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GEOTECHNICAL INVESTIGATION REPORT

PROPOSED MONTAGUE PEDESTRIAN BRIDGE

Montague River
Montague, Prince Edward Island

Prepared for:

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April 2020

Project No: 14348

FUNDY Engineering

Serving Our Clients' Needs First

OFFICES IN SAINT JOHN AND CLYDE RIVER

JOB FILE:	14348		
PROJECT TITLE:	Geotechnical Investigation – Montague Pedestrian Bridge		
VERSION	ISSUANCE DATE	PREPARED BY	REVIEWED BY
1.0	April 3, 2020	Patrick MacDonald, *EIT*	Alex Mouland, *P.Eng., PMP*

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PROFESSIONAL SEAL:

THE ASSOCIATION OF PROFEESIONAL ENGINEERS OF THE PROVINCE OF PRINCE EDWARD ISLAND
VALID FOR THE YEAR 2020

G. Alex Mouland
No. 1730

DATE: April 3, 2020

LICENSED PROFESSIONAL ENGINEER
PROVINCE OF PRINCE EDWARD ISLAND

ENGINEERS & GEOSCIENTISTS BRITISH COLUMBIA
OQM CERTIFIED

EXECUTIVE SUMMARY

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was retained by the Town of Three Rivers (the Client) to undertake a geotechnical investigation for a proposed pedestrian bridge structure in Montague, PE. The site is identified as the Montague Pedestrian Bridge and is located to the east of the existing vehicular bridge on Main Street. It is our understanding that there is a concrete retaining structure buried along the south side of the river, and the extents and depths of this structure are currently unknown.

The purpose of this geotechnical investigation was to obtain detailed information on the soil and bedrock conditions at the site and to provide recommendations for the foundation design of the new proposed pedestrian bridge. This investigation consisted of one (1) exploratory test pit and two (2) boreholes in the proposed location of the new structure as instructed by the Client.

It is our understanding that the proposed pedestrian bridge structure will consist of a single span, steel pony truss with a concrete deck flanked by two steel hollow structural steel (HSS) trusses on either side linked together by floor beams under the deck. The foundation for the structural steel and concrete bridge will consist of pile-supported concrete abutments with integrated wingwalls to retain approach fills.

For a bridge structure constructed on pile caps connected to Steel H Piles, piles should be driven into Bedrock until recommended driving criteria has been reached, as outlined below. This would result in piles with 342 – 1125 kN allowable bearing capacity depending on pile size and required factor of safety. Steel H Piles will be capable of providing 110 – 170 kN uplift resistance, depending on size, based on a factor of safety of 3.0.

Three (3) soil samples were submitted to RPC Laboratories in Fredericton, NB, for analysis of petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs), available metals and mercury. The chemical soil analyses discovered that one of the samples which were submitted for petroleum hydrocarbon analysis, and two samples which were submitted for polycyclic aromatic hydrocarbon analysis contained concentrations above allowable guidelines for a residential land use. **As such, special precautions should be made if excavated soils are required to be disposed of off-site. Any materials which contain elevated concentrations of petroleum hydrocarbons are required to be properly disposed of at a licensed soil handling facility**.

While every effort has been made to determine the geotechnical concerns pertaining to the proposed pedestrian bridge structure in Montague, PE, the discovery or development of additional geotechnical concerns cannot be precluded. Further investigation may reveal additional information that may influence the recommendations included herein. Should such information be discovered, Fundy Engineering should be notified so that any required amendments to our recommendations can be made.

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1.0 INTRODUCTION

Fundy Engineering & Consulting Ltd. (Fundy Engineering) was retained by the Town of Three Rivers (the Client) to undertake a geotechnical investigation for a proposed pedestrian bridge structure in Montague, PE. The site is identified as the Montague Pedestrian Bridge and is located to the east of the existing vehicular bridge on Main Street. It is our understanding that there is a concrete retaining structure buried along the south side of the river, and the extents and depths of this structure are currently unknown. The purpose of this geotechnical investigation was to obtain detailed information on the soil and bedrock conditions at the site and to provide recommendations for both the foundation design of the new proposed structure, as well as for potential mitigation measures with regard to the buried concrete retaining structure on the southernmost property. This investigation consisted of one (1) exploratory test pit and two (2) boreholes in the proposed location of the new structure as instructed by the Client (Figure 1).

1.1 Scope of Work Completed

This following scope of work was performed by Fundy Engineering as part of this geotechnical investigation:

- One (1) test pit was extended on the south side of the project site to explore the features of a buried concrete retaining structure in the proposed work area.
- Two (2) boreholes were drilled in the general proximity of the proposed abutment locations, depth to refusal / inferred bedrock, as instructed by the client.
- Representative soil samples were generally collected at 0.6 m intervals via split spoon sampler. The split spoon was replaced with a pen cone in BH1 beginning at a depth of 9.14 m, extending to refusal at 11.13 m.
- Three (3) soil samples were collected from BH1 at various depths and were sent for laboratory analysis. These samples were analyzed for petroleum hydrocarbon (PHCs), polycyclic aromatic hydrocarbons (PAHs), and available metals (including mercury).
- A complete geotechnical report which includes the factual findings, data collected over the course of the investigation and recommendations pertaining to the foundations for the proposed pedestrian bridge structure and associated earthworks.

1.2 Limitations

The observations made and facts presented in this report are based on a geotechnical investigation carried out in March 2020. While every effort has been made to determine the geotechnical concerns pertaining to the proposed pedestrian bridge in Montague, PE, the discovery or development of additional geotechnical concerns cannot be precluded. Further investigation may reveal additional information that may influence the recommendations included herein. Should such information be revealed, Fundy Engineering should be notified in a timely fashion so that any required amendments to our recommendations can be made.

These results are reported confidentially to the client, who is advised to take appropriate action to rectify any areas of concern. No professional responsibility is assumed for the use or interpretation of these findings by others.

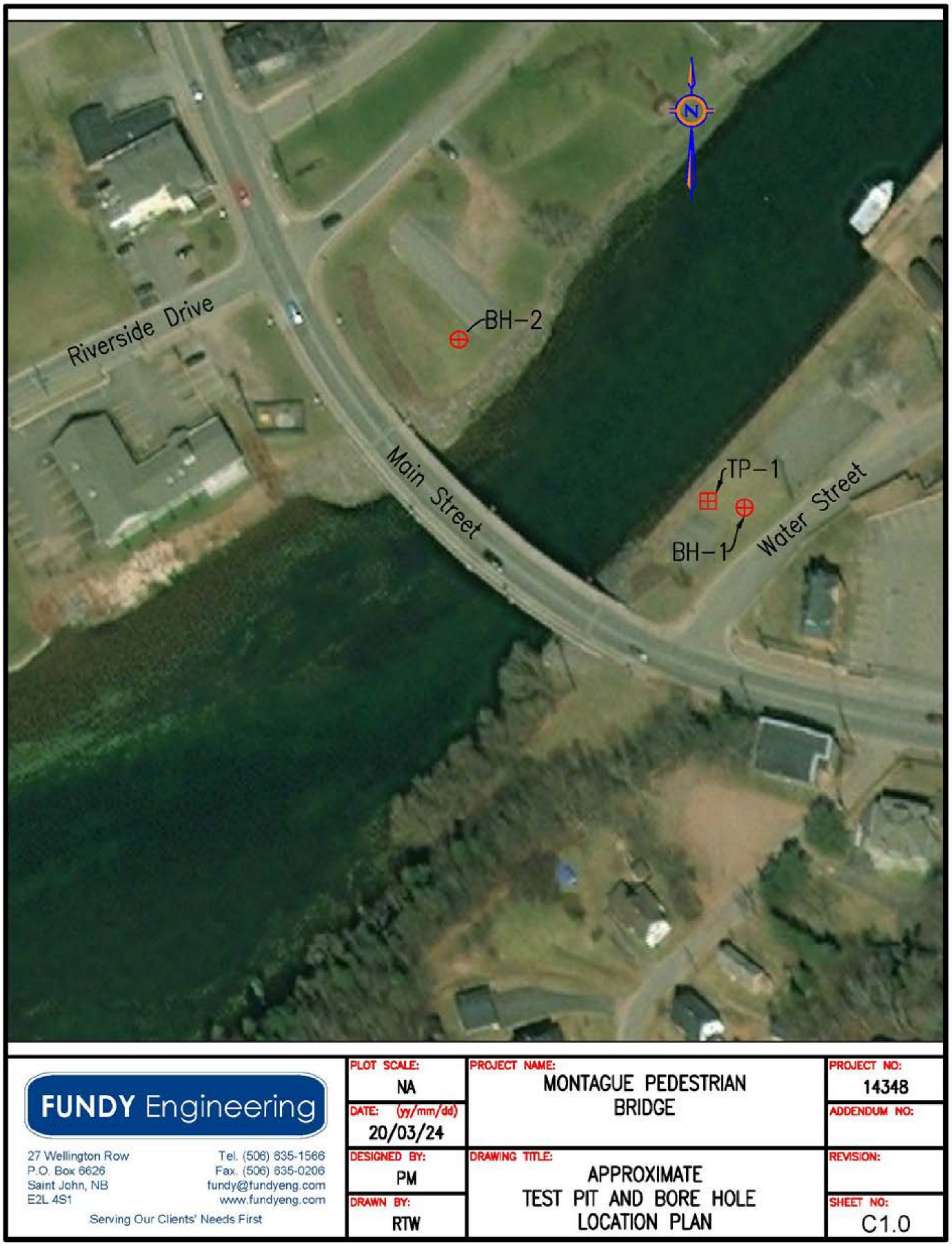


Figure 1 - Project location map showing approximate test pit and borehole locations in Montague, PE.

2.0 BACKGROUND

2.1 *Site Description And Location*

It is our understanding that the proposed pedestrian bridge will be located to the east of the Main Street Bridge in Montague, PE, with abutments located on properties to the north (PID 198275) and to the south (PID 196246), and spanning the Montague River (Figure 2).

Figure 2 – Proposed Pedestrian Bridge Location, Facing Northwest (February 28, 2020)

2.2 *Geotechnical Setting & Topography*

The bedrock geology of Prince Edward Island consists of relatively flat lying sedimentary deposits commonly referred to as the PEI Redbeds; a part of the Pictou Group that makes up a section of the Maritime Plane and lies within the Appalachian Mountain System. The PEI Redbeds can be broken down into four cyclic sequences generally comprised of conglomerate, sandstone, and siltstone, from the Late Pennsylvanian to Early Permian ages (*i.e.,* formed 286 million years ago to 320 million years ago) which fine upward (*i.e.,* conglomerate at the base and siltstone at the top), with the oldest deposits found along the south shore of the island and the youngest found along the north shore. The PEI Redbeds generally dip 1 – 3 degrees towards the northeast. Bedrock in Prince Edward Island is generally covered by a thin drift of Ground Moraine or Basal Till with occurrences of Residual, Ablation Till, and minor Glaciofluvial and Marine Deposits. Basal Till, which covers approximately 75% of the province are often local in origin and can generally be described as reddish brown, strongly acidic, and compact to dense soils further defined by their clay and silt content (Soils of Prince Edward Island. 1988. Agriculture Canada Research Branch).

An initial review of available soils information for the area revealed that the natural surficial deposits identified in the vicinity of the bridge structure comprise of Glacial deposits (south of watercourse) and Glaciofluvial and Glaciolacustrine deposits (north of watercourse). Glacial deposits may include Ablation and/or Ground Moraine. Ablation Moraine is described as loose, stony to bouldery sand till with lenses of stratified silt, sand, gravel; some substratified glacial debris. Ground Moraine is described as compact clayey to sandy basal till and includes minor loose ablation till. Glaciofluvial and Glaciolacustrine deposits may include Kame Terrace, Kame Complex, Valley-Side Kame, Valley Train and outwash, and is described as well to poorly stratified sand, gravel, boulders; includes minor ice-sloughed debris and ablation till (Surficial Deposits of Prince Edward Island. 1973. Geological Survey of Canada. Map 1366A). Furthermore, the soil type in the area is classified as part of the Culloden soil series (www.peilandonline.com).

The general topography of the area surrounding the proposed pedestrian bridge structure is described as gently-to-moderately rolling terrain which slopes downward toward the Montague River from either side of the river bank.

3.0 SITE WORK COMPLETED

3.1 TEST PIT / BOREHOLE INVESTIGATION

A geotechnical test pit and borehole investigation was completed at the site of the proposed pedestrian bridge to collect information pertaining to the soils and location of bedrock in the project area. In order to obtain such information, on March 19, 2020, one (1) test pit and was excavated using a CAT 420F-II rubber-tire backhoe provided by Kings County Construction, and two (2) boreholes were drilled using a track-mounted CME 75 Auger Core drill rig provided by Lantech Drilling Services Inc., under the direction of Patrick MacDonald, *EIT*, of Fundy Engineering.

In the *Montague Pedestrian Bridge, Preliminary Project Planning Report* provided by the client, an exploratory test pit was recommended on the south side of the project site to identify and determine the features of a buried concrete retaining structure in the proposed work area. Due to the conditions at the time of the test pit excavation, the test pit was terminated at a depth of approximately 2.9 meters. At this depth there was no observable evidence of the buried concrete retaining structure. Trapped water seepage was observed at 1.22 m, and in combination with the loose sand and gravel fills that were encountered, the sidewalls of the excavation were showing potential signs of collapse. Extending the test pit closer to the river bank might cause excavated materials to enter the watercourse as it was situated at the top of the river bank. Given these observations, as well as the history of contaminated soils on the property as per previous environmental studies included in the Preliminary Project Planning Report, the test pit was terminated to mitigate any risks of contaminating the watercourse.

During the borehole portion of the investigation, split spoon samples of the overburden soils were generally collected in 0.6 m intervals to obtain an understanding of the soil depths and stratigraphy. At the request of the Client, the boreholes were located on the north and south side of the Montague River, in the approximate location of the proposed pedestrian bridge abutments, and were drilled to refusal depth (inferred Bedrock) as depicted in Figure 1. It should be noted that upon observation of several meters of Till in BH1, a pen cone was exchanged in place of the split spoon sampler to locate

Bedrock, beginning in the Compact Till stratum at a depth of 9.14 m and extending to 11.13 m where drilling refusal occurred.

3.2 SOILS

Soils encountered can generally be described as **Very Loose to Compact Reddish Brown to Brown to Black Silty Sand and Gravel FILL with** overlying **Very Loose to Very Dense Reddish Brown to Brown and Grey Silty Sand and Gravel TILL** overlying **Inferred BEDROCK**. Till was encountered at approximately 4.88 m in BH1 (south of watercourse) and at approximately 6.10 m in BH2 (north of watercourse). Some Wood Debris was observed in BH1 at approximate depths of 3.70 m and 7.92 m, as well as Fractured Shell Fragments at approximately 6.10 m. Similarly, Wood Debris was observed in BH2 at 4.57 m at depths of approximately 3.66 m and 6.71 m. Inferred Bedrock was encountered via drilling refusal in BH1 at a depth of 11.13 m and in BH2 at a depth of 7.75 m. A summary of the findings of the borehole investigation is included in Table 1. Further details of the soils encountered in this geotechnical investigation can be found in the test pit and borehole logs that are appended to this report (Appendix II).

Table 1 - Summary of the borehole investigation with critical depths.

Borehole (Location from Existing Structure)	Very Loose to Compact Reddish Brown to Brown to Black Silty Sand & Gravel Fill (m)	Very Loose to Very Dense Reddish Brown to Brown and Grey Silty Sand & Gravel Till (m)	Drilling Refusal / Inferred Bedrock (m)	Possible Groundwater (m)
BH1 (south side of Montague River)	0.30	4.88	11.13	4.57
BH2 (north side of Montague River)	0.30	6.10	7.75	5.49

3.3 BEDROCK

Inferred Bedrock was identified via drilling refusal in BH1 at a depth of 11.13 m and in BH2 at a depth of 7.75 m.

3.4 GROUNDWATER

Groundwater was possibly encountered in BH1 at a depth of 4.57 m and in BH2 at a depth of 5.49 m. Probable trapped water was encountered in the test pit at a depth of 1.22 m. Note that tidal effects, seasonal conditions, and precipitation events will have some effects on these measured depths and hence do not represent a reference high water mark or regional groundwater table elevation.

4.0 CHEMICAL ANALYSIS

A total of three (3) soil samples were collected at approximately 3.05 m intervals in BH1 and sent to RPC Laboratories in Fredericton, NB, for analysis of PHC and PAH parameters, as well as available metals and mercury. All laboratory certificates have been included in Appendix III.

4.1 PETROLEUM HYDROCARBONS

Based on the sample analyses, one of the Ethylbenzene and Modified Total Petroleum Hydrocarbon concentrations within the soil samples submitted was found to have PHC concentrations **above** the allowable Atlantic Risk Based Corrective Action (RBCA) Tier 1 criteria for a residential property land use with coarse-grained soils and a potable water source. The sample collected in BH1 at a depth of 3.05 m to 3.66 m contained an ethylbenzene concentration of 0.42 ppm (compared to allowable guideline of 0.043 ppm), and a TPH concentration of 2200 ppm (compared to allowable guideline of 270 ppm). The samples were all found to resemble the fuel oil fraction, and possible PAHs were detected in the sample collected in BH1 at a depth of 5.49 m to 6.10 m. The soil sample analytical results and the evaluation criteria are shown below in Table 2.

Table 2 - Summary of the PHC analytical results.

Sample ID	Depth (m)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylene (mg/kg)	TPH (mg/kg)	Resemblance
BH1-1	3.05-3.66	0.03	<0.05	0.42	5.8	2200	Fuel Oil Fraction
BH1-2	5.49-6.10	0.006	<0.05	<0.01	<0.05	94	Fuel Oil Fraction, Possible PAHs detected, No Resemblance in the Lube Oil Range
BH1-3	8.53-9.14	<0.005	<0.05	<0.01	0.05	58	Fuel Oil Fraction, No Resemblance in the Lube Oil Range
Atlantic RBCA Tier I Guidelines		0.042	0.35	0.043	0.73	270	

Notes:
Shaded red indicates concentrations above allowable Atlantic Risk Based Corrective Action Tier 1 Guidelines for a residential property land use with potable water source and coarse-grained soils.

4.2 POLYCYCLIC AROMATIC HYDROCARBONS

All of the soil samples analyzed in this investigation were found to have PAH concentrations below the recommended Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health criteria for a residential property with the exception of Fluoranthene, Naphthalene and Phenanthrene. The results of this analysis are included below in Tables 3 and 4 with the relevant CCME guidelines.

Table 3 - Summary of the PAH analytical results (carcinogenic) for human health criteria (dermal contact).

Sample ID	BH1-1	BH1-2	BH1-3	CCME Canadian Soil Quality Guidelines
Depth (m)	3.05-3.66	5.49-6.10	8.53-9.14	
Benzo(a)anthracene (mg/kg)	0.03	0.04	0.10	-
Benzo(a)pyrene (mg/kg)	0.03	0.03	0.07	-
Benzo(b+j)fluoranthene	0.04	0.03	0.07	-
Benzo(ghi)perylene (mg/kg)	0.02	0.01	0.03	-
Benzo(k)fluoranthene (mg/kg)	0.02	0.01	0.03	-
Chrysene/Triphenylene (mg/kg)	0.03	0.03	0.07	-
Dibenzo(a,h)anthracene (mg/kg)	< 0.02	< 0.01	< 0.01	-
Indeno(1,2,3-c,d)pyrene (mg/kg)	0.02	0.01	0.03	-
B[a]P TPE Concentration	0.0615	0.0494	0.104	5.3

Table 4 - Summary of the PAH analytical results for environmental health criteria (non-carcinogenic effects).

Sample ID	BH1-1	BH1-2	BH1-3	CCME Canadian Soil Quality Guidelines	
Depth (m)	3.05-3.66	5.49-6.10	8.53-9.14	Residential	Commercial
Anthracene (mg/kg)	0.02	0.05	0.04	2.5	32
Benzo(a)anthracene (mg/kg)	0.03	0.04	0.10	20	72
Benzo(a)pyrene (mg/kg)	0.03	0.03	0.07	50	180
Benzo(b+j)fluoranthene	0.04	0.03	0.07	0.1	10
Benzo(k)fluoranthene (mg/kg)	0.02	0.01	0.03	0.046	0.046
Dibenzo(a,h)anthracene (mg/kg)	< 0.02	< 0.01	< 0.01	0.1	10
Fluoranthene (mg/kg)	0.06	0.09	0.12	0.1	10
Indeno(1,2,3-c,d)pyrene (mg/kg)	0.02	0.01	0.03	0.1	10
Naphthalene (mg/kg)	2.2	0.06	0.03	0.1	10
Phenanthrene (mg/kg)	0.16	0.10	0.09	0.1	10
Pyrene (mg/kg)	0.06	0.10	0.12	0.1	10

4.3 Trace Metals

All of the soil samples analyzed in this investigation were found to have trace metals concentrations that are below the CCME Canadian Soil Quality Guidelines for the Protection of the Environment and Human Health. The results from the analysis are shown below in Table 5 with the evaluation criteria for both residential and commercial properties.

Table 5 - Summary of the metal analytical results (units in mg/kg).

Sample ID	BH1-1	BH1-2	BH1-3	CCME Canadian Soil Quality Guidelines	
Depth (m)	3.05-3.66	5.49-6.10	8.53-9.14	Residential (mg/kg)	Commercial (mg/kg)
Aluminum	4980	4810	4780	NRL*	NRL
Antimony	0.2	< 0.1	< 0.1	20	40
Arsenic	4	4	3	12	12
Barium	37	8	11	500	2000
Beryllium	0.3	0.3	0.3	4	8
Boron	< 1	8	2	NRL	NRL
Cadmium	0.08	0.32	0.13	10	22
Chromium	9	11	9	64	87
Cobalt	4.4	3.6	3.7	50	300
Copper	8	7	6	63	91
Iron	10600	11100	11400	NRL	NRL
Lead	23.3	2.8	5.6	140	260
Lithium	13.6	14.6	14.3	NRL	NRL
Manganese	247	155	192	NRL	NRL
Mercury	0.10	0.01	< 0.01	6.6	24
Molybdenum	0.4	1.6	1.6	10	40
Nickel	10	10	10	50	50
Selenium	< 1	< 1	< 1	1	2.9
Silver	< 0.1	< 0.1	< 0.1	20	40
Strontium	4	17	10	NRL	NRL
Thallium	< 0.1	< 0.1	< 0.1	1	1
Tin	< 1	< 1	< 1	50	300
Uranium	0.3	0.8	0.7	23	33
Vanadium	9	9	9	130	130
Zinc	41	19	20	200	360

*NRL - No Recommended Level

5.0 RECOMMENDATIONS

5.1 GENERAL

It is our understanding that the proposed pedestrian bridge structure will consist of a single span, steel pony truss with a concrete deck flanked by two steel hollow structural steel (HSS) trusses on either side linked together by floorbeams under the deck. The foundation for the bridge will consist of pile-supported concrete abutments with integrated wingwalls to retain approach fills. The following recommendations have been developed for the foundation design and earthworks for the proposed pedestrian bridge structure in Montague, PE.

5.2 STEEL H-PILE FOUNDATION

For a bridge structure constructed on pile caps connected to Steel H Piles, piles should be driven into Bedrock until recommended driving criteria has been reached, as outlined below. This would result in piles with 342 – 1125 kN allowable bearing capacity depending on pile size and required factor of safety. Steel H Piles will be capable of providing 110 – 170 kN uplift resistance, depending on size, based on a factor of safety of 3.0. Table 6 provides a summary of allowable pile bearing and uplift capacities for various sized Steel H Piles. Due to the presence of compressible Fill deposits, negative skin friction may act on the pile foundation system. This negative skin friction has been accounted for in the pile bearing capacities provided based on the current bridge construction. All loading associated with additional fill materials placed during bridge construction (i.e., additional fill used to raise road grade or re-shape abutments) has been considered in the pile capacity.

The recommended driving criteria for Steel H Piles should be 10 blows for 25 mm of penetration with a hammer capable of delivering 415 – 625 N-m/cm^2. Twenty-four (24) hours after driving the piles, they should be re-tapped until the same criteria has been achieved or confirmed. Factor of Safety for this foundation system shall be 3.0 without pile load or Dynamic Pile Analysis (PDA) testing and may be reduced to 2.0 if deep foundations are tested using either pile load or PDA testing. Steel piles should be protected from corrosion using some form of passive or active cathodic protection system.

Strict inspection of the foundation work is required by the National Building Code on a continuous basis. Detailed requirements for such inspection are outlined in the Canadian Foundation Engineering Manuel (2006). In the case of a pile foundation, the inspection program should be based largely on the driving records.

Table 6 - Allowable Pile Bearing Capacities

FUNDY Engineering — Pedestrian Bridge - Montague, Prince Edward Island — 4/2/2020

PILE TYPE	GRADE OF STEEL MPa	SECTION AREA m^2	PILE CAPACITY KN	TIP AREA m^2	SURFACE AREA m^2 / m	NEGATIVE FRICTION KN	ULTIMATE CAPACITY KN	ALLOWABLE CAPACITY KN	ALLOWABLE CAPACITY KN	ALLOWABLE UPLIFT CAPICITY KN
H Pile Size										
HP 200 x 54	300	0.0068	2040	0.040	0.80	83	1110	513	342	110
HP 250 x 85	300	0.0108	3240	0.063	1.00	104	1693	794	529	137
HP 310 x 132	300	0.0159	4770	0.090	1.24	129	2378	1125	750	170
							Factor of Safety	2.0	3.0	3.0

NOTES:
Recommended refusal for steel piles is 10 blows / 25 mm with a Min. 415 N-m/sq.cm & Max. 625 N-m/sq.cm.
Factor of Safety = 2 based on confirmation by Dynamic Pile Analysis or Pile Load Test
Factor of Safety = 3 without Dynamic Pile Analysis
Pile dimensions obtained from LB Foster Piling product specifications
Pile end bearing capacities determined based on work completed in Rhenman & Broms (1971)
Pile skin friction bearing capacities determined using metodology outlined in Craig's Soil Mechanics Seventh Edition
H Pile capacity is limited by soil & bedrock strength

5.3 BACKFILLING ABUTMENTS/WINGWALLS

Once the abutments and wingwalls have been installed on the pile caps, the structure should be backfilled with Structural Fill consisting of an approved material which is free from Organics and deleterious materials. Fill material meeting the current PEIDTIE specifications for Select Borrow would be acceptable as backfill material.

Filter fabric or an alternative means of filtration should be used in all areas where drainage gravel transitions to surrounding soils to prevent the migration of fines into the void space of the drainage gravel.

All Structural Fill placed as backfill is to be compacted in lifts to 98% of its Standard Proctor Density at optimum moisture content to an elevation that will enable roadway construction as prescribed below. During the backfilling of the replacement structure, both sides of the structure should be backfilled in subsequent lifts, as opposed to backfilling the structure one side at a time. The lift thickness must be compatible with the compaction equipment used. A maximum lift thickness of 0.3 m is recommended for Structural Fill material placed as backfill.

It is recommended that the placement of Structural Fills be monitored by a geotechnical engineer.

All backfilled areas should be protected from scour with rip rap.

5.4 SEDIMENT CONTROL

Sediment control is recommended around the area where excavations and construction activities are to occur to prevent fine soil particles from exiting the project area, as this may have a negative impact on the surrounding aquatic habitat.

5.5 SEISMIC SITE CLASSIFICATION

Based on Table 4.1.8.4.A Site Classification for Seismic Site Response in the 2015 edition of the National Building Code of Canada (NBC) and a review of the soil and bedrock information, the Site Classification for the project area is "D".

6.0 CONCLUSIONS AND CLOSING REMARKS

The purpose of this geotechnical investigation was to determine the properties of the soils and bedrock within the project area and to provide geotechnical design parameters to facilitate the foundation design for the proposed pedestrian bridge located in Montague, PE. The geotechnical investigation consisted of one (1) test pit and two (2) boreholes placed in the proximity of the abutment locations for the proposed structure. It is our understanding that the proposed pedestrian bridge structure will consist of a single span, steel pony truss with a concrete deck flanked by two steel hollow structural steel (HSS) trusses on either side linked together by floorbeams under the deck. The foundation for the bridge will consist of pile-supported concrete abutments with integrated wingwalls to retain approach fills.

For a bridge structure constructed on pile caps connected to Steel H Piles, piles should be driven into Bedrock until recommended driving criteria has been reached, as outlined below. This would result in piles with 342 – 1125 kN allowable bearing capacity depending on pile size and required factor of safety.

The chemical soil analyses discovered that one of the samples which were submitted for petroleum hydrocarbon analysis, and two samples which were submitted for polycyclic aromatic hydrocarbon analysis contained concentrations above allowable guidelines for a residential land use. **As such, special precautions should be made if excavated soils are required to be disposed of off-site. Any materials which contain elevated concentrations of petroleum hydrocarbons are required to be properly disposed of at a licensed soil handling facility**.

We trust this is sufficient for your present needs, please feel free to contact the undersigned for any additional information or clarification that may be required. This report has been prepared by Patrick MacDonald, *EIT,* and reviewed by Alex Mouland, *P.Eng., PMP*.

Sincerely,
Fundy Engineering & Consulting Ltd.

Mr. Alex Mouland, *P.Eng., PMP*
Director – Civil / Geotechnical Engineering
Fundy Engineering &Consulting Ltd.

APPENDIX I

SYMBOLS AND TERMS

FUNDY ENGINEERING SYMBOLS AND TERMS
Borehole, Test Pit, and Monitoring Well Logs

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 oxidization 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 of 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 sizes present:

Trace, or occasional..............................less than 10%
Some...10-20%
Adjective (e.g. silty or sandy)..................20-35%
And (e.g. silt or 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 (64kg) hammer falling 30 inches (50.8mm) O.D. split spoon sampler one foot (305mm) 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

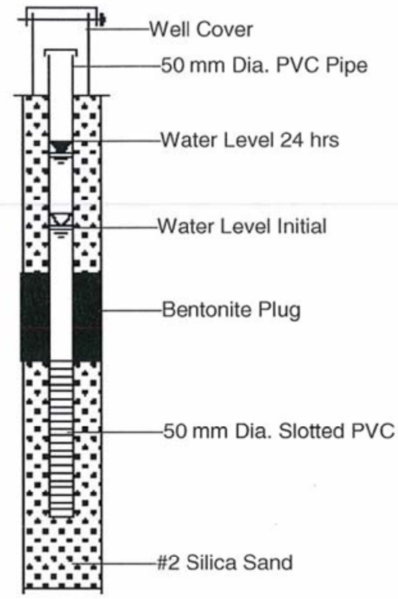
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer test, unconfined compression tests, or occasionally by standard penetration tests.

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

SOILS GRAPHIC LEGEND

Clay	Asphalt
Silt	Topsoil & Root Mat
Sand	Till
Gravel	Peat & Organic Silts
Boulders & Cobbles	Fill

MONITORING WELL SCHEMATIC



BEDROCK GRAPHIC LEGEND

Sandstone	Shale
Limestone	Granite/Igneous
Mudstone	Metamorphic

SAMPLER SYMBOLS

- Standard Penetration Test / Split Spoon
- Rock Core
- Auger / Grab

LABORATORY TESTS

MC	Moisture Content	P	Field Permeability	CD	Consolidation Drained Triaxial
SG	Specific Gravity	PF	Permeability Falling Head	CU	Consolidation Undrained Triaxial
HA	Hydrometer Analysis	PC	Permeability Constant Head	UU	Unconsolidated Undrained Triaxial
SA	Sieve Analysis	PR	Proctor	DS	Direct Shear

BEDROCK DESCRIPTION

The description of bedrock is based on the rock quality designation (RQD).

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100mm long are expressed as a percentage of total recovery. The small pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. In most cases RQD is measured on NXL core.

RQD	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

APPENDIX II

BOREHOLE & TEST PIT LOGS

FUNDY Engineering

BOREHOLE LOG No. BH-1

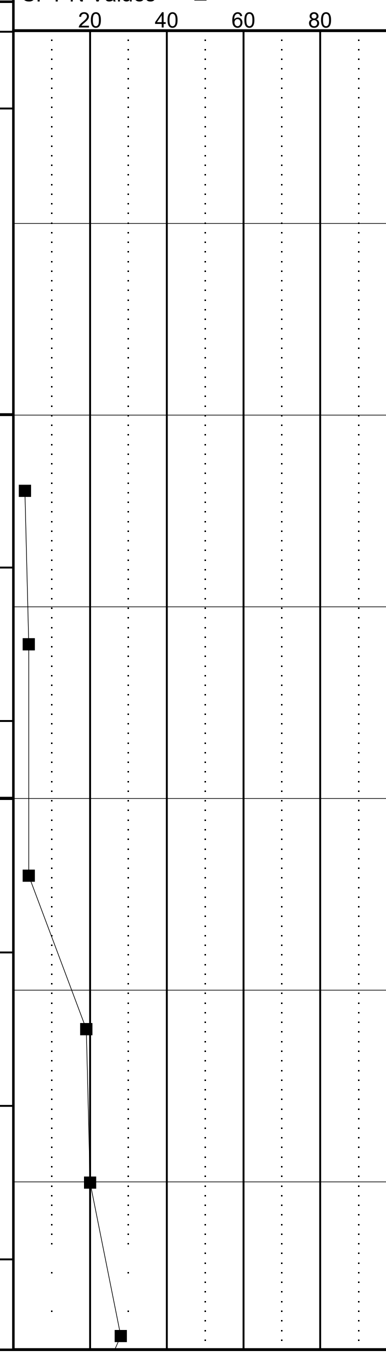
PROJECT: Montague Pedestrian Bridge **PROJECT NO.:** 14348
CLIENT: Town of Three Rivers
PROJECT LOCATION: Three Rivers, PE **ELEVATION:**
DRILLING CONTRACTOR: Lantech Drilling Services
LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland
DRILLING METHOD: Track-mounted CME 75 Auger Drill **DATE:** March 19, 2020
DEPTH TO - WATER> INITIAL: ∇ 4.57 m **AFTER 24 HOURS:** N/A **CAVING>**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (meters)	Depth (feet)	Description	Graphic	Sample Type	Sample No.	Sample Rec. (cm)	Blow Counts (N value)	RQD (%)	Undrained Shear Strength (kPa)	% < #200
0	0	Loose Reddish Brown Silty Sand TOPSOIL and Rootmat			1					
0.5 – 1.5	2 – 4	Loose Reddish Brown to Brown Silty Sand Gravel FILL with Cobbles and Boulders								
1.5 – 2	6	Very Loose Reddish Brown to Brown Silty Sand and Gravel FILL			2	14	2-2-1-3 (3)			
2.5	8				3	13	3-2-2-2 (4)			
3					4					
3 – 3.5	10	Very Loose Reddish Brown to Brown Silty Sand and Gravel FILL			5	53	1-2-2-2 (4)			
4	12	Compact Reddish Brown to Brown Silty Sand and Gravel FILL with Wood Debris			6	43	7-9-10-9 (19)			
4.5	14	Compact Reddish Brown to Brown Silty Sand and Gravel FILL			7	22	6-9-11-9 (20)			
5	16	Compact Reddish Brown to Grey Silty Sand and Gravel TILL			8	39	8-21-7-5			

TEST RESULTS SUMMARY

Bedrock Core Recovery (%) ◇
RQD (%) ▲
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
SPT N Values - ■



Supervisor - Patrick MacDonald

FUNDY Engineering

BOREHOLE LOG No. BH-1

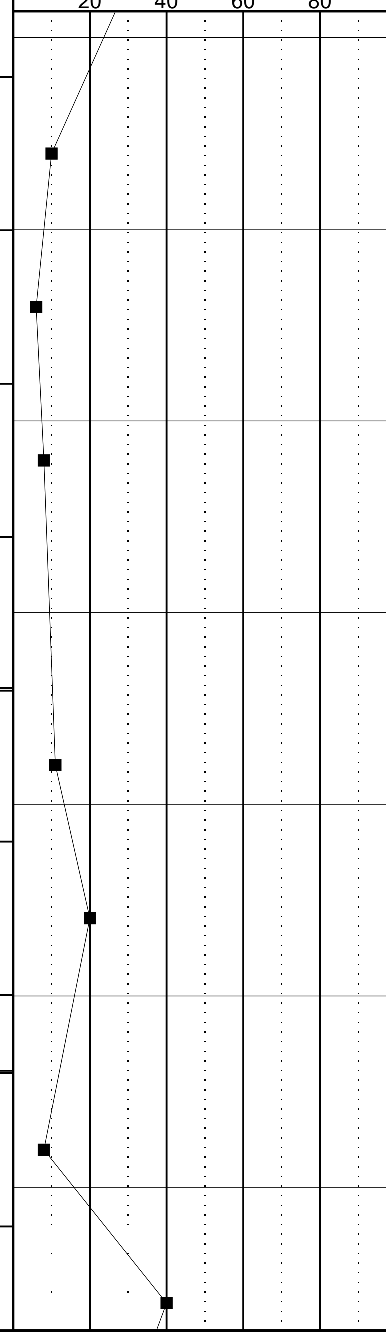
PROJECT: Montague Pedestrian Bridge **PROJECT NO.:** 14348
CLIENT: Town of Three Rivers
PROJECT LOCATION: Three Rivers, PE **ELEVATION:**
DRILLING CONTRACTOR: Lantech Drilling Services
LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland
DRILLING METHOD: Track-mounted CME 75 Auger Drill **DATE:** March 19, 2020
DEPTH TO - WATER> INITIAL: 4.57 m **AFTER 24 HOURS:** N/A **CAVING>**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (meters)	Depth (feet)	Description	Graphic	Sample Type	Sample No.	Sample Rec. (cm)	Blow Counts (N value)	RQD (%)	Undrained Shear Strength (kPa)	% < #200
							(28)			
5.5	18	Loose to Compact Reddish Brown to Brown to Grey Silty Sand and Gravel TILL			9	61	4-4-6-5 (10)			
6	20	Very Loose Reddish Brown Silty Sand and Gravel TILL with Fractured Grey Shell Fragments			10	61	2-4-2-3 (6)			
6.5–7	22	Loose Reddish Brown to Grey Silty Sand and Gravel TILL			11	61	5-5-3-5 (8)			
7.5	24				12					
8	26	Loose to Compact Reddish Brown to Grey Silty Sand and Gravel TILL with Trace Wood Debris			13	61	3-6-5-3 (11)			
8.5–9	28	Compact Reddish Brown to Grey Silty Sand and Gravel TILL			14	50	9-10-10-7 (20)			
	30				15					
9.5	32	Pen Cone used to locate Bedrock from this depth downward. Blow counts were based on 150 mm increments.			16		2-2-6-11 (8)			
10	34				17		18-17-23-35 (40)			

TEST RESULTS SUMMARY

Bedrock Core Recovery (%)
RQD (%)
Plastic Limit — Liquid Limit
Water Content -
SPT N Values -



Supervisor - Patrick MacDonald

FUNDY Engineering

BOREHOLE LOG No. BH-1

PROJECT: Montague Pedestrian Bridge **PROJECT NO.:** 14348

CLIENT: Town of Three Rivers

PROJECT LOCATION: Three Rivers, PE **ELEVATION:**

DRILLING CONTRACTOR: Lantech Drilling Services

LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland

DRILLING METHOD: Track-mounted CME 75 Auger Drill **DATE:** March 19, 2020

DEPTH TO - WATER> INITIAL: 4.57 m **AFTER 24 HOURS:** N/A **CAVING>**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (meters)	Depth (feet)	Description	Graphic	Sample Type	Sample No.	Sample Rec. (cm)	Blow Counts (N value)	RQD (%)	Undrained Shear Strength (kPa)	% < #200
10.5										
11	36	Depth to refusal Inferred BEDROCK			18		21-15-12-75 (27)			
		Boring terminated at 11.13 m.								

TEST RESULTS SUMMARY

Bedrock Core Recovery (%)

RQD (%)

Plastic Limit — Liquid Limit

Water Content -

SPT N Values -

20 40 60 80

Supervisor - Patrick MacDonald

FUNDY Engineering

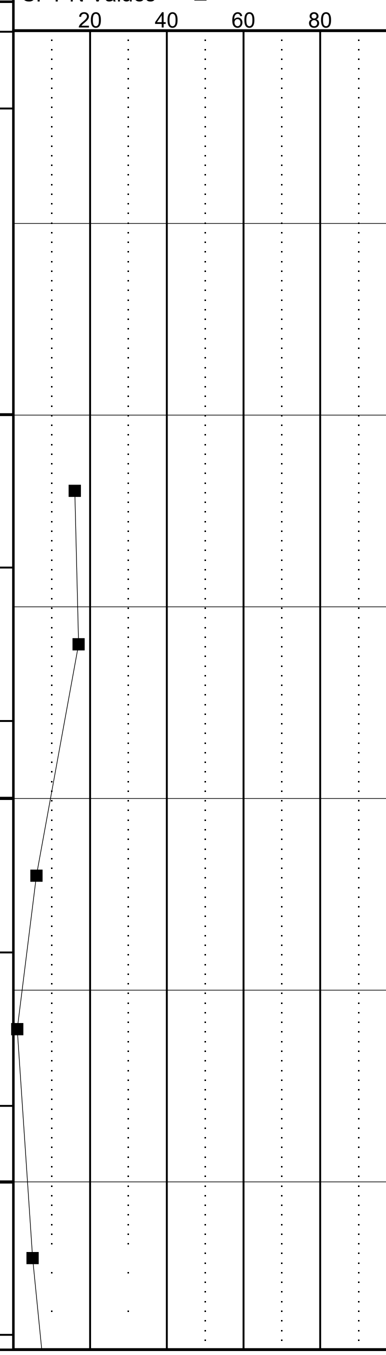
BOREHOLE LOG No. BH-2

PROJECT: Montague Pedestrian Bridge **PROJECT NO.:** 14348
CLIENT: Town of Three Rivers
PROJECT LOCATION: Three Rivers, PE **ELEVATION:**
DRILLING CONTRACTOR: Lantech Drilling Services
LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland
DRILLING METHOD: Track-mounted CME 75 Auger Drill **DATE:** March 19, 2020
DEPTH TO - WATER> INITIAL: 5.49 m **AFTER 24 HOURS:** N/A **CAVING>**

Depth (meters)	Depth (feet)	Description	Graphic	Sample Type	Sample No.	Sample Rec. (cm)	Blow Counts (N value)	RQD (%)	Undrained Shear Strength (kPa)	% < #200
0 – 0.3	0 – 1	Loose Reddish Brown Silty Sand TOPSOIL and Rootmat			1					
0.3 – 1.5	1 – 5	Loose Reddish Brown to Brown Silty Sand Gravel FILL with Cobbles and Boulders								
1.5 – 3.05	5 – 10	Compact Reddish Brown to Brown to Black Silty Sand and Gravel FILL			2	41	4-8-8-6 (16)			
					3	61	4-8-9-11 (17)			
					4					
3.05 – 3.66	10 – 12	Loose Reddish Brown to Black Silty Sand and Gravel FILL			5	23	5-3-3-1 (6)			
3.66 – 4.57	12 – 15	Very Loose Brown to Black Silty Sand and Gravel FILL			6	19	0-1-0-4 (1)			
					7					
4.57 –	15 –	Very Loose Brown to Black Silty Sand and Gravel FILL with Wood Debris			8	20	1-3-2-3 (5)			

TEST RESULTS SUMMARY

Bedrock Core Recovery (%)
RQD (%)
Plastic Limit — Liquid Limit
Water Content -
SPT N Values -



This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Supervisor - Patrick MacDonald

FUNDY Engineering

BOREHOLE LOG No. BH-2

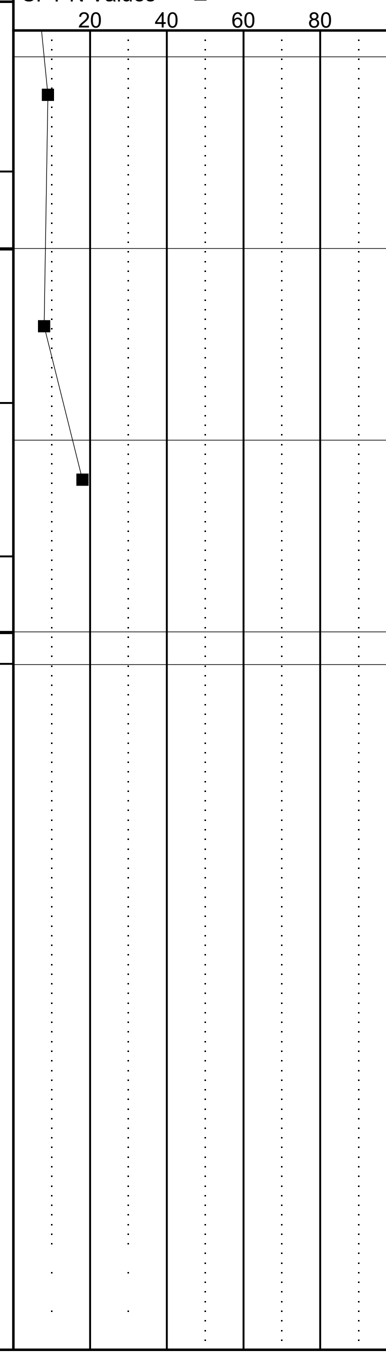
PROJECT: Montague Pedestrian Bridge **PROJECT NO.:** 14348
CLIENT: Town of Three Rivers
PROJECT LOCATION: Three Rivers, PE **ELEVATION:**
DRILLING CONTRACTOR: Lantech Drilling Services
LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland
DRILLING METHOD: Track-mounted CME 75 Auger Drill **DATE:** March 19, 2020
DEPTH TO - WATER> INITIAL: 5.49 m **AFTER 24 HOURS:** N/A **CAVING>**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (meters)	Depth (feet)	Description	Graphic	Sample Type	Sample No.	Sample Rec. (cm)	Blow Counts (N value)	RQD (%)	Undrained Shear Strength (kPa)	% < #200
5.5	18				9	0	4-5-4-5 (9)			
6	20				10					
6.5		Loose Reddish Brown to Brownish Grey Silty Sand and Gravel TILL			11	53	3-4-4-4 (8)			
7	22	Compact Reddish Brown to Black Silty Sand and Gravel TILL			12	40	3-5-13-19 (18)			
7.5	24				13					
		Dense to Very Dense Reddish Brown Silty Sand and Gravel TILL			14	12.7	50/5"			
		Depth to Refusal Inferred BEDROCK								
		Boring terminated at 7.75 m.								

TEST RESULTS SUMMARY

Bedrock Core Recovery (%)
RQD (%)
Plastic Limit Liquid Limit
Water Content -
SPT N Values -



Supervisor - Patrick MacDonald

FUNDY Engineering

TESTPIT LOG
No. TP-1

PROJECT: Montague Pedestrian Bridge
CLIENT: Town of Three Rivers
PROJECT LOCATION: Three Rivers, PE **ELEVATION (m):**
CONTRACTOR: Kings County Construction **PROJECT #** 14348
LOGGED BY: R.Wakelin **CHECKED BY:** A.Mouland
EQUIPMENT: Rubber Tire Backhoe **DATE:** March 19, 2020
DEPTH TO WATER (m): INITIAL: 1.22 m **24 hrs.** N/A

Depth (meters)	Depth (feet)	Description	Elevation (m)	Groundwater	Graphic	Sample Type	Sample No.	Lab Tests	% < #200	Notes
0	0	Loose Reddish Brown TOPSOIL and Rootmat					1			
0.5	1.67	Loose Reddish Brown to Brown Silty Sand Gravel FILL					2			
1	3.33									
		Loose Wet Gravel FILL		▽			3			Trapped water infiltration observed
1.5	5	Loose to Compact Reddish Brown to Brown Silty Sand Gravel FILL with Cobbles and Boulders					4			
2	6.67									
2.5	8.33									
		Test pit terminated at 2.90 m.								Test pit terminated due to signs of potential caving caused by water infiltration.

APPENDIX III

LABORATORY CERTIFICATES

Report ID: 348744-OAS
Report Date: 30-Mar-20
Date Received: 24-Mar-20

CERTIFICATE OF ANALYSIS

for
Fundy Engineering
945AA Upper Meadowbank Road
Clyde River, PE C0A 1H1

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Patrick MacDonald
Project #: 14348
Location: Montague PE

Hydrocarbon Analysis in Soil (Atlantic MUST)

RPC Sample ID:			348744-1	348744-2	348744-3
Client Sample ID:			14348 BH-1 10-12'	14348 BH-1 18-20'	14348 BH-1 28-30'
Date Sampled:			19-Mar-20	19-Mar-20	19-Mar-20
Matrix:			soil	soil	soil
Analytes	Units	RL			
Benzene	mg/kg	0.005	0.03	0.006	< 0.005
Toluene	mg/kg	0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg	0.01	0.42	< 0.01	< 0.01
Xylenes	mg/kg	0.05	5.8	< 0.05	0.05
VPH C6-C10 (Less BTEX)	mg/kg	2.5	650	< 2.5	7.1
EPH >C10-C16	mg/kg	12	1400	17	18
EPH >C16-C21	mg/kg	12	100	25	< 12
EPH >C21-C32	mg/kg	12	21	52	33
EPH (>C16-C32)	mg/kg	12	120	77	33
Modified TPH Tier 1	mg/kg	21	2200	94	58
VPH Surrogate (IBB)	%		comment	106	comment
EPH Surrogate (IBB)	%		comment	98	98
EPH Surrogate (C32)	%		100	96	94
Resemblance			FO	FO.PAH.NRLR	FO.NRLR
Return to Baseline at C32			Yes	No	No
Moisture Content	%		17	33	26

This report relates only to the sample(s) and information provided to the laboratory.
RL = Reporting Limit; Soil results are expressed on a dry weight basis.

Bruce Phillips
Department Head
Organic Analytical Services

Angela Colford
Lab Supervisor
Organic Analytical Services

Report ID: 348744-OAS
Report Date: 30-Mar-20
Date Received: 24-Mar-20

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Fax: 506.452.0594
www.rpc.ca

Attention: Patrick MacDonald
Project #: 14348
Location: Montague PE

PAH in Soil

RPC Sample ID:			348744-1	348744-2	348744-3	348744-3 Dup
Client Sample ID:			14348 BH-1 10-12'	14348 BH-1 18-20'	14348 BH-1 28-30'	14348 BH-1 28-30'
Date Sampled:			19-Mar-20	19-Mar-20	19-Mar-20	19-Mar-20
Matrix:			soil	soil	soil	soil
Analytes	Units	RL				
Naphthalene	mg/kg	0.01	2.2	0.06	0.03	0.06
2-Methylnaphthalene	mg/kg	0.01	5.2	0.11	0.07	0.12
1-Methylnaphthalene	mg/kg	0.01	5.7	0.12	0.07	0.15
Acenaphthylene	mg/kg	0.01	0.08	< 0.01	< 0.01	< 0.01
Acenaphthene	mg/kg	0.01	0.07	0.03	< 0.01	< 0.01
Fluorene	mg/kg	0.01	0.17	0.03	0.01	0.01
Phenanthrene	mg/kg	0.01	0.16	0.10	0.09	0.05
Anthracene	mg/kg	0.01	0.02	0.05	0.04	0.02
Fluoranthene	mg/kg	0.01	0.06	0.09	0.12	0.05
Pyrene	mg/kg	0.01	0.06	0.10	0.12	0.05
Benz(a)anthracene	mg/kg	0.01	0.03	0.04	0.10	0.04
Chrysene/Triphenylene	mg/kg	0.01	0.03	0.03	0.07	0.03
Benzo(b+j)fluoranthene	mg/kg	0.01	0.04	0.03	0.07	0.03
Benzo(k)fluoranthene	mg/kg	0.01	0.02	0.01	0.03	0.01
Benzo(e)pyrene	mg/kg	0.01	0.03	0.02	0.05	0.02
Benzo(a)pyrene	mg/kg	0.01	0.03	0.03	0.07	0.03
Perylene	mg/kg	0.01	< 0.02	0.80	0.52	0.46
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	0.02	0.01	0.03	0.01
Benzo(g,h,i)perylene	mg/kg	0.01	0.02	0.01	0.03	0.01
Dibenz(a,h)anthracene	mg/kg	0.01	< 0.02	< 0.01	< 0.01	< 0.01

This report relates only to the sample(s) and information provided to the laboratory.
RL = Reporting Limit; Soil results are expressed on a dry weight basis.

Bruce Phillips
Bruce Phillips
Department Head
Organic Analytical Services

Angela Colford
Angela Colford
Lab Supervisor
Organic Analytical Services

Report ID:	348744-OAS
Report Date:	30-Mar-20
Date Received:	24-Mar-20

CERTIFICATE OF ANALYSIS

for
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945AA Upper Meadowbank Road
Clyde River, PE C0A 1H1

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Patrick MacDonald

Project #: 14348

Location: Montague PE

PAH in Soil

RPC Sample ID:			348744-1	348744-2	348744-3	348744-3 Dup
Client Sample ID:			14348 BH-1 10-12'	14348 BH-1 18-20'	14348 BH-1 28-30'	14348 BH-1 28-30'
Date Sampled:			19-Mar-20	19-Mar-20	19-Mar-20	19-Mar-20
Matrix:			soil	soil	soil	soil
Analytes	Units	RL				
2-fluorobiphenyl (surrogate)	%		103	107	106	103
p-terphenyl-d14 (surrogate)	%		101	108	108	85
Moisture Content	%		17	33	26	26

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Fax: 506.452.0594
www.rpc.ca

Method Summary

OAS-HC03:The Determination of Petroleum Hydrocarbons (Atlantic MUST) in Soil (VPH)
OAS-HC03: Determination of Petroleum Hydrocarbons (Atlantic MUST) in Soil (EPH)
OAS-HC06:The Determination of Polynuclear Aromatic Hydrocarbons in Soil

Resemblance Legend

Resemblance Code	Resemblance	Resemblance Code	Resemblance
COMMENT	See General Report Comments	PAH	Possible PAHs Detected
FO	Fuel Oil Fraction	PG	Possible Gasoline Fraction
FO.LO	Fuel Oil and Lube Oil Fraction	PLO	Possible Lube Oil Fraction
G	Gasoline Fraction	PWFO	Possible Weathered Fuel Oil Fraction
LO	Lube Oil Fraction	PWG	Possible Weathered Gasoline Fraction
ND	Not Detected	TO	Tranformer Oil
NR	No Resemblance (not-petrogenic in origin)	UP	Unknown Peaks
NRLR	No Resemblance in the lube oil range (>C21-C32).	WFO	Weathered Fuel Oil Fraction
OP	One Product (unidentified)	WG	Weathered Gasoline Fraction

General Report Comments

VPH / EPH surrogate(s) unavailable due to product interference/sample dilution.
348744-1 - Elevated VPH and PAH RL's due to sample matrix/sample dilution.
348744-3 - PAH duplicate result outside acceptance limit likely due to sample matrix.
Return to Baseline: Samples are considered to have returned to baseline if the area from C32-C36 is less than 10% of the area from C10-C32.

Report ID: 348744-OAS
Report Date: 30-Mar-20
Date Received: 24-Mar-20

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Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Project #: 14348
Location: Montague PE
QA/QC Report

RPC Sample ID:			BLANKC7540	BLANKC7541	SPIKEC7540	SPIKEC7541
Type:			VPH	EPH	VPH	EPH
Matrix:			soil	soil	soil	soil
Analytes	Units	RL			% Recovery	% Recovery
Benzene	mg/kg	0.005	< 0.005	-	116%	-
Toluene	mg/kg	0.05	< 0.05	-	119%	-
Ethylbenzene	mg/kg	0.01	< 0.01	-	129%	-
Xylenes	mg/kg	0.05	< 0.05	-	123%	-
VPH C6-C10 (Less BTEX)	mg/kg	2.5	< 2.5	-	111%	-
EPH >C10-C16	mg/kg	12	-	< 12	-	-
EPH >C16-C21	mg/kg	12	-	< 12	-	-
EPH >C21-C32	mg/kg	12	-	< 12	-	-
EPH >C10-C32	mg/kg	21	-	-	-	101%

RL = Reporting Limit

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Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Project #: 14348
Location: Montague PE
QA/QC Report

RPC Sample ID:			BLANKC7557	SPIKEC7557
Matrix:			soil	soil
Analytes	Units	RL		% Recovery
Naphthalene	mg/kg	0.01	< 0.01	96%
Acenaphthylene	mg/kg	0.01	< 0.01	89%
Acenaphthene	mg/kg	0.01	< 0.01	90%
Fluorene	mg/kg	0.01	< 0.01	93%
Phenanthrene	mg/kg	0.01	< 0.01	99%
Anthracene	mg/kg	0.01	< 0.01	98%
Fluoranthene	mg/kg	0.01	< 0.01	79%
Pyrene	mg/kg	0.01	< 0.01	80%
Benz(a)anthracene	mg/kg	0.01	< 0.01	89%
Chrysene/Triphenylene	mg/kg	0.01	< 0.01	91%
Benzo(b+j)fluoranthene	mg/kg	0.01	< 0.01	87%
Benzo(k)fluoranthene	mg/kg	0.01	< 0.01	90%
Benzo(e)pyrene	mg/kg	0.01	< 0.01	84%
Benzo(a)pyrene	mg/kg	0.01	< 0.01	84%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	< 0.01	83%
Benzo(g,h,i)perylene	mg/kg	0.01	< 0.01	85%
Dibenz(a,h)anthracene	mg/kg	0.01	< 0.01	84%

RL = Reporting Limit

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Project #: 14348

Summary of Date Analyzed

	VPH		EPH		PAH	
RPC Sample ID	**Extracted**	**Analyzed**	**Extracted**	**Analyzed**	**Extracted**	**Analyzed**
348744-1	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	27-Mar-20
348744-2	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	27-Mar-20
348744-3	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	25-Mar-20	27-Mar-20
348744-3 Dup	-	-	-	-	25-Mar-20	27-Mar-20

Report ID: 348744-IAS
Report Date: 31-Mar-20
Date Received: 24-Mar-20

CERTIFICATE OF ANALYSIS

for
Fundy Engineering
945AA Upper Meadowbank Road
Clyde River, PE C0A 1H1

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Patrick MacDonald
Project #: 14348
Location: Montague PE

Analysis of Metals in Soil

RPC Sample ID:			348744-1	348744-1 Dup	348744-2
Client Sample ID:			14348 BH-1 10-12'	Lab Duplicate	14348 BH-1 18-20'
Date Sampled:			19-Mar-20	19-Mar-20	19-Mar-20
Analytes	**Units**	**RL**			
Aluminum	mg/kg	1	4980	4830	4810
Antimony	mg/kg	0.1	0.2	0.1	< 0.1
Arsenic	mg/kg	1	4	4	4
Barium	mg/kg	1	37	34	8
Beryllium	mg/kg	0.1	0.3	0.3	0.3
Bismuth	mg/kg	1	< 1	< 1	< 1
Boron	mg/kg	1	< 1	< 1	8
Cadmium	mg/kg	0.01	0.08	0.07	0.32
Calcium	mg/kg	50	1360	1540	2520
Chromium	mg/kg	1	9	9	11
Cobalt	mg/kg	0.1	4.4	4.3	3.6
Copper	mg/kg	1	8	8	7
Iron	mg/kg	20	10600	10300	11100
Lead	mg/kg	0.1	23.3	21.6	2.8
Lithium	mg/kg	0.1	13.6	13.0	14.6
Magnesium	mg/kg	10	2290	2240	2930
Manganese	mg/kg	1	247	231	155
Mercury	mg/kg	0.01	0.10	0.09	0.01
Molybdenum	mg/kg	0.1	0.4	0.3	1.6
Nickel	mg/kg	1	10	9	10
Potassium	mg/kg	20	780	760	990
Rubidium	mg/kg	0.1	5.4	5.2	5.5
Selenium	mg/kg	1	< 1	< 1	< 1
Silver	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Sodium	mg/kg	50	70	70	350
Strontium	mg/kg	1	4	4	17
Tellurium	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Thallium	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Tin	mg/kg	1	< 1	< 1	< 1
Uranium	mg/kg	0.1	0.3	0.3	0.8
Vanadium	mg/kg	1	9	9	9
Zinc	mg/kg	1	41	39	19

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Ross Kean

Ross Kean
Department Head
Inorganic Analytical Chemistry

Peter Crowhurst
Analytical Chemist
Inorganic Analytical Chemistry

Report ID: 348744-IAS
Report Date: 31-Mar-20
Date Received: 24-Mar-20

CERTIFICATE OF ANALYSIS

for
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Patrick MacDonald
Project #: 14348
Location: Montague PE

Analysis of Metals in Soil

RPC Sample ID:			348744-3
Client Sample ID:			14348 BH-1 28-30'
Date Sampled:			19-Mar-20
Analytes	**Units**	**RL**	
Aluminum	mg/kg	1	4780
Antimony	mg/kg	0.1	< 0.1
Arsenic	mg/kg	1	3
Barium	mg/kg	1	11
Beryllium	mg/kg	0.1	0.3
Bismuth	mg/kg	1	< 1
Boron	mg/kg	1	2
Cadmium	mg/kg	0.01	0.13
Calcium	mg/kg	50	2700
Chromium	mg/kg	1	9
Cobalt	mg/kg	0.1	3.7
Copper	mg/kg	1	6
Iron	mg/kg	20	11400
Lead	mg/kg	0.1	5.6
Lithium	mg/kg	0.1	14.3
Magnesium	mg/kg	10	2760
Manganese	mg/kg	1	192
Mercury	mg/kg	0.01	< 0.01
Molybdenum	mg/kg	0.1	1.6
Nickel	mg/kg	1	10
Potassium	mg/kg	20	860
Rubidium	mg/kg	0.1	4.9
Selenium	mg/kg	1	< 1
Silver	mg/kg	0.1	< 0.1
Sodium	mg/kg	50	260
Strontium	mg/kg	1	10
Tellurium	mg/kg	0.1	< 0.1
Thallium	mg/kg	0.1	< 0.1
Tin	mg/kg	1	< 1
Uranium	mg/kg	0.1	0.7
Vanadium	mg/kg	1	9
Zinc	mg/kg	1	20

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General Report Comments

Samples were air dried and sieved at 2 mm. A portion of each was digested according to EPA Method 3050B.
The resulting solutions were analyzed for trace elements by ICP-MS.
Mercury was analyzed by Cold Vapour AAS (SOP 4.M52 & SOP 4.M53).

Report ID: 348744-IAS
Report Date: 31-Mar-20
Date Received: 24-Mar-20

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Project #: 14348
Location: Montague PE
QA/QC Report

RPC Sample ID:			CRM114938	RB066562
Type:			CRM NIST2709a	Blank
Analytes	**Units**	**RL**		
Aluminum	mg/kg	1	23900	1
Antimony	mg/kg	0.1	0.2	< 0.1
Arsenic	mg/kg	1	9	< 1
Barium	mg/kg	1	457	< 1
Beryllium	mg/kg	0.1	0.7	< 0.1
Bismuth	mg/kg	1	< 1	< 1
Boron	mg/kg	1	35	4
Cadmium	mg/kg	0.01	0.37	< 0.01
Calcium	mg/kg	50	14000	< 50
Chromium	mg/kg	1	72	< 1
Cobalt	mg/kg	0.1	11.6	< 0.1
Copper	mg/kg	1	30	< 1
Iron	mg/kg	20	29100	< 20
Lead	mg/kg	0.1	10.9	< 0.1
Lithium	mg/kg	0.1	36.0	< 0.1
Magnesium	mg/kg	10	12500	< 10
Manganese	mg/kg	1	478	< 1
Mercury	mg/kg	0.01	0.90	< 0.01
Molybdenum	mg/kg	0.1	0.9	< 0.1
Nickel	mg/kg	1	75	< 1
Potassium	mg/kg	20	3660	< 20
Rubidium	mg/kg	0.1	33.8	< 0.1
Selenium	mg/kg	1	< 1	< 1
Silver	mg/kg	0.1	0.2	< 0.1
Sodium	mg/kg	50	540	< 50
Strontium	mg/kg	1	107	< 1
Tellurium	mg/kg	0.1	< 0.1	< 0.1
Thallium	mg/kg	0.1	0.2	< 0.1
Tin	mg/kg	1	< 1	4
Uranium	mg/kg	0.1	1.7	< 0.1
Vanadium	mg/kg	1	65	< 1
Zinc	mg/kg	1	95	< 1

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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
EPA 3050B Digestion	4.M19	EPA 3050B	Nitric Acid/Hydrogen Peroxide Digestion
Trace Metals	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES
Mercury	4.M53	EPA 245.5	Cold Vapor AAS

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