Appendix J GEOTECHNICAL INVESTIGATION AND PAVEMENT DESIGN REPORT

GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

Geotechnical Investigation

Square One Drive Extension

From Rathburn Road West to Confederation Parkway

Mississauga, Ontario

Prepared For:

Stantec Consulting Limited

GeoPro Project No.: 15-1151-01 Revised

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GeoPro CONSULTING LIMITED

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1 INTRODUCTION

GeoPro Consulting Limited (GeoPro) was retained by Stantec Consulting Limited (the Client) to conduct a geotechnical investigation for the proposed extension of Square One Drive from Rathburn Road West to Confederation Parkway (approximate 250 m), in the Mississauga, Ontario.

The purpose of this geotechnical investigation was to obtain information on the existing subsurface conditions by means of a limited number of boreholes, in-situ tests and laboratory tests of soil samples to provide required geotechnical design information. Based on GeoPro's interpretation of the obtained data, geotechnical comments and recommendations related to the project designs are provided.

This report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. Furthermore, the recommendations and opinions in this report are applicable only to the proposed project as described above. On-going liaison and communication with GeoPro during the design stage and construction phase of the project is strongly recommended to confirm that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed project shall be directed to GeoPro for further elaboration and/or clarification.

This report is provided on the basis of the terms of reference presented in our approved proposal prepared based on our understanding of the project. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this report can be relied upon.

This report deals with geotechnical issues only. The geo-environmental (chemical) aspects of the subsurface conditions, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources were not investigated and were beyond the scope of this assignment. However, limited chemical testing was carried out on selected soil samples for excess soil disposal purposes.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. Laboratory testing, for most part, follows ASTM or CSA Standards or modifications of these standards that have become standard practice in Ontario.

This report has been prepared for the Client only. Third party use of this report without GeoPro's consent is prohibited. The limitations to the report presented above form an integral part of the report and they must be considered in conjunction with this report.

2 SITE AND PROJECT DESCRIPTION

It is understood that the proposed Square One Drive Extension will intersect with the Rathburn Road West and Confederation Parkway. This section of the road is classified as a Minor Collector, with a designated right-of-way (R.O.W.) of 23.5 meters and a proposed roundabout at Rathburn Road West and Square One Drive. The new road will be constructed as a two-lane road with on-street parking along Square One Drive. It is also understood that once Square One Drive extends to Rathburn Road West it will be used as a transit route as an alternate access to the City Centre Transit Terminal. In addition, the section of Rathburn Road West from Confederation Parkway to approximately 500 m west is proposed to be realigned and widened to the south side.

3 FIELD AND LABORATORY WORK

Field work for the geotechnical investigation was carried out on February 1 and March 10, 2017, during which time seven (7) boreholes/coreholes (Boreholes BH1 to BH5 and Coreholes CH1 and CH2) were advanced to depths ranging from about 1.3 m to 2.0 m below the existing ground surface. In addition, the pavement was cored at two corehole locations using a core drill in order to obtain samples of the existing asphalt concrete for thickness measurements and visual examination. The borehole/corehole locations are shown on Borehole/Corehole Location Plan, Drawing 1. Pavement asphalt concrete core photographs are attached to Appendix A.

The boreholes were advanced using solid stem continuous flight auger equipment supplied by a drilling specialist subcontracted to GeoPro.

Groundwater condition observations were made in the open boreholes during drilling and upon completion of drilling. All boreholes were backfilled and sealed upon completion of drilling.

All soil samples obtained during this investigation were brought to our laboratory for further examination. These soil samples will be stored for a period of three (3) months after the day of issuing draft report, after which time they will be discarded unless we are advised otherwise in writing. Geotechnical classification testing (including water content, grain size distribution and Atterberg Limits, when applicable) were carried out on selected soil samples. The complete laboratory test results are shown in Figures 1 and 2.

The elevations at the as-drilled borehole locations were not available at the time of preparing the report. The borehole and corehole locations plotted on the Borehole/Corehole Location Plan, Drawing 1 were based on the measurement of the site features and should be considered to be approximate.

4 SUBSURFACE CONDITIONS

The borehole/corehole locations are shown on Drawing 1. Notes on sample descriptions are presented in Enclosure 1A. Explanations of terms used in the boreholes logs are presented in Enclosure 1B. The subsurface conditions in the boreholes/coreholes (Boreholes BH1 to BH5 and Coreholes CH1 and CH2) are presented in the individual borehole logs (Enclosures 2 to 8 inclusive).

Detailed descriptions of the major soil strata encountered in the boreholes drilled at the site are provided in the following.

4.1 Soil Conditions

Existing Pavement Structure

A flexible pavement structure was observed in the existing roadways on Rathburn Road West and Confederation Parkway. The range and average thickness of pavement structure is summarized in the following table:

Section	Pavement Structure (mm)		
	Asphalt Concrete Range (Average)	Granular Base/Subbase Range (Average)	Total Thickness
Rathburn Road West (BH1 and CH1)	130	510 - 550 (530)	640 - 680 (660)
Confederation Parkway (BH5 and CH2)	150 - 160 (155)	650 - 680 (665)	800 - 840 (820)

Fill Materials

Fill materials consisting of clayey silt, gravelly sand and fine sand were encountered below the topsoil in Boreholes BH2 to BH4, and extended to depths ranging from about 0.5 m to 1.0 m below the existing ground surface. For cohesive fill materials, SPT N values ranging from 5 to 8 blows per 300 mm penetration indicated a firm consistency. For cohesionless fill materials, SPT N value of 11 blows per 300 mm penetration indicated a compact compactness. The in-situ moisture content measured in the soil samples ranged from approximately 7% to 32%.

Clayey Silt Till

Clayey silt till deposit was encountered below the granular base/subbase in Corehole CH1 and extended to a depth of about 1.4 m below the existing ground surface. SPT N value of 13 blows per 300 mm penetration indicated a stiff consistency. The natural moisture content measured in this soil samples ranged from approximately 14% to 16%.

Clayey Silt

Clayey silt deposit was encountered below the fill materials and granular base/subbase in Boreholes BH3 and BH5 and extended to depths ranging from about 0.6 m to 1.4 m below the existing ground surface. SPT N value of 26 blows per 300 mm penetration indicated a very stiff consistency. The natural moisture content measured in the soil samples ranged from approximately 6% to 18%.

Clayey Silt Till/Shale Complex

Clayey silt till/shale complex deposit was encountered below the granular base/subbase, fill materials and clayey silt (till) in Boreholes BH1 to BH4 and Coreholes CH1 and CH2, and extended to depths ranging from about 1.2 m to 2.0 m below the existing ground surface. Boreholes BH1 and BH3 and Corehole CH1 were terminated in this deposit. SPT N values ranging from 13 to greater than 100 blows per 300 mm penetration indicated a stiff to hard consistency. The natural moisture content measured in the soil samples ranged from approximately 3% to 15%.

The "clayey silt till/shale complexes" exists as a transitional deposit between the bedrock and the overlying clayey silt till. This deposit has characteristics of both the clayey silt and of the shale/siltstone/limestone bedrock. The deposit is very difficult to auger through due to the fragmented shale/siltstone/limestone content and the hardness condition. The bedrock slabs found within the soil may be quite large (over 1 m in length/thickness).

Sandy Silt/Shale Complex

Sandy silt/shale complex deposit was encountered below clayey silt in Borehole BH5 and extended to a depth of about 1.7 m below the existing ground surface. SPT N value of greater than 100 blows per 300 mm penetration indicated a very dense compactness. The natural moisture content measured in this soil sample was approximately 11%.

The "sandy silt/shale complexes" exists as a transitional deposit between the bedrock and the overlying sandy silt. This deposit has characteristics of both the sandy silt and of the shale/siltstone/limestone bedrock. The deposit is very difficult to auger through due to the fragmented shale/siltstone/limestone content and the very high density condition. The bedrock slabs found within the soil may be quite large (over 1 m in length/thickness).

Weathered Shale

Weathered shale was encountered below the clayey silt till/shale complex and sandy silt/shale complex in Boreholes BH2, BH4, BH5 and Corehole CH2, and extended to depths ranging from about 1.3 m to 1.8 m below the existing ground surface. Boreholes BH2, BH4, BH5 and Corehole CH2 were terminated in the weathered shale. Exploration of the bedrock was not carried out as part of this assignment, however based on samples recovered from the penetration testing, the bedrock beneath the site consisted of weathered grey shale interbedded with limestone/siltstone.

4.2 Groundwater Conditions

All the boreholes were open and dry upon the completion of drilling. It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to weather events.

5 LABORATORY TEST RESULTS

In the laboratory, each soil sample was examined as to its visual and textural characteristics by the project engineer. Moisture content determinations were carried out on all subsoil samples. Sieve analyses were completed on two samples of the recovered granular base/subbase materials, and the results were compared to OPSS.MUNI 1010 Granular A and Granular B Type I specifications. The gradation distribution curves for these samples are presented in Figure 1, and a summary of the results is provided in the following table.

Sample	OPSS.MUNI 1010 Granular A	OPSS.MUNI 1010 Granular B Type I
BH1 AS1	Does not meet requirements due to excessive percentages passing most sieves	Does not meet requirements due to excessive fines (17.8% passing 0.075 mm sieve)
BH5 AS1	Does not meet requirements due to excessive percentages passing 0.15 mm and 0.075 mm sieves	Does not meet requirements due to excessive fines (15.9% passing 0.075 mm sieve)

Grain size analysis of two subgrade samples confirmed the visual description of the subgrade soils. In addition, the soil was examined and compared to frost susceptibility characteristics in accordance with the MTO Pavement Design and Rehabilitation Manual. The summarized results are provided in the following table, and the grain size distribution curves of these samples are presented in Figure 2.

Soil Sample	Description	Susceptibility of Frost Heaving
BH2 SS2	Clayey Silt, some Sand, trace Gravel	Low
BH4 SS2B	Clayey Silt, some Sand, trace Gravel	High

6 DISCUSSION AND RECOMMENDATIONS

6.1 General Report Consideration

This report contains the findings of GeoPro's geotechnical investigation, together with geotechnical engineering recommendations and comments. These recommendations and comments are based on factual information and are intended only for use by the design engineers. The number of boreholes may not be sufficient to determine all factors that may affect construction methods and costs. Subsurface conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction that could not be detected or anticipated at the time of the site investigation. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. The construction methods discussed, however, express GeoPro's opinion only and are not intended to direct contractors on how to carry out construction. Contractors should also be aware that the data and interpretation presented in this report may not be sufficient to assess all factors that may have an effect on construction.

6.2 Existing Pavement Condition

In general, the existing pavement on Rathburn Road West at the proposed intersection of Square One Drive Extension was observed to be in good to fair condition. The most significant distresses are intermittent low to medium severity longitudinal and transverse cracking and low severity utility cut patching. The existing pavement on Confederation Parkway at the proposed intersection of Square One Drive Extension was observed to be in generally good condition.

The existing roadways were designed and constructed to an urban cross-section (curb and catchbasins). The overall surface drainage within the project limits is generally considered to be good.

6.3 Traffic Data Analysis

It is understood that Square One Drive is classified as a Minor Collector, and Square One Drive will intersect with Rathburn Road West and Confederation Parkway, which are both classified as Major Collector Roads. The traffic volumes for the roads are estimated using back calculation method based on the traffic data provided by the Client in an e-mail dated March 24, 2017; the compound growth rates are also calculated based on the forecasting traffic data provided.

The traffic data was interpreted by GeoPro to estimate the number of Equivalent Single Axle Loads (ESALs) for pavement design purposes. Traffic loading repetitions were determined for the 20-year pavement design life period that is considered typical for municipal pavements of this type. On this basis, the ESAL applications during the design period were calculated in accordance with the Appendix D of MTO MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions. The traffic data and estimated ESALs are presented in the following table:

Parameters	AADT (2021)	AADT (2031)	AADT (2041)	Percentage of Heavy Vehicle	Estimated Design ESALs (million)
Square One Drive Extension	4,100	4,500	4,900	5.0	0.55
Rathburn Road West Widening Section	21,900	24,400	24,700	5.0	2.7
Intersection of Square One Drive Extension/Rathburn Road West *	26,000	28,900	29,600	5.0	3.2
Intersection of Square One Drive Extension/Confederation Parkway	39,600	44,300	50,700	4.0	4.0

* The total AADT on both Rathburn Road West and Square One Drive Extension were considered in traffic and ESALs analyses for roundabout.

6.4 Pavement Design

The subgrade soils along the length of subject roadway section generally consisted of native clayey silt/shale complex based on GeoPro's borehole information. The resilient modulus of subgrade has been assumed to be 25 MPa. The pavement designs were developed based on the '1993 AASHTO Guide for Design of Pavement Structures and MTO MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions'. The pavement design parameters are summarized in the following table:

Design Parameters	Values
Design Life	20 Years
Initial Serviceability Index	4.4
Terminal Serviceability Index	2.2
Reliability Level, %	85
Overall Standard Deviation	0.45
Design Subgrade Resilient Modulus, MPa	25
Layer Coefficient of Hot Mix Asphalt	0.42
Layer Coefficient of Granular Base Course	0.14
Layer Coefficient of Granular Subbase Course	0.12

The minimum Structural Number required for the new pavement on Square One Drive Extension is about 95 mm; the minimum Structural Number required for the Rathburn Road West widening section is about 119 mm; the minimum Structural Number required for the Roundabout on Rathburn Road West is about 122 mm; the minimum Structural Number required for the intersection of Confederation Parkway and Square One Drive is about 126 mm.

6.5 Pavement Design Recommendations

6.5.1 Square One Drive Extension

Based on the expected traffic on this road section and the type and strength of subgrade soil, the recommended pavement structure for Square One Drive Extension is provided in the following table:

Material		Thickness of Pavement (mm)
Hot-Mix Asphalt (OPSS 1150)	HL 3(HS) Surface Course	40
	HDBC Binder Course	100
Granular Material (OPSS.MUNI 1010)	Granular A Base (19 mm Crusher Run Limestone)	200
	Granular B Type II Subbase	300
Prepared and Approved Subgrade		

The construction procedure should be as follows:

- Completely remove the existing topsoil and any other obviously deleterious materials;
- Excavate subgrade to the depth required to accommodate the new pavement structure (about 640 mm below the proposed pavement surface); the exposed subgrade surface should be graded and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD);
- The prepared subgrade should be carefully proofrolled using a heavily loaded truck in conjunction with the inspection by the geotechnical engineer from GeoPro; any soft/loose or wet areas or other obviously deleterious materials must be excavated and properly replaced with material similar to the existing subgrade soils or other granular soils approved by the geotechnical engineer;
- All backfill materials should be placed in uniform loose lifts not exceeding 200 mm thickness and compacted to at least 98 percent of SPMDD. The finished subgrade should be provided with a grade of 3 percent towards the positive drainages;
- Place a minimum of 300 mm OPSS.MUNI Granular B Type II subbase course in loose lifts not exceeding 200 mm thickness, compact to 98 percent of SPMDD;
- Place 200 mm of OPSS.MUNI Granular A (19 mm Crusher Run Limestone) base course and compact to 98 percent of SPMDD; and
- Place 140 mm of hot-mix asphalt (100 mm lift of OPSS 1150 HDBC hot-mix asphalt binder course in two lifts and one 40 mm lift of OPSS 1150 HL 3(HS) hot-mix asphalt surface course). The surface of the completed pavement should be provided with a grade of 2 percent.

The constructed pavement Structural Number for Square One Drive Extension is 123, which is greater than the Design Structural Numbers (95). As such, the pavement will be structurally adequate for the expected traffic loads over the 20-year design period with required regular maintenance.

6.5.2 Rathburn Road West Widening Section

Based on the expected traffic on Rathburn Road West, the type and strength of subgrade soil and borehole investigation at proposed roundabout location, the recommended pavement structure for widening section is provided in the following table:

Material		Thickness of Pavement (mm)
Hot-Mix Asphalt (OPSS 1150)	HL 1 Surface Course	40
	HDBC Binder Course	100 (2 lifts)
Granular Material (OPSS.MUNI 1010)	Granular A Base (19 mm Crusher Run Limestone)	200
	Granular B Type II Subbase	400
Prepared and Approved Subgrade		

The construction procedure should be as follows:

- Completely remove the existing topsoil, any other obviously deleterious materials and on the proposed widening area to the depth required to accommodate the new pavement structure (about 740 mm below the proposed pavement surface);
- The exposed subgrade surface should be graded and compacted to 98 percent of SPMDD;
- The prepared subgrade should be carefully using a heavily loaded truck in conjunction with the inspection by the geotechnical engineer from GeoPro; any soft/loose or wet areas or other obviously deleterious materials must be excavated and properly replaced with material similar to the existing subgrade soils or other granular soils approved by the geotechnical engineer;
- All backfill materials should be placed in uniform loose lifts not exceeding 200 mm thickness and compacted to at least 98 percent of SPMDD. The finished subgrade should be provided with a grade of 3 percent towards the positive drainages;
- Place a minimum of 400 mm OPSS.MUNI Granular B Type II subbase course in loose lifts not exceeding 200 mm thickness, compact to 98 percent of SPMDD;
- Place 200 mm of OPSS.MUNI Granular A (19 mm Crusher Run Limestone) base course and compact to 98 percent of SPMDD; and
- Place 140 mm of hot-mix asphalt (100 mm of OPSS 1150 HDBC hot-mix asphalt binder course in two lifts and one 40 mm lift of OPSS 1150 HL 1 hot-mix asphalt surface course). The surface of the completed pavement should be provided with a grade of 2 percent.

The constructed pavement Structural Number is about 135, which is equal to the Design Structural Numbers (119). As such, the pavement will be structurally adequate for the expected traffic loads over the 20-year design period with required regular maintenance.

It should be noted that the provided pavement structure for the Rathburn Road West widening section should be considered for preliminary design purposes only and should be reviewed by GeoPro and further recommendations be provided as appropriate once the detail design drawings and detail site plan are available.

6.5.3 Roundabout on Rathburn Road West

Based on the expected traffic and the type and strength of subgrade soil, the recommended pavement structure for roundabout on Rathburn Road West is provided in the following table:

Material		Thickness of Pavement (mm)
Hot-Mix Asphalt (OPSS 1150)	HL 1 Surface Course	40
	HDBC Binder Course	110 (2 lifts)
Granular Material (OPSS.MUNI 1010)	Granular A Base (19 mm Crusher Run Limestone)	200
	Granular B Type II Subbase	400
Prepared and Approved Subgrade		

Note: This pavement structure should apply to each leg of the roundabout for at least 20 m.

The construction procedure should be as follows:

- Excavate the existing asphalt concrete, granular base/subbase and subgrade materials to the depth required to accommodate the new pavement structure (about 750 mm below the proposed pavement surface);
- The exposed subgrade surface should be graded and compacted to 98 percent of SPMDD;
- The prepared subgrade should be carefully using a heavily loaded truck in conjunction with the inspection by the geotechnical engineer from GeoPro; any soft/loose or wet areas or other obviously deleterious materials must be excavated and properly replaced with material similar to the existing subgrade soils or other granular soils approved by the geotechnical engineer;
- All backfill materials should be placed in uniform loose lifts not exceeding 200 mm thickness and compacted to at least 98 percent of SPMDD. The finished subgrade should be provided with a grade of 3 percent towards the positive drainages;
- Place a minimum of 400 mm OPSS.MUNI Granular B Type II subbase course in loose lifts not exceeding 200 mm thickness, compact to 98 percent of SPMDD;
- Place 200 mm of OPSS.MUNI Granular A (19 mm Crusher Run Limestone) base course and compact to 98 percent of SPMDD; and
- Place 150 mm of hot-mix asphalt (110 mm of OPSS 1150 HDBC hot-mix asphalt binder course in two lifts and one 40 mm lift of OPSS 1150 HL 1 hot-mix asphalt surface course). The surface of the completed pavement should be provided with a grade of 2 percent.

The constructed pavement Structural Number is about 139, which is greater than the Design Structural Numbers (122). As such, the pavement will be structurally adequate for the expected traffic loads over the 20-year design period with required regular maintenance.

6.5.4 Intersection of Confederation Parkway and Square One Drive

This section of the report provides recommendations for the restoration of the pavement structure at the intersection of Confederation Parkway and Square One Drive, where required. Disturbed/damaged pavement, resulting from the road connection operations, should be restored in kind to match the existing pavement structure. Based on the expected traffic and the results of this investigation, the general pavement restoration design is recommended in the following table:

Material		Thickness of Pavement (mm)
Hot-Mix Asphalt (OPSS 1150)	HL 1 Surface Course	40
	HDBC Binder Course	120 (2 lifts)
Granular Material (OPSS.MUNI 1010)	Granular A Base (19 mm Crusher Run Limestone)	200
	Granular B Type II Subbase	460
Prepared and Approved Subgrade		

Note: In consideration of the existing pavement thickness is structurally adequate for the current and anticipated future traffic, the designed thicknesses should match the existing depths of the adjacent pavement structure.

The construction procedure should be as follows:

- Excavate the existing asphalt concrete, granular base/subbase and subgrade materials to the depth required to accommodate the new pavement structure (about 820 mm below the proposed pavement surface);
- The exposed subgrade surface should be graded and compacted to 98 percent of SPMDD;
- The prepared subgrade should be carefully using a heavily loaded truck in conjunction with the inspection by the geotechnical engineer from GeoPro; any soft/loose or wet areas or other obviously deleterious materials must be excavated and properly replaced with material similar to the existing subgrade soils or other granular soils approved by the geotechnical engineer;
- All backfill materials should be placed in uniform loose lifts not exceeding 200 mm thickness and compacted to at least 98 percent of SPMDD. The finished subgrade should be provided with a grade of 3 percent towards the positive drainages;
- Place a minimum of 460 mm OPSS.MUNI Granular B Type II subbase course in loose lifts not exceeding 200 mm thickness, compact to 98 percent of SPMDD;
- Place 200 mm of OPSS.MUNI Granular A (19 mm Crusher Run Limestone) base course and compact to 98 percent of SPMDD; and

- Place 160 mm of hot-mix asphalt (120 mm of OPSS 1150 HDBC hot-mix asphalt binder course in two lifts and one 40 mm lift of OPSS 1150 HL 1 hot-mix asphalt surface course). The surface of the completed pavement should be provided with a grade of 2 percent.

The constructed pavement Structural Number for the intersection of Confederation Parkway and Square One Drive is about 150, which is greater than the Design Structural Numbers (126). As such, the pavement will be structurally adequate for the expected traffic loads over the 20-year design period with required regular maintenance.

6.6 Drainage Improvements

Control of surface water is an important factor in achieving a good pavement service life. Therefore, we recommend that provisions be made to drain the new pavement subgrade and its granular layers. It is understood that the proposed road is anticipated to consist of typical urban section (concrete curb/gutter and catchbasins). To provide positive drainage across the pavement platform, the surface of pavement should be sloped at a grade of 2 percent and the pavement subgrade should be sloped at a grade of 3 percent towards the subdrains. Subdrains should be designed and constructed in accordance with City of Mississauga Standard Specifications Section 02712 and Standard Drawing No. 2220.040 “Subdrains”, and the subdrain pipe should be connected to a positive outlet.

6.7 General Pavement Recommendations

6.7.1 Pavement Materials

The following hot-mix asphalt mix types should be selected:

- HL 1 and HL 3(HS) Surface Course; and
- HDBC Binder Course

These hot mix asphalt mixes should be designed and produced in conformance with OPSS 1150 requirements.

Granular A and Granular B Type II material should be used as base course and subbase course, respectively. Both Granular A and Granular B Type II material should meet OPSS.MUNI 1010 specifications.

6.7.2 Asphalt Cement Grade

Performance graded asphalt cement PGAC 64-28 conforming to OPSS.MUNI 1101 requirements is recommended for the HMA binder and surface courses.

6.7.3 Tack Coat

A tack coat (SS1) should be applied to all construction joints prior to placing hot-mix asphalt to create an adhesive bond. Prior to placing hot-mix asphalt, SS1 tack coat must also be applied to all existing surfaces and between all new lifts in accordance with OPSS 308 requirements.

6.7.4 Compaction

All granular base and subbase materials should be placed in uniform lifts not exceeding 200 mm loose thickness and compacted to 98 percent of the material SPMDD at ±2 percent of the materials Optimum Moisture Content (OMC) in accordance with the City of Mississauga Specifications Section 02512. Hot-mix asphalt should be placed and compacted in accordance with OPSS 310 specifications.

6.7.5 Pavement Tapers

At the limits of construction, appropriate tapering of the pavement thickness to match the existing pavement structure should be implemented in accordance with OPSS and the applicable local municipality specifications.

6.7.6 Subgrade Preparation

All topsoil, organics, soft/loose and otherwise disturbed soils should be stripped from the subgrade area. The exposed subgrade consisting of fine grained sandy/silty soils will be disturbed by construction traffic when wet; especially if site work is carried out during periods of wet weather. Under inclement weather conditions, an adequate granular working surface may be required to facilitate construction traffic as well as to minimize subgrade disturbance and to protect its integrity.

Immediately prior to placing the granular subbase, the exposed subgrade should be compacted and then proofrolled with a heavy rubber tired vehicle (such as a loaded gravel truck) in conjunction with inspection by a geotechnical engineer from GeoPro. The subgrade should be inspected for signs of rutting or displacement. Areas displaying signs of rutting or displacement should be recompacted and retested, or the material should be subexcavated and replaced with well-compacted clean fill materials approved by the geotechnical engineer from GeoPro.

The fill materials may consist of either granular material or local inorganic soils provided that its moisture content is within ±2 percent of OMC. Fill should be placed and compacted in accordance with OPSS.MUNI 501 and the final 300 mm of the subgrade should be compacted to 98 percent of SPMDD.

6.7.7 Reuse and Disposal of Existing Pavement Materials

It should be noted that gradation analyses of the selected samples of the existing granular base/subbase materials do not meet the OPSS.MUNI 1010 granular A and B Type I gradation specifications with excessive content of fines. Therefore, the existing granular materials could not be reused as subbase/base materials, however, they can be reused as subgrade material to replace soft, wet or otherwise disturbed areas identified during proofrolling.

The existing asphalt concrete may be salvaged and utilized as Recycled Asphalt Pavement (RAP) in the production of the new hot mix asphalt in accordance with the requirements of the contract or the relevant OPS specifications.

6.7.8 Maintenance

Routine maintenance should be considered to extend the life of the pavement. Systematic routine preventative maintenance is strongly recommended for all newly constructed pavements. Crack routing and sealing will generally be required within 2 to 3 years after pavement construction. As the pavement ages, it will also be necessary to patch areas of medium to high severity distresses, such as potholes and ravelling.

7 SOIL ENVIRONMENTAL ANALYTICAL RESULTS

7.1 Soil Sample Submission

In order to provide information on the chemical quality of the subsurface soils, selected soil samples were submitted to AGAT Laboratories in Mississauga, Ontario ("AGAT") for chemical analyses. Descriptions of the selected soil samples and analytical parameters are presented in the following table:

Borehole ID	Soil Depth (mBGS)	Primary Soil	Analytical Parameters
BH1 AS1B	0.7 – 0.8	Clayey Silt Till/Shale Complex	Metals/Inorganics
CH1 AS1B	0.7 – 0.8	Clayey Silt Till	PHCs
BH3 SS2	0.6 – 1.2	Clayey Silt Till/Shale Complex	Metals/Inorganics
BH4 SS1A	0.2 – 0.5	Gravelly Sand Fill	Metals/Inorganics
BH5 AS1	0.2 – 0.8	Sand and Gravel Fill	PHCs
CH2 SS2	0.8 – 1.3	Clayey Silt Till/Shale Complex	Metals/Inorganics

Note: PHCs = Petroleum Hydrocarbon Fractions F1 to F4

It should be noted that at the time of the sampling, no obvious visual or olfactory evidence of environmental impact (i.e. staining or odours) was observed at the sampling locations.

7.2 Soil Analytical Results

A total of six (6) soil samples were analysed for the parameters of metals and inorganics and PHCs, under Ontario Regulation 153/04 ("O. Reg. 153/04") as amended. A copy of the soil analytical results is provided in the Laboratory Certificates of Analysis, attached to Appendix B.

The soil analytical results were compared with the Ontario Ministry of the Environment and Climate Change ("MOECC") "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", April 2011, Table 1: Full Depth Background Site Condition Standards for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Uses ("2011 MOECC Table 1 Standards"); Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition ("2011 MOECC Table 2 Standards"), and Table 3: Full Depth Generic Site Condition Standards in a non-potable Ground Water Condition ("2011 MOECC Table 3 Standards").

Based on the comparison, exceedances of MOECC Table 1, Table 2 or Table 3 standards were noted for Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) in the tested soil samples in Boreholes BH1 and BH2 and Corehole CH2, and Copper in Corehole CH2. The exceedance values detected in the soil samples are summarized in the following table:

Soil Sample ID	Parameter	Detected Value / Unit	MOECC Table 1 Standards Guideline Value	MOECC Table 2 and 3 Standards (R/P/I) Guideline Value	MOECC Table 2 and 3 Standards (I/C/C) Guideline Value
BH1 AS1B	EC	0.967 mS/cm	**0.57**	**0.7**	1.4
	SAR	27.1	**2.4**	**5**	**12**
BH3 SS2	EC	0.585 mS/cm	**0.57**	0.7	1.4
CH2 SS2	Copper	96 µg/g	**92**	140	230
	EC	1.14 mS/cm	**0.57**	**0.7**	1.4
	SAR	15.9	**2.4**	**5**	**12**

Note: R/P/I = Residential, Parkland and Institutional Property Use
I/C/C = Industrial, Commercial and Community property Use
0.57 = standard value exceeded by the analytical result

7.3 Discussion of Analytical Results

Based on the analytical results, no exceedances were found for PHCs in the soil samples analyzed; however, exceedances of the MOECC Table 1, Table 2 or Table 3 Standards were noted for EC, SAR and Copper in the tested soil samples from Borehole BH1 and Corehole CH2. It should be noted that the samples selected for analysis were taken from the boreholes located on the roadway. The elevated EC and SAR values in the tested soil samples may likely be attributed to the application of de-icing salt on the road.

Based on the results of soil sample analysis, GeoPro would recommend the following disposal options:

1) The soils generated at the Site at the same tested sample depth from Borehole BH4 can be re-used on Site or re-used at a receiving site which is not used for agricultural purposes and would accept the soils as per the test results;

2) The soils generated at the Site at the same tested sample depth from Borehole BH3 can be re-used for the on-site development, provided that the soils will not be in contact with groundwater, or re-used at a receiving site which is not considered as an environmentally sensitive site and would accept the soil as per the test results;

3) The soils generated at the Site at the same tested sample depth from Borehole BH1 may be disposed at facilities, which are suitable to accept salt-impacted excess soil (i.e., certain former aggregate sites, mines, etc.); however, additional chemical testing may be required by these facilities; and

4) The soils generated at the Site at the same tested sample depths from Corehole CH2 may be disposed at a licensed landfill site; however, additional chemical testing under O. Reg. 347 as amended may be required by the landfill site.

It should be noted that the results of the chemical analysis refer only to the soil samples analyzed, which were obtained from specific sampling locations and sampling depths, and that the soil chemistry may vary between and beyond the location and depth of the samples taken. Therefore, soil materials to be used on site or transported to other sites must be inspected during excavation for indication of variance in composition or any chemical/environmental constraints. If conditions indicate significant variations, further chemical analyses should be carried out.

Please note that the level of testing outlined herein is meant to provide a broad indication of soil quality based on the limited soil samples tested. The analytical results contained in this report should not be considered a warranty with respect to the soil quality or the use of the soil for any specific purpose. Furthermore, it must be noted that our scope of work was only limited to the review of the analytical results of the limited number of samples. The scope of work did not include any environmental evaluation or assessment of the subject site (such as a Phase One or Phase Two Environmental Site Assessment).

Sites accepting fill may have requirements relating to its aesthetic or engineering properties in addition to its chemical quality. Some receiving sites may have specific chemical testing protocols, which may require additional tests to meet the requirements. The requirements for accepting the fill at an off-site location must be confirmed in advance. GeoPro would be pleased to assist once the receiving sites are determined and the requirements of the receiving sites are available.

8 MONITORING AND TESTING

The geotechnical aspects of the final design drawings and specifications should be reviewed by this office prior to tendering and construction, to confirm that the intent of this report has been met. During construction, full-time engineered fill monitoring and sufficient foundation

inspections, subgrade inspections, in-situ density tests and materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes, and to monitor conformance to the pertinent project specification.

9 CLOSURE

We appreciate the opportunity to be of service to you and trust that this report provides sufficient geotechnical engineering information to facilitate the detailed design of this project. We look forward to providing you with continuing service during the construction stage. Please do not hesitate to contact our office should you wish to discuss, in further detail, any aspects of this project.

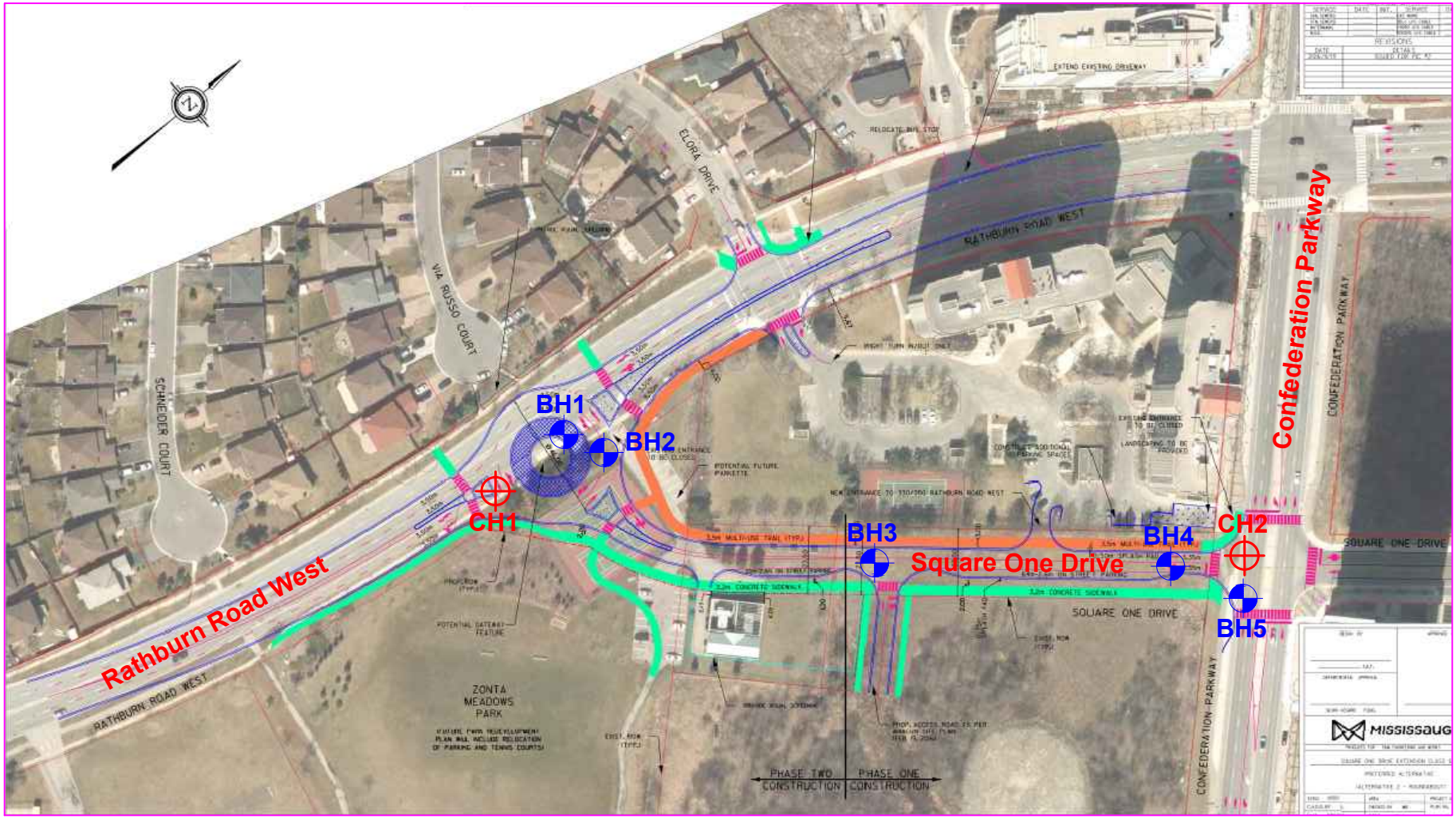
Yours very truly,

GEOPRO CONSULTING LIMITED

Jessica Yao, P.Eng.
Senior Geotechnical Engineer

David B. Liu, P.Eng., Principal

DRAWINGS



Legend:

Borehole Location

Corehole Location

Client:	**Stantec Consulting Limited**			Project No.: **15-1151-01**	Drawing No.: **1**
Drawn:	**GH**	Approved:	**DL**	Title:	**Borehole Location Plan**
Date:	**March, 2017**	Scale:	**N.T.S.**	Project:	**Geotechnical and Pavement Investigation for Square One Drive, Mississauga, Ontario City of Mississauga FA.49.464-15**
Original Size:	**Letter**	Rev:	**TP**		*GeoPro* Consulting Limited

ENCLOSURES

Enclosure 1A: Notes on Sample Descriptions

1. Each soil stratum is described according to the *Modified Unified Soil Classification System*. The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined according to Canadian Foundation Engineering Manual, 4th Edition. Different soil classification systems may be used by others. Please note that a description of the soil stratums is based on visual and tactile examination of the samples augmented with field and laboratory test results, such as a grain size analysis and/or Atterberg Limits testing. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

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Enclosure 1B: Explanation of Terms Used in the Record of Boreholes

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube Sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

PM – Samples advanced by manual pressure
WR – Samples advanced by weight of sampler and rod
WH – Samples advanced by static weight of hammer

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60 degree conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurement of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

Textural Classification of Soils (ASTM D2487)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm – 4.75 mm
Silt	0.002 mm-0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Compactness Condition (Formerly Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

LOG OF BOREHOLE BH1

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Feb/01/2017

REF. NO.: 15-1151

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT CONCRETE:** (130 mm)										
0.1	**GRANULAR BASE/SUBBASE:** (550 mm)		1A	AS					○		
0.7	**CLAYEY SILT TILL/ SHALE COMPLEX:** trace to some sand, trace gravel, containing cobbles and boulders, containing shale/ siltstone/limestone fragments, brown to grey, moist, very stiff to hard		1B	AS					○		
1			2	SS	21				○		
			3	SS	54				○		
2.0	**END OF BOREHOLE** Note: 1) The borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε_{f}=3% Strain at Failure

LOG OF BOREHOLE BH2

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Mar/10/2017

REF. NO.: 15-1151

ENCL NO.: 3

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** (250 mm)										
0.3	**FILL:** clay silt, trace sand, trace gravel, trace organics/rootlets, organic odour, containing wood fragments, dark grey, moist, firm		1A	SS	8						
0.5	**CLAYEY SILT TILL/SHALE COMPLEX:** trace to some sand, trace gravel, containing cobbles and boulders, containing shale/siltstone/limestone fragments, grey, moist, firm to hard		1B	SS							
1			2	SS	61						
1.2	**WEATHERED SHALE:** containing layers of siltstone/limestone, grey										
1.3	**END OF BOREHOLE DUE TO SPOON REFUSAL ON PROBABLE SHALE BEDROCK** Note: 1) The borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon}$=3% Strain at Failure

LOG OF BOREHOLE BH3

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Mar/10/2017

REF. NO.: 15-1151

ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** (150 mm)											
0.2	**FILL:** clayey silt, trace sand, trace gravel, some organics/rootlets, organic odour, containing siltstone/limestone fragments, dark brown, moist, firm		1A	SS	5				○ at 30			
0.5	**CLAYEY SILT:** trace sand, trace gravel, trace organics/rootlets, containing shale fragments, brown to grey, moist, firm		1B	SS					○ at 20			
0.6	**CLAYEY SILT TILL/ SHALE COMPLEX:** trace to some sand, trace gravel, seams of sand, containing cobbles and boulders, containing shale/limestone/siltstone fragments, grey, moist, very stiff to hard		2	SS	22				○ at 10			
1			3	SS	50/130 mm				○ at 20			
1.4	**END OF BOREHOLE DUE TO SPOON REFUSAL** Note: 1) Water encountered at a depth of 0.6 m below ground surface (mBGS) during drilling.											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH4

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Mar/10/2017

REF. NO.: 15-1151

ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** (150 mm)											
0.2	**FILL:** gravelly sand, some silt, trace organics/rootlets, dark brown, moist, compact		1A	SS	11				○			
0.5	**FILL:** fine sand, some silt, trace gravel, trace rootlets, brown, moist, compact		1B	SS					○			
0.5	**FILL:** clayey silt, trace sand, trace gravel, some organics, dark brown, moist, stiff to hard		1C	SS					○			
			2A	SS					○			
1.0	**CLAYEY SILT TILL/SHALE COMPLEX:** trace to some sand, trace gravel, containing cobbles and boulders, containing shale/siltstone/limestone fragments, brown, moist, hard		2B	SS	64				○			
			3	SS	67/280 mm				○			
1.8	**WEATHERED SHALE:** containing layers of siltstone/limestone, grey											
1.8	**END OF BOREHOLE DUE TO SPOON REFUSAL ON PROBABLE SHALE BEDROCK** Note: 1) Water encountered at a depth of 0.9 m below ground surface (mBGS) during drilling.											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH5

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Mar/10/2017

REF. NO.: 15-1151

ENCL NO.: 6

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
0.0	**ASPHALT CONCRETE:** (150 mm)						
0.2	**GRANULAR BASE/SUBBASE:** (650 mm)		1	AS			
0.8	**CLAYEY SILT:** trace sand, containing shale/limestone fragments, containing cobbles and boulders, brown to grey, moist, very stiff		2	SS	26		
1.4	**SANDY SILT/ SHALE COMPLEX:** trace clay, grey, moist, very dense		3	SS	50/50 mm		
1.7	**WEATHERED SHALE:** containing limestone fragments, grey						
1.7	**END OF BOREHOLE DUE TO SPOON REFUSAL ON PROBABLE SHALE BEDROCK** Note: 1) The borehole was open and dry upon completion of drilling.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

LOG OF BOREHOLE CH1

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Feb/01/2017

REF. NO.: 15-1151

ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT CONCRETE:** (130 mm)										
0.1	**GRANULAR BASE/SUBBASE:** (510 mm)		1A	AS					○		
0.6	**CLAYEY SILT TILL:** trace to some sand, trace gravel, containing cobbles and boulders, containing shale fragments, brown to grey, moist, stiff		1B	AS							
1			2	SS	13				○		
1.4	**CLAYEY SILT TILL/ SHALE COMPLEX:** trace to some sand, trace gravel, containing shale/siltstone/limestone fragments, grey, moist, very stiff		3	SS	27				○		
2.0	**END OF BOREHOLE** Note: 1) The borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE CH2

PROJECT: Geotechnical Investigation for Square One Drive Extension

CLIENT: Stantec Consulting Limited

PROJECT LOCATION: Mississauga, Ontario

DATUM: N/A

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155 mm

Date: Feb/01/2017

REF. NO.: 15-1151

ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT CONCRETE:** (160 mm)										
0.2	**GRANULAR BASE/BASE:** (680 mm)		1A	AS					○		
0.8	**CLAYEY SILT TILL/ SHALE COMPLEX:** trace fine sand, containing shale fragments, brown, moist, stiff to hard		2B	SS	13				○		
1.7	**WEATHERED SHALE:** containing siltstone/limestone fragments, grey		3	SS	50/100 mm				○		
1.8	**END OF BOREHOLE DUE TO SPOON REFUSAL ON PROBABLE SHALE BEDROCK** Note: 1) The borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon_f}$=3% Strain at Failure

FIGURES

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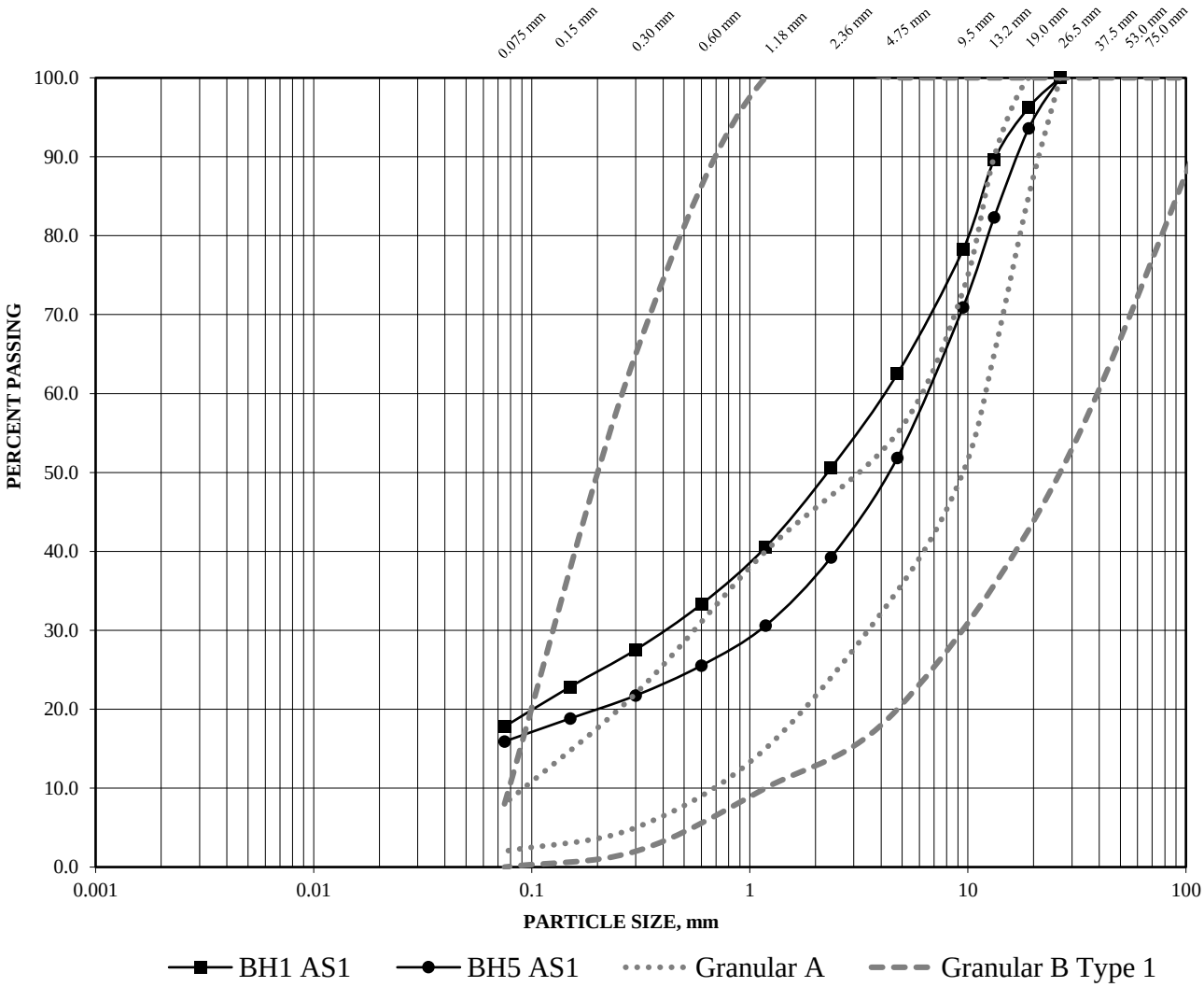
Figure 1

PARTICLE SIZE DISTRIBUTION

U.S. BUREAU	CLAY	SILT			VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL		
UNIFIED	FINES (SILT & CLAY)					FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL		COBBLES
M.I.T.	CLAY	SILT			SAND			GRAVEL				COBBLES
		FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE					



Project No.	15-1151
Project Name	Square One Drive Extension, Mississauga

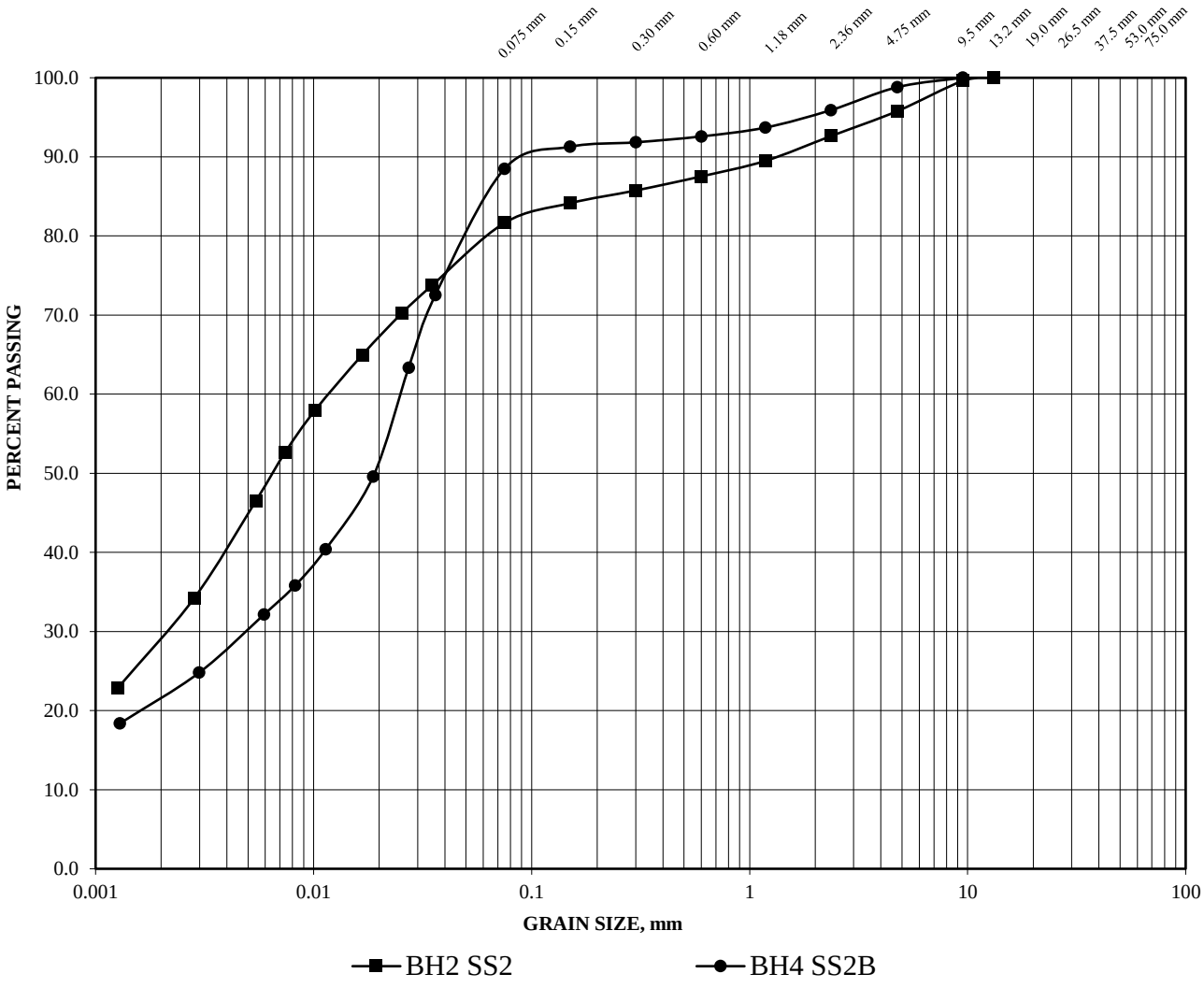
GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

Figure 2

GRAIN SIZE DISTRIBUTION

U.S. BUREAU	CLAY	SILT			VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL		
UNIFIED	FINES (SILT & CLAY)					FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL	COBBLES	
M.I.T.	CLAY	SILT			SAND			GRAVEL			COBBLES	
		FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE					



Project No.	15-1151
Project Name	Square One Drive Extension, Mississauga

APPENDIX A

Photograph 1 – AC Core 1

Photograph 2 – AC Core 2

APPENDIX B

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GEOPRO CONSULTING LTD
40 VOGELL ROAD UNIT 25-27
RICHMOND HILL, ON L4B3N6
(905) 237-8336

ATTENTION TO: Bujing Guan

PROJECT: 15-1151

AGAT WORK ORDER: 17T188032

SOIL ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Feb 28, 2017

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:T. P.

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2017-02-16

DATE REPORTED: 2017-02-28

		SAMPLE DESCRIPTION:		CH2 SS2	BH1 AS1B
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2017-02-01	2017-02-01
Parameter	Unit	G / S	RDL	8197505	8197506
Antimony	µg/g	1.3	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	6	6
Barium	µg/g	220	2	28	38
Beryllium	µg/g	2.5	0.5	0.9	<0.5
Boron	µg/g	36	5	10	7
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.25	0.20
Cadmium	µg/g	1.2	0.5	<0.5	<0.5
Chromium	µg/g	70	2	24	8
Cobalt	µg/g	21	0.5	16.9	4.2
Copper	µg/g	92	1	96	27
Lead	µg/g	120	1	7	7
Molybdenum	µg/g	2	0.5	<0.5	<0.5
Nickel	µg/g	82	1	35	9
Selenium	µg/g	1.5	0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.7	<0.5
Vanadium	µg/g	86	1	30	13
Zinc	µg/g	290	5	85	35
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	1.14	0.967
Sodium Adsorption Ratio	NA	2.4	NA	15.9	27.1
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.96	8.20

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

8197505-8197506 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Elizabeth Rolokowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:T. P.

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2017-02-16

DATE REPORTED: 2017-02-28

		SAMPLE DESCRIPTION:		CH1 AS1B	BH5 AS1
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2017-02-01	2017-02-01
Parameter	Unit	G / S	RDL	8197501	8197508
Benzene	µg/g	0.02	0.02	<0.02	<0.02
Toluene	µg/g	0.2	0.08	<0.08	<0.08
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05
Xylene Mixture	µg/g	0.05	0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g	25	5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	210
F4 (C34 to C50)	µg/g	120	50	<50	100
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA
Moisture Content	%		0.1	4.7	2.6
Surrogate	Unit	Acceptable Limits			
Terphenyl	%	60-140		86	100

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

8197501-8197508 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By:

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

5835 COOPERS AVENUE
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CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8197505	CH2 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Copper	µg/g	92	96
8197505	CH2 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	1.14
8197505	CH2 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	15.9
8197506	BH1 AS1B	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	0.967
8197506	BH1 AS1B	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	27.1

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Quality Assurance

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:T. P.

Soil Analysis

RPT Date: Feb 28, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	8195051		<0.8	<0.8	NA	< 0.8	111%	70%	130%	102%	80%	120%	76%	70%	130%
Arsenic	8195051		6	6	0.0%	< 1	113%	70%	130%	106%	80%	120%	105%	70%	130%
Barium	8195051		138	144	4.3%	< 2	102%	70%	130%	100%	80%	120%	109%	70%	130%
Beryllium	8195051		0.8	0.8	NA	< 0.5	93%	70%	130%	107%	80%	120%	97%	70%	130%
Boron	8195051		7	6	NA	< 5	93%	70%	130%	103%	80%	120%	93%	70%	130%
Boron (Hot Water Soluble)	8197925		<0.10	<0.10	NA	< 0.10	125%	60%	140%	99%	70%	130%	93%	60%	140%
Cadmium	8195051		<0.5	<0.5	NA	< 0.5	104%	70%	130%	112%	80%	120%	109%	70%	130%
Chromium	8195051		27	27	0.0%	< 2	97%	70%	130%	110%	80%	120%	128%	70%	130%
Cobalt	8195051		14.4	15.0	4.1%	< 0.5	105%	70%	130%	112%	80%	120%	110%	70%	130%
Copper	8195051		35	35	0.0%	< 1	100%	70%	130%	111%	80%	120%	108%	70%	130%
Lead	8195051		11	11	0.0%	< 1	106%	70%	130%	107%	80%	120%	105%	70%	130%
Molybdenum	8195051		0.6	0.6	NA	< 0.5	106%	70%	130%	103%	80%	120%	103%	70%	130%
Nickel	8195051		33	34	3.0%	< 1	110%	70%	130%	116%	80%	120%	113%	70%	130%
Selenium	8195051		<0.4	<0.4	NA	< 0.4	93%	70%	130%	102%	80%	120%	104%	70%	130%
Silver	8195051		<0.2	<0.2	NA	< 0.2	116%	70%	130%	115%	80%	120%	125%	70%	130%
Thallium	8195051		<0.4	<0.4	NA	< 0.4	104%	70%	130%	105%	80%	120%	106%	70%	130%
Uranium	8195051		0.8	0.8	NA	< 0.5	98%	70%	130%	98%	80%	120%	99%	70%	130%
Vanadium	8195051		36	37	2.7%	< 1	102%	70%	130%	107%	80%	120%	123%	70%	130%
Zinc	8195051		64	65	1.6%	< 5	105%	70%	130%	114%	80%	120%	126%	70%	130%
Chromium VI	8199238		<0.2	<0.2	NA	< 0.2	99%	70%	130%	107%	80%	120%	103%	70%	130%
Cyanide	8197505	8197505	<0.040	<0.040	NA	< 0.040	104%	70%	130%	96%	80%	120%	102%	70%	130%
Mercury	8195051		<0.10	<0.10	NA	< 0.10	91%	70%	130%	89%	80%	120%	92%	70%	130%
Electrical Conductivity	8167018		3.64	3.72	2.2%	< 0.005	91%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8167018		1.32	1.35	2.2%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8197506	8197506	8.20	8.19	0.1%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Elizabeth Rolakowska

AGAT Laboratories

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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:T. P.

Trace Organics Analysis

RPT Date: Feb 28, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	8195247		< 0.02	< 0.02	NA	< 0.02	101%	60%	130%	106%	60%	130%	113%	60%	130%
Toluene	8195247		< 0.08	< 0.08	NA	< 0.08	101%	60%	130%	80%	60%	130%	108%	60%	130%
Ethylbenzene	8195247		< 0.05	< 0.05	NA	< 0.05	105%	60%	130%	86%	60%	130%	93%	60%	130%
Xylene Mixture	8195247		< 0.05	< 0.05	NA	< 0.05	102%	60%	130%	99%	60%	130%	101%	60%	130%
F1 (C6 to C10)	8195247		< 5	< 5	NA	< 5	88%	60%	130%	95%	85%	115%	81%	70%	130%
F2 (C10 to C16)	8197723		< 10	< 10	NA	< 10	104%	60%	130%	102%	80%	120%	83%	70%	130%
F3 (C16 to C34)	8197723		< 50	< 50	NA	< 50	103%	60%	130%	102%	80%	120%	94%	70%	130%
F4 (C34 to C50)	8197723		< 50	< 50	NA	< 50	92%	60%	130%	98%	80%	120%	95%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T188032

PROJECT: 15-1151

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:T. P.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID

AGAT Laboratories

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Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

SR-10 / Rush

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 17T188032

Cooler Quantity:

Arrival Temperatures: 7.7 | 8.1 | 8.1 / 6.9 | 7.1 | 7.1

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: GeoPro Consulting Ltd.
Contact: Buying Guan
Address: Unit 57, 46 Vogell Rd, Richmond Hill, ON
Phone: 905-237-8336 Fax: 905-248-3699
Reports to be sent to:
1. Email: bguan@geoproconsulting.ca
2. Email: tedp@geoproconsulting.ca

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 *Indicate One*
☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture *(Check One)* ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region _____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
_____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): _____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 15-1151
Site Location: Mississauga
Sampled By: Ted Pan
AGAT Quote #: GeoPro PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	O. Reg 153: All Metals ☐ 153 Metals (excl. Hydrides)	O. Reg 153: Hydride Metals	O. Reg 153: ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use
CH1 AS1B	Feb 1, 2017	PM	2	S											X						
CH2 SS2	Feb 1, 2017	PM	1	S			X														
BH1 AS1B	Feb 1, 2017	PM	1	S			X														
BH5 AS1	Feb 1, 2017	PM	2	S											X						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
2017/02/16			2017/02/16		12:10
Samples Relinquished By (Print Name and Sign): 2017/02/16	Date	Time 2:10	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign): Shannon Feb 16/17	Date 2:10p	Time

Page 1 of 1

N°: T 046417

AGAT Laboratories

5835 COOPERS AVENUE
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CLIENT NAME: GEOPRO CONSULTING LTD
40 VOGELL ROAD UNIT 25-27
RICHMOND HILL, ON L4B3N6
(905) 237-8336

ATTENTION TO: Bujing Guan

PROJECT: 15-1151

AGAT WORK ORDER: 17T197849

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Mar 29, 2017

PAGES (INCLUDING COVER): 6

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
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FAX (905)712-5122
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Certificate of Analysis

AGAT WORK ORDER: 17T197849

PROJECT: 15-1151

CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2017-03-20

DATE REPORTED: 2017-03-29

		SAMPLE DESCRIPTION:		BH3 SS2	BH4 SS1A
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2017-03-10	2017-03-10
Parameter	Unit	G / S	RDL	8264955	8264958
Antimony	µg/g	1.3	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	8	4
Barium	µg/g	220	2	46	30
Beryllium	µg/g	2.5	0.5	0.8	<0.5
Boron	µg/g	36	5	14	7
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.37	0.15
Cadmium	µg/g	1.2	0.5	<0.5	<0.5
Chromium	µg/g	70	2	23	8
Cobalt	µg/g	21	0.5	16.6	3.7
Copper	µg/g	92	1	64	15
Lead	µg/g	120	1	5	33
Molybdenum	µg/g	2	0.5	<0.5	0.7
Nickel	µg/g	82	1	33	7
Selenium	µg/g	1.5	0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.8	0.5
Vanadium	µg/g	86	1	31	18
Zinc	µg/g	290	5	69	269
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.585	0.151
Sodium Adsorption Ratio	NA	2.4	NA	0.639	0.173
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.95	7.96

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

8264955-8264958 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Amanjot Bhela

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Guideline Violation

AGAT WORK ORDER: 17T197849

PROJECT: 15-1151

CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8264955	BH3 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	0.585

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Quality Assurance

CLIENT NAME: GEOPRO CONSULTING LTD
AGAT WORK ORDER: 17T197849
PROJECT: 15-1151
ATTENTION TO: Bujing Guan
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date: Mar 29, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	8264958	8264958	<0.8	<0.8	NA	< 0.8	109%	70%	130%	101%	80%	120%	103%	70%	130%
Arsenic	8264958	8264958	4	4	NA	< 1	108%	70%	130%	101%	80%	120%	110%	70%	130%
Barium	8264958	8264958	30	30	0.0%	< 2	104%	70%	130%	98%	80%	120%	110%	70%	130%
Beryllium	8264958	8264958	<0.5	<0.5	NA	< 0.5	89%	70%	130%	101%	80%	120%	100%	70%	130%
Boron	8264958	8264958	7	7	NA	< 5	73%	70%	130%	104%	80%	120%	103%	70%	130%
Boron (Hot Water Soluble)	8264536		<0.10	<0.10	NA	< 0.10	107%	60%	140%	101%	70%	130%	95%	60%	140%
Cadmium	8264958	8264958	<0.5	<0.5	NA	< 0.5	102%	70%	130%	105%	80%	120%	114%	70%	130%
Chromium	8264958	8264958	8	8	NA	< 2	90%	70%	130%	100%	80%	120%	113%	70%	130%
Cobalt	8264958	8264958	3.7	3.7	0.0%	< 0.5	98%	70%	130%	105%	80%	120%	105%	70%	130%
Copper	8264958	8264958	15	15	0.0%	< 1	94%	70%	130%	112%	80%	120%	104%	70%	130%
Lead	8264958	8264958	33	33	0.0%	< 1	106%	70%	130%	101%	80%	120%	102%	70%	130%
Molybdenum	8264958	8264958	0.7	0.7	NA	< 0.5	110%	70%	130%	103%	80%	120%	118%	70%	130%
Nickel	8264958	8264958	7	7	0.0%	< 1	98%	70%	130%	106%	80%	120%	105%	70%	130%
Selenium	8264958	8264958	<0.4	<0.4	NA	< 0.4	114%	70%	130%	100%	80%	120%	114%	70%	130%
Silver	8264958	8264958	<0.2	<0.2	NA	< 0.2	118%	70%	130%	115%	80%	120%	122%	70%	130%
Thallium	8264958	8264958	<0.4	<0.4	NA	< 0.4	102%	70%	130%	102%	80%	120%	106%	70%	130%
Uranium	8264958	8264958	0.5	0.5	NA	< 0.5	95%	70%	130%	94%	80%	120%	98%	70%	130%
Vanadium	8264958	8264958	18	18	0.0%	< 1	96%	70%	130%	99%	80%	120%	112%	70%	130%
Zinc	8264958	8264958	269	262	2.6%	< 5	100%	70%	130%	110%	80%	120%	121%	70%	130%
Chromium VI	8257361		<0.2	<0.2	NA	< 0.2	96%	70%	130%	96%	80%	120%	95%	70%	130%
Cyanide	8262148		<0.040	<0.040	NA	< 0.040	106%	70%	130%	105%	80%	120%	107%	70%	130%
Mercury	8264958	8264958	<0.10	<0.10	NA	< 0.10	98%	70%	130%	94%	80%	120%	80%	70%	130%
Electrical Conductivity	8265219		0.338	0.335	0.9%	< 0.005	94%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8270799		0.727	0.742	2.0%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8259663		9.79	9.77	0.2%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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Method Summary

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T197849

PROJECT: 15-1151

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

AGAT Laboratories

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Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 17T197849

Cooler Quantity:

Arrival Temperatures: 4.5 | 4.3 | 4.2 / 36 | 34 | 37

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: GeoPro Consulting Ltd.
Contact: Bujing Guan
Address: Unit 57, 40 Vogell Rd, Richmond Hill, ON
Phone: 905-237-8336 Fax: 905-248-3699
Reports to be sent to:
1. Email: bguan@geoproconsulting.ca
2. Email: tedp@geoproconsulting.ca

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 (Indicate One)
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☒ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ (Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): ____

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 15-1151
Site Location: Mississauga George Hts
Sampled By:
AGAT Quote #: GeoPro PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☐ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	All Metals ☐ 153 Metals (excl. Hydrides)	Hydride Metals	ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use
BH3 SS2	Mar 10, 2017	AM	1	S			X														
BH4 SS1A	Mar 10, 2017	AM	1	S			X														

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Kaiying Qiu	2017/3/20	4:35		2017/3/20	1:03

Page ____ of ____

N°: T 039864

LIMITATIONS TO THE REPORT

This report is intended solely for the Client named. The report is prepared based on the work has been undertaken in accordance with normally accepted geotechnical engineering practices in Ontario.

The comments and recommendations given in this report are based on information determined at the limited number of the test hole and test pit locations. The boundaries between the various strata as shown on the borehole logs are based on non-continuous sampling and represent an inferred transition between the various strata and their lateral continuation rather than a precise plane of geological change. Subsurface and groundwater conditions between and beyond the test holes and test pits may differ significantly from those encountered at the test hole and test pit locations. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole and test pit locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The report reflects our best judgment based on the information available to GeoPro Consulting Limited at the time of preparation. Unless otherwise agreed in writing by GeoPro Consulting Limited, it shall not be used to express or imply warranty as to any other purposes. No portion of this report shall be used as a separate entity, it is written to be read in its entirety. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated.

The design recommendations given in this report are applicable only to the project designed and constructed completely in accordance with the details stated in this report.

Should any comments and recommendations provided in this report be made on any construction related issues, they are intended only for the guidance of the designers. The number of test holes and test pits may not be sufficient to determine all the factors that may affect construction activities, methods and costs. Such as, the thickness of surficial topsoil or fill layers may vary significantly and unpredictably; the amount of the cobbles and boulders may vary significantly than what described in the report; unexpected water bearing zones/layers with various thickness and extent may be encountered in the fill and native soils. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and make their own conclusions as to how the subsurface conditions may affect their work and determine the proper construction methods.

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. GeoPro Consulting Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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