, when fifteen (15) boreholes were drilled across the site. Figure 1 in the appendix shows the approximate locations. The boreholes were drilled using a truck-mounted auger drill rig supplied by Nova Drilling of Mount Uniacke, NS.

The site investigation was carried out by qualified geotechnical engineering personnel who located the boreholes in the field and logged the subsurface conditions. The borehole locations were predetermined with the collaboration of SNC Lavalin, Englobe and the underground utility locator in advance of the investigation. The boreholes were advanced using continuous flyte augers with field sampling and testing performed in the open borehole. Standard Penetration Tests (SPT) were carried out at regular intervals in select boreholes to obtain soil blow counts (i.e. N-values) using a 50-mm O.D. split spoon sampler. Disturbed soil samples were obtained from the boreholes using conventional techniques.

Following field sampling and visual description, overburden samples were placed in waterproof sample bags and transported to our Dartmouth laboratory for further examination and scheduling for geotechnical index testing.

4 SUBSURFACE CONDITIONS

An explanation of terms and symbols used in the report is provided in Appendix 1. A summary of the encountered geologic conditions is provided on the Borehole Logs in Appendix 2. Laboratory Testing results are provided in Appendix 3.

It should be noted that the stratigraphic boundaries on the Borehole Logs typically represent a transition of one soil type to another and do not necessarily indicate an exact plane of geologic change. Subsurface conditions may vary between and beyond the Borehole locations.

The soil conditions encountered at the boreholes consisted of asphalt pavement or organic soils overlying fill deposits, native till (at select locations) and inferred bedrock. Bedrock was inferred by practical refusal of the drill augers or split spoon sampler during drilling. The following paragraphs and table further describe the subsurface conditions at the site.

Table 1: Summary of Subsurface Conditions

BOREHOLE NUMBER	DEPTH TO TILL, (metres)	DEPTH TO GROUNDWATER, (metres)	DEPTH TO INFERRED BEDROCK OR LARGE BOULDER, (metres) [1.]	TOTAL DEPTH OF BOREHOLE, (metres)
BH 1	--	--	1.9	1.9
BH 2	--	--	1.8	2.4
BH 3	1.2	--	2.2	2.7
BH 4	--	--	1.5	1.7
BH 5	--	--	2.1	2.1
BH 6	--	3.0	3.8	3.8
BH 7	--	--	2.4	2.6
BH 8	--	2.8	--	4.3
BH 9	--	--	1.2	1.5
BH 10	--	3.0	3.0	3.2
BH 11	--	--	1.6	1.8
BH 12	--	--	--	3.0
BH 13	--	--	2.1	2.6
BH 14	--	--	--	3.3
BH 15	--	--	--	3.0

1. Practical refusal to advance augers or split spoon sampler refusal.

4.1 Asphalt Pavement

Asphalt pavement was encountered at the surface of all boreholes, except BH 1, BH 2, BH 3, BH 4 and BH 15. The asphalt ranged in thickness from 50 mm to 120 mm.

4.2 Organic Soils

Organic soils consisting of grass and topsoil were encountered at the surface of boreholes BH 1, BH 2, BH 3 and BH 4. The organic soils were approximately 300 mm in thickness.

4.3 Fill

Fill deposits have been encountered in all boreholes either below the asphalt pavement or organic soils or at the surface of the borehole. The fill composition varied from sand and gravel, trace silt to a gravelly sand, some silt with abundant to some cobbles and boulders. The fill varies from greyish brown, dark grey to black in colour, and its moisture content can be described as moist to saturated. At borehole BH 12, below a depth of 2.1 metres, the fill consisted of a silty sand, some gravel, occasional cobbles and contained trace organic material. Voids were observed within the fill deposits at borehole BH 7. Standard penetration N-values for the fill at the boreholes ranged from 6 to in excess of 50 blows per 300 mm penetration, indicating a loose to dense material. The higher N-values recorded in the fill deposit may be attributed to the gravel and cobble content and generally not representative of the insitu relative density.

Laboratory gradation testing was completed on two select fill samples, and indicated a material with 37 and 39 percent gravel, 43 and 44 percent sand, and a fines (i.e. silt and clay sizes) content of 18 and 19 percent. Moisture content testing indicated values ranging from 5.4 to 11.6 percent.

4.4 Till (Site-Native Glacial Soil)

Till deposits have been encountered at borehole BH 3 below the fill deposits. The till consisted of silty sandy gravel and contained occasional to some cobbles and boulders. The till was typically light brown in colour and its moisture content can be described as wet to saturated. Standard penetration N-values for the till at the borehole ranged from 68 to in excess of 50 blows per 300 mm penetration, indicating a dense material. The higher N-values recorded in the till deposit may be attributed to the gravel and cobble content and generally not representative of the insitu relative density. The till was proven for a total depth of 2.2 metres at BH 3.

Laboratory gradation testing was completed on one select till sample, and indicated a material with 41 percent gravel, 31 percent sand, and a fines (i.e. silt and clay sizes) content of 28 percent. Moisture content testing of a select till sample indicated a value of 11.3 percent.

4.5 Inferred Bedrock

Geologic mapping of the proposed development area indicates that the site is underlain by the Goldenville formation that comprises mainly of Greywacke (quartzite). During the investigation, Quartzite bedrock was inferred at all borehole locations, except BH 8, BH 12, BH 14 and BH 15, by refusal to advance the drill auger or split spoon refusal. Bedrock was encountered either below the glacial till or fill deposits at total depths ranging from 1.2 to 3.8 metres at the boreholes. Diamond core drilling of bedrock was not conducted at the site.

4.6 Groundwater

Groundwater observations were made during the field investigation through open-hole measurement at the borehole locations. A summary of the accumulated groundwater information is provided on Table 1, and included in the Borehole Logs in Appendix 2.

During the current investigation, groundwater was encountered at boreholes BH 6, BH 8 and BH 10 at depths ranging from 2.8 metres to 3.0 metres below the existing ground surface. Perched groundwater can be expected during construction. Seasonal fluctuations in groundwater levels can be expected.

5 DISCUSSION AND RECOMMENDATIONS FOR DESIGN

5.1 Site Development – General

In the following paragraphs, a discussion of site development is presented in light of the observed subsurface conditions. The recommendations outlined in the following sections assume that the new underground infrastructure will be located in the investigated areas shown on Figure 1.

The subsurface conditions encountered throughout the development area are considered variable and consist of shallow to moderately deep fill deposits overlying “undisturbed" site-native till deposits (at BH 3) and inferred bedrock (or large boulder). The shallow depth of bedrock at select locations may require rock breaking during earthworks.

5.2 Site Preparation, Excavation and Earthworks

Based on anticipated design grades for the new underground infrastructure (i.e. a minimum of 1.5 metres below finished grade) and encountered subsurface conditions, the new pipe work and associated works will be founded within the fill deposits or bedrock at most locations. Following excavations to design subgrade levels with fill materials, the exposed subgrade should be recompacted and proof tested with approved vibratory equipment prior to placement of bedding gravels. Any loose, wet or organic soils identified following excavation to design subgrade level(s) for the systems should be subexcavated and replaced with approved site or imported fill.

Voids were encountered within the fill deposit at borehole BH 7. This area will require subexcavation of effected areas, processing to remove segregated materials/voids and placement and compaction of structural fill to reach design grades. As an alternative, unshrinkable fill (i.e. low strength concrete or grout) could be considered as an option to fill any voids within the trench excavation. It is recommended that this area be evaluated by geotechnical personnel during construction to determine the full extent and best approach to remediate the unsuitable conditions encountered at the borehole locations.

Inferred bedrock (or large boulders) were encountered in most boreholes at depths ranging from 1.2 to 3.8 metres below ground surface. Depending on final design elevations, breaking bedrock (or large boulders) and/or blasting may be required in the service trenches. Blasting operations, if required, should be carried out in accordance with applicable regulations and bylaws including Nova Scotia’s Blasting Safety Regulations and Halifax Regional Municipality’s Blasting Bylaw. The exposed subgrade should be suitably prepared, levelled and recompacted to receive bedding gravels.

Imported structural fill should consist of well-graded sand and gravel or rockfill with a maximum particle size of 150 mm diameter. The fill is to be free of organics, debris, and slate and should have a fines (i.e. silt and clay sized) content not greater than 15 percent. The material should be placed in lifts not exceeding 300 mm in thickness compacted to 100 percent of the material's standard Proctor maximum dry density or equivalent for rockfill. Water and loose/soft soils should be removed from excavations, and bearing stratum approved prior to fill placement. Quality control inspection and testing of engineered fill is recommended.

Excavations in the fill / till deposits are expected to remain temporarily stable at side slopes of 1:1 (horizontal to vertical), while long-term stability can be achieved at 3:1 for both types of soils. Subject to rockmass evaluation and stabilization measures, excavations taken to shallow levels within bedrock are expected to remain temporarily stable at-near vertical side slopes, depending on fracturing and bedding planes. Shoring of the trench / excavation may be required where site conditions limit sloping of the soils to create a safe working environment.

5.3 Underground Services

All work should be carried out in accordance with recommended municipal service installation standards. Reference should be made to HRM and Halifax Water Standard Specifications for Municipal Services Systems.

Underground services should be bedded in free-draining granular fill (i.e. NSTIR Type I Gravel). The bedding should be placed for a minimum thickness of 250 mm above and below the service(s) (subject to pipe diameter) and compacted in-place to 95 percent standard Proctor maximum dry density. The remainder of the service trench can be backfilled with on-site or imported materials in accordance with previous recommendations. Services should be placed a minimum of 1.5 metres below finished outside grade for frost protection unless permanent insulation is provided.

5.4 Re-use of On-site Materials and Backfilling

The existing fill, site-native glacial till and broken bedrock may be considered suitable for reuse as engineered fill within subgrade areas and trench backfill. Any organic soils and loose/wet soils are not suitable to reuse for engineered fill. The reuse of on-site materials will be contingent to a large extent on the condition of the materials after excavation, handling and stockpiling.

To qualify as engineered backfill within the subgrade, all boulders, debris and deleterious inclusions should be removed. Backfill should be placed in lifts not exceeding 250 mm thickness and compacted in-place to 95 percent standard Proctor maximum dry density. A higher level of compaction (i.e. 98 percent) is recommended within 0.3 metres of finished subgrade.

5.5 Interpreted Soil and Bedrock Design Parameters

Soil and bedrock parameters recommended for use in design are outlined in the Table 3. The parameters indicated have been summarized from laboratory and field testing and from known empirical correlations. The values indicated are provided as a guide and their specific use in design should be confirmed with the geotechnical engineer.

Table 2: Interpreted Soil and Bedrock Design Parameters

PARAMETER	GLACIAL TILL	EXISITNG FILL	BEDROCK
Bulk Unit Weight, kN/m^3	21	21.5	25
Moisture Content, %	11	9	-
Effective Unit Weight, kN/m^3	11	11.5	15
Soil Cohesion (C_u), kN/m^3	0	0	0

PARAMETER	GLACIAL TILL	EXISITNG FILL	BEDROCK
Effective Angle of Internal Friction	32˚	30˚	40˚
Active Earth Pressure Coeff.(K_a)	0.31	0.33	-
Passive Earth Pressure Coeff.(K_p)	3.3	3.0	-
At Rest Earth Pressure Coeff. (K_o)	0.47	0.50	-

5.6 De-watering

During earthworks, water may be expected to enter excavations during precipitation events, as surface runoff or as seepage from within the soil strata. The rate of infiltration into shallow excavations is expected to be minor to moderate and can be controlled by conventional dewatering techniques consisting of 75 to 100 mm diameter portable pumps and grading of excavations to sump locations. The rate of infiltration into deep excavations, particularly adjacent to the harbour, will be high and likely require several 150 mm diameter pumps and staging earthworks to coincide with low tide levels. Water pumped from excavations is expected to contain “fines” and will require care in disposal. Provision for proper site drainage in accordance with applicable municipal, provincial, and federal environmental requirements should be made at the construction stage.

5.7 Erosion and Sediment Control Guidelines

Nova Scotia Environment has published a set of guidelines dealing with environmental protection, specifically, erosion and sedimentation control. The document is of a general nature, however, presents proven methods for lessening the impact of soil erosion on downstream receptors. The Guidelines should be adopted for construction.

5.8 Flexible Pavement Design

It is understood that reinstatement of roadway areas will be required following installation and backfilling of the new underground infrastructure. Our recommended pavement structure for the proposed work is presented in Table 4 below, and assumes an approved subgrade with improvements in accordance with previous recommendations. Two pavement structures are presented, one for heavily travelled areas and one for lightly traveled areas.

Table 3: Recommended Pavement Structure

Pavement Structure	High Traffic Areas	Low Traffic Areas
Asphalt Concrete : Surface Course, Type C-HF Base Course, Type B-HF	 40 mm 50 mm	 75 mm -
Base Gravel NSTIR Type 1 Gravel	 150 mm	 150 mm
Subbase Gravel NSTIR Type 2 Gravel	 250 mm	 200 mm

All pavement structure materials to meet Nova Scotia Transportation and Infrastructure Renewal Specifications. Minimum compaction for pavement is 92.5% based on Theoretical Maximum Density (ASTM D2041). Minimum compaction for granular materials is 100% based on Standard Proctor Maximum Dry Density.

All pavement structures assume a prepared subgrade leveled and compacted to a minimum of 98 percent standard Proctor Maximum Dry Density. Subgrade areas are to be prepared with inspections and testing carried out, and approved by geotechnical personnel prior to gravel placement.

6 COMMENTS ON CONSTRUCTION

The following comments on specific construction aspects of the project are provided for the guidance of designers. The contractor undertaking the work should make their own interpretation of the factual information provided in this report as it affects their construction procedures and scheduling.

The in situ soils are subject to loosening and softening in the presence of water. Construction methods and scheduling should reflect this. In periods of inclement weather or during extended work delays, excavations within the site native soils should be protected by a granular working mat placed over the bearing soil immediately following excavation and preparation of the foundation contact area.

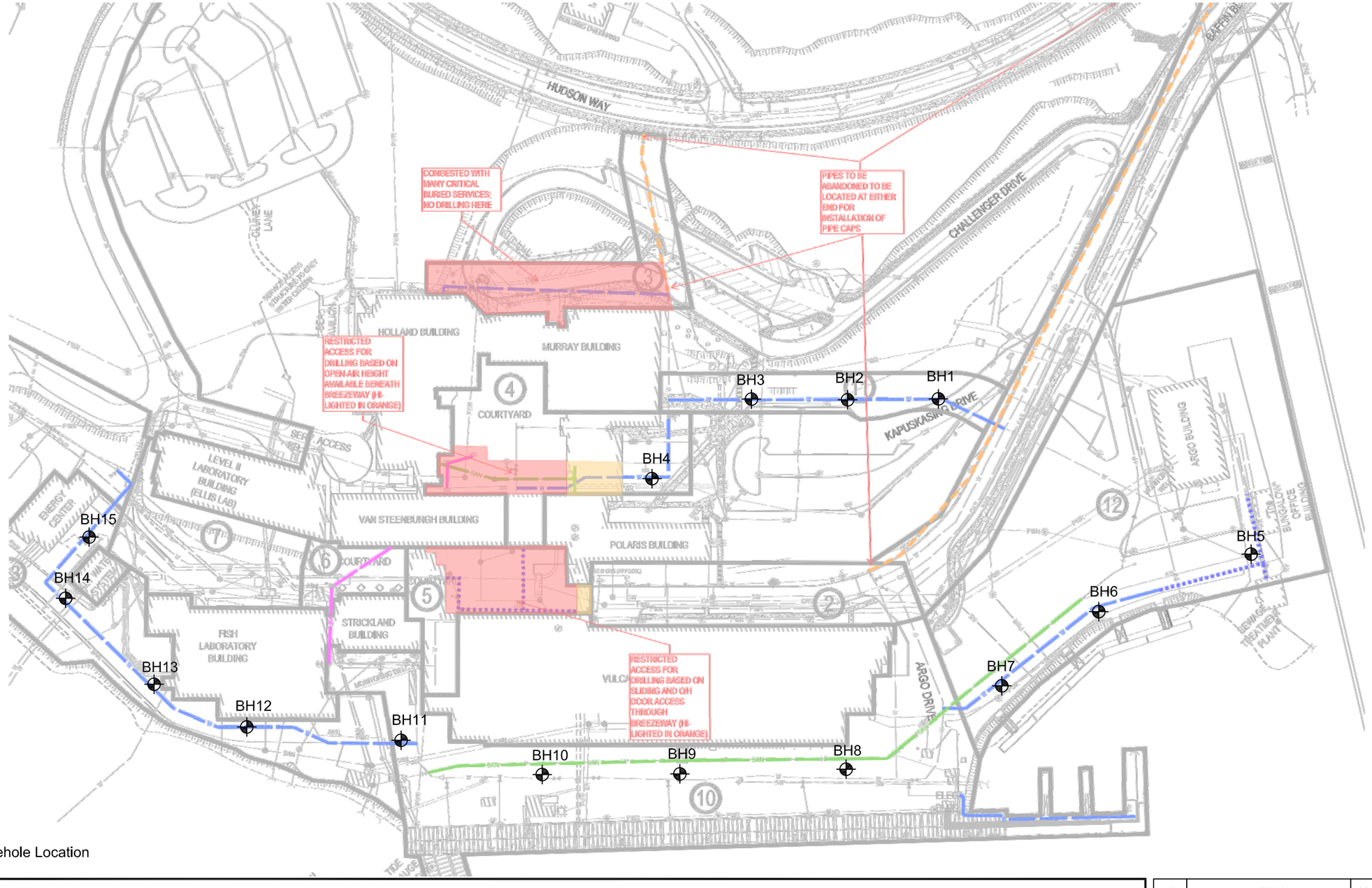
If construction takes place in the winter months care must be taken not to allow freezing of subsoil. Any fill or native soil that freezes must be sub excavated and replaced.

Geotechnical inspection and testing by qualified personnel is recommended during earthworks construction.

7 CLOSURE

The geotechnical investigation undertaken has involved a limited sampling of the site. Should any conditions be encountered during constructions that are contrary to those reported herein, we request immediate notification so that reassessment can be undertaken.

Figure 1 Site Plan with Borehole Locations



LEGEND

⊕ - Approximate Borehole Location

G:\148\B_Projects\B-0017022_SNC_Geotechnical Investigation_BIO Underground Infrastructure Upgrades\z4_CADBIO Upgrade_Borehole Plan.dwg / ANSI B-PAY (mm) / 17-12- 2017 / 1:12pm

SNC LAVALIN

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450-929-4949 ■ 1-877-929-4949

0 15 30 45 60m

1:1500

Seal

BIO UNDERGROUND INFRASTRUCTURE UPGRADES

Dartmouth, Nova Scotia

Borehole Location Plan

No.	Version	Date	By	Check.	Appr.
1	FINAL	2017/05/02	GG	RH	RH

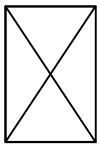
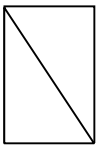
Discipline :	Geotechnical	Prepared by : RH	Checked by : RH
Scale :	1:1500	Drawn by : GG	Approved by : RH
Date :	2017/05/02	Figure no. :	1
Layout : ANSI B-PAY (mm)	Paper size : Ledger	Registration no. :	B-0017022-1

Resp.	Project	Otp	Project/ Disc	Phase/ Type	Electronic ref./ Drawing no.	Rev.
148	B-0017022	1				

Appendix 1 Explanation of Terms and Symbols

SOIL SAMPLES

CONDITION – This column graphically indicates the depth and condition of the sample:

 undisturbed  disturbed  not recovered

TYPE – The type of sample is indicated in this column as follows:

A auger sample
B block sample
C rock core, or frozen soil core
D drive sample
G grab sample
SS split spoon
P Pitcher tube sample
U tube sample (usually thin-walled)
W wash or air return sample
O other (see report text)

PENETRATION RESISTANCE – Unless otherwise noted this column refers to the number of blows (N) of a 140 pound (63.5 kg) hammer freely dropping 30 inches (0.76 m) required to drive a 2 inch (50.8 mm) O.D. open-end sampler 0.5 feet (0.15 m) to 1.5 feet (0.45 m) into the soil, or until 100 blows have been applied, in which case, the penetration is stated. This is the standard penetration test referred to in ASTM D 1586.

OTHER TESTS

In this column are tabulated results of other laboratory tests as indicated by the following symbols:

*C	Consolidation test
Fines	Percentage by weight smaller than #200 sieve
D_R	Relative density (formerly specific gravity)
k	Permeability coefficient
*MA	Mechanical grain size analysis and hydrometer test (if appropiate)
pp	Pocket pentrometer strength
*q	Triaxial compression test
q_U	Unconfined compressive strength
*SB	Shearbox test
SO_4	Concentration of water-soluble sulphate
*ST	Swelling test
TV	Torvane shear strength
VS	Vane Shear Strength (undistrubed-remolded)
ε_f	Unit strain at failure
γ	Unit weight of soil or rock
γ_d	Dry unit weight of soil or rock
ρ	Density of soil or rock
ρ_d	Dry density of soil or rock

* The results of these tests usually are reported separately

SYMBOLS AND TERMS USED ON THE BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Behavioural properties (i.e. plasticity, permeability) take precedence over particle gradation in describing soils.

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidation of clay minerals, shrinkage cracks etc.
Fissured	- having cracks, and hence a blocky structure
Varved	-composed of regular alternating layers of silt and clay
Stratified	- composed of alternating layers or different soil types, e.g. silt and sand or silt and clay
Well Graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Uniformly Graded	- predominantly of one grain size.

Terminology used for describing soil strata based upon the proportion of individual particle size present:

Trace, or occasional	Less than 10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. silt and sand)	35-50%

The standard terminology to describe cohesionless soils includes the relative density, as determined by laboratory test or by the Standard Penetration Test 'N' - value: the number of blows of 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil.

Relative Density	'N' Value	Relative Density %
Very loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression test, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength		'N' Value
	Kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25-0.5	12.5-25	2-4
Firm	0.5-1.0	25-50	4-8
Stiff	1.0-2.0	50-100	8-15
Very Stiff	2.0-4.0	100-200	15-30
Hard	>4.0	>200	>30

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

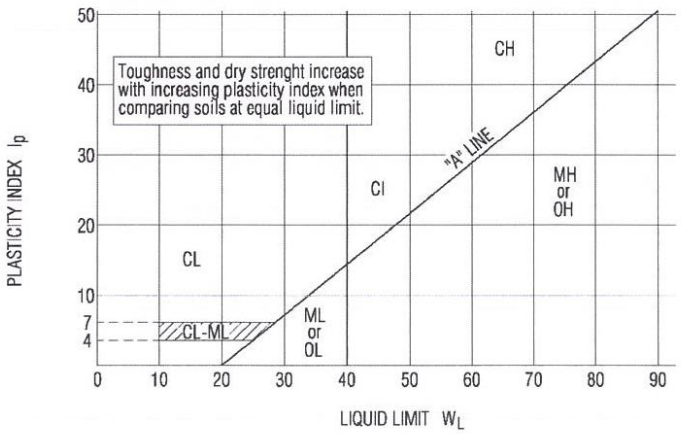
MAJOR DIVISION			GROUP SYMBOL	GRAPHIC SYMBOL	COLOR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
HIGHLY ORGANIC SOILS			Pt		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS MORE THAN HALF COARSE FRACTION LARGER THAN NO.4 SIEVE SIZE	CLEAN GRAVELS	GW		RED	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, <5% FINES	$Cu = \frac{D_{60}}{D_{10}} > 4$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		RED	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, <5% FINES	NOT MEETING ALL ABOVE REQUIRMENTS	
		DIRTY GRAVELS	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$	
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE OR $I_p > 7$	
	SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO.4 SIEVE SIZE	CLEAN SANDS	SW		RED	WELL-GRADED SANDS, GRAVELLY SANDS, <5% FINES	$Cu = \frac{D_{60}}{D_{10}} > 6$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		RED	POORLY-GRADED SANDS, OR GRAVELLY SANDS, <5% FINES	NOT MEETING ALL ABOVE REQUIRMENTS	
		DIRTY SANDS	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$	
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE OR $I_p > 7$	
FINE - GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO.200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$	SEE CHART BELOW
			MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$	
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$	
			CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS	$W_L > 30, < 50$	
			CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$	
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART		OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$	
			OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$	

FILL TILL BEDROCK

1. All sieve sizes mentioned on this chart are U.S. Standard, ASTM E11.
2. Boundary classifications possessing characteristics of two groups are given combined group symbols eg GW-GC is a well-graded gravel-sand mixture wtih clay binder between 5% and 12%.
3. Soil fractions and limiting textural boundaries are in accordance with the Unified Soil Classification System, except that an inorganic clay of medium plasticity (CI) is recognized.
4. The following adjectives may be employed to define percentage ranges by weight of minor components:

and	50 - 36%
gravelly, sandy, silty, clayey, ect.	35 - 21%
some	20 - 11%
trace	10 - 1%

PLASTICITY CHART



Englobe

Appendix 2 Borehole Logs

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 1

DRILL TYPE: Drill Rig

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION (DATUM Existing Ground Surface)	COND.	TYPE	PENE. RESIST.
0				Topsoil/organic soils.			
1				FILL: sand and gravel, trace silt, lightly compact, moist, grey.		SS	N=15
2				FILL: gravelly sand, some silt abundant to some cobbles/boulders, loose to compact, moist, greyish brown.			
3	1					SS	N=29
4							
5							
6						SS	99/225
	2			Inferred Bedrock Level or large Boulder.			
7				Auger refusal at 1.9 metres below existing ground surface on inferred bedrock or large boulder.			
8				Borehole dry upon completion.			
9							
10	3						
11							
12							
13	4						
14							
15							
16							
	5						

OTHER TESTS

PLATE 1

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 2

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft m

MODIFIED USCS

SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE

COND. | TYPE | PENE. RESIST.

DRILL TYPE

Drill Rig

OTHER TESTS

ft	m	SOIL DESCRIPTION	COND.	TYPE	PENE. RESIST.
0	0	Topsoil/organic soils.			
1		FILL: gravelly sand, some silt, abundant to some cobbles/boulders, loose, moist, greyish brown.		AUGER	
5				SS	N=50/50
6	2	Inferred Bedrock Level or large Boulder.			
8		Auger refusal at 2.4 metres below existing ground surface on inferred bedrock or large boulder. Borehole dry upon completion.			
10	3				
13	4				
16	5				

PLATE 2

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 3

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION (DATUM Existing Ground Surface; SURFACE ELEVATION)	COND.	TYPE	PENE. RESIST.
0				Topsoil/organic soils.			
1				FILL: gravelly sand, some silt, abundant cobbles/boulders, trace organics (creosote odour detected), loose, moist, greyish brown.		SS	N=6
2							
3	1					SS	N=20
4				TILL: silty sandy gravel, occasional to some cobbles/boulders, compact to dense, wet to saturated, light brown.			
5						SS	N=68
6							
7	2					SS	50/75
8				Inferred Bedrock Level or large Boulder.			
9							
10	3			Auger refusal at 2.7 metres below existing ground surface on inferred bedrock or large boulder. Borehole dry upon completion.			
11							
12							
13	4						
14							
15							
16	5						

PLATE 3

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 4

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft m

MODIFIED USCS

SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

DRILL TYPE: Drill Rig

OTHER TESTS

ft	m	SOIL DESCRIPTION	COND.	TYPE	PENE. RESIST.
		Topsoil/organic soils.			
1		FILL: gravelly sand, some silt, abundant to some cobbles/boulders, loose, moist, greyish brown.			
2					
3	1		AUGER		
4					
5		Inferred Bedrock Level or large Boulder.			
6		Auger refusal at 1.7 metres below existing ground surface on inferred bedrock or large boulder.			
7	2	Borehole dry upon completion.			
8					
9					
10	3				
11					
12					
13	4				
14					
15					
16	5				

PLATE 4

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 5

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION (DATUM Existing Ground Surface; SURFACE ELEVATION)	SOIL SAMPLE COND.	SOIL SAMPLE TYPE	SOIL SAMPLE PENE. RESIST.
				Asphalt.			
1				FILL: sand and gravel, trace silt, compact, moist, grey.			
2				FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.		SS	N=30
3	1						
4						SS	N=22
5							
6						SS	N=10
	2						
7				Inferred Bedrock Level or large Boulder.			
8				Auger refusal at 2.1 metres below existing ground surface on inferred bedrock or large boulder.			
9				Borehole dry upon completion.			
10	3						
11							
12							
13	4						
14							
15							
16							
	5						

PLATE 5

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 6

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft m

MODIFIED USCS | SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

Asphalt.

FILL: sand and gravel, trace silt, compact, moist, grey.

FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist to saturated, greyish brown.

AUGER

AUGER

SS N=28

SS 50/125

Inferred Bedrock Level or large Boulder.

Auger refusal at 3.8 metres below existing ground surface on inferred bedrock or large boulder.

Groundwater encountered at 3.0 metres below ground surface.

PLATE 6

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 7

DRILL TYPE: Drill Rig

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △ (10 20 30 40 50)

DEPTH ft / m

MODIFIED USCS | SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

OTHER TESTS

Depth (ft)	Depth (m)	Soil Description	Type	Pene. Resist.
0		Asphalt.		
0		FILL: gravelly sand, some silt, abundant cobbles/boulders, lightly compact to loose, moist, greyish brown.		
2			SS	N=19
4	1		SS	N=24
6			SS	58/250
7	2	-Voids present within fill deposits between large boulders.		
8		Inferred Bedrock Level or large Boulder.		
9		Auger refusal at 2.6 metres below existing ground surface on inferred bedrock or large boulder.		
10	3	Borehole dry upon completion.		
13	4			
16	5			

PLATE 7

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/21/17 | JOB B-0017022-1 | HOLE NO. BH 8

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △

10 20 30 40 50

DEPTH ft m

MODIFIED USCS

SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

Asphalt.

FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist to saturated, greyish brown.

AUGER

AUGER

AUGER

End of borehole at 4.3 metres below exisitng ground surface in Fill.

Groundwater encountered at 2.8 metres below ground surface.

PLATE 8

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 9

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE COND.	SOIL SAMPLE TYPE	SOIL SAMPLE PENE. RESIST.
				DATUM Existing Ground Surface SURFACE ELEVATION			
				Asphalt.			
1				FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.		SS	87/250
2							
3	1						
4				Inferred Bedrock Level or large Boulder.		SS	73/175
5				Auger refusal at 1.5 metres below existing ground surface on inferred bedrock or large boulder. Borehole dry upon completion.			
6							
7	2						
8							
9							
10	3						
11							
12							
13	4						
14							
15							
16	5						

PLATE 9

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 10

DRILL TYPE: Drill Rig

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft m

MODIFIED USCS | SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

OTHER TESTS

ft	m	Description	COND.	TYPE	PENE. RESIST.
0	0	Asphalt.			
0	0	FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.			
10	3	Inferred Bedrock Level or large Boulder.		AUGER	
		Auger refusal at 3.2 metres below existing ground surface on inferred bedrock or large boulder.			
		Groundwater encountered at 3.0 metres below ground surface.			

PLATE 10

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 11

DRILL TYPE: Drill Rig

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △ (10 20 30 40 50)

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION (DATUM Existing Ground Surface)	COND.	TYPE	PENE. RESIST.
				Asphalt.			
0 to 3	0 to 1			FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.		SS	N=49
3 to 5	1 to 1.5					SS	50/125
5 to 6	1.5 to 2			Inferred Bedrock Level or large Boulder.			
6 to 16	2 to 5			Auger refusal at 1.8 metres below existing ground surface on inferred bedrock or large boulder. Borehole dry upon completion.			

SOIL SAMPLE

OTHER TESTS

PLATE 11

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 12

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △

10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE COND.	SOIL SAMPLE TYPE	SOIL SAMPLE PENE. RESIST.
				DATUM Existing Ground Surface SURFACE ELEVATION			
0				Asphalt.			
0 to 2				FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.			
2 to 3				FILL: silty sand, some gravel, occasional cobbles, trace organic material, loose, saturated, dark grey to black.		AUGER	
10	3			End of borehole at 3.0 metres below exisitng ground surface in Fill. Borehole dry upon completion.			

PLATE 12

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 13

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △ (10 20 30 40 50)

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION	SOIL SAMPLE COND.	SOIL SAMPLE TYPE	SOIL SAMPLE PENE. RESIST.
				DATUM Existing Ground Surface SURFACE ELEVATION			
				Asphalt.			
1				FILL: sand and gravel, trace silt, compact, moist, grey.			
2				FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.		SS	N=49
3	1						
4							
5						SS	50/125
6							
7	2			Inferred Bedrock Level or large Boulder.			
8							
9				Auger refusal at 2.6 metres below existing ground surface on inferred bedrock or large boulder. Borehole dry upon completion.			
10	3						
11							
12							
13	4						
14							
15							
16	5						

PLATE 13

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 14

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △
10 20 30 40 50

DEPTH ft	DEPTH m	MODIFIED USCS	SOIL SYMBOL	SOIL DESCRIPTION (DATUM Existing Ground Surface)	SOIL SAMPLE COND.	SOIL SAMPLE TYPE	SOIL SAMPLE PENE. RESIST.
				Asphalt.			
				FILL: sand and gravel, trace silt, compact, moist, grey.			
1				FILL: gravelly sand, some silt, abundant to some cobbles/boulders, compact to loose, moist, greyish brown.			
2						SS	N= 39
3	1						
4						SS	N= 67
5							
6						SS	N= 31
7	2						
8						SS	N= 16
9							
10	3					SS	N= 31
11				End of borehole at 3.3 metres below exisitng ground surface in Fill.			
12				Borehole dry upon completion.			
13	4						
14							
15							
16							
	5						

PLATE 14

BOREHOLE LOG

PROJECT

Geotechnical Investigation - Site Infrastructure Upgrades
BIO, Dartmouth, NS

LOGGED/DWN. NMD | CKD. SS | DATE OF INVEST. 4/24/17 | JOB B-0017022-1 | HOLE NO. BH 15

DRILL TYPE: Drill Rig

OTHER TESTS

CASING RESISTANCE blows/300mm

WC % wp- □ w- ● wl- △

10 20 30 40 50

DEPTH ft m

MODIFIED USCS

SOIL SYMBOL

SOIL DESCRIPTION

DATUM Existing Ground Surface

SURFACE ELEVATION

SOIL SAMPLE: COND. | TYPE | PENE. RESIST.

FILL: sand and gravel, some cobbles, trace silt, lightly compact, moist, grey.

FILL: gravelly sand, some silt, abundant cobbles/boulders, lightly compact to loose, moist, greyish brown.

AUGER

End of borehole at 3.0 metres below exisitng ground surface in Fill.

Borehole dry upon completion.

PLATE 15

Appendix 3 Laboratory Results

TABLE 3-1: SUMMARY OF LABORATORY DATA
Geotechnical Investigation
BIO Site Infrastructure Upgrades, Dartmouth, NS
Project No. B-0017022-1

Borehole No.	Sample No.	Depth (metres)	Description	Moisture Content (%)	Particle Size Distribution		
					Gravel (%)	Sand (%)	Fines (silts and clays) (%)
BH 3	1	1.2-1.8 m	TILL : silty sandy gravel	11.3	41	31	28
BH 5	3	0.3-1.5 m	FILL : gravelly sand, some silt	5.4	37	44	19
BH 14	1	0.3-0.9 m	FILL	8.7			
	2	0.9-1.5 m	FILL : gravelly sand, some silt	7.1	39	43	18
	3	1.5-2.1 m	FILL	9.2			
	4	2.1-2.7 m	FILL	9.3			
	5	2.7-3.3m	FILL	11.6			

METRIC SIEVE ANALYSIS REPORT

97 TROOP AVE., DARTMOUTH, N.S. B3B 2A7 - TEL (902) 468-6486 FAX 468-4919

Client:

SNC Lavalin Inc. (Maritimes)
Suite 200, Park Lane Terraces
5657 Spring Garden Road
Halifax, NS B3J 3R4

Attn: Michael Eakins
PHONE (902) 492-4544 **FAX:**

Our Project No: B-0017022-1
Client Contract No.:
Client PO.:
CC:

Project: BIO, Underground Infrastructure Upgrades
Source: BH #3
Sample No: SS3
Location: 1.2-1.8 m
Date Sampled: 24-Apr-17
Sampled by: NMD
Date Received: 24-Apr-17
Date Tested: 01-May-17

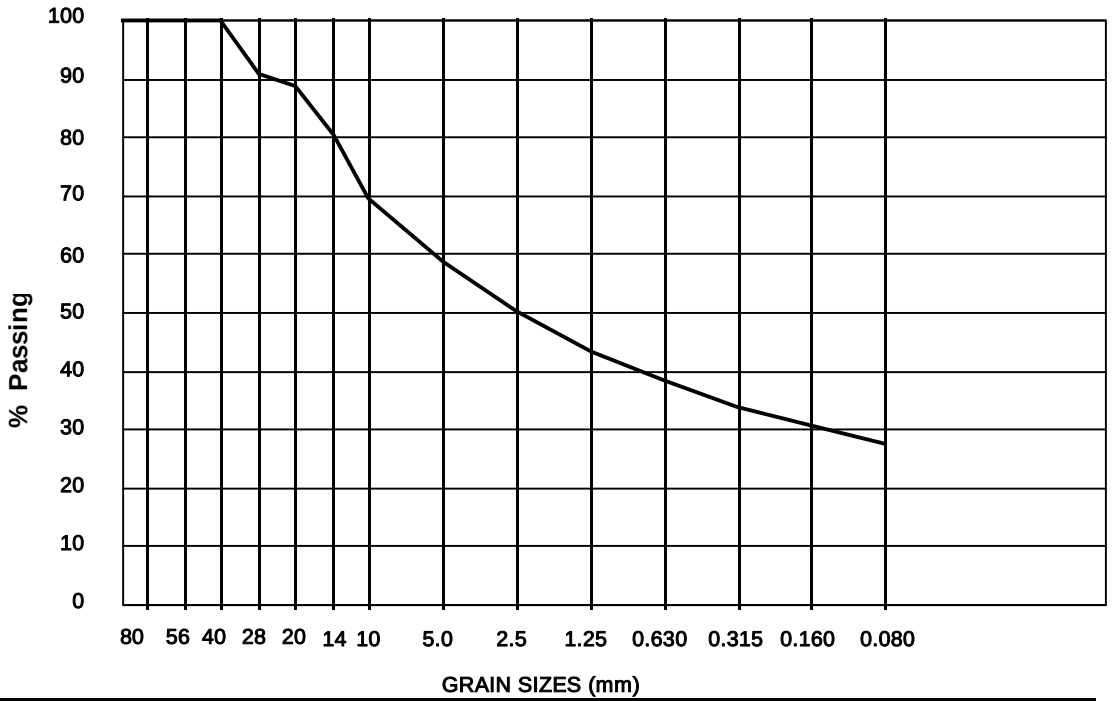
PHYSICAL PROPERTY TESTS

Soil Type	Till	**Liquid Limit**		**Flat and Elongated Particles, %**	
Gravel, %	41	**Plastic Limit**		**Coarse Spec. Gravity**	
Sand, %	31	**Plasticity Index**		**Fractured Faces, %**	
Silt and Clay, %	28	**Coarse Absorption, %**		**Petrographic No.**	
Moisture Cont., %	11.3	**Fine Absorption, %**		**Max. Dry Density, (kg/m3)**	
Abrasion Loss, %		**Micro Deval Loss, %**		**Optimum Moisture, %**	

Sieve Size (mm)	Percent Passing	Spec. Band
112		
80		
56		
40	100	
28	91	
20	89	
14	80	
10	70	
5.0	59	
2.5	50	
1.25	43	
0.630	38	
0.315	34	
0.160	31	
0.080	27.5	

GRAIN SIZE CURVE

Spec Band
NO SPEC



Comments:

Record No: 10399 Englobe Tech: BM PER

CERTIFIED LABORATORY FOR TESTING CONCRETE

project manager Richard Henry

METRIC SIEVE ANALYSIS REPORT

97 TROOP AVE., DARTMOUTH, N.S. B3B 2A7 - TEL (902) 468-6486 FAX 468-4919

Client:
SNC Lavalin Inc. (Maritimes)
Suite 200, Park Lane Terraces
5657 Spring Garden Road
Halifax, NS B3J 3R4

Attn: Michael Eakins
PHONE (902) 492-4544 **FAX**

Our Project No: B-0017022-1
Client Contract No.:
Client PO.:
CC:

Project: BIO, Underground Infrastructure Upgrades
Source: BH 5
Sample No: 3/4
Location: 0.3-1.5 m

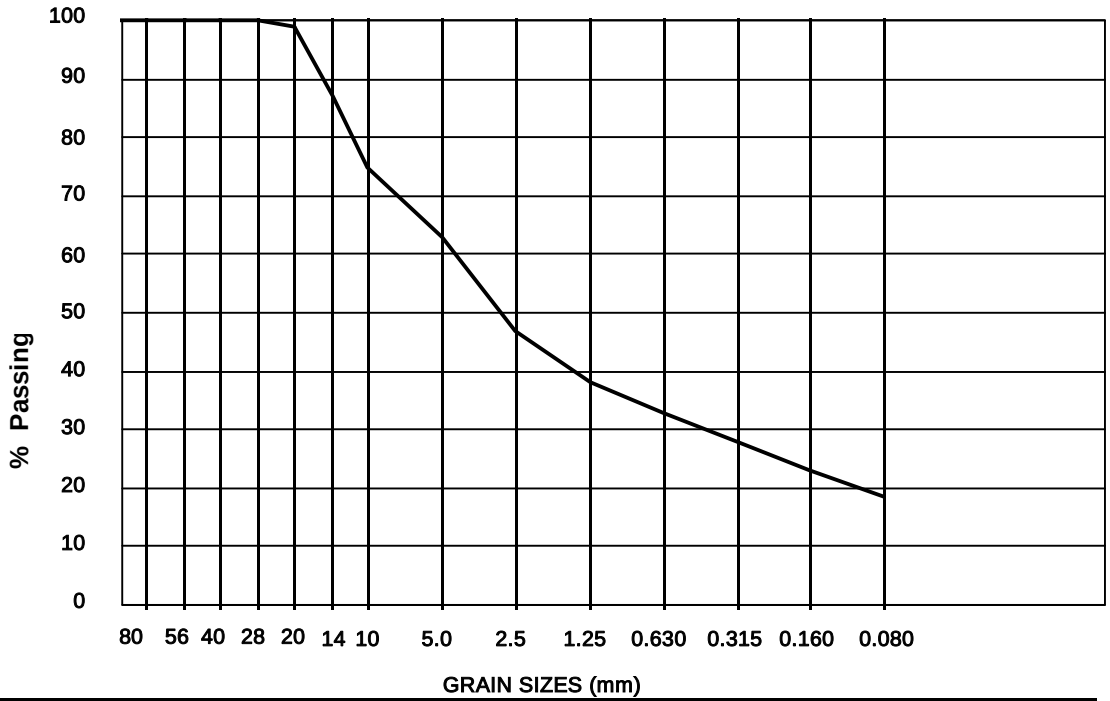
Sampled by: NMD
Date Received: 24-Apr-17
Date Tested: 01-May-17

PHYSICAL PROPERTY TESTS					
Soil Type	Fill	**Liquid Limit**		**Flat and Elongated Particles, %**	
Gravel, %	37	**Plastic Limit**		**Coarse Spec. Gravity**	
Sand, %	44	**Plasticity Index**		**Fractured Faces, %**	
Silt and Clay, %	19	**Coarse Absorption, %**		**Soundness Loss, %**	
Petrographic No.		**Fine Absorption, %**		**Max. Dry Density, (kg/m3)**	
Abrasion Loss, %		**Micro Deval Loss, %**		**Optimum Moisture, %**	

Sieve Size (mm)	Percent Passing	Spec. Band
150		
112		
80		
56		
40		
28	100	
20	99	
14	87	
10	75	
5.0	63	
2.5	47	
1.25	38	
0.630	33	
0.315	28	
0.160	23	
0.080	18.6	

GRAIN SIZE CURVE

Spec Band
NO SPEC



Comments: Moisture Content 5.4%

Record No: 727 **Englobe Tech**BM **PER**

CERTIFIED LABORATORY FOR TESTING CONCRETE

project manager Richard Henry

METRIC SIEVE ANALYSIS REPORT

97 TROOP AVE., DARTMOUTH, N.S. B3B 2A7 - TEL (902) 468-6486 FAX 468-4919

Client:
SNC Lavalin Inc. (Maritimes)
Suite 200, Park Lane Terraces
5657 Spring Garden Road
Halifax, NS B3J 3R4

Attn: Michael Eakins
PHONE (902) 492-4544 **FAX**

Our Project No: B-0017022-1
Client Contract No.:
Client PO.:
CC:

Project: BIO, Underground Infrastructure Upgrades
Source: BH 14
Sample No: 2
Location: 0.9-1.5 m

Sampled by: NMD
Date Received: 24-Apr-17
Date Tested: 01-May-17

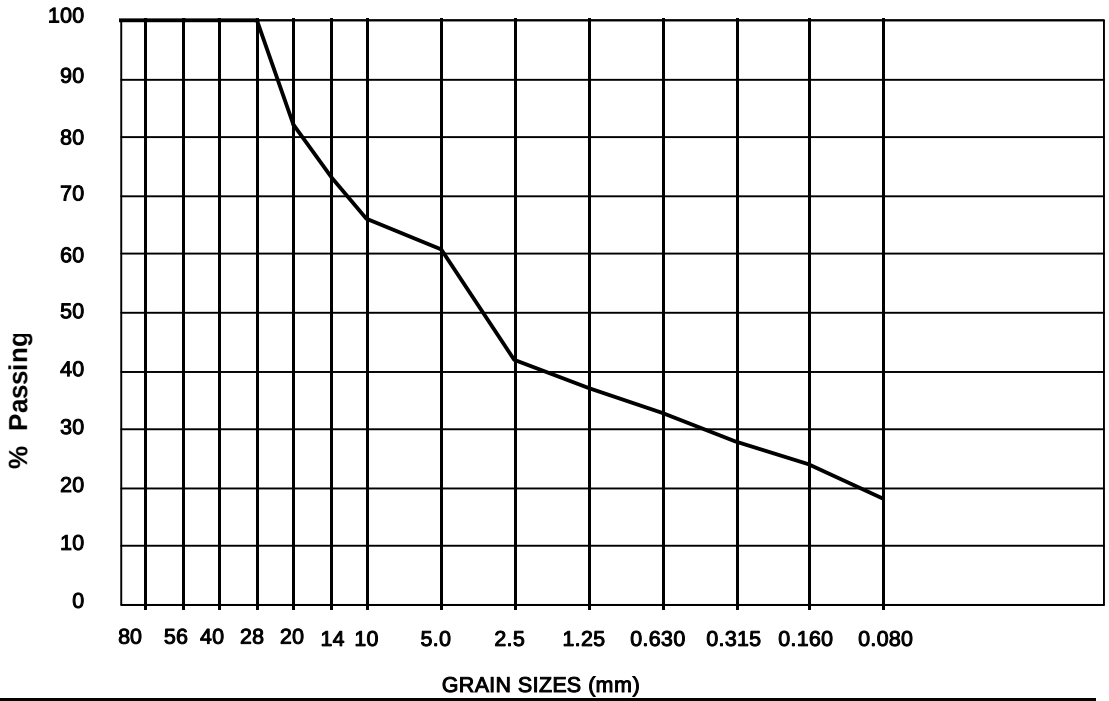
PHYSICAL PROPERTY TESTS

Soil Type	Fill	**Liquid Limit**		**Flat and Elongated Particles, %**	
Gravel, %	39	**Plastic Limit**		**Coarse Spec. Gravity**	
Sand, %	43	**Plasticity Index**		**Fractured Faces, %**	
Silt and Clay, %	18	**Coarse Absorption, %**		**Soundness Loss, %**	
Petrographic No.		**Fine Absorption, %**		**Max. Dry Density, (kg/m3)**	
Abrasion Loss, %		**Micro Deval Loss, %**		**Optimum Moisture, %**	

Sieve Size (mm)	Percent Passing	Spec. Band
150		
112		
80		
56		
40		
28	100	
20	82	
14	73	
10	66	
5.0	61	
2.5	42	
1.25	37	
0.630	33	
0.315	28	
0.160	24	
0.080	18.1	

GRAIN SIZE CURVE

Spec Band
NO SPEC



Comments: Moisture Content = 7.1%

Record No: 728 **Englobe Tech**BM **PER**

CERTIFIED LABORATORY FOR TESTING CONCRETE

project manager Richard Henry