Geotechnical Investigation Report

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
Fenelon Falls, Ontario

The Corporation of the City of Kawartha Lakes

GHD | 347 Pido Road Unit 29 Peterborough Ontario K9J 6X7 Canada

11139234| 01| Report No 1 | January 3, 2016

Table of Contents

Table Index

Enclosures

Appendix Index

1. Introduction

This report presents the results of a Geotechnical Investigation that was conducted for the proposed replacement of municipal services and road reconstruction of various roadway sections within the Village of Fenelon Falls, in the City of Kawartha Lakes, Ontario, Canada. GHD Limited (GHD) was retained by the Corporation of the City of Kawartha Lakes (the Client) to complete this geotechnical investigation. The work conducted for this investigation was carried out under the authorization of Mr. Taylor Burke, representing the Client, in accordance with our proposal No. PG- 3710, dated November 2, 2016.

It is GHD's understanding that the project shall consist of road reconstruction including replacement of watermain, sanitary sewer and storm sewer, for the following sections of roadway:

- Elliot Street from Lindsay Street to Juniper Street;
- Ellice St reet from Juniper Street to Wychwood Crescent;
- Murray Street from Elliot Street to West Street;
- West Street from Murray Street to Lindsay Street; and
- Green Street and Murray Street to Lindsay Street.

The Request for a Quotation (RFQ) RFQ 2016-ENGG 01, included a site plan illustrating the Client's requested borehole locations and directions regarding borehole depths and soils testing specifications.

2. Purpose and Scope

The purpose of this geotechnical investigation is to define the subsurface soil and groundwater conditions at the project site and to develop geotechnical engineering recommendations regarding earthwork construction, reuse of existing soils and backfill material, dewatering and drainage, service installation (including bedding and backfill), and pavement structure. In addition, excess soils handling options will be provided based on chemical laboratory results. The information contained herein must in no way be construed as an opinion of this site's environmental status.

The following scope of work was performed in order to accomplish the foregoing purposes:

1. Underground services were cleared prior to advancing the boreholes. The boreholes were located as shown on the Test Hole Location Plan (Figures 1 to 5). The Client provided a plan with the requested borehole locations; the boreholes were located and advanced in locations as close as possible to those requested locations taking into account the location of existing services.

2. The subsurface soils conditions were explored by advancing, sampling and logging a total of eleven (11) boreholes to depths at which practical refusal to further borehole advancement was encountered. The depth of practical refusal ranged from approximately 0.5 to 2.4 metres below existing grade (mbeg).

3. Traffic control was carried out in accordance with OTM Book 7 (January 2014).

4. The ground at the borehole locations was reinstated as close as possible to its original condition upon completion of the fieldwork.

5. Physical laboratory analysis of the encountered material was carried out including grain size analysis and moisture content tests.

6. As requested, three (3) soil samples were submitted for chemical laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons (PHCs, F1 to F4), Polychlorinated Biphenyls (PCBs), and a suite of metals and inorganics including electrical conductivity (EC) and sodium adsorption ratio (SAR).

7. Geotechnical engineering analysis of acquired field and laboratory data have been compiled in this report outlining our findings, conclusions, and geotechnical engineering recommendations.

3. Field and Laboratory Procedures

A field investigation was conducted under the supervision of GHD staff on December 9, 2016. The work consisted of subsurface exploration by means of advancing and sampling a total of eleven (11) exploratory boreholes to practical refusal, which occurred at depths ranging from about 0.5 to 2.4 mbeg. The location of each borehole is illustrated on the attached Test Hole Plans (Figures 1 to 5).

A detailed log of each borehole was maintained and representative samples of the materials encountered in the boreholes were collected. A detailed log of each borehole is presented in Appendix A.

The boreholes were advanced using a truck mounted drill rig equipped with continuous flight, 115mm diameter, solid stem power augers. Representative, disturbed samples of the strata penetrated were obtained directly from auger cuttings. Disturbed samples were also obtained using a split-barrel, 50 mm outer-diameter (OD) sampler advanced by a 63.5 kg hammer dropping approximately 760 mm. The results of these standard penetration tests (SPT's) are reported as "N" values on the borehole logs at the corresponding depths.

Soil samples obtained from the boreholes were inspected in the field immediately upon retrieval for type, texture, and colour. All test holes were backfilled following completion of the fieldwork,. All samples were sealed in clean plastic containers and transported to the GHD laboratory for further visual-tactile examination, and to select appropriate samples for laboratory analysis.

Groundwater measurements and observations were obtained from the open boreholes during drilling operations. Groundwater data is presented on individual borehole logs.

Physical laboratory testing was completed on soil samples, and consisted of moisture content tests on all samples recovered and gradation analyses on eight (8) representative soil samples (including three (3) hydrometers). The analytical results of the moisture content tests are plotted on the attached logs. The results of the gradation testing are incorporated into the borehole logs, and are presented graphically in Appendix B.

Three (3) soil samples obtained from boreholes specified by the Client were submitted to Caduceon Environmental Laboratories (CEL) for chemical testing of O.Reg 153 parameters; BTEX, PHCs (F1 to F4 fractions), PCBs and a suite of metals and inorganics including EC, SAR. CEL's Certificates of Analysis for the testing are included in Appendix C.

4. Site Location and Surface Conditions

The subject area (Site) consists of five existing streets located within the Village of Fenelon Falls, City of Kawartha Lakes, Ontario. The investigated roadway sections are as follows:

- Elliot Street from Lindsay Street to Juniper Street;
- Ellice Street from Juniper Street to Wychwood Crescent;
- Murray Street from Elliot Street to West Street;
- West Street from Murray Street to Lindsay Street; and
- Green Street and Murray Street to Lindsay Street.

The site topography is generally flat to rolling, with elevation generally dropping to the south and east. Surrounding properties are a mixture of residential and commercial use properties.

5. Subsurface Conditions

5.1 General

Details of the subsurface conditions encountered at the Site are graphically presented on the borehole logs (Appendix A). It should be noted that the boundaries between the strata have been inferred from the borehole observations and non-continuous samples. They generally represent a transition from one soil type to another, and should not be inferred to represent an exact plane of geological change. Further, conditions may vary between and beyond the boreholes.

The boreholes generally encountered a surficial layer of asphalt over fill, over inferred bedrock. Groundwater was not encountered in the open boreholes during drilling operations. Practical refusal to borehole advancement was encountered in all the boreholes. The presence of bedrock was inferred at the depths of refusal, while zones of weathered bedrock were also inferred above such depths of refusal.

The following sections describe the soil and groundwater conditions encountered in more detail.

5.2 Asphalt

A surficial layer of asphalt was encountered in all boreholes. The asphalt thickness ranged from approximately 25 to 100 mm.

5.3 Fill

Layers of fill were observed immediately beneath the asphalt in nine (9) boreholes. The fill extended to depths ranging from approximately 0.4 and 2.0 mbeg. The fill generally consisted of brown sand and gravel, containing varying amount of silt, occasional cobbles, and was noted to exist in a compact occasionally loose, moist in-situ state.

Moisture content tests conducted on samples of the fill yielded values of approximately 3 to 12 % moisture by weight. Grain size distribution analysis conducted on representative samples of the fill suggest the following compositional ranges: 4 to 50 % gravel; 28 to 63 % sand; and 11 to 23 % silt and clay-sized particles. All samples of the fill tested did not meet Ontario Provincial Standard Specifications (OPSS) for Granular B Type I material due to an excess of fine grained soils. Three of the four samples tested do meet grain size distribution OPSS for Select Subgrade Material (SSM).

5.4 Bedrock (Inferred)

All eleven (11) of the boreholes encountered practical refusal to further borehole advancement during drilling operations. Details regarding these depths are provided on the borehole logs (Appendix A). Based on the overall drilling results, and a general knowledge of subsurface conditions in the vicinity of this project, the cause of the refusal was inferred to be the presence of bedrock. A layer of material that was inferred to be weathered/fractured bedrock overlying the more competent bedrock was encountered in five (5) boreholes.

The following table summarizes the depth of practical refusal (inferred bedrock) and inferred weathered bedrock in each borehole location.

Table 5.1 Depth to Practical Refusal (Inferred Bedrock) and Weathered Bedrock

Street Name	Borehole ID	Depth to Inferred Weathered Bedrock (mbeg)	Depth to Practical Refusal (Inferred Bedrock) (mbeg)
West Street	BH-1	NE	0.5
Murray Street	BH-2	NE	0.5
	BH-3	0.4	1.7
	BH-4	NE	1.2
	BH-6	0.4	1.2
Green Street	BH-5	0.1	2.3
Elliot Street	BH-7	0.1	1.1
	BH-8	NE	0.8
Ellice Street	BH-9	1.2	1.4
	BH-10	2.0	2.4
	BH-11	NE	0.7

Note:
mbeg – metres below exterior grade
NE – Weathered bedrock not inferred

Due to the general properties of bedrock material in this area, (including a zone of highly weathered/fractured bedrock near its surface), and the nature of drilling with penetrative augering equipment, definitive information regarding the exact depth of the bedrock surface is difficult to obtain from boreholes alone. It is possible that some of the material shown as being fill in the logs may be highly weathered/fractured/fragmented bedrock that was penetrated by the drilling prior to practical refusal occurring. Conversely, some of the material shown as weathered bedrock on the borehole logs may be a fill or a glacial till material containing higher levels of cobbles and/or fractured rock particles. Further exploration (i.e., test pitting and/or diamond coring) to confirm the bedrock presence and properties was not conducted as part of this investigation.

Moisture content tests conducted on augered samples of the inferred weathered bedrock yielded values ranging from approximately 2 to 8 % moisture by weight. Grain size distribution analyses conducted on augered samples of the inferred weathered bedrock material suggest the following compositional ranges: 31 to 63 % gravel; 26 to 60 % sand; and 8 to 18 % silt and clay-sized particles. Hydrometer analyses conducted on these samples suggests it contains 5 to 8 % particles between 5 and 75 ⇑m in size. It is noted that the augering action on this material may have caused a crushing action on some particles, thereby increasing the fine-grained particle content in the augered samples obtained.

5.5 Groundwater

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling each borehole. Groundwater seepage or accumulation was not encountered in any of the boreholes during drilling operations.

It must be noted that groundwater levels are transient and tend to fluctuate with the seasons, periods of precipitation, and temperature.

5.6 Chemical Analysis

Three (3) soil samples obtained from boreholes specified by the Client were submitted to CEL for chemical testing of O.Reg 153 parameters of BTEX, PHCs (F1 to F4), PCBs and a suite of metals and inorganics including EC, SAR. CEL's Certificates of Analysis for the testing are included in Appendix C.

The results of the chemical analyses are presented in Tables 5.1 and 5.2 below, and are compared to Ministry of the Environment and Climate Change (MOECC) Table 2 Full Depth Generic Site Condition Standards in a Potable Groundwater Condition, coarse textured soil ("Soil, Groundwater and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act", April 15, 2011), Residential / Parkland / Institutional (RPI) Property Use.

Table 5.2 Summary of BTEX, PHCs and PCBs

Parameter	Sample Identification			MOECC Table 2*
	BH-4, SS-1 Dec. 9, 2016	BH-7, SS-1 Dec. 9, 2016	BH-10, SS-1 Dec. 9, 2016	
PHC F1 (C6 to C10)	< 10	< 10	< 10	55
PHC F2 (C10 to C16)	6	15	< 5	98
PHC F3 (C16 to C34)	20	80	60	300
PHC F4 (C34 to C50)	40	20	30	2800
Benzene	< 0.02	< 0.02	< 0.02	0.21
Ethylbenzene	< 0.05	< 0.05	< 0.05	1.1
Toluene	< 0.2	< 0.2	< 0.2	2.3
m&p-Xylene	< 0.03	< 0.03	< 0.03	NS
o-Xylene	< 0.03	< 0.03	< 0.03	NS
Total Xylenes	< 0.03	< 0.03	< 0.03	26
Poly-Chlorinated Byphenyls (PCB's)	< 0.3	< 0.3	< 0.3	0.35

Notes: all values in ug/g, unless otherwise noted. (<) denotes less than laboratory detection limits

*Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition. Soil, Ground Water and Sediment Standards for Residential/Parkland/Institutional (RPI) Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011.

Table 5.3 Summary of Metals and Inorganics

Parameter	Sample Identification			MOECC Table 2*
	BH-4, SS-1 Dec. 9, 2016	BH-7, SS-1 Dec. 9, 2016	BH-10, SS-1 Dec. 9, 2016	
Antimony	< 0.4	< 0.4	< 0.4	7.5
Arsenic	< 0.5	0.9	1.6	18
Barium	29.4	19.5	23.6	390
Beryllium	0.15	0.20	0.14	4
Boron	4.6	7.1	4.4	120
Cadmium	< 0.03	0.03	< 0.03	1.2
Chromium	6.5	8.7	6.5	160
Cobalt	1.7	0.7	1.9	22
Copper	8.0	4.9	6.7	140
Lead	2.5	24.9	4.6	120
Mercury	< 0.005	0.007	< 0.005	0.27
Molybdenum	0.2	0.3	0.3	6.9
Nickel	3.9	4.4	3.6	100
Selenium	0.2	0.5	0.4	2.4
Silver	0.03	0.06	0.02	20
Thallium	0.05	0.07	0.06	1
Uranium	0.41	0.40	0.51	23
Vanadium	15.9	10.1	15.4	86
Zinc	< 30	< 30	< 30	340
pH @ 25°C	8.10	8.06	8.12	5-9(1)
Electrical Conductivity (2:1) (mS/cm)	**0.73**	0.54	0.42	0.7
Sodium Absorption Ratio (2:1) (no units)	3.92	3.17	2.24	5

Notes: all values in ug/g, unless otherwise noted. (<) denotes less than laboratory detection limits

*Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition. Soil, Ground Water and Sediment Standards for Residential/Parkland/Institutional (RPI) Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011.

Bold – Exceeds the Table 2 Provincial Standards

Sample BH-4, SS-1 exceeded EC parameter levelsi under Table 2 Provincial Site Condition Standards (SCS) for Agricultural (Ag), and Residential/Parkland/Institutional (RPI) land use but meets Table 2 SCS for Industrial/Commercial/Community (ICC) land use. All other parameters meet concentration under Table 2 Provincial SCS for Ag, RPI and ICC land use. See Section 6.4 of this report for commentary on handling and disposal options available for excess soils generated during construction.

6. Discussion and Recommendations

Supporting data upon which our recommendations are based have been presented in the foregoing sections of this report. The following recommendations are governed by the physical properties of the subsurface materials that were encountered at the site and assume that they are representative of the overall site conditions. It should be noted that these conclusions and recommendations are intended for use by the designers only. Contractors bidding on or undertaking any work at the Site should examine the factual results of the assessment, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of this factual data as it affects their proposed construction techniques, equipment capabilities, costs, sequencing, and the like. Comments, techniques, or recommendations pertaining to construction should not be construed as instructions to the contractor.

The boreholes generally encountered a surficial layer of asphalt over fill, over inferred bedrock. Groundwater was not encountered in the open boreholes during drilling operations. Practical refusal to borehole advancement was encountered in all the boreholes. The presence of bedrock was inferred at the depths of refusal while zones of weathered bedrock were also inferred above such depths of refusal.

Details regarding our conclusions and recommendations are outlined in the following sections.

6.1 Excavation, Dewatering and Backfill

Excavations should be carried out to conform to the manner specified in Ontario Regulation 213/91 and the Occupational Health and Safety Act and Regulations for Construction Projects (OHSA). All excavations above the water table not exceeding 1.2 m in depth may be constructed with unsupported slopes. The fill soils encountered during this investigation above the groundwater table are generally classed by OHSA as Type 3. As such, unsupported / unshored excavation walls in these soils must maintain a gradient of 1 horizontal to 1 vertical (1H:1V) or flatter, to the base of the excavation.

Any groundwater or surficial water infiltration into open excavation above the groundwater table is expected to be controlled by pumping from a sump to an acceptable outlet. Note that excavations into the underlying inferred bedrock my encounter groundwater bearing fractures or zones which may require more intensive groundwater dewatering or control methods.

Based on the borehole results, and the potential depth of excavations for this project, it is expected that construction excavation operations will encounter bedrock at variable depths throughout. It is strongly recommended that a unit price allowance for bedrock removal be included in the construction contract due to the variable bedrock elevations that are expected during the proposed construction. Excavation of any highly fractured / weathered bedrock may be possible using a large hydraulic backhoe. However, it is anticipated that the majority of any fractured and any sound bedrock to be excavated will require the use of hydraulic breaking techniques and /or blasting, preceded by property condition surveys in the effected vicinities, and accompanied by vibration monitoring during construction.

Some excavated inorganic soils may be suitable for use as service trench or pavement subgrade backfill. The existing granulars are expected to be suitable for reuse as select subgrade materials (SSM) as per OPSS. The reuse of all existing excavated soils is conditional on it being workable, at a suitable moisture content, and receiving final review and approval for such reuse at the time of construction. Some soils may require prior processing (such as aeration) to lower their moisture content before being considered for approval as backfill material.

6.2 Service Installation

The materials encountered during this investigation at the anticipated service invert elevations typically consist of inferred bedrock. As such, a normal compacted Class "B" bedding is recommended for all underground services. Class "B" bedding is Granular "A", or 19 mm crusher run (angular) limestone, as per Ontario Provincial Standards (OPSS 1010). The minimum recommended bedding thickness for the underground services is 150 mm. All bedding should be compacted to 100 % of its Standard Proctor Maximum Dry Density (SPMDD).

It is recommended that cover backfilling of the underground services be accomplished using Granular "A", sand, or other suitable material as allowed by the Municipality's standards, to a minimum of 300 mm above the pipe. Compaction of this material should attain 100 % SPMDD. It is expected that some of the excavated soils may be suitable for reuse as trench backfill, conditional upon suitable moisture content (within 2 % of optimum), final review and approval by an experienced geotechnical engineer at the time of construction, and regular monitoring and inspection of such reuse throughout construction. Compaction of any native soil in service trenches is recommended to be a minimum of 98 % of its SPMDD. The soils observed may require processing (such as aeration) to lower their moisture content to appropriate levels prior to being considered as backfill material.

It is recommended that the service bedding subgrade be inspected and approved by GHD prior to placing the bedding fill, to ensure its suitability and consistency with conditions encountered during this investigation. Bedding and backfill materials and compaction should also be inspected and tested.

6.3 Road Reconstruction

6.3.1 Road Reinstatement

For any areas where the pavement is being merely reinstated within the trenched areas versus full road-width reconstruction, the material and thicknesses of the granular and asphalt used to reinstate the trenched areas should match the existing, adjacent granular and asphalt.

6.3.2 Road Reconstruction

For sections of the roadway to be fully reconstructed following repair and/or replacement of the services, we recommend the following procedures be implemented.

1. Subexcavate the entire width of the existing roadway. Remove all asphalt, any free organic topsoil, fill, subsurface organics and organic-bearing materials, frozen earth, and boulders larger than 150 mm in diameter encountered at subgrade elevation for the full width of construction. It is expected that some of the excavated native soils may be suitable for reuse as trench backfill, conditional upon suitable moisture content (within 2 % of optimum) and final review and approval by an experienced geotechnical engineer at the time of construction.
2. Any bedrock shatter should be achieved in accordance with OPSS 202.
3. Proof roll the subgrade for the purpose of detecting possible zones of overly wet or soft subgrade. Any deleterious areas thus delineated should be replaced with acceptable earth fill or granular material compacted to a minimum of 98 % of its SPMDD.
4. Contour the subgrade surface to prevent ponding of water during the construction and to promote rapid drainage of the sub-base and base course materials.
5. To maximize drainage potential, and ensure satisfactory pavement performance, 150 mm diameter perforated pipe subdrains should be installed along any curb lines. The pipe should be encased in filter fabric and surrounded by clear stone aggregate. It is recommended that the subdrains outlet to the storm sewer system.
6. Construct transitions between varying depths of granular base materials at a rate of 1:25 minimum.

It is expected these streets will typically experience vehicular traffic in the form of passenger and commercial vehicles. Data regarding vehicular traffic volumes was not available to GHD at the time of writing this report. In this regard the following minimum flexible pavement structure is recommended for the proposed roadway reconstruction.

Table 6.1 Pavement Structure for Roadway

Profile	Material	Thickness (mm)	In Conformance with OPSS Form
Asphalt Surface	H.L.3	40	1150
Asphalt Base	H.L.8	50	
Granular Base	Granular “A”	150	1010
Granular Subbase	Granular “B”	300	

The following steps are recommended for optimum construction of paved areas:

1. The Granular "A" and "B" courses should be compacted to a minimum 100 percent of their respective SPMDD's.
2. All asphaltic concrete courses should be placed, spread and compacted conforming to OPSS Form 310 or equivalent. All asphaltic concrete should be compacted to a minimum 92.0 % of their respective laboratory Maximum Relative Densities (MRD's).
3. Adequate drainage should be provided to ensure satisfactory pavement performance.

It is recommended that all fill material be placed in uniform lifts not exceeding 200 mm in thickness before compaction. It is suggested that all granular material used as fill should have an in-situ moisture content within 2 % of their optimum moisture content. All granular materials should be compacted to 100 % SPMDD. Granular materials should consist of Granular "A" and "B" conforming to the requirements of OPSS Form 1010 or equivalent.

It is noted that the above recommended pavement structures are for the end use of the project. During construction of the project, the recommended granular depths may not be sufficient to support loadings encountered.

6.4 Excess Soil Generated During Construction – Handling Options

Section 5.6 summarizes the results of chemical testing performed on soil samples as part of this investigation. Based on these results, and anticipating that the Client will try to maximize reuse of the existing fill materials as trench and/or pavement subgrade backfill on this project site, the following handling options are recommended for excess soils excavated at this site during the proposed construction for this project:

1. Remain on-site (i.e.: appropriately reused as trench or road subgrade backfill), under the guidance of a Qualified Person (QP) as defined by the MOECC. Note that additional chemical testing is recommended during the proposed works for quality control purposes;
2. Move to another similar land setting (ie., municipal road right-of-way that is not within an environmentally sensitive area) or a Table 2 or 3 ICC property, under the guidance of a QP. Additional chemical testing to further assess EC and PHC levels in other areas of these sites is recommended prior to utilizing this option;
3. Disposed at a waste disposal landfill appropriately certified by the MOECC. This option would require further chemical testing to ensure compliance with the landfill's C of A.

Note that the chemical results are intended to generally characterize the soils and that the number of samples, or the analytical parameters tested, may not be sufficient to meet the requirements of the chosen option and additional testing may be required.

The testing completed as part of this report should not be misconstrued as an Environmental Site Assessment. Should conditions encountered or the proposed work scope vary from those described in this report, GHD should be notified to evaluate the need for further work.

6.5 General Recommendations

6.5.1 Wells

Any decommissioning of wells on-site must be performed by an appropriately- licensed well contractor, in compliance with O.Reg. 903.

6.5.2 Test Pits During Tendering

It is strongly recommended that test pits be excavated at representative locations of this Site during the tendering phase, with mandatory attendance of interested contractors. This will allow them to make their own assessments of the bedrock, groundwater and soil conditions at the Site and how these will affect their proposed construction methods, techniques and schedules.

6.5.3 Subsoil Sensitivity

The native subsoils are susceptible to strength loss or deformation if saturated or disturbed by construction traffic. Therefore, where the subgrade consists of approved soil, care must be taken to protect the exposed subgrade from excess moisture and from construction traffic.

6.5.4 Winter Construction

The subsoil encountered across the site are frost-susceptible and freezing conditions could cause problems to the pavement subgrade, pipe bedding subgrades, and/or culvert founding subgrades. Suitable protective measures should be utilized during any winter construction to ensure such subgrade soil surfaces are not compromised.

Because of the frost heave potential of soils during winter, it is recommended that the trenches for underground services be excavated with shallow transition slopes in order to minimise the abrupt change in density between the granular backfill, which is relatively non-frost susceptible, and the more frost-susceptible native soils.

6.5.5 Design Review and Inspection

Due to the preliminary nature of the design details at the time of this report, it is recommended that GHD's geotechnical group be allowed to review the roadway design, including utility profiles and final grading, prior to its finalization. In addition, we strongly recommend that our firm be retained to review the grading proposals when they are available.

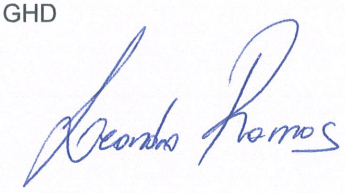
Geotechnical inspection and review of foundation excavations and compaction procedures must be carried out to ensure compliance with our recommendations.

7. Statement of Limitations

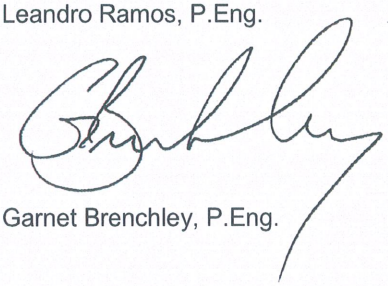
The attached Statement of Limitations is an integral part of this report. Should questions arise regarding any aspect of this report, please contact our office.

Sincerely,

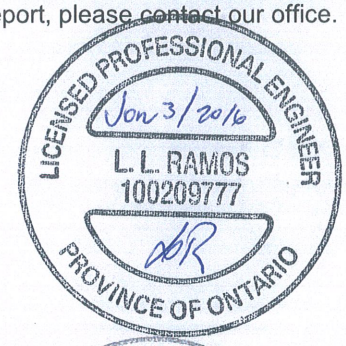
GHD



Leandro Ramos, P.Eng.



Garnet Brenchley, P.Eng.



STATEMENT OF LIMITATIONS

This report is intended solely for the Corporation of the City of Kawartha Lakes and other parties explicitly identified in the report and is prohibited for use by others without GHD's prior written consent. This report is considered GHD's professional work product and shall remain the sole property of GHD. Any unauthorized reuse, redistribution of or reliance on the report shall be at the Client and recipient's sole risk, without liability to GHD. Client shall defend, indemnify and hold GHD harmless from any liability arising from or related to Client's unauthorized distribution of the report. No portion of this report may be used as a separate entity; it is to be read in its entirety and shall include all supporting drawings and appendices.

The recommendations made in this report are in accordance with our present understanding of the project, the current site use, ground surface elevations and conditions, and are based on the work scope approved by the Client and described in the report. The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality. No other representations, and no warranties or representations of any kind, either expressed or implied, are made. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

All details of design and construction are rarely known at the time of completion of a geotechnical study. The recommendations and comments made in the study report are based on our subsurface investigation and resulting understanding of the project, as defined at the time of the study. We should be retained to review our recommendations when the drawings and specifications are complete. Without this review, GHD will not be liable for any misunderstanding of our recommendations or their application and adaptation into the final design.

By issuing this report, GHD is the geotechnical engineer of record. It is recommended that GHD be retained during construction of all foundations and during earthwork operations to confirm the conditions of the subsoil are actually similar to those observed during our study. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of our study is correctly carried forward to the construction phases.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based on the results obtained at the eleven (11) test hole locations only. The subsurface conditions confirmed at the 11 test hole locations may vary at other locations. The subsurface conditions can also be significantly modified by construction activities on site (e.g. excavation, dewatering and drainage, blasting, pile driving, etc.). These conditions can also be modified by exposure of soils or bedrock to humidity, dry periods or frost. Soil and groundwater conditions between and beyond the test locations may differ both horizontally and vertically from those encountered at the test locations and conditions may become apparent during construction which could not be detected or anticipated at the time of our investigation. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by GHD is completed.

Enclosures

Source: Base plan obtained from Ministry of Natural Resources and Forestry, Make a Topographic Map, accessed December 30, 2016.

Scale:
See Above
Coordinate System:
NAD 1983 UTM Zone 17

GHD

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
Fenelon Falls, Ontario
Geotechnical Investigation

11139234-01
December 30, 2016

Test Hole Location Plan

FIGURE 1

Source: Base plan obtained from Ministry of Natural Resources and Forestry, Make a Topographic Map, accessed December 30, 2016.

Scale:
See Above
Coordinate System:
NAD 1983 UTM Zone 17

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
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Geotechnical Investigation

11139234-01
December 30, 2016

Test Hole Location Plan

FIGURE 2

Source: Base plan obtained from Ministry of Natural Resources and Forestry, Make a Topographic Map, accessed December 30, 2016.

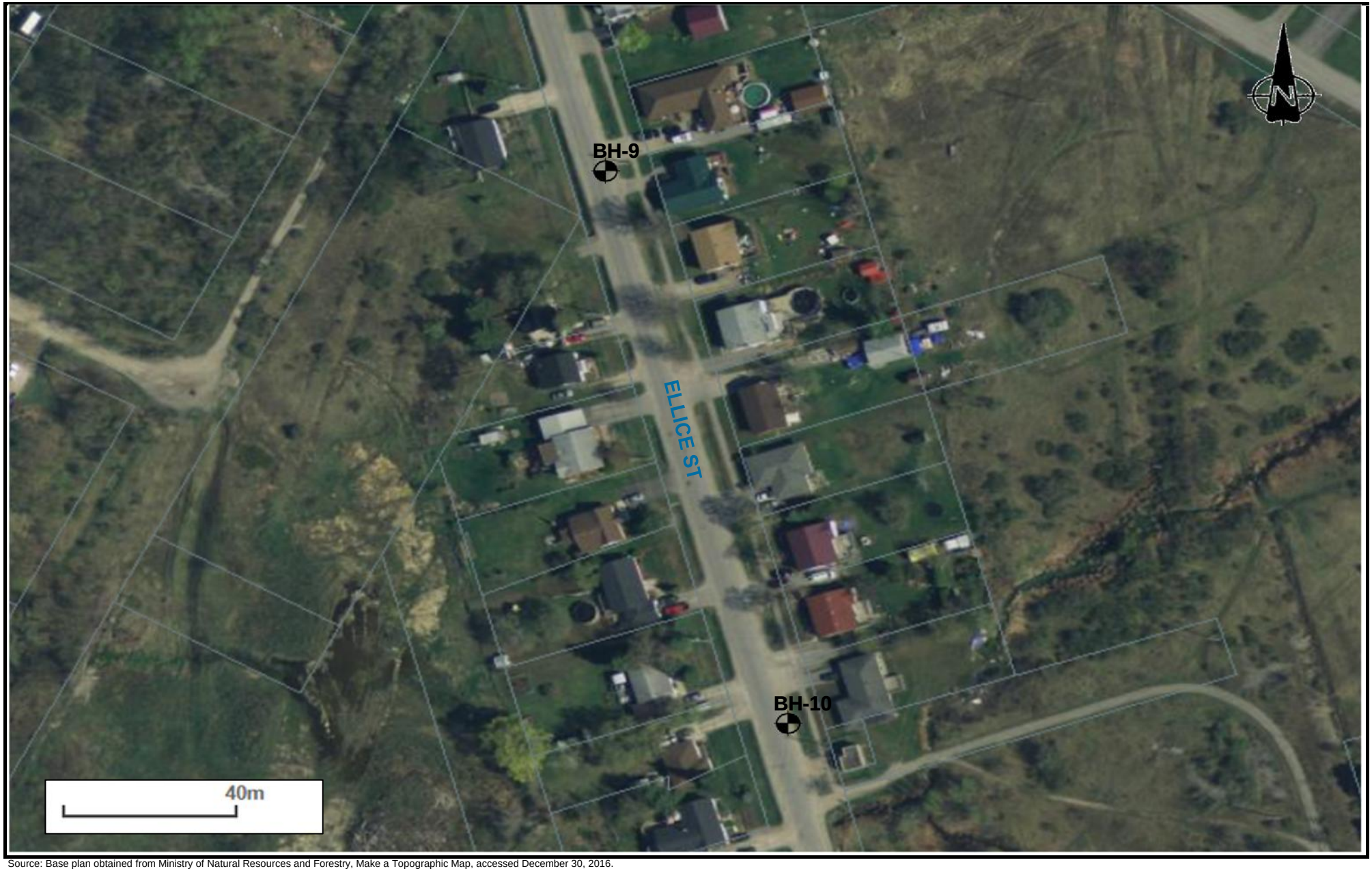
Scale:
See Above
Coordinate System:
NAD 1983 UTM Zone 17

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
Fenelon Falls, Ontario
Geotechnical Investigation

Test Hole Location Plan

11139234-01
December 30, 2016

FIGURE 3



Source: Base plan obtained from Ministry of Natural Resources and Forestry, Make a Topographic Map, accessed December 30, 2016.

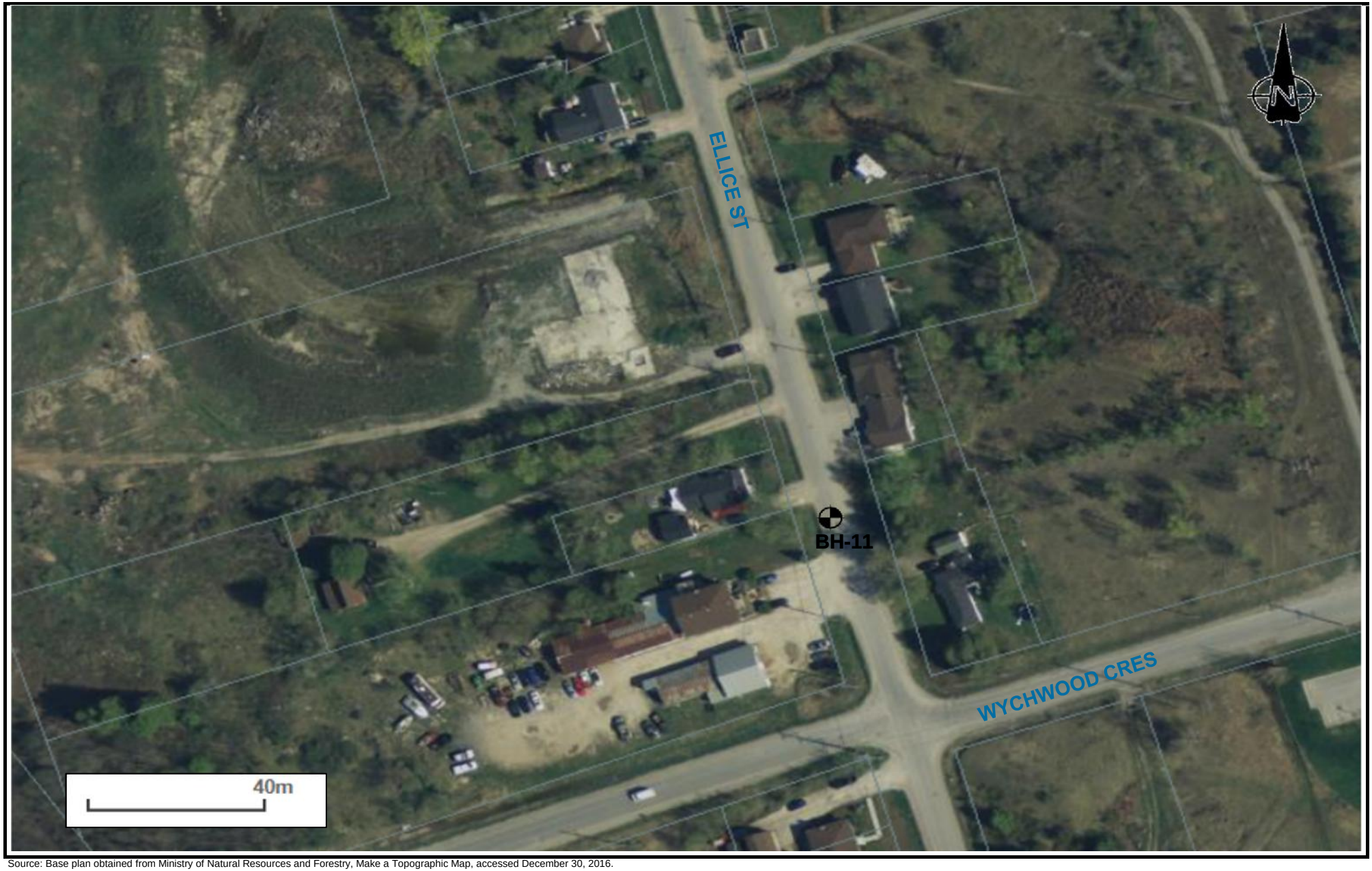
Scale:
See Above
Coordinate System:
NAD 1983 UTM Zone 17

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
Fenelon Falls, Ontario
Geotechnical Investigation

11139234-01
December 30, 2016

Test Hole Location Plan

FIGURE 4



Source: Base plan obtained from Ministry of Natural Resources and Forestry, Make a Topographic Map, accessed December 30, 2016.

Scale:
See Above
Coordinate System:
NAD 1983 UTM Zone 17

GHD

Elliot Street, Ellice Street, Murray Street, West Street and Green Street
Fenelon Falls, Ontario
Geotechnical Investigation

11139234-01
December 30, 2016

Test Hole Location Plan

FIGURE 5

Attachment A
Borehole Logs

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-1

BOREHOLE No.: BH-1
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE — Field △ Lab □	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (100 mm)							
1				**FILL** - Brown Sand and Gravel, Some Silt, Damp, Compact	AS-1		6			○	Open borehole remained dry throughout drilling operation AS-1: Did not meet OPSS for Granular 'B' Type I gravel (22 % passing 75 µm) Borehole terminated at practical refusal to further auger advancement at 0.5 m (presence of bedrock inferred) AS-2: 4% Gravel 57% Sand 39% Silt and Clay 23% between 5-75 µm
		0.4		Brown Silty Sand, Trace Gravel, Damp, Compact	AS-2		7			○	
	0.5	0.5		END OF BOREHOLE							
2											
3	1.0										
4											
5	1.5										
6											
7	2.0										
8											
9	2.5										
	3.0										

10 20 30 40 50 60 70 80 90

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-2

BOREHOLE No.: BH-2

ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes

PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario

LOGGED BY: L. Ramos DATE: 9 December 2016

DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55

NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (W_p W_l) / "N" Value (blows / 0.3 m) / RQD / CONE — 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.0		**ASPHALT** (25 mm)							
				FILL - Brown Sand and Gravel, Damp, Compact	AS-1		3			○	Open borehole remained dry throughout drilling operation
1					AS-2		4			○	
	0.5	0.5		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 0.5 m (presence of bedrock inferred)
2											
3											
	1.0										
4											
5	1.5										
6											
	2.0										
7											
8	2.5										
9											
	3.0										

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-3

BOREHOLE No.: BH-3
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (W_p, W_l) / "N" Value (blows / 0.3 m) / Field △ / Lab □ / RQD ◆ / CONE ◎ — 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.0		**ASPHALT** (40 mm)							
				FILL - Brown Sand and Gravel, Some Silt, Damp, Compact	AS-1		5			○	Open borehole remained dry throughout drilling operation AS-1: Did not meet OPSS for Granular 'B' Type I gravel (15 % passing 75 µm)
1		0.4		**WEATHERED BEDROCK** (Inferred)							
	0.5										
2					AS-2		7			○	
3											AS-2: 51% Gravel 31% Sand 18% Silt and Clay
	1.0										
4											
					AS-3		2			○	
5	1.5	1.7		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 1.7 m (presence of bedrock inferred)
6											
	2.0										
7											
8											
	2.5										
9											
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-4

BOREHOLE No.: BH-4

ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes

PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario

LOGGED BY: L. Ramos DATE: 9 December 2016

DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55

NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE (△ Field, □ Lab)	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (50 mm)							Open borehole remained dry throughout drilling operation
				FILL - Brown Sand and Gravel, Some Silt, Damp, Compact							
		0.2		Brown Sandy Silt, Some Gravel, Moist, Loose							
1					SS-1	65	8	12 5 5 9	10	×	
2	0.5										
3					SS-2	78	12	4 2 4	8	× ○	
4	1.0	1.2		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 1.2 m (presence of bedrock inferred)
5	1.5										
6											
7	2.0										
8											
9	2.5										
	3.0										

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-5

BOREHOLE No.: BH-5
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / Field / Lab / RQD / CONE	COMMENTS
		0.0		GROUND SURFACE							
				ASPHALT (90 mm)							Open borehole remained dry throughout drilling operation
		0.1		**WEATHERED BEDROCK** (Inferred)							
1					AS-1		3			○	
	0.5										
2											
					AS-2		3			○	AS-2: 63% Gravel, 26% Sand, 11% Silt and Clay, 8% between 5-75 µm
3											
	1.0										
4											
	1.5										
5											
6											
	2.0										
7					AS-3		2			○	
		2.3		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 2.3 m (presence of bedrock inferred)
8											
	2.5										
9											
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-6

BOREHOLE No.: BH-6
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / Field / Lab / RQD / CONE	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (75 mm)							
				FILL - Brown Sand and Gravel, Moist, Compact	AS-1		6			○	Open borehole remained dry throughout drilling operation
1		0.4		**WEATHERED BEDROCK** (Inferred)							
	0.5										
2											
3											AS-2: 31% Gravel 60% Sand 9% Silt and Clay
	1.0				AS-2		8			○	
4		1.2		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 1.2 m (presence of bedrock inferred)
5	1.5										
6											
	2.0										
7											
8	2.5										
9											
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-7

BOREHOLE No.: BH-7
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE (△ Field, □ Lab) 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (50 mm)							
				WEATHERED BEDROCK (Inferred)							
1	0.5				SS-1	65	2	19 50 38 34	88	○ × ○	Open borehole remained dry throughout drilling operation
2											
3	1.0				AS-2		2			○	
		1.1		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 1.1 m (presence of bedrock inferred)
4											
5	1.5										
6											
7	2.0										
8	2.5										
9											
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-8

BOREHOLE No.: BH-8
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE — 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (65 mm)							
				FILL - Brown Sand and Gravel, Damp, Compact	AS-1		2			○	Open borehole remained dry throughout drilling operation
1		0.4		Occasional Cobbles							
	0.5										
2					AS-2		3			○	
		0.8		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 0.8 m (presence of bedrock inferred)
3	1.0										
4											
5	1.5										
6											
7	2.0										
8											
9	2.5										
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-9

BOREHOLE No.: BH-9
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth ft	Depth m	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / Field / Lab / RQD / CONE 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (50 mm)							
				FILL - Brown Sand and Gravel, Damp, Compact	AS-1		4			○	Open borehole remained dry throughout drilling operation
1											
	0.5										
2											
3											
	1.0										AS-2: 62% Gravel 30% Sand 8% Silt and Clay 5% between 5-75 µm
4		1.2		**WEATHERED BEDROCK** (Inferred)	AS-2		4			○	
		1.4		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 1.4 m (presence of bedrock inferred)
5	1.5										
6											
	2.0										
7											
8	2.5										
9											
	3.0										

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-10

BOREHOLE No.: BH-10
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth ft	Depth m	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) / "N" Value (blows / 0.3 m) / RQD / CONE (△ Field, □ Lab)	COMMENTS
		0.0		GROUND SURFACE						10 20 30 40 50 60 70 80 90	
		0.1		**ASPHALT** (50 mm)							Open borehole remained dry throughout drilling operation
		0.2		**FILL** - Brown Sand and Gravel, Damp, Compact, Dense							
1				Occasional Cobbles, Compact	SS-1	82	3	31 28 18 18	46	○ × W_p W_l	
2	0.5										
3	1.0				SS-2	35	5	7 6 6	12	○ ×	
4											
5	1.5				SS-3	35	8	5 7 5	12	○ ×	
6											
	2.0	2.0		**WEATHERED BEDROCK** (Inferred)							
7											
8		2.4		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 2.4 m (presence of bedrock inferred)
9	2.5										
	3.0										

BOREHOLE LOG GEOTECH 11139234-01, 16-12-13, BOREHOLE LOGS.GPJ GEOLOGIC.GDT 3/1/17

REFERENCE No.: 11139234-01 ENCLOSURE No.: A-11

BOREHOLE No.: BH-11
ELEVATION: Existing Grade

BOREHOLE REPORT

Page: 1 of 1

CLIENT: City of Kawartha Lakes
PROJECT: Subsurface Investigation - Various Streets, Fenelon Falls, Ontario
LOGGED BY: L. Ramos DATE: 9 December 2016
DRILLING COMPANY: Strong Soil Search Inc. METHOD: Truck Mounted CME-55
NOTES:

LEGEND

- SS - SPLIT SPOON
- AS - AUGER SAMPLE
- ST - SHELBY TUBE
- CS - CORE SAMPLE
- ▼ - WATER LEVEL

Depth ft	Depth m	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Recovery %	Moisture Content %	Blows per 6 in. / 15 cm	Penetration Index N	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (W_p W_l) / "N" Value (blows / 0.3 m) / Field △ / Lab □ / RQD ◆ / CONE ◎ — 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE							
		0.1		**ASPHALT** (50 mm)							
				FILL - Brown Sand and Gravel, Damp, Compact	AS-1		2			○	Open borehole remained dry throughout drilling operation AS-1: Did not meet OPSS for Granular 'B' Type I gravel (11 % passing 75 µm)
1		0.4		Occasional Cobbles							
	0.5				AS-2		4			○	
2		0.7		END OF BOREHOLE							Borehole terminated at practical refusal to further auger advancement at 0.7 m (presence of bedrock inferred)
3	1.0										
4											
5	1.5										
6											
7	2.0										
8											
9	2.5										
	3.0										

Attachment B
Physical Laboratory Data

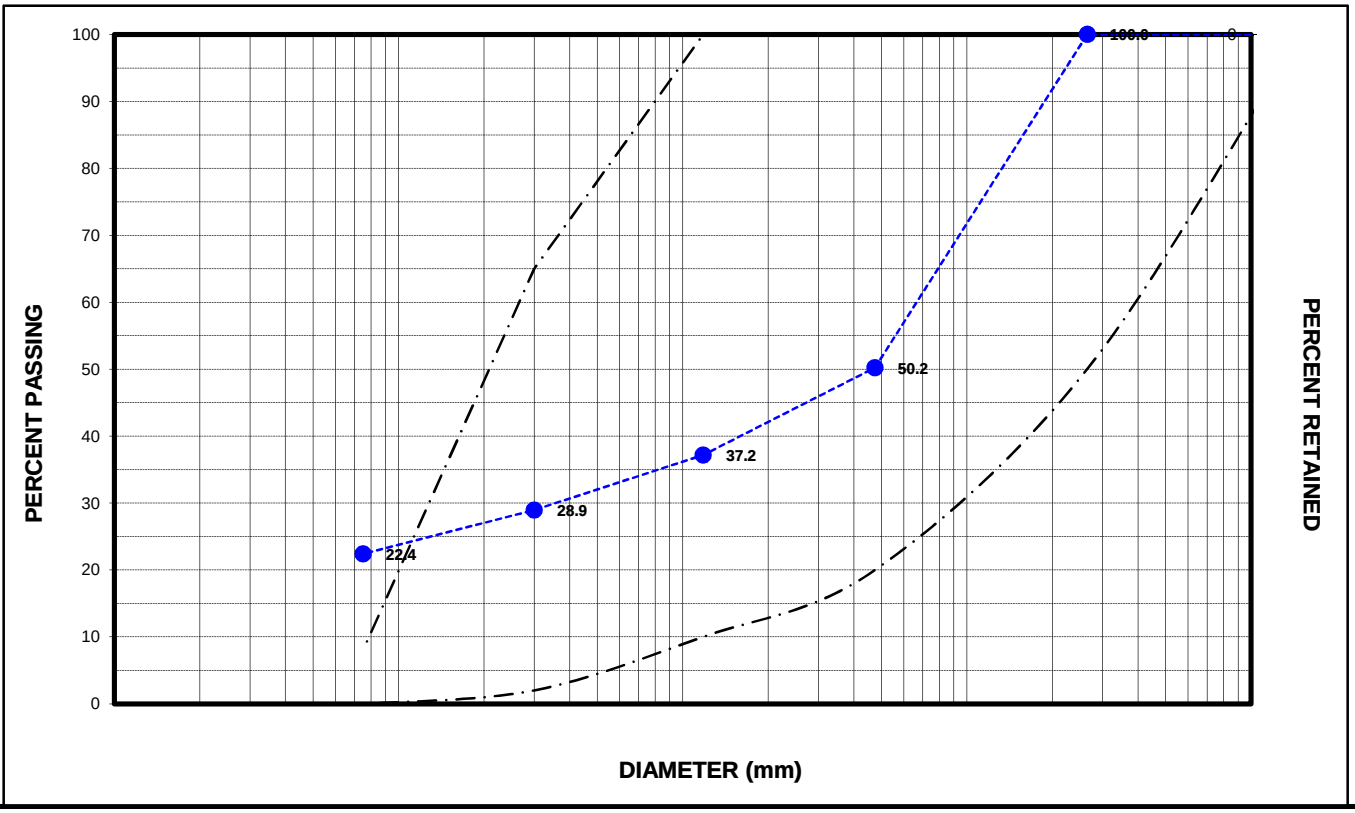
GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL) (LS-602)

CLIENT:	City of Kawartha Lakes	**LAB No.:**	SS-16-110
PROJECT/SITE:	Reconstruction - Various Roads	**PROJECT No.:**	11139234-01

Source: BH-1 AS-1 (0.2-0.3 m) Enclosure: B-1

Sampled By: L. Ramos Date Sampled: December 9, 2016

SIEVE SIZE (mm)		SAMPLE % PASSING	O.P.S.S. Form 1010 SPECIFICATIONS		
150.00		**100.0**	100		
26.50		**100.0**	50	-	100
4.75		**50.2**	20	-	100
1.18		**37.2**	10	-	100
0.300		**28.9**	2	-	65
0.075	*	**22.4**	0	-	8



REMARKS:

* Denotes sieve result that does not meet the project specification for: GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL)

PERFORMED BY:	D. Williams	**DATE:**	January 3, 2017
VERIFIED BY:		**DATE:**	January 3, 2017

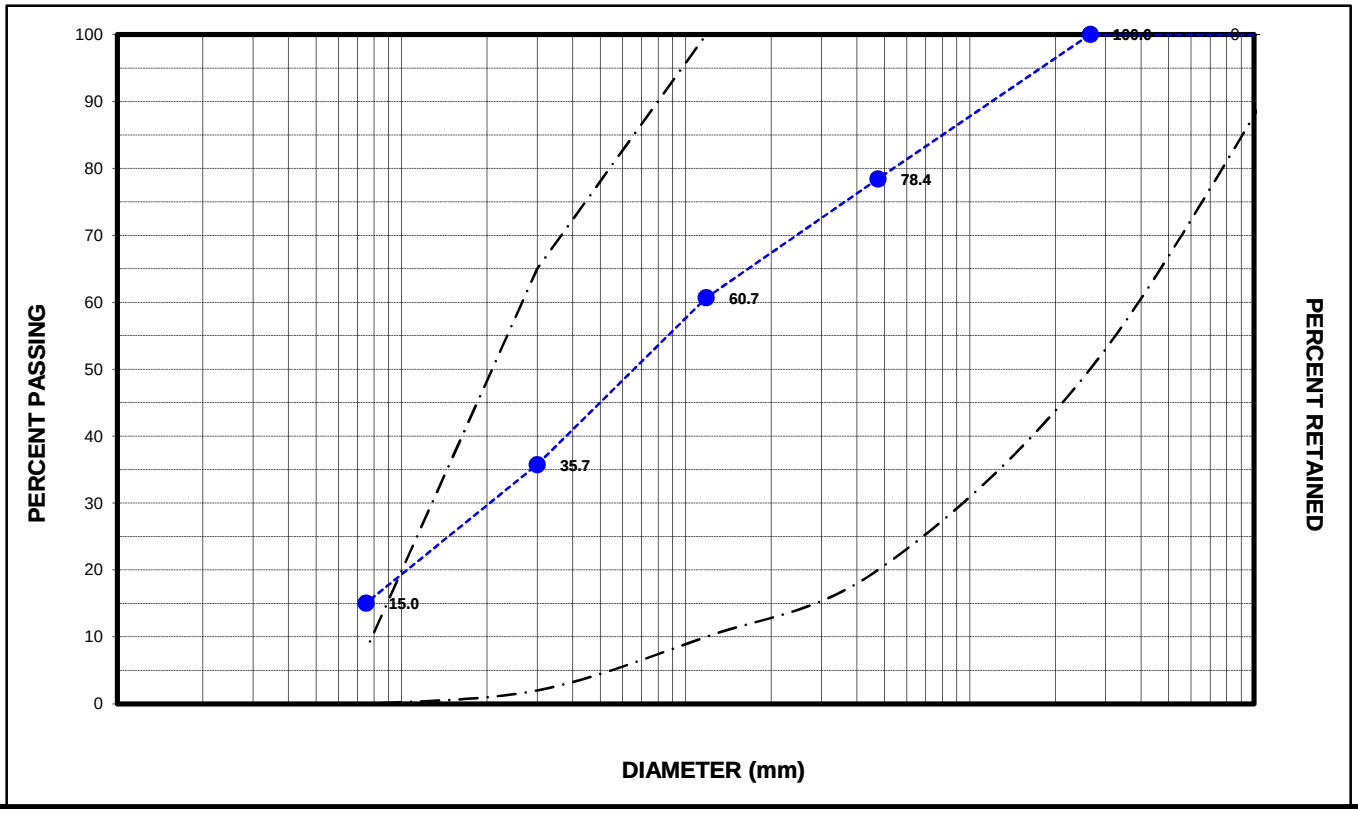
GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL) (LS-602)

CLIENT:	City of Kawartha Lakes	**LAB No.:**	SS-16-110
PROJECT/SITE:	Reconstruction - Various Roads	**PROJECT No.:**	11139234-01

Source: BH-3 AS-1 (0.2-0.3 m) Enclosure: B-2

Sampled By: L. Ramos Date Sampled: December 9, 2016

SIEVE SIZE (mm)	SAMPLE % PASSING	O.P.S.S. Form 1010 SPECIFICATIONS		
150.00	**100.0**	100		
26.50	**100.0**	50	-	100
4.75	**78.4**	20	-	100
1.18	**60.7**	10	-	100
0.300	**35.7**	2	-	65
0.075	* **15.0**	0	-	8



REMARKS:

* Denotes sieve result that does not meet the project specification for: GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL)

PERFORMED BY:	D. Williams	**DATE:**	January 3, 2017
VERIFIED BY:		**DATE:**	January 3, 2017

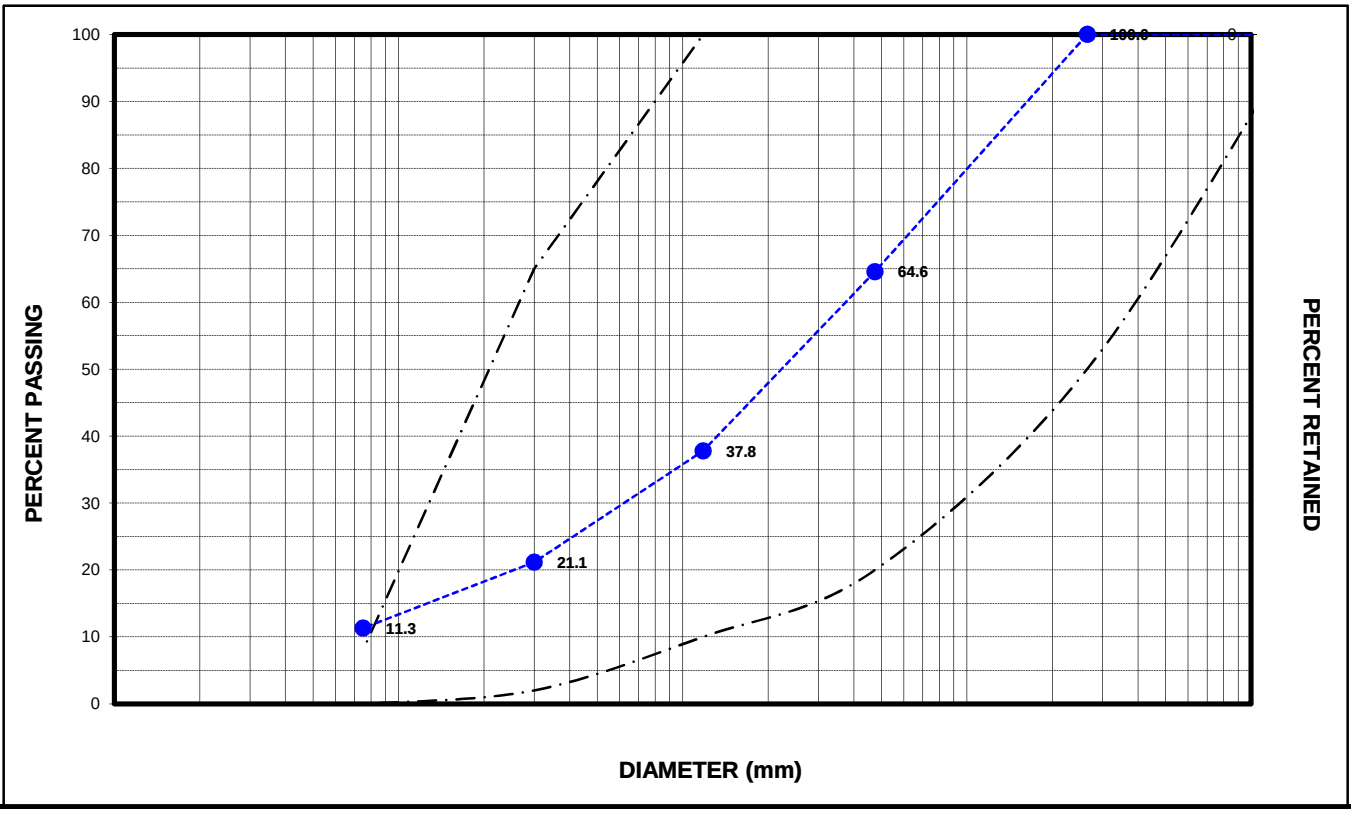
GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL) (LS-602)

CLIENT:	City of Kawartha Lakes	**LAB No.:**	SS-16-110
PROJECT/SITE:	Reconstruction - Various Roads	**PROJECT No.:**	11139234-01

Source: BH-11 AS-1 (0.2-0.3m) Enclosure: B-3

Sampled By: L. Ramos Date Sampled: December 9, 2016

SIEVE SIZE (mm)	SAMPLE % PASSING	O.P.S.S. Form 1010 SPECIFICATIONS
150.00	**100.0**	100
26.50	**100.0**	50 - 100
4.75	**64.6**	20 - 100
1.18	**37.8**	10 - 100
0.300	**21.1**	2 - 65
0.075	* **11.3**	0 - 8



REMARKS:

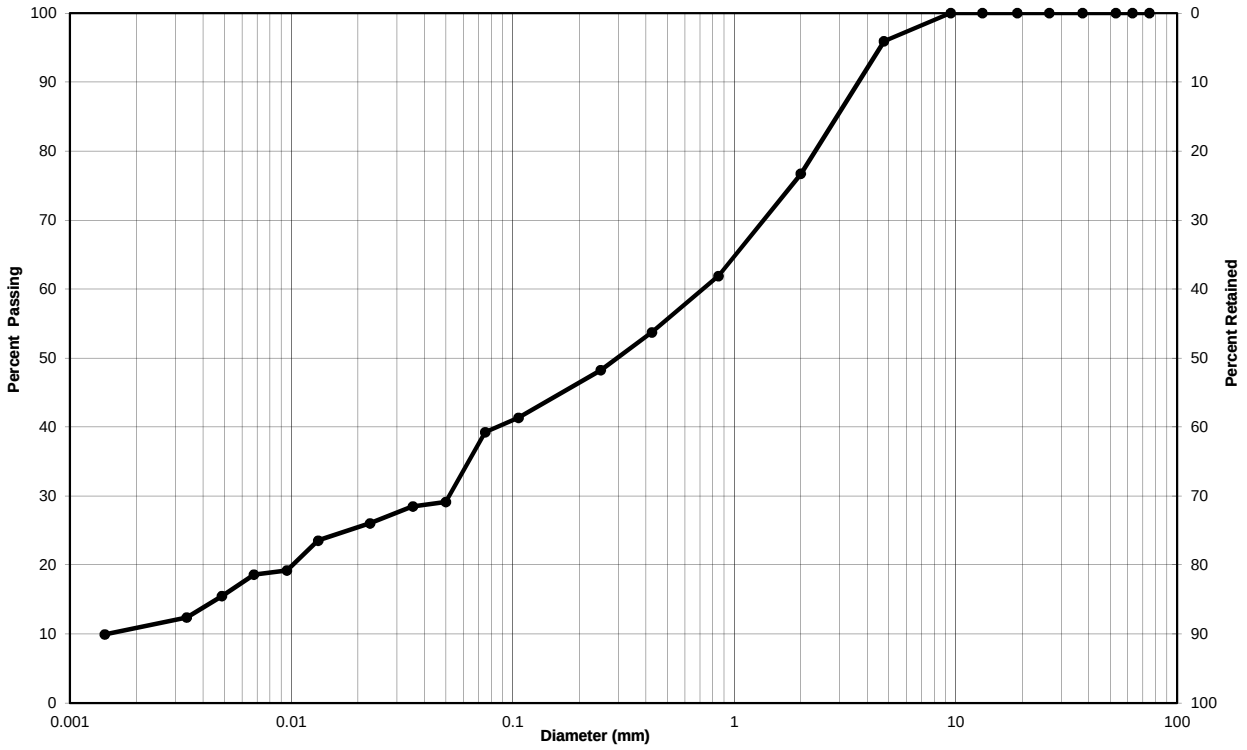
* Denotes sieve result that does not meet the project specification for: GRANULAR 'B' TYPE I - SIEVE ANALYSIS (GRAVEL)

PERFORMED BY:	D. Williams	**DATE:**	January 3, 2017
VERIFIED BY:		**DATE:**	January 3, 2017

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	City of Kawartha Lakes	**Lab no.:**	SS-16-110
Project/Site:	Reconstruction - Various Streets, Fenelon Falls	**Project no.:**	11139234-01

Borehole no.:	BH-1	Sample no.:	AS-2
Depth:	0.5 - 0.8 m	Enclosure:	B-4



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

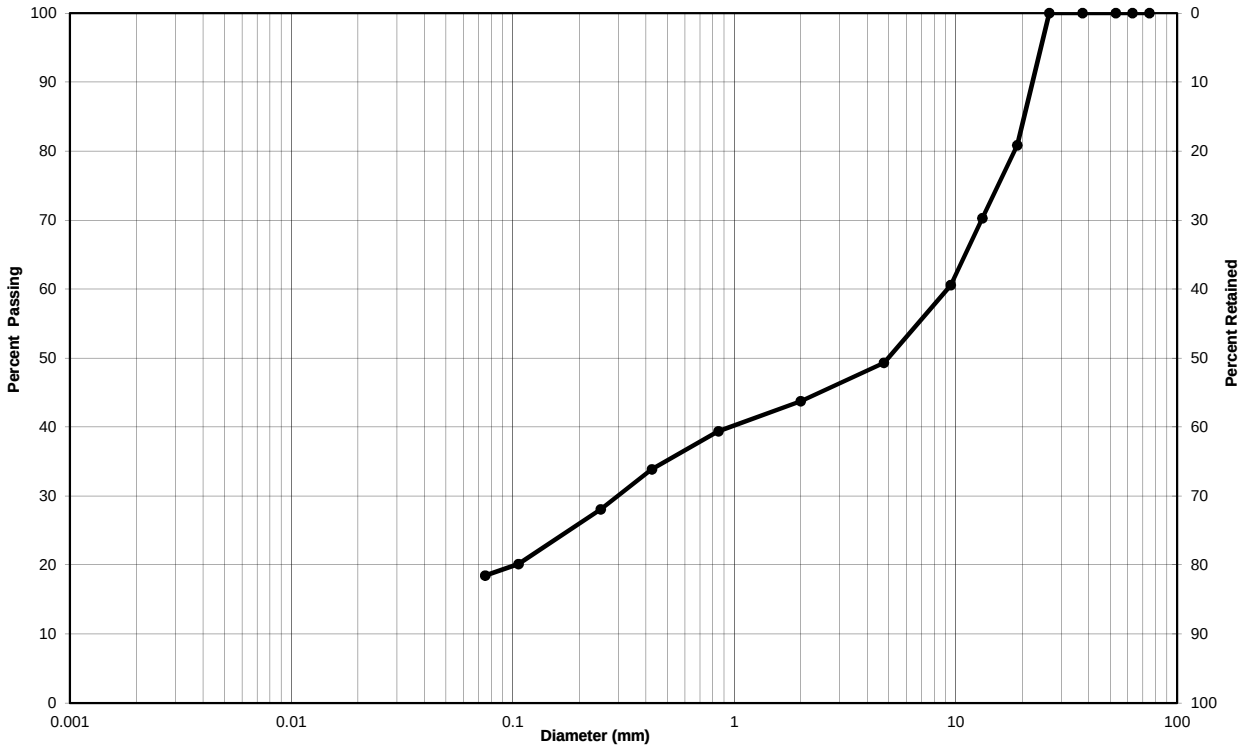
Soil Description	Gravel	Sand	Clay & Silt
BH-1 AS-2	4	57	39

Remarks:

Performed by:	D. Williams	**Date:**	2-Jan-17
Verified by:		**Date:**	2-Jan-17

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	City of Kawartha Lakes	**Lab no.:**	SS-16-110
Project/Site:	Reconstruction - Various Streets, Fenelon Falls	**Project no.:**	11139234-01
Borehole no.:	BH-3	Sample no.:	AS-2
Depth:	0.8 - 0.9 m	Enclosure:	B-5



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

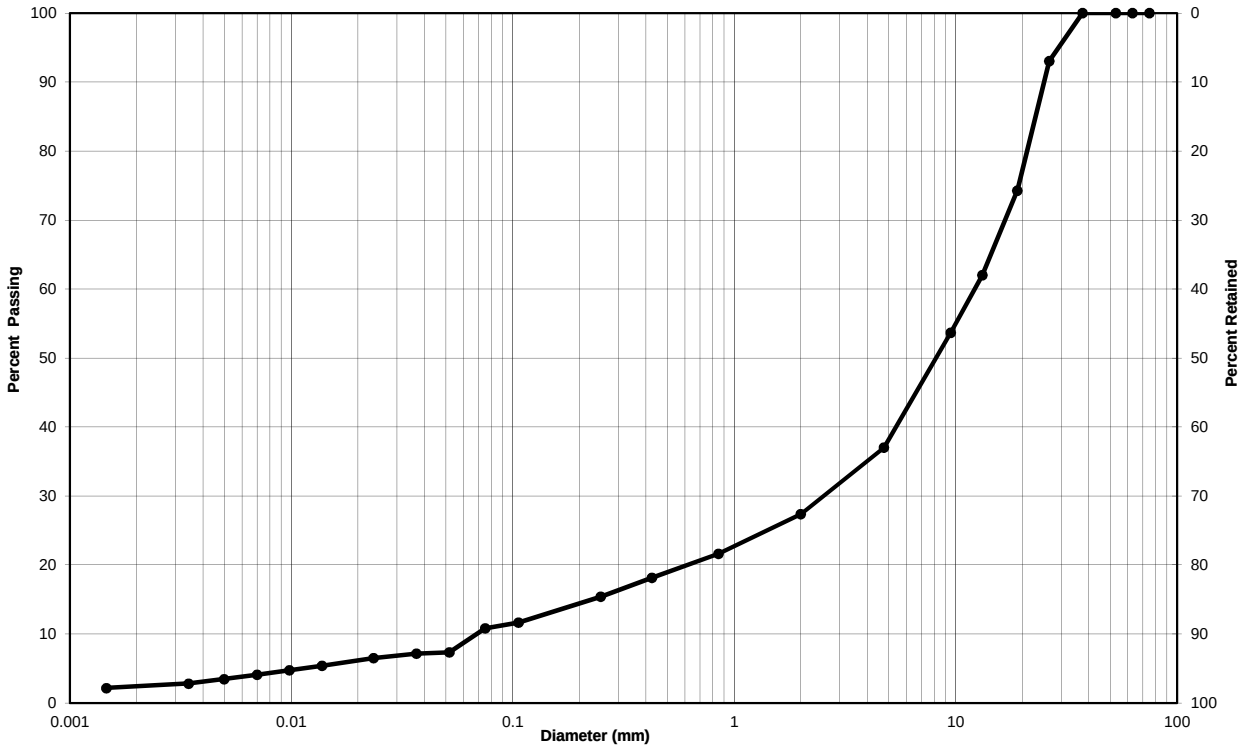
Soil Description	Gravel	Sand	Clay & Silt
BH-3 AS-2	51	31	18

Remarks:

Performed by:	D. Williams	**Date:**	2-Jan-17
Verified by:		**Date:**	2-Jan-17

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	City of Kawartha Lakes	**Lab no.:**	SS-16-110
Project/Site:	Reconstruction - Various Streets, Fenelon Falls	**Project no.:**	11139234-01
Borehole no.:	BH-5	Sample no.:	AS-2
Depth:	0.8 - 1.1 m	Enclosure:	B-6



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

Soil Description	Gravel	Sand	Clay & Silt
BH-5 AS-2	63	26	11

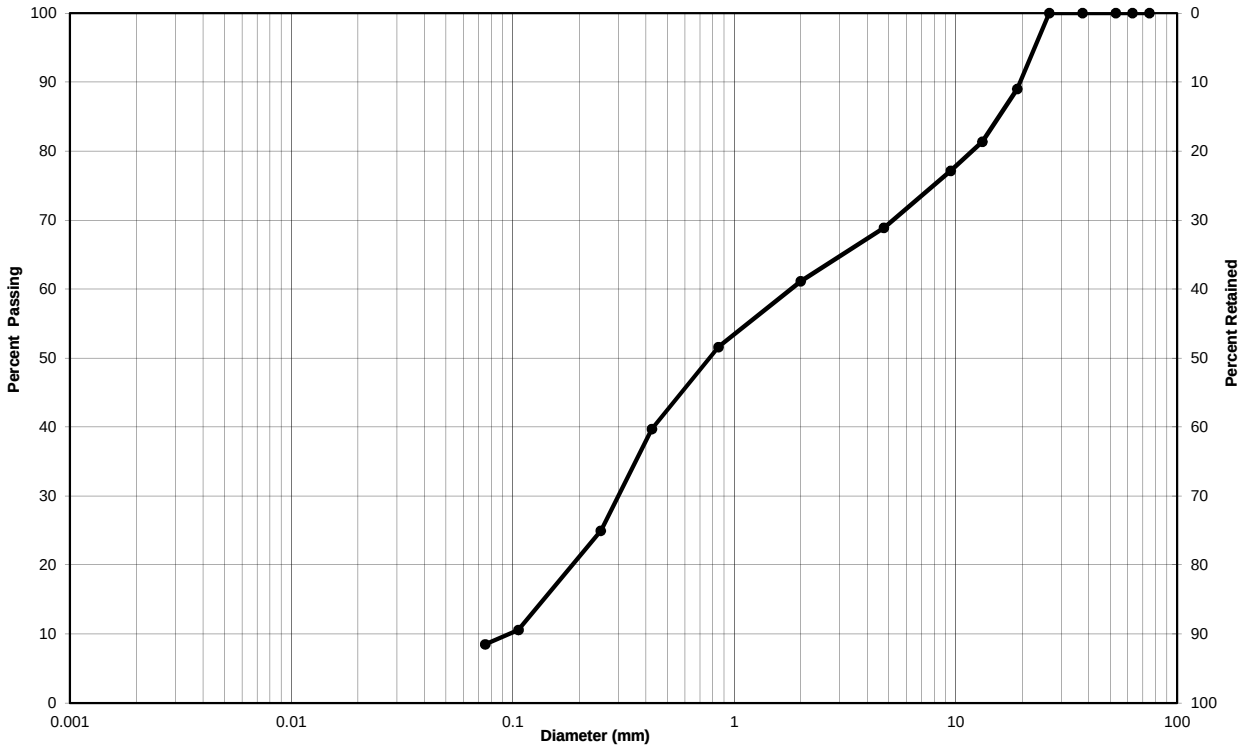
Remarks:

Performed by:	D. Williams	**Date:**	2-Jan-17
Verified by:		**Date:**	2-Jan-17

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	City of Kawartha Lakes	**Lab no.:**	SS-16-110
Project/Site:	Reconstruction - Various Streets, Fenelon Falls	**Project no.:**	11139234-01

Borehole no.:	BH-6	Sample no.:	AS-2
Depth:	0.9 - 1.2 m	Enclosure:	B-7



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

Soil Description	Gravel	Sand	Clay & Silt
BH-6 AS-2	31	60	9

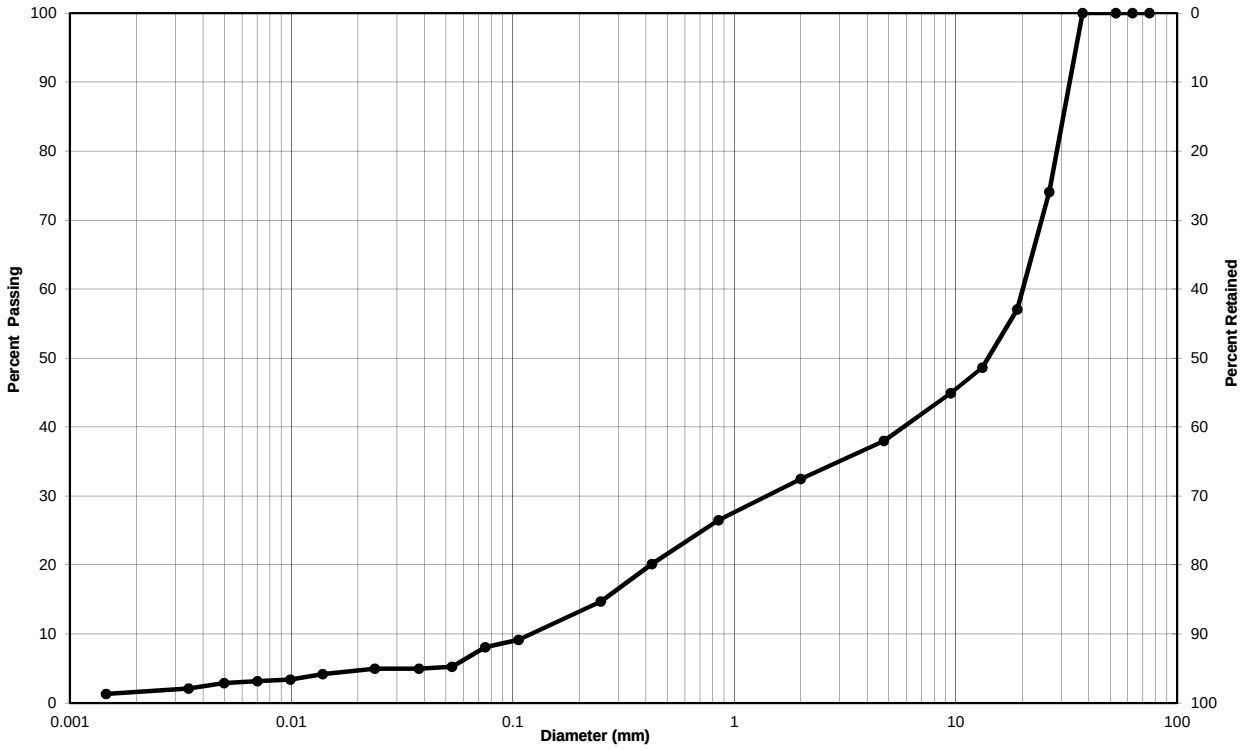
Remarks:

Performed by:	D. Williams	**Date:**	2-Jan-17
Verified by:		**Date:**	2-Jan-17

Particle-Size Analysis of Soils (Geotechnical)
(USCS) (ASTM D422)

Client:	City of Kawartha Lakes	**Lab no.:**	SS-16-110
Project/Site:	Reconstruction - Various Streets, Fenelon Falls	**Project no.:**	11139234-01

Borehole no.:	BH-9	Sample no.:	AS-2
Depth:	1.2 - 1.4 m	Enclosure:	B-8



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

Soil Description	Gravel	Sand	Clay & Silt
BH-9 AS-2	62	30	8

Remarks:

Performed by:	D. Williams	**Date:**	2-Jan-17
Verified by:		**Date:**	2-Jan-17

Attachment C
Chemical Laboratory Data

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G55980 **REPORT No. B16-36963 (i)**

Report To:

GHD Limited
651 Colby Drive,
Waterloo Ontario N2V 1C2 Canada
Attention: Leandro Ramos

Caduceon Environmental Laboratories
110 West Beaver Creek Rd Unit 14
Richmond Hill ON L4B 1J9
Tel: 289-475-5442
Fax: 289-562-1963

DATE RECEIVED: 13-Dec-16
DATE REPORTED: 19-Dec-16
SAMPLE MATRIX: Soil

JOB/PROJECT NO.: Fenelon Falls/11139234-01
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		BH-4, SS-1	BH-7, SS-1	BH-10, SS-1	
			Sample I.D.		B16-36963-1	B16-36963-2	B16-36963-3	
			Date Collected		09-Dec-16	09-Dec-16	09-Dec-16	
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
pH @25°C	pH Units		MOEE 3137	15-Dec-16/R	8.10	8.06	8.12	
Conductivity @25°C	mS/cm	0.07	MOEE3138	15-Dec-16/R	0.73	0.54	0.42	
Sodium Adsorption Ratio	units		SM 3120	15-Dec-16/O	3.92	3.17	2.24	
Antimony	µg/g	0.4	EPA 200.8	14-Dec-16/R	< 0.4	< 0.4	< 0.4	
Arsenic	µg/g	0.5	EPA 200.8	14-Dec-16/R	< 0.5	0.9	1.6	
Barium	µg/g	0.4	EPA 200.8	14-Dec-16/R	29.4	19.5	23.6	
Beryllium	µg/g	0.05	EPA 200.8	14-Dec-16/R	0.15	0.20	0.14	
Boron	µg/g	0.5	EPA 200.8	14-Dec-16/R	4.6	7.1	4.4	
Cadmium	µg/g	0.03	EPA 200.8	14-Dec-16/R	< 0.03	0.03	< 0.03	
Chromium	µg/g	0.4	EPA 200.8	14-Dec-16/R	6.5	8.7	6.5	
Cobalt	µg/g	0.2	EPA 200.8	14-Dec-16/R	1.7	0.7	1.9	
Copper	µg/g	0.4	EPA 200.8	14-Dec-16/R	8.0	4.9	6.7	
Lead	µg/g	0.1	EPA 200.8	14-Dec-16/R	2.5	24.9	4.6	
Mercury	µg/g	0.005	EPA7471A	16-Dec-16/R	< 0.005	0.007	< 0.005	
Molybdenum	µg/g	0.1	EPA 200.8	14-Dec-16/R	0.2	0.3	0.3	
Nickel	µg/g	0.4	EPA 200.8	14-Dec-16/R	3.9	4.4	3.6	
Selenium	µg/g	0.1	EPA 200.8	14-Dec-16/R	0.2	0.5	0.4	
Silver	µg/g	0.01	EPA 200.8	14-Dec-16/R	0.03	0.06	0.02	
Thallium	µg/g	0.02	EPA 200.8	14-Dec-16/R	0.05	0.07	0.06	
Uranium	µg/g	0.02	EPA 200.8	14-Dec-16/R	0.41	0.40	0.51	
Vanadium	µg/g	0.8	EPA 200.8	14-Dec-16/R	15.9	10.1	15.4	
Zinc	µg/g	30	EPA 200.8	14-Dec-16/R	< 30	< 30	< 30	

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G55980 **REPORT No. B16-36963 (ii)**

Report To:

GHD Limited
651 Colby Drive,
Waterloo Ontario N2V 1C2 Canada
Attention: Leandro Ramos

Caduceon Environmental Laboratories
110 West Beaver Creek Rd Unit 14
Richmond Hill ON L4B 1J9
Tel: 289-475-5442
Fax: 289-562-1963

DATE RECEIVED: 13-Dec-16
DATE REPORTED: 19-Dec-16
SAMPLE MATRIX: Soil

JOB/PROJECT NO.: Fenelon Falls/11139234-01
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		BH-4, SS-1	BH-7, SS-1	BH-10, SS-1	
			Sample I.D.		B16-36963-1	B16-36963-2	B16-36963-3	
			Date Collected		09-Dec-16	09-Dec-16	09-Dec-16	
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Benzene	µg/g	0.02	EPA 8260	13-Dec-16/R	< 0.02	< 0.02	< 0.02	
Toluene	µg/g	0.2	EPA 8260	13-Dec-16/R	< 0.2	< 0.2	< 0.2	
Ethylbenzene	µg/g	0.05	EPA 8260	13-Dec-16/R	< 0.05	< 0.05	< 0.05	
Xylene, m,p-	µg/g	0.03	EPA 8260	13-Dec-16/R	< 0.03	< 0.03	< 0.03	
Xylene, o-	µg/g	0.03	EPA 8260	13-Dec-16/R	< 0.03	< 0.03	< 0.03	
Xylene, m,p,o-	µg/g	0.03	EPA 8260	13-Dec-16/R	< 0.03	< 0.03	< 0.03	
PHC F1 (C6-C10)	µg/g	10	CWS Tier 1	13-Dec-16/R	< 10	< 10	< 10	
PHC F2 (>C10-C16)	µg/g	5	CWS Tier 1	14-Dec-16/R	6	15	< 5	
PHC F3 (>C16-C34)	µg/g	10	CWS Tier 1	14-Dec-16/R	20	80	60	
PHC F4 (>C34-C50)	µg/g	10	CWS Tier 1	14-Dec-16/R	40	20	30	
Poly-Chlorinated Biphenyls (PCB's)	µg/g	0.3	EPA 8082A	15-Dec-16/R	< 0.3	< 0.3	< 0.3	
Aroclor	-		-	15-Dec-16	-	-	-	
% moisture	%			13-Dec-16/R	6.00	13.1	3.74	

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill