APPENDIX A

Geotechnical Report

DEPARTMENT OF FISHERIES AND OCEANS

GEOTECHNICAL INVESTIGATION - FINAL REPORT

SKINNER'S POND BRIDGE, SKINNER'S POND, PE

JUNE 5, 2018

GEOTECHNICAL INVESTIGATION - FINAL REPORT

SKINNER’S POND BRIDGE, SKINNER’S POND, PE

DEPARTMENT OF FISHERIES AND OCEANS

FINAL REPORT

PROJECT NO.: 171-13488
DATE: JUNE 2018

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June 5, 2018

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Attention: Patrick Mazerolle, P.Eng.,ing.

Subject: **Draft Geotechnical Investigation Report –Skinner's Pond Bridge, Skinners Pond, PE**

Please find enclosed our Final Geotechnical Investigation Report completed by WSP Canada Inc. for the proposed Skinner's Pond Bridge Replacement, in Skinner's Pond, PE. The report presents observations, findings and recommendations from the geotechnical investigation and testing programs.

We trust this report meets your present requirements. Please review and provide us with your comments prior to our issuance of a final report.

Yours truly,

Taylor Elson
Geotechnical Engineer-in-Training

Clayton J. Rogers, P.Eng
Manager, Geotechnical - Dartmouth

Encl.

WSP ref.: 171-13488

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SIGNATURES

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1 INTRODUCTION AND BACKGROUND

WSP Canada Inc. (WSP) has been retained by the Department of Fisheries and Oceans (DFO) to complete a geotechnical investigation for the proposed replacement of Skinner's Pond Bridge, in Skinner's Pond, Prince Edward Island. The purpose of this investigation was to obtain information on subsurface soil and bedrock conditions at the site and provide geotechnical recommendations for earthworks, site preparation, geotechnical foundation design and construction. Soil and bedrock samples were collected at various depths and submitted for analysis of properties such as moisture content, gradation, Atterberg limits and unconfined compressive strength (UCS) for bedrock.

Fieldwork for the subsurface investigation was carried out from November 2 to 4, 2017 and consisted of drilling six (6) boreholes at the approximate locations as shown on the attached Figure 1. This report presents the results of the field investigation and laboratory testing programs.

2 SITE DESCRIPTION

The Skinner's Pond Bridge is located Skinner's Pond, Prince Edward Island. The bridge is approximately 146m long complete with thirty three 4.2m spans and a center span over the navigational channel of 7.5m long. The decks are supported on timber pile caps. The piers are comprised of vertical timber piers and steel batter piles typically at the ends of each pier.

The Skinners Pond Bridge (Structure 411 and 412) has undergone some significant defects that warrant a reconstruction. WSP conducted a structural inspection and report in March of 2017, which concluded the following issues:

- *Concrete deck has significant wide cracking due to deflection;*
- *Laminated timber deck has sagging and laminated timber separated indicating loss of capacity;*
- *Given the poor condition of the deck, the deck cannot support original MS-200 truck loading. It is difficult to determine any acceptable loading criteria for the bridge beyond lightly loaded vehicles, (i.e. half-ton truck).*

It is understood that the bridge replacement concept would be to remove all these structures and replace with a typical timber and/or steel H-Pile structure that would span the whole length and at the same elevation (or slightly higher) than the existing 411 and 412. It is understood that there will no longer be a need to have a bridge that would allow boats to navigate under, but this may still be optional. Approximate borehole locations are referenced in Figure 1, attached.

2.1 GEOLOGY

Available surficial soil mapping of the area indicates that the site consists of "Beach, bar, spit; tidal flat; dune: Silt, sand, Minor Gravel". (Geological Survey of Canada, 1973)

Available bedrock geologic mapping of the proposed development indicate that the bedrock is of the Orby Head Formation belonging to the Prince Edward Island group. Generally this formation could be described as consisting of mainly conglomerate and coarse- to medium-grained wacke. (Lynch & Deblonde, 1997)

3 INVESTIGATION PROCEDURE

3.1 BOREHOLE PROGRAM

The purpose of the geotechnical investigation was to develop an understanding of the subsurface soil, bedrock and groundwater conditions at the site. Subsurface investigation of the site was carried out from November 2 to 4, 2017 and included drilling six (6) boreholes (designated BH-01 to BH-06), at the locations shown on the attached Figure 1. The boreholes were drilled using a truck mounted drill rig supplied by Logan Geotech Drilling Inc. The boreholes were drilled off the east side of the exiting bridge. All boreholes were terminated within sandstone and/or mudstone bedrock.

During the borehole investigation soil samples were taken at 600-mm increments using a 50 mm outside diameter split-spoon sampler, driven in accordance with standard penetration resistance procedures (ASTM D1586). N-index values, described as the number of blows required to drive the sampler 305 mm (1 ft) into the soil were recorded for each sample location and are plotted on the borehole logs.

An explanation of the symbols and terms used in this report are enclosed in Appendix A. Borehole logs detailing the subsurface conditions are enclosed in Appendix B. Confirmatory laboratory index testing results are presented in Appendix C.

3.2 LABORATORY TESTING

Basic laboratory testing and visual examinations were carried out on selected soil samples from the borehole investigation. Tests were performed in accordance with materials testing requirements and procedures outlined in the ASTM and CSA testing manuals, as applicable. All laboratory testing was carried out by WSP and laboratory results can be found in Appendix C.

4 SUBSURFACE CONDITONS

In Summary, the subsurface conditions were found to be relatively similar in the subject boreholes. An organic silt (seabed sediment) overlying silt/clay, till and siltstone/mudstone bedrock was encountered in the subject boreholes. The Organic silt consisted of silty sand some clay with trace gravel, was in a dry to moist condition, compact to dense in relative density and red-brown in colour. The till generally consisted of silty clayey sand to silty sandy clay with trace gravel and occasional cobbles and boulders. Sandstone bedrock was encountered below the till. Groundwater was observed at depths of 9.8 and 6.8 metres below the ground surface in the boreholes at time of the investigation.

Table 4-1 - Summary of Subsurface Conditons

BOREHOLE	SEAFLOOR SURFACE ELEVATION (METRES)*	DEPTH TO TILL (METRES)	TILL ELEVATION (METRES)	DEPTH TO BEDROCK (METRES)	BEDROCK ELEVATION (METRES)*
BH-01	0.63	3.3	-2.67	5.4	-4.77
BH-02	0.73	4.8	-4.07	5.2	-4.47
BH-03	0.63	4.8	-4.17	6.5	-5.87
BH-04	0.73	5.4	-4.67	6.4	-5.67
BH-05	0.63	3.0	-2.37	6.4	-5.77
BH-06	0.73	1.8	-1.07	4.2	-3.47

**Elevations taken from sounding data and benchmark provided by Fisheries and Oceans Canada, Dated June 21, 2017.*

4.1 ORGANIC SILT

A silt with high organic content (i.e. seabed sediment) was encountered at the surface of all boreholes with a thickness ranging from 0.8 to 2.4 metres beneath the ground surface. The material generally consisted of silt with some sand and was very soft in consistency.

Five (5) samples were tested for moisture content with values ranging from 49.0 to 83.7 percent.

4.2 SANDY SILT

A sandy silt layer was encountered in all boreholes (expect BH-06) beneath the organic silt layer. This layer can generally be described as low plasticity sandy silt with some clay and shells. The material was brown to reddish brown in colour, in a saturated condition and very soft in relative density.

Laboratory grain size analysis of three (3) select samples of the material indicated a particle size distribution of 0.0 percent gravel, 28.6 to 36.7 percent sand, and a silt/clay content of 63.3 to 71.4 percent. Hydrometer analysis of two (2) samples indicated a particle size distribution of 51.7 to 57.4 percent silt and 10.0 to 14.0 percent clay. Seven (7) samples were tested for moisture content with values ranging from 65.3 to 109.6 percent.

Atterberg limits were conducted on two (2) sample of silt and indicated the material to be low plasticity silt/clay with a liquid limit ranging from 45 to 47 and a plasticity index of 18 to 20.

4.3 SILTY CLAYEY SAND

A silty clayey sand layer was encountered in borehole BH-06 beneath the organic silt layer. This layer can generally be described as consisting of silty clayey sand with trace gravel. The material was reddish brown in colour, in a wet condition and very loose in relative density.

Laboratory grain size analysis of one (1) select samples of the material indicated a particle size distribution of 3.8 percent gravel, 46.9 percent sand, and a silt/clay content of 49.3 percent. Hydrometer analysis of the sample indicated a particle size distribution of 33.3 percent silt and 16.0 percent clay. One (1) sample was tested for moisture content with a value of 29.0 percent.

4.4 TILL

Till was encountered at all borehole locations. The material generally consisted of sandy lean clay with gravel, was in a saturated to moist condition, very soft to very stiff in consistency and reddish-brown in colour.

Laboratory grain size analysis of two (2) select samples of till indicated a particle size distribution of 3.9 to 4.3 percent gravel, 9.2 to 14.7 percent sand, and a silt/clay content of 80.9 to 86.9 percent. Seven (7) samples were tested for moisture content with values ranging from 16.6 to 29.8 percent.

4.5 BEDROCK

Fractured and weathered siltstone/mudstone bedrock was encountered in all boreholes at depths ranging from 4.6 to 6.4 metres below the ground surface. Generally, the bedrock was observed to be medium strong, highly fractured, weathered and red-maroon in color. The Rock Quality Designation (RQD) values of the core samples ranged from 0 to 87%, indicating very poor to good rock.

Laboratory compressive strength testing of six (6) intact rock core samples indicated unconfined compressive strengths (UCS) ranging from 0.5 MPa to 34.8 MPa with an average of 15.6 MPa. Based on classification systems used in the Canadian Foundation Engineering Manual (4th Ed), Section 3.2.4.1, the fully-intact bedrock is generally very weak (Grade R1) to weak (Grade R2). Rock core photos are included in Appendix C.

4.6 GROUNDWATER

Groundwater was not able to be observed at the time of the investigation. Groundwater can be expected to fluctuate seasonally and tidally.

5 DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL

The site is located at Skinner's Pond Wharf, in Skinner's Pond Prince Edward Island. It is understood that the bridge (Structure 411/412) has been identified by as being in relatively poor condition and in need of replacement. The bridge was constructed in 1983. The bridge is approximately 146m long complete with thirty three 4.2m spans and a center span over the navigational channel of 7.5m long. The deck is comprised of a concrete deck supported by a laminated timber deck. The laminated timber deck is fabricated using the "groove and dap" method. The method involves using timber boards of different depths and notching them at regular intervals to try and achieve composite-like action with the concrete deck.

The following discussion and recommendations for the proposed bridge replacement are based on the observed subsurface conditions. As previously noted, the subsurface conditions encountered at the site generally consist of organic silt overlying till and siltstone/mudstone bedrock (at an elevation of -4.5 to -5.9, chart datum).

The use of driven steel "H" Piles refusal into bedrock will be suitable and practical for the site. Pile penetration into the Siltstone/ Mudstone bedrock cannot be predicted accurately but is anticipated to be between approximately 1 m and 3 m based on the current investigation. Some of the recommendations below are preliminary in nature and can be confirmed once specific design information is available.

The following sections of the report discuss the geotechnical engineering aspects for the bridge replacement and provide geotechnical foundation recommendations. The recommendations are in accordance with the Canadian Highway Bridge Design Code (CHBDC 2013) and Canadian Foundation Engineering Manual (CFEM 2006).

5.2 DRIVEN STEEL H PILES

We understand that a replacement bridge design has not been determined at the time of this report, and as such these findings should be preliminary in nature and further detailed design can be completed once a bridge design has been selected.

It is understood the bridge foundations will be supported on steel 'H' piles, driven to practical refusal on bedrock. Practical refusal shall be defined by an accepted pile inspection method.

For steel H piles driven to refusal in bedrock, the factored ultimate geotechnical resistance in axial compression is estimated at 50 MPa. This includes a geotechnical resistance factor of 0.4, in accordance with the Canadian Highway Bridge Design Code (CHBDC). As noted above, the bedrock is very fractured and weak and pile penetration into the siltstone/mudstone bedrock cannot be predicted accurately but it is anticipated to be between approximately 1 metres and 3 metres. If an HP310x132 pile (with a cross sectional area of 167 cm^2) is being considered for this site, we would have a design factored ultimate geotechnical resistance of 835 kN in axial compression.

The above recommendations for pile axial capacities should be confirmed using PDA Testing. This should be undertake on minimum of 10 % of the driven piles and we recommend that 48 to 72 hour retap testing be conducted. Pile testing reduces uncertainty in the estimate of soil parameters and can allow an increase of Geotechnical Resistance Safety Factor from 0.4 to 0.6 or 0.5 for static and dynamic testing, respectively.

Assuming an embedment length ratio (i.e. embedment length divided by pile diameter/width) of less than 20 (i.e. short piles), horizontal resistance is estimated at approximately 20 kN, based on Figure 18.9 used in the Canadian Foundation

Engineering Manual (4th Ed). We should be contacted to review pile capacities when more structural information is available.

Due to variations in the bedrock surface elevation and the bedrock quality, pile tip elevations will vary slightly. It is expected that piles may penetrate from 1 m to 3 m into the weathered bedrock zone. Maximum pile length is expected to be less than 10 metres. The possibility of piles encountering cobbles and boulders in the till layer above the bedrock surface may be anticipated. If necessary, pre-drilling may be required for some piles that encounter obstructions.

Full time inspection should be undertaken for the construction of pile foundations. Field records including pile equipment, pile lengths, depth to refusal, location of splices, blow counts, stroke and blow rate should be taken. The engineer should be notified of any anomalies or problems during installation, such as damage to piles during driving and early refusal, so that design assumptions can be reviewed.

5.3 TIMBER PILES

It is understood that timber piles may be considered as an alternative to steel H piles. The capacity of timber piles driven to refusal on bedrock would be governed by the allowable fiber stress of the pile. For the analysis of lateral resistance, an effective pile width of 2.5 times the pile diameter may be used. Geotechnical inspections are required during construction to record pile driving data and confirm acceptable pile depth and driving resistance.

Axial capacities should be confirmed using PDA Testing. This should be undertaken on minimum of 10 % of the driven piles and we recommend that 48 to 72 hour retap testing be conducted. Pile testing reduces uncertainty in the estimate of soil parameters and can allow an increase of Geotechnical Resistance Safety Factor from 0.4 to 0.6 or 0.5 for static and dynamic testing, respectively.

5.4 GENERAL PILE CONSIDERATIONS

The Canadian Foundation Engineering Manual (4th edition) recommends that driving hammer energy be limited to $6x10^6$ Joules for steel H piles and $1.6x10^5$ Joules for timber piles, respectively, multiplied by the cross-sectional area of the pile. As a guide, the minimum acceptable driving resistance for piles seated in sound rock should be taken as 5 blows/6mm for steel H piles and 4 blows/8mm for timber piles, respectively. Geotechnical inspections are required during construction to record pile driving data and confirm acceptable pile depth and driving resistance.

Where adjacent piles are driven parallel to one another, we recommend a minimum pile spacing of three (3) times the outside diameter of the piles to avoid group reduction effects and potential “following” during installation. This requirement can be reviewed if the need for smaller spacing arises during design or construction.

A protective driving shoe should be used to protect piles during hard driving in Stony Till soils with cobbles and/or boulders. The maximum cobble/boulder size was not determined during this investigation and shallow refusal of driven piles on cobbles or boulders is not anticipated. Where piles are refused above design elevations, pile extraction and drilling to clear obstructions should be undertaken prior to re-driving.

Down drag loads are not anticipated from the native soils or bedrock and do not need to be considered in pile design.

GEOTECHNICAL DESIGN PARAMATERS

5.4.1 MATERIAL DESIGN PARAMETERS FOR RETAINING WALLS

Recommended material design parameters for retaining walls are provided below, in Table 5-1. If conditions are different at time of construction we should be contacted immediately to re-evaluate the below design parameters.

Table 5-1 - Summary of Recommended Material Design Parameters

PARAMETER	TILL	BEDROCK	IMPORTED SAND AND GRAVEL (PEI TIE CLASS A GRAVEL)
Total Unit Weight (kN/m3)	20	25	21
Submerged Unit Weight (kN/m3)	10	15	11
Angle of Internal Friction	30	28	36˚
Coefficient of Active Earth Pressure, Ka	0.33	-	0.26
Coefficient of Passive Earth Pressure, Kp	3.00	-	3.85
Friction Factor (Soil-Concrete Interface)	0.4	0.70	0.60

Retaining walls should be designed for anticipated surcharges from structures, vehicle loads, sloping backfill, etc. The above parameters assume the backfill behind the wall is horizontal. If inclined backfill is being constructed behind the wall, the Geotechnical Engineer should be contacted for appropriate revision of design parameters.

Compaction of backfill behind the retaining wall should be performed using a walk-behind vibratory plate roller or plate tamper rather than a large vibratory drum roller to avoid damage to the wall.

5.4.2 EARTHQUAKE DESIGN PARAMETERS

The subsurface conditions at the proposed site consist of siltstone/mudstone bedrock at foundation design grades. According to clause 4.4.3.2 of the Canadian Highway Bridge Design Code (CHBDC, 2014), the soil profile designation for seismic analysis is Class "C" for soft rock. The applicable site coefficients are found in Table 4.2 to 4.9 of the same code.

The structural engineer should confirm the applicable site coefficients.

5.5 GENERAL RECOMMENDATIONS

5.5.1 EXCAVATIONS

We expect that any excavations above the water table will be reasonably straightforward. A 2:1 excavation slope should be feasible in the existing materials. We expect that steel sheet pile enclosures will be required to excavate any significant depth below the groundwater and water levels (if required).

All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) requirements. All side slopes of excavations must be maintained within OHSA criteria, or they must be supported.

Any groundwater or surface water encountered must be diverted to avoid softening/loosening of the exposed subgrade. Measures to divert groundwater/surface water may include excavating subgrade to sump locations where water will be disposed of by pumping.

5.5.2 STRUCTURAL FILL

Imported structural fill (if required) should consist of a well-graded sand and gravel material, free of organics and have less than 10 % fines. The structural fill should consist of a 31.5-mm minus or 75-mm minus (or equivalent), as specified in the PEI TIE Specifications.

The on-site soils will not be suitable for re-use as structural fill against the abutments but may be used in common areas for general site grading; materials must be approved by a Geotechnical Engineer prior to use. Saturated material is not suitable for re-use in structural applications and removal of oversize material (particle size greater than 200mm) will be required prior to re-use for backfilling. Proper construction methods during excavation, handling and stockpiling of the on-site materials will be required to prevent addition and excessive water content in the soil.

5.5.3 APPROACH FILL

The approach fill should consist of a non-frost susceptible 31.5-mm minus or 75-mm minus (or equivalent), as specified in the PEI TIE Specifications.

During fill placement, lift thickness should be compatible with type of compaction equipment and material used (i.e. gradation, particle size, etc.). Compaction of fill adjacent to the structure should be completed with hand operated compactors to prevent the build-up of significant “wedging” pressures that may develop if large compactors are used. Generally, abutment backfill should be placed in compacted lifts not to exceed 200-mm and compacted to 98 percent of the material’s Standard Proctor Maximum Dry Density (SPMDD) for structural applications (ASTM D698 procedure). Water and loose/soft soils should be removed prior to fill placement. Fill material, compaction equipment, lift thicknesses, etc. are to be evaluated for approval by the Geotechnical Engineer prior to fill placement.

5.5.4 WATER CONTROL

If construction and excavation is being considered below the water level, temporary water control measure (i.e. steel sheet pile enclosure) will likely be required to work in dry conditions and below the water level.

Typical de-watering techniques for groundwater seepage may include grading excavations to sump locations to dispose of water by pumping. If necessary, soft/wet soils can be over excavated and replaced by an imported rock fill. Proper erosion and sedimentation control measures should be provided to limit site disturbance, as in accordance with provincial and municipal regulations.

5.5.5 EROSION AND SEDIMENT CONTROL

Erosion and sedimentation control measures (e.g. silt booms, silt fences, check dams, settling ponds, etc.) should be provided, as required, for the site as part of the detailed design activity in accordance with local government requirements. Application of these control measures should be utilized to minimize soil erosion.

6 CLOSURE

This report has been prepared for the sole benefit of The Department of Fisheries and Oceans and is note intended for use by others. This report may not be reproduced without the prior written permission of WSP and The Department of Fisheries and Oceans. Contractors undertaking work must draw their own interpretations of the investigation results provided in this report as it affects construction costs, procedures and scheduling.

As boreholes provide a localized representation of the total study area, subsurface conditions may vary between and/or beyond the borehole locations. If conditions encountered at the site vary significantly from the reported herein, we should be notified immediately so that our interpretations and recommendations can be reviewed and revised if necessary.

We trust this report meets your present requirements. If you have any questions with the information contained in the report, please do not hesitate to contact us at your convenience.

Yours truly,

WSP Canada Inc.

Clayton J. Rogers. P.Eng.

Manager, Geotechnical - Dartmouth

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TITLE:

DEPARTMENT OF FISHERIES AND OCEANS
GEOTECHNICAL INVESTIGATION
APPROXIMATE BOREHOLE LOCATIONS

SCALE: 1:1000
DATE: (YYYY/MM/DD) 2017/11/07
PROJECT NO: 171-13488
REVISION: 0
DRAWING NO: FIGURE 1

WSP REF. NO.: ---- K:\DARTMOUTH\2017\171-13488_DEPTOFFISHERIES\06-GEOTECH\6.4-FIGURES\171-13488-GEOT.DWG FIGURE 1 PRINTED: 10:41 AM 2017/12/12 BY: TAYLOR.ELSON

APPENDIX

A

BOREHOLE LOG EXPLANATION FORM

BOREHOLE LOG EXPLANATION FORM

This explanatory section provides the background to assist in the use of the borehole logs. Each of the headings used on the borehole log, is briefly explained.

DEPTH

This column gives the depth of interpreted geologic contacts in metres below ground surface.

STRATIGRAPHIC DESCRIPTION

This column gives a description of the soil based on a tactile examination of the samples and/or laboratory test results. Each stratum is described according to the following classification and terminology.

Soil Classification*		Terminology	Proportion
Clay	<0.002 mm		
Silt	0.002 to 0.06 mm	"trace" (e.g. trace sand)	<10%
Sand	0.06 to 2 mm	"some" (e.g. some sand)	10% - 20%
Gravel	2 to 60 mm	adjective (e.g. sandy)	20% - 35%
Cobbles	60 to 200 mm	"and" (e.g. and sand)	35% - 50%
Boulders	>200 mm	noun (e.g. sand)	>50%

* Extension of MIT Classification system unless otherwise noted.

The use of the geologic term "till" implies that both disseminated coarser grained (sand, gravel, cobbles or boulders) particles and finer grained (silt and clay) particles may occur within the described matrix.

The compactness of cohesionless soils and the consistency of cohesive soils are defined by the following:

COHESIONLESS SOIL		COHESIVE SOIL	
Compactness	Standard Penetration Resistance "N", Blows / 0.3 m	Consistency	Standard Penetration Resistance "N", Blows / 0.3 m
Very Loose	0 to 4	Very Soft	0 to 2
Loose	4 to 10	Soft	2 to 4
Compact	10 to 30	Firm	4 to 8
Dense	30 to 50	Stiff	8 to 15
Very Dense	Over 50	Very Stiff	15 to 30
		Hard	Over 30

The moisture conditions of cohesionless and cohesive soils are defined as follows.

COHESIONLESS SOILS	COHESIVE SOILS		
Dry	DTPL	-	Drier Than Plastic Limit
Moist	APL	-	About Plastic Limit
Wet	WTPL	-	Wetter Than Plastic Limit
Saturated	MWTPL	-	Much Wetter Than Plastic Limit

STRATIGRAPHY

Symbols may be used to pictorially identify the interpreted stratigraphy of the soil and rock strata.

MONITOR DETAILS

This column shows the position and designation of standpipe and/or piezometer ground water monitors installed in the borehole. Also the water level may be shown for the date indicated.

●	Standpipe	◼	Geotextile Material / Liner	▩	Granular Backfill
▲	Piezometer	▧	Borehole Seal (Bentonite Grout)	▦	Granular (Filter) Pack
▤	Screened Interval	▨	Cement Seal	☐	Native Soil Backfill / Cave / Slough
▧	Borehole Seal (Peltonite, Bentonite or Hole Plug)				

Where monitors are placed in separate boreholes, these are shown individually in the "Monitor Details" column. Otherwise, monitors are in the same borehole. For further data regarding seals, screens, etc., the reader is referred to the summary of monitor details table.

SAMPLE

These columns describe the sample type and number, the "N" value, the water content, the percentage recovery, and Rock Quality Designation (RQD), of each sample obtained from the borehole where applicable. The information is recorded at the approximate depth at which the sample was obtained. The legend for sample type is explained below.

SS = Split Spoon
ST = Thin Walled Shelby Tube
AS = Auger Flight Sample
CC = Continuous Core
GS = Grab Sample
CS = Channel Sample
WS = Wash Sample
RC = Rock Core

$$\% \text{ Recovery} = \frac{\underline{\text{Length of Core Recovered Per Run}}}{\text{Total Length of Run}} \times 100$$

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundness of the rock mass. It is obtained from the rock cores by summing the length of core recovered, counting only those pieces of sound core that are 100 mm or more in length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very poor quality	< 25
Poor quality	25 - 50
Fair quality	50 - 75
Good quality	75 - 90
Excellent quality	90 - 100

TEST DATA

The central section of the log provides graphs which are used to plot selected field and laboratory test results at the depth at which they were carried out. The plotting scales are shown at the head of the column.

Dynamic Penetration Resistance - The number of blows required to advance a 51 mm diameter, 60º steel cone fitted to the end of 45 mm OD drill rods, 0.3 m into the subsoil. The cone is driven with a 63.5 kg hammer over a fall of 750 mm.

Standard Penetration Resistance - Standard Penetration Test (SPT) "N" Value - The number of blows required to advance a 51 mm diameter standard split-spoon sampler 300 mm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 750 mm. In cases where the split spoon does not penetrate 300 mm, the number of blows over the distance of actual penetration in millimetres is shown as $\frac{xBlows}{mm}$

Water Content - The ratio of the mass of water to the mass of oven-dry solids in the soil expressed as a percentage.

W_P - Plastic Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

W_L - Liquid Limit of a fine-grained soil expressed as a percentage as determined from the Atterberg Limit Test.

REMARKS

The last column describes pertinent drilling details, field observations and/or provides an indication of other field or laboratory tests that were performed.

APPENDIX

B

BOREHOLE LOGS AND PHOTOPLATES

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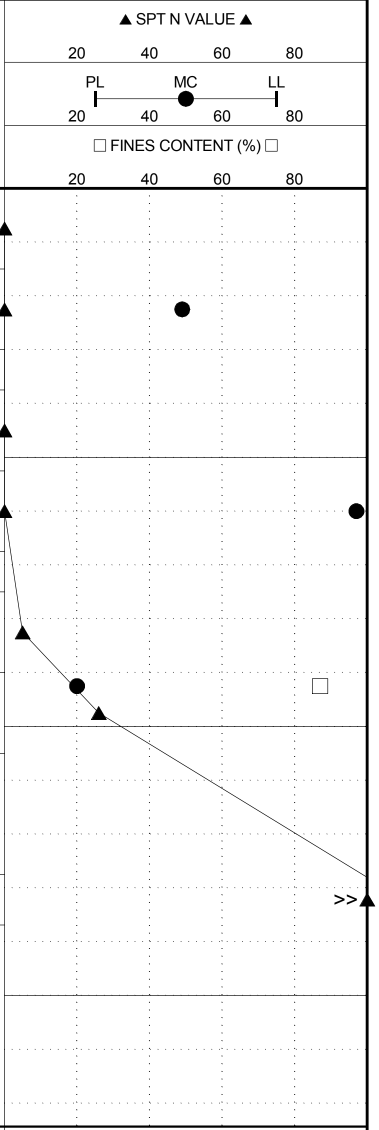
BORING NUMBER BH-01

PAGE 1 OF 1

CLIENT Department of Fisheries and Oceans
PROJECT NAME Skinner's Pond Bridge
PROJECT NUMBER 171-13488
PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI
DATE STARTED 11/2/17 **COMPLETED** 11/2/17
GROUND ELEVATION 0.63 m **HOLE SIZE** 125
DRILLING CONTRACTOR Logan Geotech Drilling Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME-55 All-Terrain Drill Rig
AT TIME OF DRILLING ---
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers
AT END OF DRILLING ---
NOTES Depth to bottom from Concrete deck : 2.025 m
AFTER DRILLING ---

DEPTH (m)	GRAPHIC LOG	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
		0.63	High organic content silt, some sand, black to reddish brown, saturated, very soft.		SS 1	0-0-0-0 (0)	21
					SS 2	0-0-0-0 (0)	25
2		-0.72	OL : Low plasticity sandy silt, some clay and shells, grey, saturated, very soft.		SS 3	0-0-0-0 (0)	50
					SS 4	0-0-0-0 (0)	42
					SS 5	0-1-4-6 (5)	54
4		-2.67	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, compact to very dense.		SS 6	8-10-16-17 (26)	100
					SS 7	54-28-50/0.08	80
6		-4.77	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface. UCS = 17.4 MPa		RC 1		100 (87)
8 10		-6.345	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				



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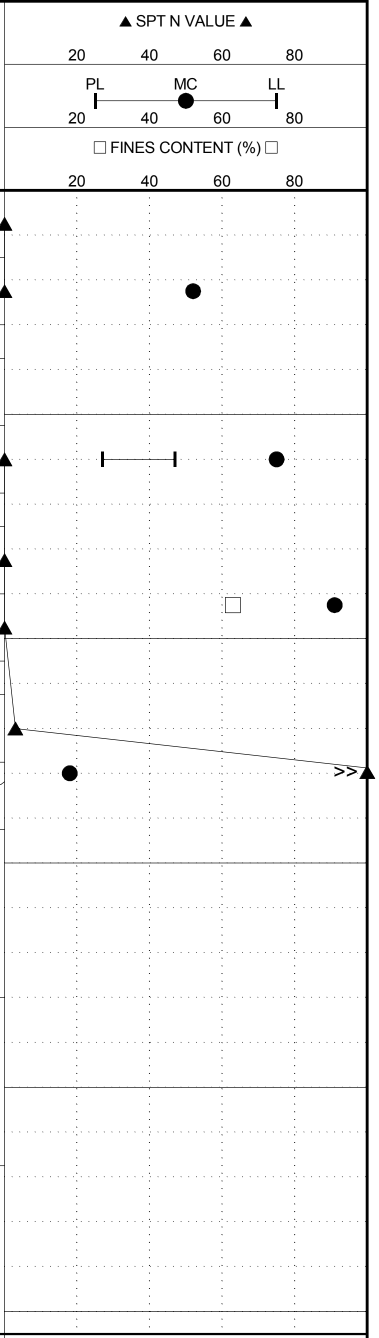
1 Spectacle Lake Drive
Dartmouth, Nova Scotia B3B 1X7
Telephone: 1 (902) 835-9955

BORING NUMBER BH-02

CLIENT Department of Fisheries and Oceans
PROJECT NAME Skinner's Pond Bridge
PROJECT NUMBER 171-13488
PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI
DATE STARTED 11/3/17 **COMPLETED** 11/3/17
GROUND ELEVATION 0.73 m **HOLE SIZE** 125
DRILLING CONTRACTOR Logan Geotech Drilling Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME-55 All-Terrain Drill Rig
AT TIME OF DRILLING ---
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers
AT END OF DRILLING ---
NOTES Depth to bottom from Concrete deck : 2.025 m
AFTER DRILLING ---

DEPTH (m)	GRAPHIC LOG	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
		0.73	High organic content silt, some sand, black to reddish brown, saturated, very soft,		SS 1	0-0-0-0 (0)	83
					SS 2	0-0-0-0 (0)	50
					SS 3		0
2		-1.07	OL : Low plasticity sandy silt, some clay and shells, brown to reddish brown, saturated, very soft.		SS 4	0-0-0-0 (0)	58
		-2.12	OL : Low plasticity sandy silt, some clay and shells, grey, saturated, very soft.		SS 5	0-0-0-0 (0)	42
4					SS 6	0-0-0-0 (0)	42
					SS 7	0-1-2-3 (3)	67
		-4.07	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, firm to hard.		SS 8	2-50/0.03	86
		-4.52	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface,				
6					RC 1		100 (0)
			UCS = 3.1 MPa				
8					RC 2		100 (40)
					RC 3		100 (48)
10			UCS = 16.9 MPa				
		-9.47	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				
12							



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BORING NUMBER BH-03

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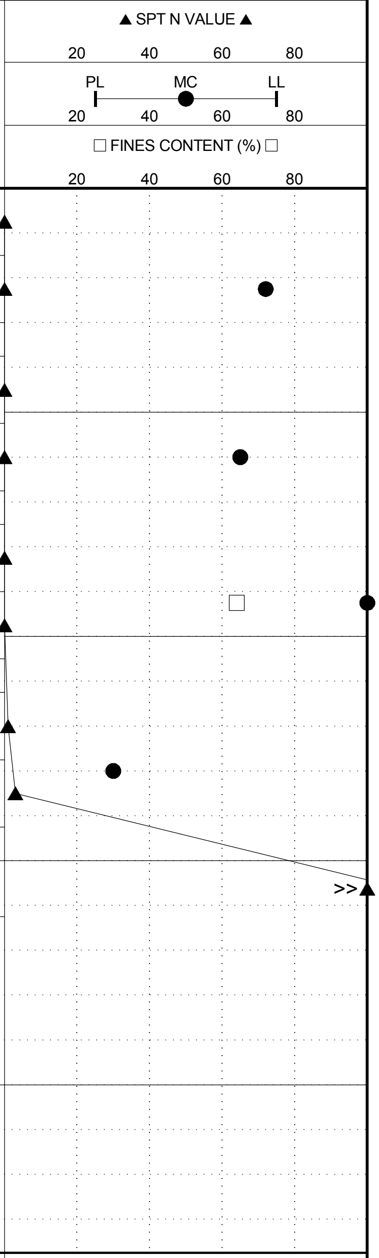
CLIENT Department of Fisheries and Oceans
PROJECT NAME Skinner's Pond Bridge
PROJECT NUMBER 171-13488
PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI
DATE STARTED 11/3/17 **COMPLETED** 11/3/17
GROUND ELEVATION 0.63 m **HOLE SIZE** 125
DRILLING CONTRACTOR Logan Geotech Drilling Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME-55 All-Terrain Drill Rig
AT TIME OF DRILLING ---
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers
AT END OF DRILLING ---
NOTES Depth to bottom from Concrete deck : 2.025 m
AFTER DRILLING ---

DEPTH (m)	GRAPHIC LOG	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
		0.63	High organic content silt, some sand, black to reddish brown, saturated, very soft,		SS 1	0-0-0-0 (0)	63
					SS 2	0-0-0-0 (0)	100
2					SS 3	0-0-0-0 (0)	75
		-1.47	OL : Low plasticity sandy silt, some clay and shells, brown to reddish brown, saturated, very soft.		SS 4	0-0-0-0 (0)	42
					SS 5	0-0-0-0 (0)	58
4		-2.67	OL : Low plasticity sandy silt, some clay and shells, grey, saturated, very soft.		SS 6	0-0-0-0 (0)	54
					SS 7	0-0-1-1 (1)	100
		-4.17	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, very soft to hard.		SS 8	0-1-2-3 (3)	38
6					SS 9	15-23-40-50/0.05	50
		-5.87	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface, UCS = 21.3 MPa		RC 1		100 (67)
8					RC 2		100 (75)
10		-8.87	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				
12							



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BORING NUMBER BH-04

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CLIENT Department of Fisheries and Oceans

PROJECT NAME Skinner's Pond Bridge

PROJECT NUMBER 171-13488

PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI

DATE STARTED 11/3/17 **COMPLETED** 11/4/17

GROUND ELEVATION 0.73 m **HOLE SIZE** 125

DRILLING CONTRACTOR Logan Geotech Drilling Inc.

GROUND WATER LEVELS:

DRILLING METHOD CME-55 All-Terrain Drill Rig

AT TIME OF DRILLING ---

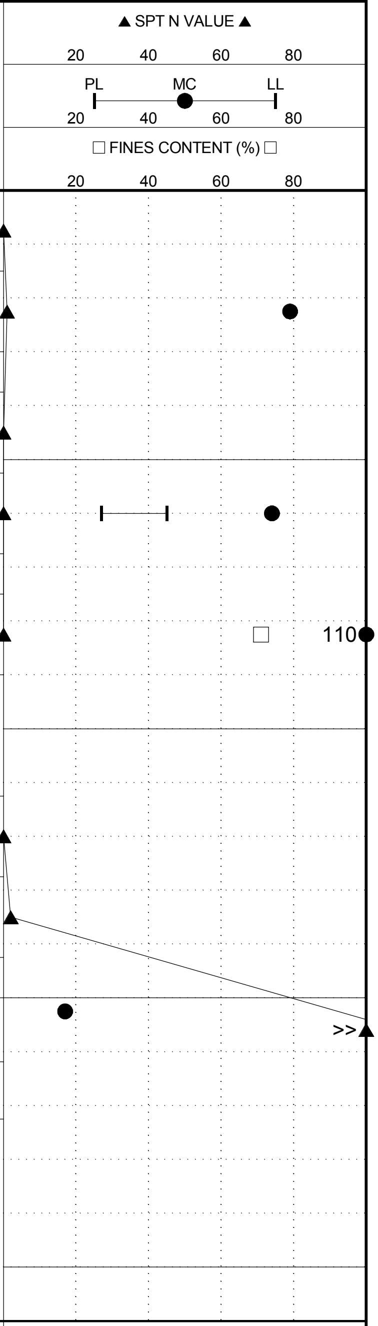
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers

AT END OF DRILLING ---

NOTES Depth to bottom from Concrete deck : 2.025 m

AFTER DRILLING ---

DEPTH (m)	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
	0.73	High organic content silt, some sand, black to reddish brown, saturated, very soft,		SS 1	0-0-0-0 (0)	42
				SS 2	0-1-0-0 (1)	50
2				SS 3	0-0-0-0 (0)	42
	-1.67	OL : Low plasticity sandy silt, some clay and shells, brown to reddish brown, saturated, very soft.		SS 4	0-0-0-0 (0)	54
	-2.12	OL : Low plasticity sandy silt, some clay and shells, grey, saturated, very soft.		SS 5	0-0-0-0 (0)	63
4				VA 1		
				SS 6	0-0-0-0 (0)	79
				SS 7	0-1-1-1 (2)	92
6	-4.67	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, very soft to very stiff.		SS 8	8-9-15-50/0.03	63
	-5.67	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface,		RC 1		94 (59)
8				RC 2		100 (68)
10	-7.67	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				



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BORING NUMBER BH-05

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CLIENT Department of Fisheries and Oceans

PROJECT NAME Skinner's Pond Bridge

PROJECT NUMBER 171-13488

PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI

DATE STARTED 11/4/17 **COMPLETED** 11/4/17

GROUND ELEVATION 0.63 m **HOLE SIZE** 125

DRILLING CONTRACTOR Logan Geotech Drilling Inc.

GROUND WATER LEVELS:

DRILLING METHOD CME-55 All-Terrain Drill Rig

AT TIME OF DRILLING ---

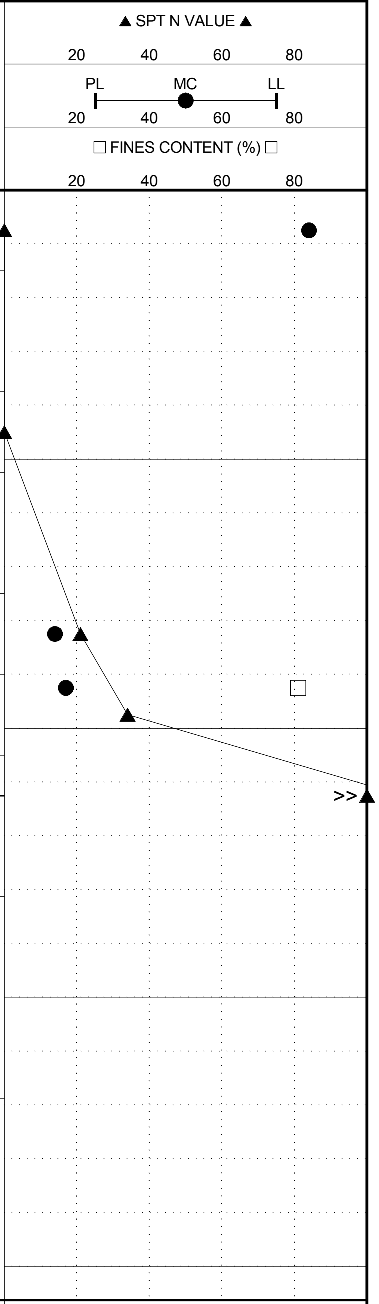
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers

AT END OF DRILLING ---

NOTES Depth to bottom from Concrete deck : 2.025 m

AFTER DRILLING ---

DEPTH (m)	GRAPHIC LOG	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
		0.63	High organic content silt, some sand, black to reddish brown, saturated, very soft,		SS 1	0-0-0-0 (0)	67
2					SS 2	0-0-0-0 (0)	42
		-1.62	OL : Low plasticity sandy silt, some clay and shells, brown to reddish brown, saturated, very soft.				
		-2.37	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, very stiff to hard.		SS 3	10-9-12-14 (21)	71
4					SS 4	17-17-17-8 (34)	75
					SS 5 RC 1	50/0.01	0 100 (0)
6					RC 2		100 (33)
		-5.77	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface,				
8					RC 3		100 (63)
10		-7.62	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				



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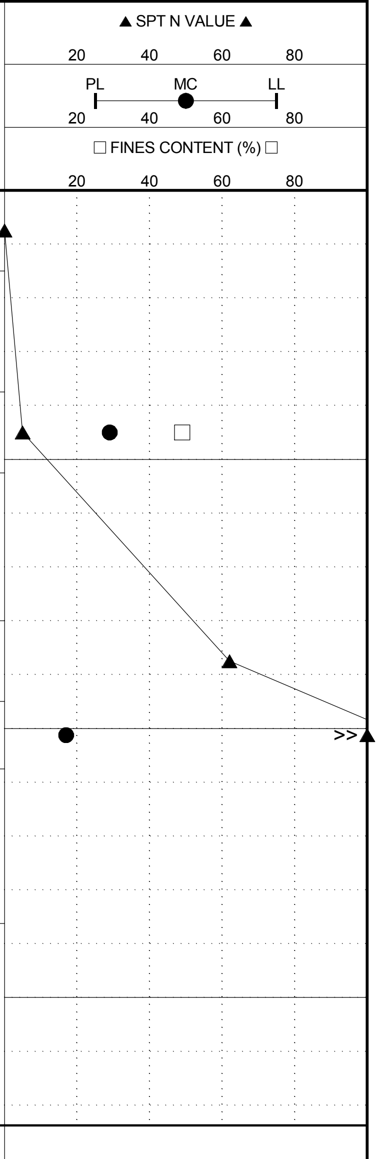
BORING NUMBER BH-06

PAGE 1 OF 1

CLIENT Department of Fisheries and Oceans
PROJECT NAME Skinner's Pond Bridge
PROJECT NUMBER 171-13488
PROJECT LOCATION Stomping Tom Lane, Skinner's Pond, PEI
DATE STARTED 11/4/17 **COMPLETED** 11/4/17
GROUND ELEVATION 0.73 m **HOLE SIZE** 125
DRILLING CONTRACTOR Logan Geotech Drilling Inc.
GROUND WATER LEVELS:
DRILLING METHOD CME-55 All-Terrain Drill Rig
AT TIME OF DRILLING ---
LOGGED BY M. Mazerolle **CHECKED BY** C. Rogers
AT END OF DRILLING ---
NOTES Depth to bottom from Concrete deck : 2.025 m
AFTER DRILLING ---

DEPTH (m)	GRAPHIC LOG	ELEVATION (m)	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
		0.73	High organic content silt, some sand, black to reddish brown, saturated, very soft,		SS 1	0-0-0-0 (0)	67
		0.03	silty clayey sand, trace gravel, loose, wet, reddish-brown.				
					SS 2	1-1-4-5 (5)	63
2		-1.07	TILL (CL) : sandy lean clay, with gravel to soft mudstone, reddish brown, saturated to moist, stiff to hard.				
					SS 3	19-33-29-15 (62)	75
4					SS 4	21-22-24-50/0.05	80
		-3.47	SILTSTONE : red-maroon siltstone/mudstone, fractured, weathered near surface,		RC 1		100 (46)
6					RC 2		100 (67)
			UCS = 34.8 MPa				
		-6.22	End of borehole in siltstone/mudstone. Groundwater was not identified at the time of the investigation. *Approximate elevations taken from sounding data and benchmark of 2.03 metres provided by Fisheries and Oceans Canada, Dated June 21, 2017.				
8							
10							



Bedrock Cores – BH-01

Bedrock Cores – BH-02

Bedrock Cores – BH-03

Bedrock Cores – BH-04

Bedrock Cores – BH-05

Bedrock Cores – BH-06

APPENDIX

C

LABORATORY TESTING RESULTS

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH6, RC2

DEPTH: 22' (6.7m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED:

Loading device No.: 1

Caliper No.: 1

	Average	
Diameter:	63.2	(mm)
Length:	75.2	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 592.0 (g)

Volume: 235539.3 (mm³)

Density: 2513 (kg/m^3)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.08 (MPa/sec)

Type of fracture: 2 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 6:37 (minutes)

Maximum applied load: 109 (kN)

Compressive strength **34.8** (MPa)

REMARKS:

TESTED BY: N.Krebs

DATE: November 30, 2017

VERIFIED BY: N.Krebs

DATE: November 30, 2017

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH3, RC2

DEPTH: 23' (7.0m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED: **Loading device No.:** 1 **Caliper No.:** 1

	Average	
Diameter:	63.3	(mm)
Length:	110.2	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 870.5 (g)

Volume: 346363.8 (mm³)

Density: 2513 (kg/m^3)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.08 (MPa/sec)

Type of fracture: 2 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 4:15 (minutes)

Maximum applied load: 66.8 (kN)

Compressive strength **21.3** (MPa)

REMARKS:

TESTED BY: N.Krebs **DATE:** November 30, 2017

VERIFIED BY: N.Krebs **DATE:** November 30, 2017

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH3, RC1

DEPTH: 21' (6.4m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED: **Loading device No.:** 1 **Caliper No.:** 1

	Average	
Diameter:	63.5	(mm)
Length:	106.9	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 816.5 (g) Volume: 338833.3 (mm³)

Density: 2410 (kg/m³)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.001 (MPa/sec)

Type of fracture: 1 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 6:38 (minutes)

Maximum applied load: 1.47 (kN)

Compressive strength **0.5** (MPa)

REMARKS:

TESTED BY: N.Krebs **DATE:** November 30, 2017

VERIFIED BY: N.Krebs **DATE:** November 30, 2017

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH2, RC3

DEPTH: 34' (10.4m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED:

Loading device No.: 1

Caliper No.: 1

	Average	
Diameter:	63.1	(mm)
Length:	112.9	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 893.5 (g)

Volume: 353144.8 (mm³)

Density: 2530 (kg/m^3)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.08 (MPa/sec)

Type of fracture: 2 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 3:13 (minutes)

Maximum applied load: 53 (kN)

Compressive strength **16.9** (MPa)

REMARKS:

TESTED BY: N.Krebs

DATE: November 30, 2017

VERIFIED BY: N.Krebs

DATE: November 30, 2017

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH2, RC2

DEPTH: 24' (7.3m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED: **Loading device No.:** 1 **Caliper No.:** 1

	Average	
Diameter:	63.1	(mm)
Length:	87.0	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 680.5 (g) Volume: 271532.8 (mm³)

Density: 2506 (kg/m^3)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.008 (MPa/sec)

Type of fracture: 2 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 6:08 (minutes)

Maximum applied load: 9.56 (kN)

Compressive strength **3.1** (MPa)

REMARKS:

TESTED BY: N.Krebs **DATE:** November 30, 2017

VERIFIED BY: N.Krebs **DATE:** November 30, 2017

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMEN
ASTM D 7012 / D 4543

CLIENT: Department of Fisheries and Oceans

PROJECT: Skinner's Pond Bridge

PROJECT No.: 171-13488-00

LAB No.: OL 240

SAMPLE No.: BH1, RC1

DEPTH: 21' (6.4m)

SAMPLING DATE: Nov 2-4, 2017

TESTING APPARATUS USED: **Loading device No.:** 1 **Caliper No.:** 1

	Average	
Diameter:	63.4	(mm)
Length:	102.9	(mm)
Straightness (0.5mm maximum) (S1):	<0.5	(mm)
Flatness (25µm maximum) (FP2):	<25	(µm)
Parallelism (0.25 ° maximum) (FP2)	<0.25	(°)
Perpendicularity (0.25 ° maximum) (P2)	<0.25	(°)

Mass: 815.0 (g) Volume: 324239.6 (mm³)

Density: 2514 (kg/m^3)

Moisture conditions: as received

Loading rate (0.5 to 1.0 MPa / sec): 0.05 (MPa/sec)

Type of fracture: 1 (As per CSA A23.2-9C)

Test duration (2-15 minutes) 5:24 (minutes)

Maximum applied load: 54.8 (kN)

Compressive strength **17.4** (MPa)

REMARKS:

TESTED BY: N.Krebs **DATE:** November 30, 2017

VERIFIED BY: N.Krebs **DATE:** November 30, 2017

MOISTURE CONTENTS

Project # : 171-13488-00
Project Name : Skinner's Pond Bridge
Client : Department of Fisheries and Oceans
Lab # : OL 240
Date: November 24, 2017
Tech: M.Tippett

TIN NO.	101	7	B82		
BOREHOLE NO.	BH 01	BH 01	BH 01		
SAMPLE & DEPTH	SS2 (0.6-1.2m)	SS4 (2.1-2.7m)	SS6 (3.7-4.3m)		
WT of TIN & WET SOIL (g)	86.4	70.5	798.0		
WT of TIN & DRY SOIL (g)	62.8	43.1	689.6		
WT of WATER (g)	23.6	27.4	108.4		
TARE WT (g)	14.6	14.9	156.0		
WT of DRY SOIL (g)	48.2	28.2	533.6		
MOISTURE CONTENT	49.0%	97.2%	20.3%		

TIN NO.	48	128	B79	148	
BOREHOLE NO.	BH 02	BH 02	BH 02	BH 02	
SAMPLE & DEPTH	SS2 (0.6-1.2m)	SS4 (2.1-2.7m)	SS6 (3.7-4.3m)	SS8 (5.2-5.8m)	
WT of TIN & WET SOIL (g)	91.6	98.0	595.5	72.2	
WT of TIN & DRY SOIL (g)	65.3	61.8	385.4	63.2	
WT of WATER (g)	26.3	36.2	210.1	9.0	
TARE WT (g)	14.5	14.0	154.8	15.0	
WT of DRY SOIL (g)	50.8	47.8	230.6	48.2	
MOISTURE CONTENT	51.8%	75.7%	91.1%	18.7%	

TIN NO.	88	R1	B81	34	
BOREHOLE NO.	BH 03	BH 03	BH 03	BH 03	
SAMPLE & DEPTH	SS2 (0.6-1.2m)	SS4 (2.1-2.7m)	SS6 (3.7-4.3m)	SS8 (5.2-5.8m)	
WT of TIN & WET SOIL (g)	82.5	75.8	458.1	87.6	
WT of TIN & DRY SOIL (g)	53.8	51.3	305.4	70.6	
WT of WATER (g)	28.7	24.5	152.7	17.0	
TARE WT (g)	14.2	13.8	153.1	13.5	
WT of DRY SOIL (g)	39.6	37.5	152.3	57.1	
MOISTURE CONTENT	72.5%	65.3%	100.3%	29.8%	

TIN NO.	74	15	B77	117	
BOREHOLE NO.	BH 04	BH 04	BH 04	BH 04	
SAMPLE & DEPTH	SS2 (0.6-1.2m)	SS4 (2.1-2.7m)	SS5 (3-3.7m)	SS8 (6.1-6.6m)	
WT of TIN & WET SOIL (g)	76.6	80.6	592.3	81.0	
WT of TIN & DRY SOIL (g)	48.9	52.2	368.8	71.1	
WT of WATER (g)	27.7	28.4	223.5	9.9	
TARE WT (g)	14.0	13.8	164.8	14.3	
WT of DRY SOIL (g)	34.9	38.4	204.0	56.8	
MOISTURE CONTENT	79.4%	74.0%	109.6%	17.4%	

TIN NO.	8	64	B308		
BOREHOLE NO.	BH 05	BH 05	BH 05		
SAMPLE & DEPTH	SS1 (0-0.6m)	SS3 (3-3.7m)	SS4 (3.7-4.3m)		
WT of TIN & WET SOIL (g)	74.8	78.0	778.8		
WT of TIN & DRY SOIL (g)	47.5	70.4	691.3		
WT of WATER (g)	27.3	7.6	87.5		
TARE WT (g)	14.9	14.4	164.6		
WT of DRY SOIL (g)	32.6	56.0	526.7		
MOISTURE CONTENT	83.7%	13.6%	16.6%		

MOISTURE CONTENTS

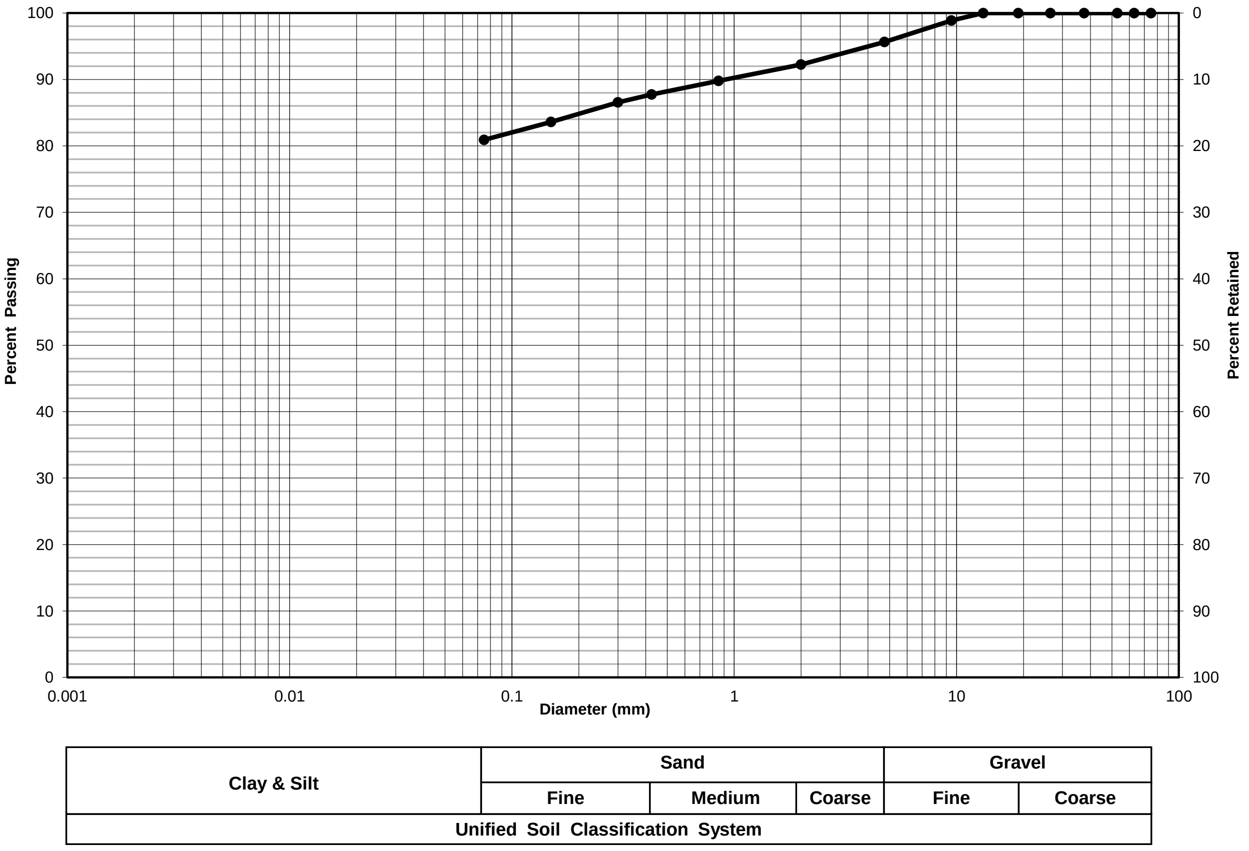
Project # : 171-13488-00
Project Name : Skinner's Pond Bridge
Client : Department of Fisheries and Oceans
Lab # : OL 240
Date: November 24, 2017
Tech: M.Tippett

TIN NO.	B306	73			
BOREHOLE NO.	BH 06	BH 06			
SAMPLE & DEPTH	SS2 (1.5-2.1m)	SS4 (3.86-4.37m)			
WT of TIN & WET SOIL (g)	929.4	88.6			
WT of TIN & DRY SOIL (g)	758.0	77.8			
WT of WATER (g)	171.4	10.8			
TARE WT (g)	167.1	14.5			
WT of DRY SOIL (g)	590.9	63.3			
MOISTURE CONTENT	29.0%	17.1%			
TIN NO.					
BOREHOLE NO.					
SAMPLE & DEPTH					
WT of TIN & WET SOIL (g)					
WT of TIN & DRY SOIL (g)					
WT of WATER (g)					
TARE WT (g)					
WT of DRY SOIL (g)					
MOISTURE CONTENT					
TIN NO.					
BOREHOLE NO.					
SAMPLE & DEPTH					
WT of TIN & WET SOIL (g)					
WT of TIN & DRY SOIL (g)					
WT of WATER (g)					
TARE WT (g)					
WT of DRY SOIL (g)					
MOISTURE CONTENT					
TIN NO.					
BOREHOLE NO.					
SAMPLE & DEPTH					
WT of TIN & WET SOIL (g)					
WT of TIN & DRY SOIL (g)					
WT of WATER (g)					
TARE WT (g)					
WT of DRY SOIL (g)					
MOISTURE CONTENT					
TIN NO.					
BOREHOLE NO.					
SAMPLE & DEPTH					
WT of TIN & WET SOIL (g)					
WT of TIN & DRY SOIL (g)					
WT of WATER (g)					
TARE WT (g)					
WT of DRY SOIL (g)					
MOISTURE CONTENT					

Particle-Size Analysis of Soils
(ASTM D422)

Client:	Department of Fisheries and Oceans	**Lab no.:**	OL 240-10
Project/Site:	Skinner's Pond Bridge	**Project no.:**	171-13488-00

Borehole no.:	BH 05	Sample no.:	SS4
Depth:	3.7-4.3m		



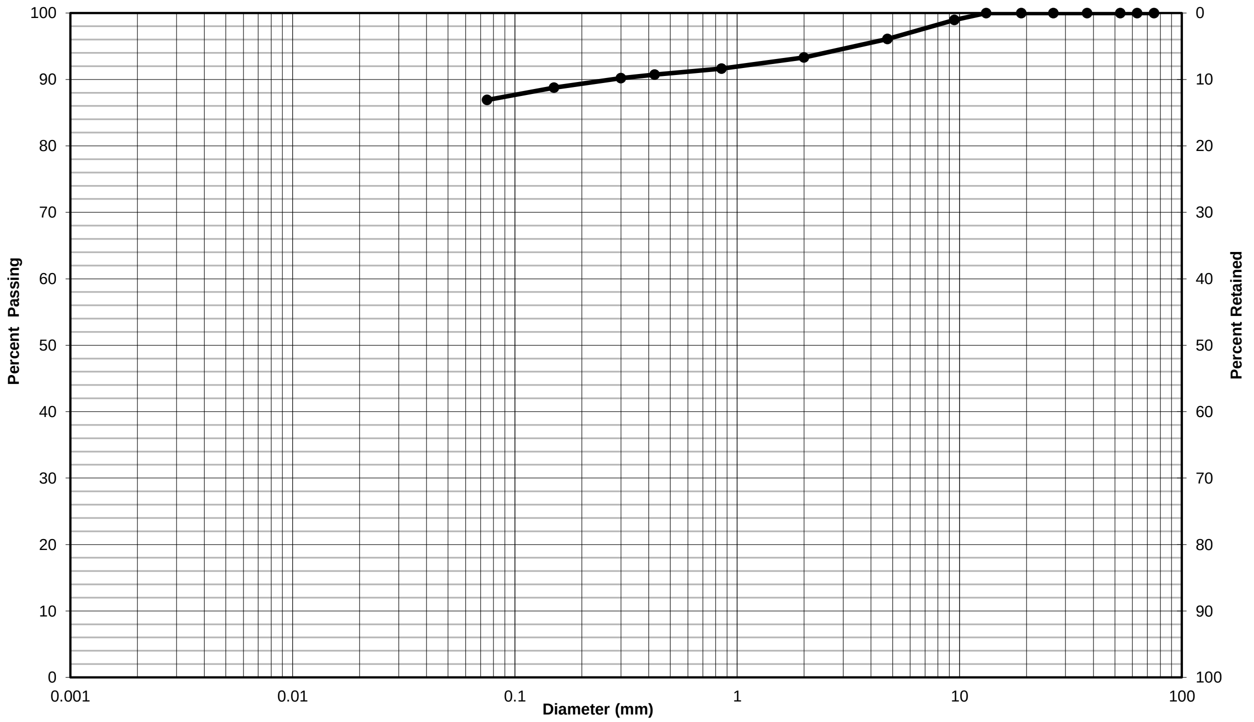
Percent %	Gravel	Sand	Clay & Silt	Silt	Clay
	4.3	14.7	80.9	-	-

Remarks:

Performed by:	N.Krebs	**Date:**	December 1, 2017
Verified by:	N.Krebs	**Date:**	December 1, 2017

Particle-Size Analysis of Soils
(ASTM D422)

Client:	Department of Fisheries and Oceans	**Lab no.:**	OL 240-1
Project/Site:	Skinner's Pond Bridge	**Project no.:**	171-13488-00
Borehole no.:	BH 01	Sample no.:	SS6
Depth:	3.7-4.3m		



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Percent %	Gravel	Sand	Clay & Silt	Silt	Clay
	3.9	9.2	86.9	-	-

Remarks:

Performed by:	N.Krebs	**Date:**	December 1, 2017
Verified by:	N.Krebs	**Date:**	December 1, 2017

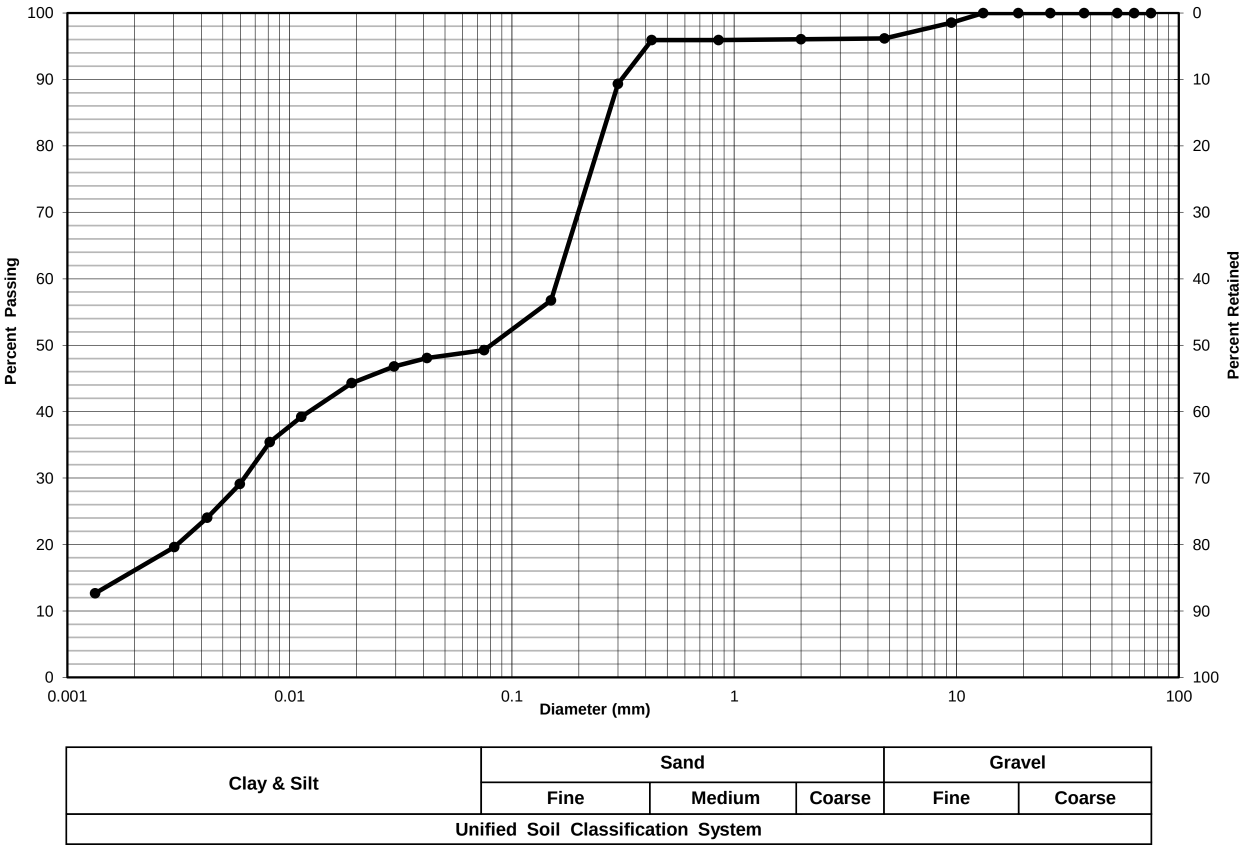
Particle-Size Analysis of Soils
(ASTM D422)

Client:	Department of Fisheries and Oceans	**Lab no.:**	OL 240-12
Project/Site:	Skinner's Pond Bridge	**Project no.:**	171-13488-00

Borehole no.: BH 6

Sample no.: SS2

Depth: 1.5-2.1m



Percent %	Gravel	Sand	Clay & Silt	Silt	Clay
	3.8	46.9	49.3	33.3	16.0

Remarks:

Performed by:	M.Tippett	**Date:**	December 6, 2017
Verified by:	N.Krebs	**Date:**	December 7, 2017

Particle-Size Analysis of Soils
(ASTM D422)

Client: Department of Fisheries and Oceans

Lab no.: OL 240-7

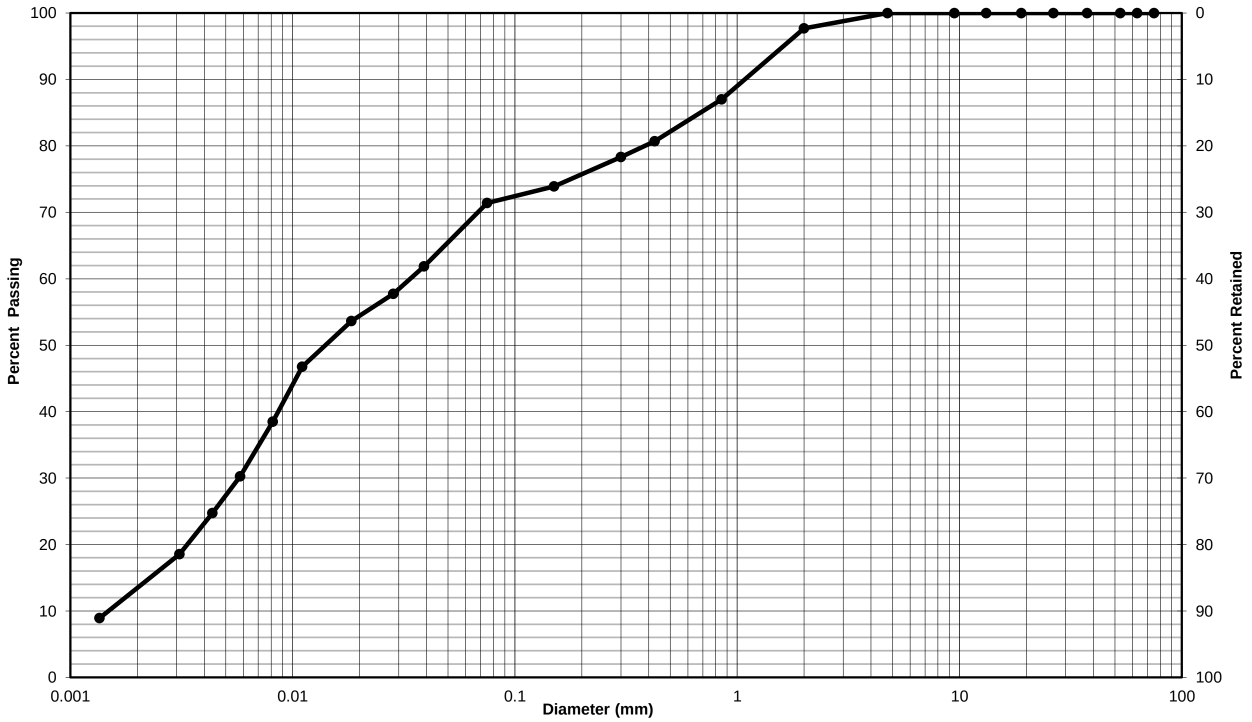
Project/Site: Skinner's Pond Bridge

Project no.: 171-13488-00

Borehole no.: BH 4

Sample no.: SS5

Depth: 3-3.7m



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

	Gravel	Sand	Clay & Silt	Silt	Clay
Percent %	0.0	28.6	71.4	57.4	14.0

Remarks:

Performed by: M.Tippett

Date: December 6, 2017

Verified by: N.Krebs

Date: December 7, 2017

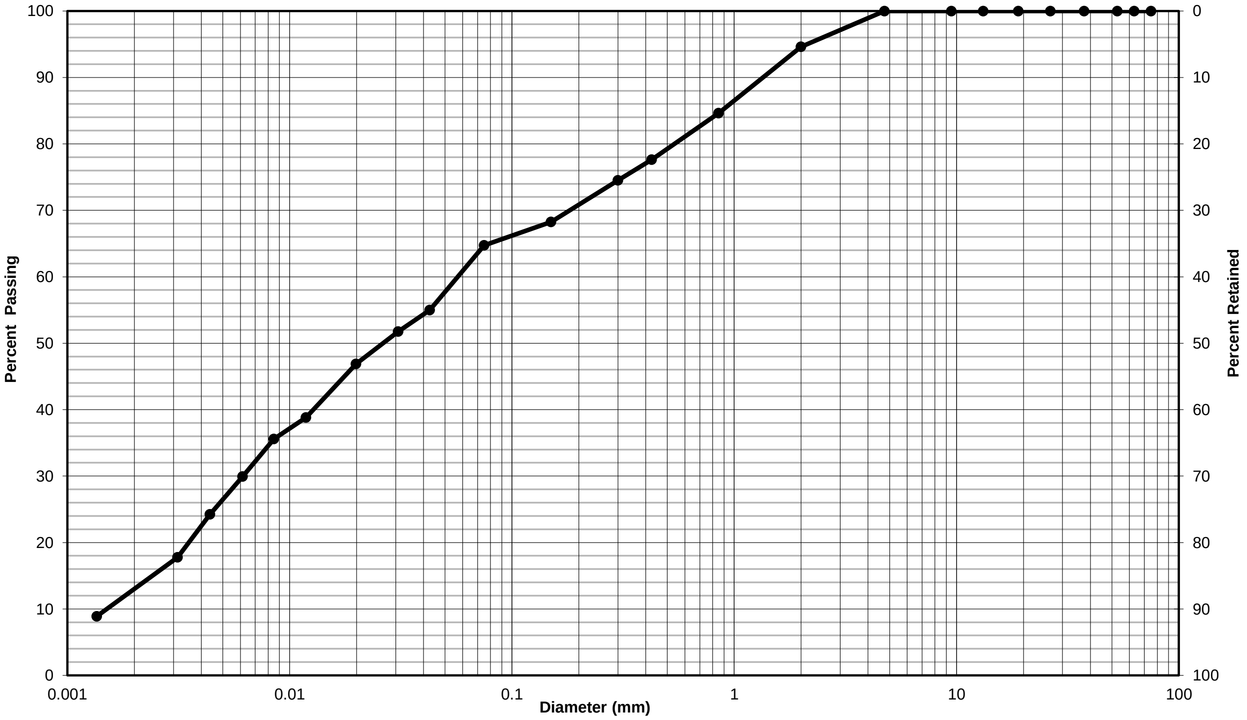
Particle-Size Analysis of Soils
(ASTM D422)

Client:	Department of Fisheries and Oceans	**Lab no.:**	OL 240-5
Project/Site:	Skinner's Pond Bridge	**Project no.:**	171-13488-00

Borehole no.: BH 3

Sample no.: SS6

Depth: 3.7-4.3m



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

	Gravel	Sand	Clay & Silt	Silt	Clay
Percent %	0.0	35.3	64.7	51.7	13.0

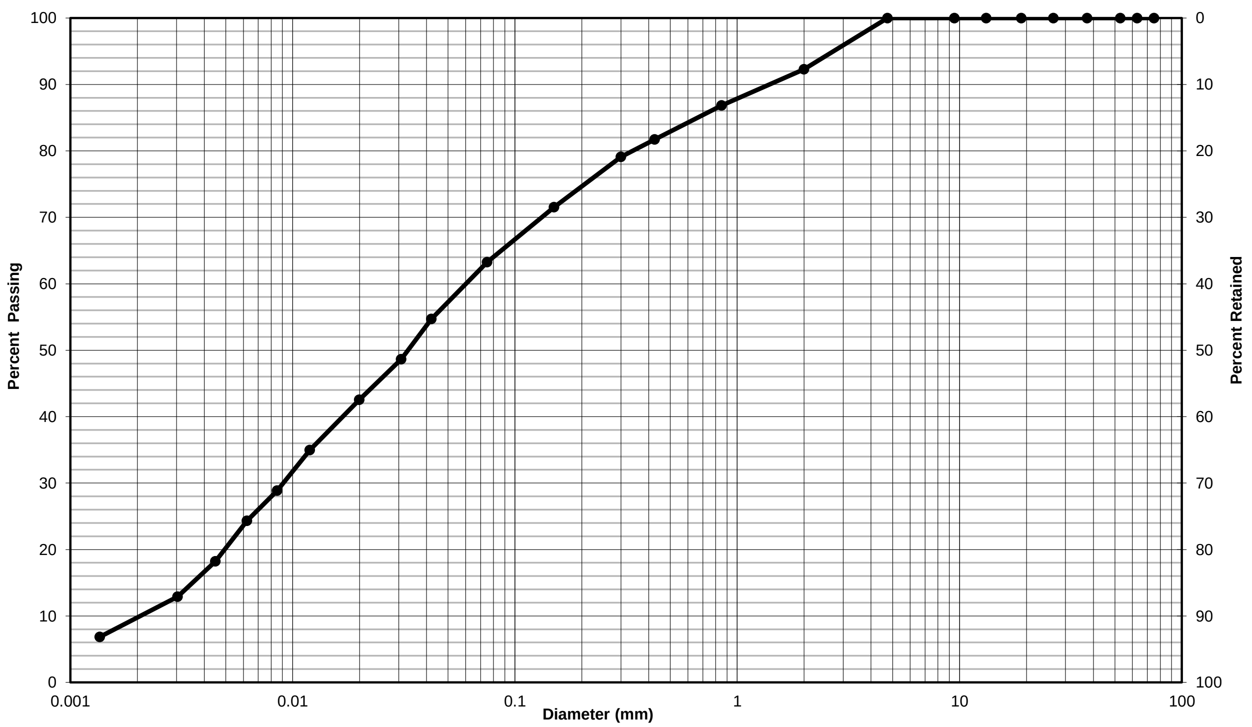
Remarks:

Performed by:	M.Tippett	**Date:**	December 6, 2017
Verified by:	N.Krebs	**Date:**	December 7, 2017

Particle-Size Analysis of Soils
(ASTM D422)

Client:	Department of Fisheries and Oceans	**Lab no.:**	OL 240-2
Project/Site:	Skinner's Pond Bridge	**Project no.:**	171-13488-00

Borehole no.:	BH 2	Sample no.:	SS6
Depth:	3.7-4.3m		



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

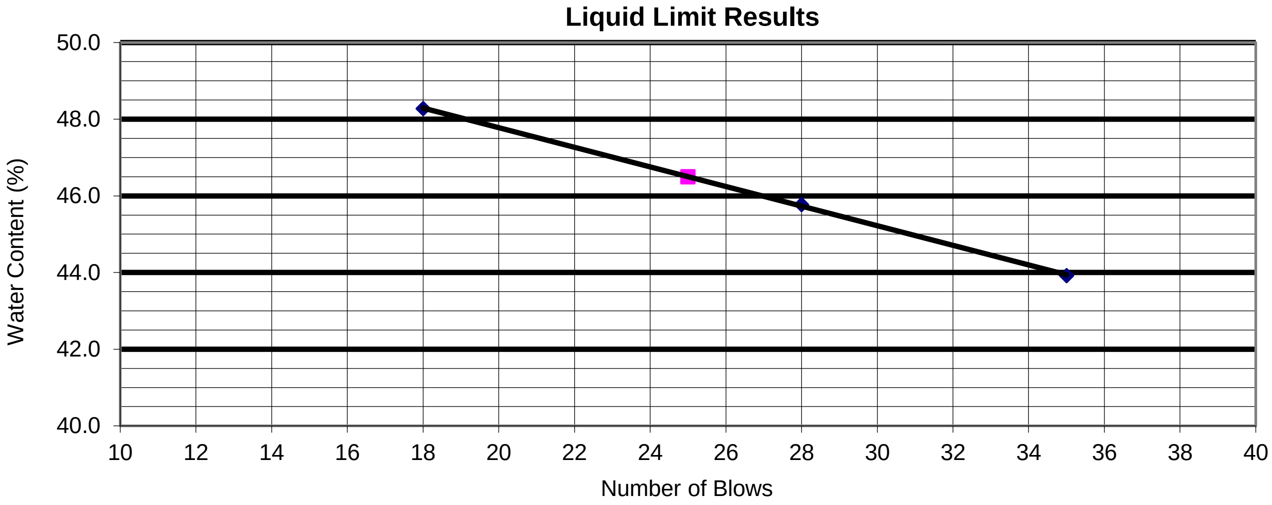
Percent %	Gravel	Sand	Clay & Silt	Silt	Clay
	0.0	36.7	63.3	53.3	10.0

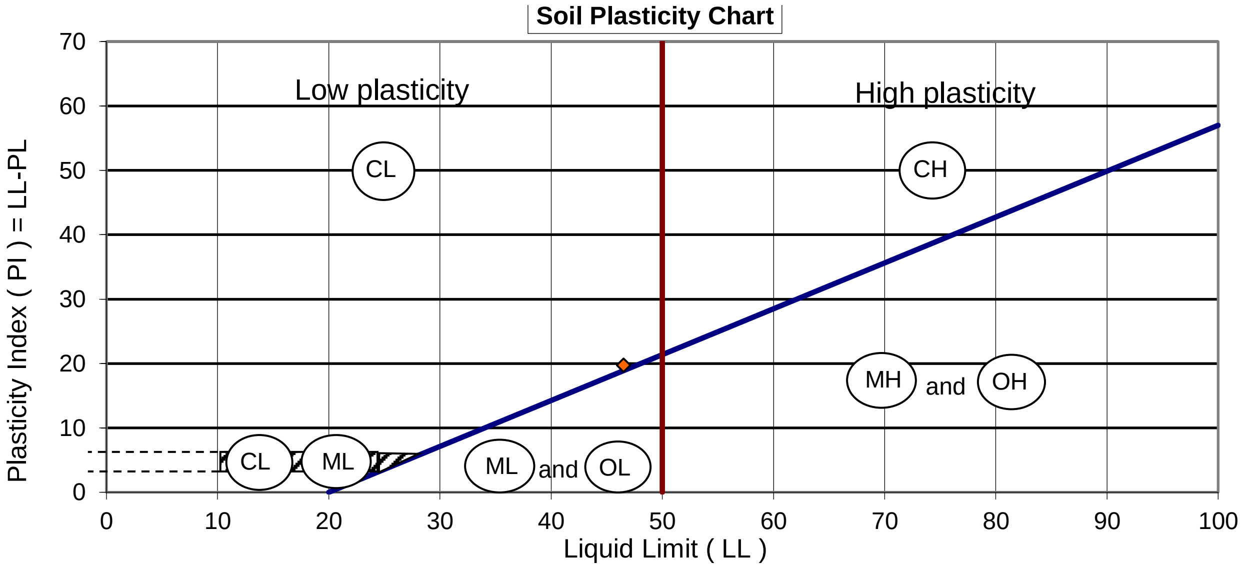
Remarks:

Performed by:	M.Tippett	**Date:**	December 6, 2017
Verified by:	N.Krebs	**Date:**	December 7, 2017

Liquid Limit, Plastic Limit and Plasticity Index of Soils
(ASTM D4318)

Client:	Department of Fisheries and Oceans	**Lab No.:**	OL 240-15
Project/Site:	Skinner's Pond Bridge	**Project No.:**	171-13488-00
Borehole No.:	BH 02	Sample No.:	SS04
Sample Depth:	2.1-2.7m		





Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content %
47	27	20	75.7

Sample Description: **CL - Low plasticity, inorganic clay**

Performed By:	N.Krebs	**Date:**	December 6, 2017
Verified By:	N.Krebs	**Date:**	December 6, 2017

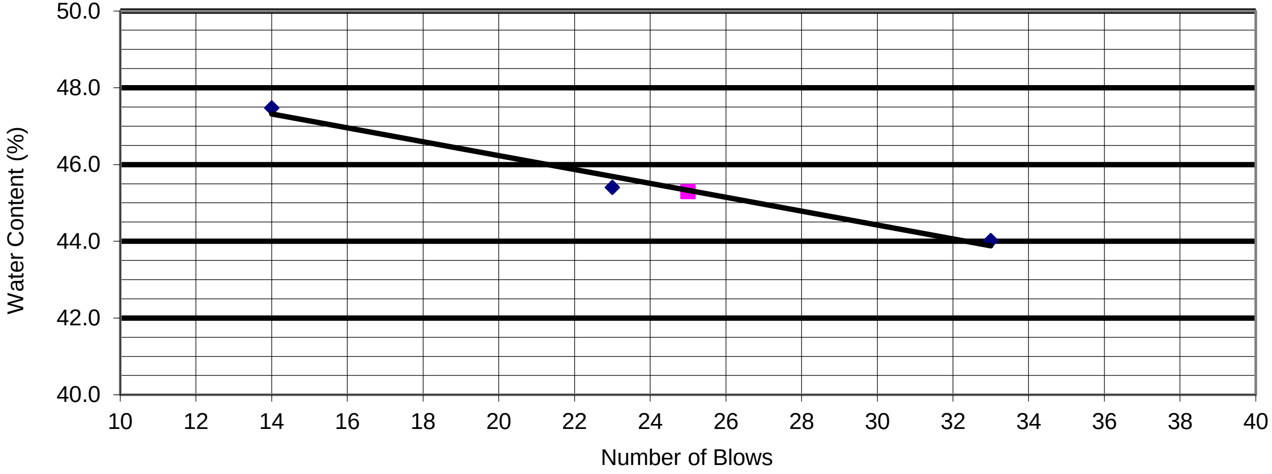
Liquid Limit, Plastic Limit and Plasticity Index of Soils
(ASTM D4318)

Client: Department of Fisheries and Oceans **Lab No.:** OL 240-14

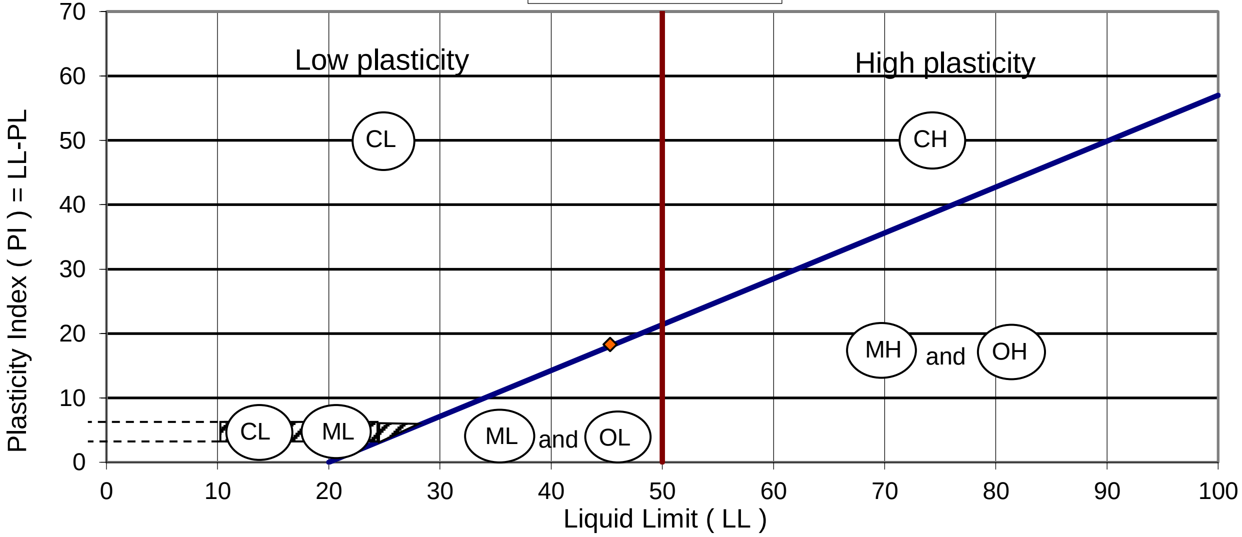
Project/Site: Skinner's Pond Bridge **Project No.:** 171-13488-00

Borehole No.: BH 04 Sample No.: SS04
Sample Depth: 2.1-2.7m

Liquid Limit Results



Soil Plasticity Chart



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content %
45	27	18	74.0

Sample Description: **CL - Low plasticity, inorganic clay**

Performed By: N.Krebs **Date:** December 5, 2017

Verified By: N.Krebs **Date:** December 5, 2017