REPORT

Region of Peel

Geotechnical and Pavement Investigation Coleraine Drive Grade Separation

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Distribution List

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by CIMA+ (CIMA) to provide preliminary geotechnical and pavement engineering services in support of the Class Environmental Assessment study for the proposed grade separation of Coleraine Drive south of Old Ellwood Drive, and pavement rehabilitation and widening of Coleraine Drive, in the Town of Caledon, Ontario (see Figure 1). The report also provides recommendations for excess soil that may be generated during the construction based on limited environmental testing. It is prudent to confirm the adequacy of the environmental testing and confirm the recommendations provided herein during detail design.

The purpose of the investigation was to determine the subsurface soil and groundwater conditions at the site by means of a limited number of boreholes and based on our interpretation of the data, to provide preliminary geotechnical and pavement engineering recommendations for the project, and recommendations for additional work during detail design of the project. The investigation and reporting was carried out in accordance with the scope of work provided in our Proposal No. P1665649, dated September 23, 2016. The scope of work was developed based on the requirements of the Terms of Reference outlined in The Regional Municipality of Peel's TOR 2016-568P, Project 16-4315.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid.

This report should be read in conjunction with "Important Information and Limitations of This Report", following the text of this report. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 PROJECT AND SITE DESCRIPTION

It is understood that a Scehdule 'C' Municipal Class Environmental Assessment (EA) was proposed for an approximately 1.0 centreline kilometre section of Coleraine Drive between Harvest Moon Drive/King Street West and Holland Drive in the Town of Caledon, Ontario. The existing Coleraine Drive is an arterial road with four through lanes and a center turning lane. The CP Rail traverses Coleraine Drive south of Old Ellwood Drive, and a tributary of the Humber River crosses Coleraine Drive near the northern limit of the project. In general, residential developments are located to the north of CP Rail while industrial/commercial developments are located to the south. A storm water management pond is present at the southwest corner of Coleraine Drive and Harvest Moon Drive and drains to the Humber River tributary. It is also understood that an existing retaining wall at the southwest corner of Harvest Moon Drive and Coleraine Drive will need to be relocated as part of the Coleraine Drive widening.

As part of the EA, consideration has been given to widening the 1.0 km long section of Coleraine Drive, adding one through lane in each direction and constructing a grade separation structure at the intersection with the CP Rail. The details of the grade separation structure are not available at this time and both overhead (a structure carrying a road over a railway) and subway (a structure carrying a railway over a road) options are being considered.

3.0 SUBSURFACE EXPLORATION PROCEDURES

Golder's field investigation for this assignment included carrying out a borehole subsurface exploration, pavement visual condition inspection and Falling Weight Deflectometer (FWD) load/deflection testing. The geotechnical and pavement exploration was carried out between January 26 and July 14, 2017, during which time a total of 16 boreholes (designated as Boreholes BH17-01 to BH17-16) were advanced at the locations shown on Figure 1, Borehole Location plan.

Our exploration methodologies and findings are detailed in the following sections of this report.

3.1 Borehole Exploration

The boreholes were advanced using a CME-75 truck-mounted drill rig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard Penetration Testing (SPT) and sampling were carried out at 0.75 m to 1.5 m intervals of depth in the boreholes using conventional 35 mm internal diameter split-spoon sampling equipment advanced using an automatic hammer. Groundwater conditions were noted in the open boreholes during drilling and four monitoring wells were installed in Boreholes BH17-04, BH17-07, BH17-09 and BH17-14, to permit monitoring of the groundwater conditions at these locations. The monitoring wells consist of 50 mm diameter PVC pipe, with a slotted screen sealed at a selected depth within the boreholes. The borehole and annulus surrounding the monitoring wells above the screen sand pack was backfilled to the ground surface with bentonite pellets/grout, in accordance with Ontario Regulation 903 (as amended). Monitoring well installation details and groundwater level readings are described on the Record of Boreholes presented in Appendix A. All other boreholes were backfilled using cement/bentonite grout or bentonite pellets in accordance with Ontario Regulation 903 (as amended); road surface was reinstated using cold-patch asphalt.

The fieldwork was observed by a member of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground utilities, supervised the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's geotechnical laboratory in Mississauga, Ontario where the samples underwent further visual examination and laboratory testing. Classification testing (water content determination, grain size distribution, and Atterberg limits) was carried out on selected soil samples. All laboratory testing were carried out in accordance with ASTM standards.

3.2 Visual Condition Inspection

A member of Golder's engineering and technical staff carried out a pavement visual condition inspection of Coleraine Drive between Holland Drive and Harvest Moon Drive on January 26, 2017 to observe the existing type, severity and density of surface distresses. This section of Coleraine Drive has two through lanes in each direction as well as turning lanes at the intersections and an urban cross section, with gutters and catch basins.

3.3 Falling Weight Deflectometer Testing

The FWD load/deflection testing was carried out on the inside lane (Lane 1) and outside lane (Lane 2) of Coleraine Drive. The testing was carried out in both the northbound and southbound directions between Holland Drive and Harvest Moon Drive. For both directions, the testing in each lane was carried out at 50 m intervals, and the test points in adjacent lanes were staggered by 25 m.

The FWD load/deflection testing was carried out on the above-mentioned pavement section on July 14, 2017. Testing was performed by a calibrated FWD unit owned and operated by Golder. During the FWD testing an impulse load similar in magnitude and duration to a moving truck wheel load was applied to a loading plate sitting on the pavement surface. The response of the pavement (resulting pavement deflection) to the applied load was measured using eight seismic transducers (geophones) spaced at predetermined intervals from the centre of the loading plate (0, 200, 300, 500, 600, 900, 1200 and 1500 mm). From these deflection readings shape of the deflection basin at a specific location was determined. At each test location three selected load impulses of about 40, 55 and 70 kN were applied to the pavement and deflections were measured for each load pulse.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The site is located in the South Slope physiographic region, close to the border of the Peel Plain, as delineated in *The Physiography of Southern Ontario (Chapman and Putnam, 1984)*.[1]

The South Slope is a smooth and drumlinized till plain that has formed as a result of glacial actions and deposition of till materials to the south of the Oak Ridges Moraine. Various soil layers and types have been deposited over the till layer within the South Slope plain.

4.2 Subsurface Conditions

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the borehole records, following the text of this report. Method of Soil Classification and Symbols and Terms Used on Records of Boreholes are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the soil deposits have been inferred from drilling 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 will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this investigation, followed by more detailed descriptions of the major soil deposits and shallow groundwater conditions.

In general, boreholes encountered the pavement structure at ground surface, underlain by granular fill material comprised of gravelly sand to sand and gravel to gravelly silty sand, underlain by a silty clay fill. The fill material is underlain by a till deposit consisting of stiff to hard silty clay in all boreholes.

In Boreholes BH17-08 and BH17-09 the till material is underlain by a silt deposit which in turn is underlain by a cohesive silty clay/clayey silt deposit.

A detail description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Fill – (SP-SM) to (SM) Gravelly Sand to Silty Sand

A 180 mm to 240 mm thick layer of asphalt (average thickness of 212 mm) was encountered at ground surface in all boreholes.

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[1] Chapman, L.J. and Putnam, D,F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P. 2715, Scale 1:600,000.

Approximately 0.4 m to 2.8 m of non-cohesive (granular) fill was encountered below the asphalt layer in all borehole locations. The non-cohesive fill is comprised of sand and gravel to gravelly sand to silty sand and extends to depths of 0.6 m to 3 m.

A summary of the pavement structure encountered throughout the project length is presented in Table 1 below.

Table 1: Pavement Structure

Borehole	Layer Thickness	
	Asphalt (mm)	Granular Material (mm)
17-01	230	840*
17-02	240	700
17-03	230	840*
17-04	200	710
17-05	230	840
17-06	230	530
17-07	200	870
17-08	240	520
17-09	200	710
17-10	230	680
17-11	220	850
17-12	200	870
17-13	200	870
17-14	180	430
17-15	180	730
17-16	180	890
Average	212	743
* additional underlying sand layer		

The SPT ‘N’-values measured within the non-cohesive fill layer range from 6 blows to 67 blows per 0.3 m of penetration, indicating a loose to very dense state of compactness.

The natural water contents measured on samples of the fill range from about 4 per cent to 12 per cent.

The results of grain size analyses carried out on five samples of the non-cohesive fill are presented on Figure B1. In general, the samples were within the gradation envelope of Granular ‘B’ Type I with the exception of the material passing the 75 µm sieve which exceeded the allowable limit.

4.2.2 Fill – (CL/CI) Silty Clay

Approximately 0.4 m to 1.5 m of cohesive fill was encountered underlying the granular fill in Boreholes BH17-02, BH17-03, BH17-06, BH17-07, BH17-08, BH17-11 and BH17-14. The cohesive fill is comprised of low to intermediate plasticity silty clay and generally contains organics and brick and wood fragments.

The SPT ‘N’-values of the fill material typically range from 5 blows to 22 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency.

The natural water content typically ranges from about 10 per cent to 23 per cent.

4.2.3 (CL/CI) Silty Clay

A deposit of silty clay was encountered below the fill in Boreholes BH17-01, BH17-07 to BH17-13 and BH17-15. In Boreholes BH17-01, BH17-08, BH17-09 and BH17-15, the silty clay deposit was found to be between 1.1 m and 3.4 m thick. All other boreholes were terminated within this deposit at a depth of 5.2 m, corresponding to depths of penetration up to 4.3 m into the deposit. The SPT ‘N’-values within this deposit range from 7 to 25 blows per 0.3 m penetration, suggesting a firm to very stiff consistency.

The natural water contents measured on samples from this deposit range from about 21 per cent to 28 per cent.

The results of grain size analyses carried out on samples of this deposit are presented on Figure B2.

Atterberg limits tests were carried out on four samples of the silty clay deposit and measured liquid limits between 26 and 49 per cent, plastic limits between 14 and 21 per cent, corresponding to plasticity indices between 12 and 28 per cent as shown on Figure B3.

In Borehole BH17-15, a 1.6 m thick silt interlayer was encountered within the silty clay deposit at a depth of 2.1 m. The SPT ‘N’-values of the silt interlayer range from 28 blows to 44 blows per 0.3 m of penetration, indicating a very stiff to hard consistency.

A natural water content of 17 per cent was measured on a sample of silt interlayer.

An Atterberg limits test was carried out on a sample of silt deposit and measured a liquid limit about 22 per cent, a plastic limit about 20 per cent, corresponding to a plasticity index about 2 per cent. The result of the Atterberg limits tests is shown on the plasticity chart on Figure B4 and indicated that the material is classified as a silt of slight plasticity.

4.2.4 (CL/CI) Silty Clay Till – Upper

A cohesive till deposit comprised of silty clay was encountered below the fill or the silty clay deposit in Boreholes BH17-01 to BH17-06, BH17-08, BH17-09 and BH17-14 to BH17-16 at depths ranging from 0.9 m to 5.5 m. In Boreholes BH17-08 and BH17-09, the silty clay till deposit was 9 m and 6.1 m respectively.

Boreholes BH17-01 to 17-06 were terminated within this deposit at a depth of 5.2 m, corresponding to depths of penetration up to 4.3 m.

In general, the SPT ‘N’-values within the upper till deposit range from 13 blows to 35 blows per 0.3 m of penetration, suggesting a stiff to hard consistency.

The natural water contents measured on samples of the till deposit range from about 12 per cent to 25 per cent.

The results of grain size analyses carried out on samples of the silty clay till deposit are shown on Figure B5.

An Atterberg limits test was carried out on a sample of the cohesive till deposit and measured a liquid limit of about 24 per cent, a plastic limit of about 13 per cent, and a corresponding plasticity index of about 10 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure B6 and indicates that the material is classified as a silty clay of low plasticity.

4.2.5 (CL-ML) Silty Clay-Clayey Silt

In Boreholes BH17-08 and BH17-09, a cohesive deposit of silty clay-clayey silt, between 6 m and 7.6 m thick, was encountered below the till deposit at depths of 11.8 m and 12.1 m, respectively.

The SPT ‘N’-values within the silty clay-clayey silt deposit range from 11 blows to 32 blows per 0.3 m of penetration, suggesting a stiff to hard consistency.

The natural water contents measured on samples of this deposit range from about 19 per cent to 29 per cent.

A grain size distribution analysis was carried out on a sample of this deposit as shown on Figure B7.

4.2.6 (CL) Sandy Silty Clay to Silty Clay (Till) – Lower

A lower till deposit comprised of sandy silty clay to silty clay was encountered below the silty-clay-clayey silt deposit at depths of 17.8 m and 19.4 m, respectively. The lower till deposit is between 1.1 m and 2.7 m thick prior to depth of borehole termination.

The SPT ‘N’-values within the lower till deposit range from 16 blows to 32 blows per 0.3 m of penetration, suggesting a very stiff to hard consistency.

The natural water content measured on a sample of the till deposit is about 14 per cent.

A grain size distribution analysis was carried out on a sample of this deposit as shown on Figure B8.

An Atterberg limits test was carried out on a sample of this deposit and measured a liquid limit of about 21 per cent, a plastic limit of about 13 per cent, and a corresponding plasticity index of about 8 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure B9 and indicates that the material is classified as a silty clay of low plasticity.

4.3 Groundwater Conditions

All boreholes were observed to be dry upon completion of drilling. Monitoring wells were installed in Boreholes BH17-04, BH17-07, BH17-09 and BH17-04 to monitor the groundwater conditions at these locations. The groundwater level measurements in the monitoring wells installed as part of this investigation are shown in the following table.

Table 2 : Groundwater Level Measurements

	Depth to Groundwater Level below Existing Ground Surface (m)	Approximate Elevation of Groundwater Level (m)	Date
BH17-04	2.7	253.2	July 14, 2017
BH17-07	2.8	255.8	July 14, 2017
BH17-09	4.4	254.7	July 14, 2017
BH17-14	Dry	--	July 14, 2017

The groundwater level is expected to fluctuate seasonally and is expected to be higher during wet periods of the year.

5.0 PAVEMENT VISUAL CONDITION INSPECTION

Based on the visual condition inspection, the pavement was assessed to be in fair condition. The following distresses were observed:

- Frequent, slight to moderate transverse cracking;
- Intermittent, slight to moderate meandering cracking;
- Intermittent, slight to moderate fatigue cracking;
- Intermittent, slight rutting;
- Intermittent, slight distortion; and
- Frequent, slight longitudinal construction joint opening.

Patching of the full lane width has been carried out in various locations and is in good to fair condition. Cracking and distortion has developed frequently at manholes.

Photo 1 to Photo 3 show examples of the pavement condition on Coleraine Drive.

Photo 1: Transverse cracking on Coleraine Drive

Photo 2: Patching and fatigue cracking on Coleraine Drive

Photo 3: Transverse and meandering cracking on Coleraine Drive

6.0 FALLING WEIGHT DEFLECTOMETER (FWD) ANALYSIS

6.1 Normalized Deflection and Pavement Surface Modulus

The measured deflections were normalized to represent a standard wheel load of 40 kN and a standard temperature of 21°C. In addition to normalizing the measured deflections, the analysis of the FWD data also involved determination of the pavement surface modulus. Pavement surface modulus is determined using the normalized deflection measured by the geophone located at the centre of the loading plate. Pavement surface modulus is an indication of the overall load bearing/support characteristics of the entire pavement structure. The detailed analysis results are provided in Appendix C.

Based on the results of the FWD testing, the total length of Coleraine Drive that is included in this project was further subdivided into two sections, as follows:

- Section A- from Station 0+000 (Holland Drive) to 0+550; and
- Section B – from Station 0+550 to 0+950 (Harvest Moon Drive).

Table 3 shows a summary of the normalized deflections and pavement surface modulus for the tested section. The typical pavement surface modulus for a heavy traffic asphalt pavement in relatively good condition is typically between 800 MPa and 1,200 MPa. Section A for both northbound lanes and southbound Lane 2, with the exception of Section A southbound Lane 1, was either at the lower end or below this typical range, indicating that the pavement has some structural deficiency. Section B for all the lanes was within this typical range, indicating that the pavement is in relatively good structural condition.

Table 3: Summary of Normalized Deflection and Pavement Surface Modulus

Lane	Section	Normalized Deflection (mm)		Pavement Surface Modulus (MPa)	
		Mean	Standard Deviation	Mean	Standard Deviation
Northbound Lane 1	A	0.19	0.03	807	116
	B	0.15	0.03	1,038	177
Northbound Lane 2	A	0.22	0.02	678	71
	B	0.14	0.02	1,029	116
Southbound Lane 1	A	0.15	0.04	1,044	207
	B	0.17	0.02	878	98
Southbound Lane 2	A	0.19	0.02	792	104
	B	0.18	0.03	852	115

Based on the mean normalized deflection and the standard deviation, the corrected spring static deflection for each of the sections was determined. The maximum allowable deflection for each tested lane was determined using The Asphalt Institute Manual Series No. 17 (MS-17) and using the anticipated future traffic loading for each lane. The anticipated future traffic loading was calculated to be approximately 7,900,000 ESALs, as detailed in subsequent sections of this report. Table 4 shows a summary of the corrected spring static deflection and the maximum allowable deflection for each section and also summarizes the structural condition of the pavement.

Table 4: Summary of Structural Condition Based on FWD Testing

Lane	Section	Corrected Spring Static Deflection (mm)	Maximum Allowable Deflection (mm)	Structural Condition	Structural Improvement
Northbound Lane 1	A	0.57	0.55	Somewhat Deficient	Required
	B	0.50	0.55	Good	Not Required
Northbound Lane 2	A	0.64	0.55	Deficient	Required
	B	0.43	0.55	Good	Not Required
Southbound Lane 1	A	0.55	0.55	Good	Not Required
	B	0.51	0.55	Good	Not Required

Lane	Section	Corrected Spring Static Deflection (mm)	Maximum Allowable Deflection (mm)	Structural Condition	Structural Improvement
Southbound Lane 2	A	0.56	0.55	Somewhat Deficient	Required
	B	0.54	0.55	Good	Not Required

If the corrected spring static deflection is found to be lower or equal to the maximum allowable deflection, this indicates that the existing pavement is structurally adequate for the anticipated traffic loading. Conversely, a corrected static spring deflection higher than the maximum allowable deflection indicates that the pavement requires structural improvement. Section A of both northbound lanes, and Southbound Lane 2 have a corrected spring static deflection higher than the maximum allowable deflection; therefore, the pavement requires some structural improvement. Section B of all the lanes had corrected spring static deflection values lower than the maximum allowable deflection; therefore, the pavement does not require structural improvement in these locations.

Even though the Section B pavement and Southbound Lane 1 Section A does not require structural improvement, some pavement rehabilitation may be required due to the following factors:

- Improve smoothness and ride quality;
- Correct the crown and crossfall; and
- Address surface distresses including the cracks in the pavement to prevent moisture and debris ingress into the pavement structure.

6.2 Layer Moduli

If the layer thicknesses are known, the deflection basins that are measured during the FWD testing, can be subsequently used to back-calculate the modulus of each of the pavement layers at each test point. For the purpose of the analysis, all the asphalt layers of the pavement structure were combined. Additionally, the base, subbase and subgrade layers were also combined for the back-calculation and a combined modulus for the granular/subgrade materials was obtained.

The pavement structure on Coleraine Drive consists of an asphalt layer overlying a granular layer. For the back-calculation analysis, a modulus value was obtained for the asphalt layer, the combined pavement granular layers, and subgrade soil. The detailed analysis results are provided in Appendix C.

Back-calculation of layer moduli is very sensitive to the input layer thickness and if the layer thickness at a particular test location are not representative of the actual thicknesses at that location the back-calculated moduli can be inaccurate. Very low modulus value for the asphalt concrete layers could indicate that the asphalt is either cracked and/or delaminated in that location, although this can be verified during visual condition inspection, and/or that the layer thickness is questionable. Similarly, very high modulus values could indicate that the asphalt thickness input for the back-calculation is questionable. Table 5 and Table 6 each show a summary of the back-calculated pavement layer moduli for each lane of Coleraine Drive. Typically, the modulus of Hot Mix Asphalt

(HMA) in relatively good condition is between 3,000 and 6,000 MPa. The asphalt modulus values for all the lanes were within this typical range. Typical granular layer modulus values are between 200 and 700 MPa and the granular layer modulus on Coleraine Drive was within this typical range; however, at the lower end of this range. Additionally, the granular layer modulus for Section A of Northbound Lane 2 is below this typical range. Based on the results of the back-calculation analysis, it is anticipated that the structural deficiency identified in the previous section is likely due to a somewhat lower structural capacity of the pavement granular layers in the weaker sections.

Table 5: Summary of Back-Calculated Layer Moduli

Lane	Section	Asphalt Modulus (MPa)		Granular Modulus (MPa)		Subgrade Modulus (MPa)	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Northbound Lane 1	A	4,914	880	237	43	130	36
	B	5,769	2,068	299	43	179	50
Northbound Lane 2	A	5,008	1,065	177	23	101	12
	B	6,950	1,721	295	26	155	28
Southbound Lane 1	A	5,886	1,027	339	130	188	76
	B	4,711	1,278	259	41	154	21
Southbound Lane 2	A	5,898	1,122	214	33	114	18
	B	5,467	1,519	216	26	136	31

Table 6: 30th Percentile of the Back-Calculated Pavement Layer Moduli

Lane	Section	30th Percentile Asphalt Modulus (MPa)	30th Percentile Granular Modulus (MPa)	30th Percentile Subgrade Modulus (MPa)
Northbound Lane 1	A	4,383	215	113
	B	5,088	283	147
Northbound Lane 2	A	3,997	172	92
	B	6,104	277	140
Southbound Lane 1	A	5,458	276	163
	B	4,211	238	142

Lane	Section	30th Percentile Asphalt Modulus (MPa)	30th Percentile Granular Modulus (MPa)	30th Percentile Subgrade Modulus (MPa)
Southbound Lane 2	A	5,542	202	101
	B	4,337	205	115

For the purpose of pavement design, the back-calculated subgrade modulus values are multiplied by a factor of 0.35 to obtain a design subgrade resilient modulus.

7.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

7.1 General

This section of the report provides preliminary foundation and pavement engineering design recommendations and recommendations for additional work during detail design for the proposed overheard/subway structure at the intersection of the CP Rail and Coleraine Drive and relocation of the existing retaining wall at the southwest corner of Harvest Moon Drive and Coleraine Drive. These preliminary recommendations are based on interpretation of the factual data obtained from the boreholes advanced during this subsurface investigation. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess the feasible foundation alternatives, to carry out the preliminary design of the structures' foundations and to plan for a detailed geotechnical investigation.

Where comments are made on construction, they are provided to highlight those aspects that could affect the future detail design of the project. Those requiring information on the aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

7.2 Foundations Design

It is understood that the grade separation structure will be required at the intersection of Coleraine Drive and the existing CP Rail. Based on the preliminary design drawings provided to us by CIMA, the CP rail is located at Station 0+925 and the existing grade of Coleraine Drive is approximately at Elevation 259 m. The following two options have been considered by the Civil Design team at this time:

- ***Option 1 (Subway)*** – Lowering the grade (cut) along the existing Coleraine Drive and construction of a subway structure to allow passage of the CP rail over the new Coleraine Drive. It is understood that the proposed subway option will require the Coleraine Drive grade to be lowered to provide a minimum clearance of 7.4 m, which warrants additional geotechnical investigation to investigate the subsurface conditions to sufficient depths below the foundations of the subway structure. Further, additional geotechnical investigation and design will be required to assess the stability of the cut slope and any proposed retaining walls along the new Coleraine Drive and any wing walls associated with the new subway structure.

- ***Option 2 (Overhead)*** – Raising the grade along the existing Coleraine Drive and construction of an overhead structure to allow passage of the new Coleraine Drive over the existing CP rails. The overhead structure will require a grade raise along Coleraine Drive to provide the CP rail a minimum clearance of 5 m. Additional geotechnical investigation and design will be required to delineate the depth to competent soil and to assess the stability and settlement performance of the new road embankment and any wing walls associated with the new overhead structure.

The details of the proposed grade separation (e.g., number of spans, founding elevations, etc.) were not available at the time of preparing this report. Based on the subsurface conditions encountered at this site, both shallow foundation and deep foundation options are feasible for support of the new grade separation structure and associated retaining walls. The following foundation recommendations are for preliminary design and planning purposes only and will require refinement during detail design and once the details of the grade separation structure become available.

7.2.1 Shallow Foundations

Consideration could be given to using shallow foundations founded on native firm to very stiff silty clay/silty clay till based on the preliminary geotechnical axial resistance values provided below. It should be noted that a geotechnical resistance factors for low degree of understanding in accordance with CHBDC is applied to calculated geotechnical axial resistances. However, if sufficient additional geotechnical investigation is carried out during detail design, geotechnical resistance factors for typical degree of understanding may be applied to the calculated geotechnical resistances. In addition, details such as footing dimensions, founding elevation of the footing will need to be confirmed and refined during detail design.

Shallow Foundation	Founding Soils	Factored Ultimate Geotechnical Resistance [1] (kPa)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement [2] (kPa)
3 m wide Spread / Strip Footings	Stiff to Very Stiff Silty Clay / Silty Clay Till	250	200

Note:
1. A geotechnical resistance factor of 0.45 is applied for factored ultimate geotechnical resistance provided.
2. A geotechnical resistance factor of 0.7 is applied for factored serviceability geotechnical resistance provided.

If adopted, shallow foundations should be founded on native soils free of organics and deleterious materials and loose/soft soils. The subgrade should be inspected prior to concrete placement by qualified geotechnical personnel. During detail design, consideration should be given to recommending appropriate measures to protect the founding soils, such as providing a concrete working slab/mud mat placed on the subgrade.

The factored ultimate geotechnical resistances provided are based on a load applied concentrically to the centreline/centroid of the footing, as shown on Figure 6.4 of the *CHBDC (2019)*. Where a load is applied eccentrically from the centreline/centroid of the footing, the pressure distribution at ULS and SLS and the eccentricity limit of the footing should be taken into consideration in accordance with Section 6.10.5 of the CHDBC (2019) and its Commentary.

Resistance to lateral forces/sliding resistance between cast-in-place concrete footings and the founding soils should be calculated in accordance with Section 6.10.4 of the CHBDC (2019). The following presents the unfactored coefficient of friction, tan φ', for the interface between the concrete footing and the stiff to very stiff silty clay.

Founding Material	Coefficient of Friction (tan φ')
Cast-in-place Concrete Footing on Stiff to Very Stiff Silty Clay / Silty Clay Till	0.3

The footings should be provided with a minimum 1.4 m of soil cover for frost protection as per OPSD 3090.101 (Frost Penetration Depths for Southern Ontario), as measured vertically and perpendicular from the face of the abutment slope to the edge of the underside of the footing.

7.2.2 Deep Foundations

Consideration could be given to using deep foundations, such as driven piles or caissons for supporting the new grade separation structure. Alternatively, consideration could be given to support the grade separation structure on drilled shafts (caissons). If deep foundation option is adopted, additional geotechnical investigations will be required to delineate the depth to practical refusal. The depth to refusal is used to determine the founding elevations for deep foundations.

Driven Piles

The grade separation structure may be supported on driven steel H-piles or pipe piles. Additional geotechnical investigation will be required to determine the design tip elevation for driven piles. The boreholes from this preliminary investigation did not extend to practical refusal and, as such the following geotechnical resistances are based on frictional resistance between the pile and surrounding soils and should be considered only preliminary.

The factored ultimate and serviceability geotechnical resistances for HP 310x110 pile and closed-end, concrete filled 324 mm diameter, 9.5 mm wall thickness steel pipe piles are presented below.

Driven Piles	Approximate Length of Driven Pile (m)	Factored Ultimate Geotechnical Resistance [1] (kN)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement [2] (kN)
CP Rail Over Coleraine Drive (Subway Structure)			
HP 310x110	9	225	> 250
324 mm O.D. Pipe Pile		200	> 225
Coleraine Drive Over CP Rail (Overhead Structure)			
HP 310x110	17	325	> 325
324 mm O.D. Pipe Pile		300	> 300

Driven Piles	Approximate Length of Driven Pile (m)	Factored Ultimate Geotechnical Resistance [1] (kN)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement [2] (kN)

Note:
1. A geotechnical resistance factor of 0.35 is applied for factored ultimate geotechnical resistance provided.
2. A geotechnical resistance factor of 0.7 is applied for factored serviceability geotechnical resistance provided.

Cobbles and/or boulders are typically present within glacially-derived deposits. In this regard, steel H-piles are preferred over steel pipe piles as pipe piles are considered to pose a higher risk of experiencing refusal on boulders or being deflected away from the vertical/battered orientation during installation due to their larger end area. Piles should be reinforced at the tip with driving shoes and/or flange plates in accordance with OPSD 3000.100 (Steel H-Pile Driving Shoe) or OPSD 3001.100 (Steel Tube Pile Driving Shoe) Type II, as appropriate, to reduce the potential for damage to the piles during driving. In very dense strata containing cobbles and/or boulders, as encountered at this site, driving shoes (such as Titus Standard ‘H’ Bearing Pile Points) are preferred over flange plates.

All pile caps should be provided with a minimum 1.4 m of soil cover for frost protection as per OPSD 3090.101 (Frost Penetration Depths for Southern Ontario), as measured vertically and perpendicular from the face of the abutment slope to the edge of the underside of the pile cap footing.

If adequate soil cover cannot be provided for the footing, rigid styrofoam insulation could be installed to compensate for the lack of soil cover and provide protection from frost penetration.

Caissons

The grade separation structure may be supported on drilled caissons. Additional geotechnical investigation will be required to confirm and refine the preliminary geotechnical resistances provided below.

Caisson	Approximate Length of Caisson (m)	Factored Ultimate Geotechnical Resistance [1] (kN)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement [2] (kN)
CP Rail Over Coleraine Drive (Subway Structure)			
0.6 m Diameter Caisson	9	400	375
Coleraine Drive Over CP Rail (Overhead Structure)			
0.6 m Diameter Caisson	17	600	550
Note: 1. A geotechnical resistance factor of 0.35 is applied for factored ultimate geotechnical resistance provided. 2. A geotechnical resistance factor of 0.7 is applied for factored serviceability geotechnical resistance provided.			

If caisson foundations are adopted, a temporary liner and/or drilling slurry may be required to support the overburden soils during construction and to minimize disturbance to the side walls and to control base disturbance / basal heave. In addition, placement of concrete by tremie methods would be required.

All caisson caps should be provided with a minimum 1.4 m of soil cover for frost protection as per OPSD 3090.101 (Frost Penetration Depths for Southern Ontario), as measured vertically and perpendicular from the face of the abutment slope to the edge of the underside of the pile cap footing.

For caissons designed for end bearing and shaft friction combined, the performance of the caissons in compression will depend to a large degree upon the final cleaning and verification of the condition of the subgrade rock at the base of the caisson. The base of each caisson excavation must be cleaned to remove all loose cuttings to ensure that the tremie concrete is in intimate contact with the competent bearing stratum.

7.2.3 Retaining Walls / Slopes

It is envisaged that slopes/retaining walls will be required along a section of Coleraine Drive leading to the grade separation structure. Further and based on the preliminary drawing, it is understood that the existing retaining wall located in the southwest corner of Harvest Moon Drive and Coleraine Drive will be relocated.   Additional geotechnical design will be required to verify adequate factor of safety against global instability for the slopes/retaining walls.

The following factored geotechnical resistances below may be used for preliminary design purposes. The preliminary geotechnical resistance/reaction values should be reviewed and revised during detail design, considering the results of additional geotechnical investigation and the final configuration of retaining walls.

Retaining Wall	Founding Soils	Factored Ultimate Geotechnical Resistance [1] (kPa)	Factored Serviceability Geotechnical Resistance for 25 mm of Settlement [2] (kPa)
Mechanically Stability Earth Retaining Wall Soil Mass	Stiff to Very Stiff Silty Clay	150	100

Note:
1. A geotechnical resistance factor of 0.45 is applied for factored ultimate geotechnical resistance provided.
2. A geotechnical resistance factor of 0.7 is applied for factored serviceability geotechnical resistance provided.

7.2.4 Lateral Earth Pressures for Design

The lateral earth pressures acting on the abutment stems, any associated wing walls/retaining walls and retaining walls will depend on the type and method of placement of the backfill material, the nature of the soils behind the backfill, the magnitude of surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the walls.

The following recommendations are made concerning the design of the abutment walls and associated retaining walls. These design recommendations and parameters assume level backfill and ground surface behind the walls. Where there is sloping ground behind the walls, the coefficient of lateral earth pressure must be adjusted to account for the slope.

- Free draining granular fill meeting the specifications of OPSS.MUNI 1010 (Aggregates) Granular ‘A’ or Granular ‘B’ Type II, but with less than 5 per cent passing the No. 200 sieve, should be used as backfill behind the walls. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill. Compaction (including type of equipment, target densities, etc.) should be carried out in accordance with OPSS.MUNI 501 (Compacting). Other aspects of the granular backfill requirements with respect to sub-drains and frost taper should be in accordance with OPSD 3121.150 (Retaining Walls, Backfill, and Minimum Granular Requirement).
- A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the wall stem, in accordance with *CHBDC (2019)* Section 6.12.3 and Figure 6.8. Other surcharge loadings should be accounted for in the design as required.
- For restrained walls, granular fill should be placed in a zone with the width equal to at least 1.4 m behind the back of the wall in accordance with Figure C6.31(a) of the *Commentary* to the *CHBDC (2019)*. For unrestrained walls, fill should be placed within the wedge-shaped zone defined by a line drawn at flatter than 1 horizontal to 1 vertical (1H:<1V) extending up and back from the rear face of the footing in accordance with Figure C6.31(b) of the *Commentary* to the *CHBDC (2019)*. The pressures are based on the proposed embankment fill material and the following parameters (unfactored) may be used:

Fill Type	**Soil Unit Weight (kN/m^3)**	**Coefficients of Static Lateral Earth Pressure**	
		At-Rest, K_o	**Active, K_a**
Granular ‘A’	22	0.43	0.27
Granular ‘B’ Type II	21	0.43	0.27

Where the wall support does not allow lateral yielding, at-rest earth pressures should be assumed for the geotechnical design. Where the wall support allows lateral yielding of the stem, active earth pressures should be used in the geotechnical design of the wall structure(s). The movement required to allow active pressures to develop within the backfill, and thereby assume an unrestrained structure for design, should be calculated in accordance with Section C6.12.1 and Table C6.12 of the Commentary to the *CHBDC* (2019).

7.2.5 Construction and Detail Design Considerations

The following sections identify future construction considerations that may impact the future design and construction.

7.2.5.1 Open-Cut Excavation

If the subway structure is adopted as the preferred option for the grade separation, the construction will require excavations up to about 9 m below the existing Coleraine Drive. The existing fill material and native stiff to hard silty clay soils are classified as Type 3 soils, according to the Occupational Health and Safety Act (OHSA) and, as such, temporary open-cut excavations above the groundwater level should be made with side slopes no steeper than 1H:1V. However, given the depth of excavation stability analysis should be carried out during detail design to ensure an adequate factor of safety is maintained during and upon completion of construction.

All excavations must be carried out in accordance with Ontario Regulation 213 (Ontario Occupational Health and Safety Act for Construction Projects) (as amended).

7.2.5.2 Temporary Protection Systems

Temporary protection systems may be required along the Coleraine Drive to facilitate the installation of the piles/caissons and construction of spread footings. Where required, temporary protection systems should be designed and constructed in accordance with OPSS.MUNI 539 (Temporary Protection System).

The selection and design of the protection system will be the responsibility of the Contractor.

7.3 Pavement Design

The findings of the field investigation, laboratory testing and provided traffic data were used to carry out a pavement structural design analysis for the rehabilitation of the existing pavement on Coleraine Drive, and the pavement widening.

7.3.1 Traffic Analysis

The traffic volume data for Coleraine Drive, provided by CIMA, was used to calculate the Equivalent Single Axle Loads (ESALs) that the pavement on Coleraine Drive would be required to accommodate, over its design life (20 years). Table 7 summarizes the parameter values that were used in the ESAL calculations.

Table 7: Summary of Traffic Parameters

Parameter	Value
2017 Average Annual Daily Traffic – Two Way*	13,716
Truck Percentage*	8.5%
Truck Factor	1.8
Directional Distribution Factor	0.5
Lane Distribution Factor	0.8
Design Life	20 years
* Provided by CIMA	

The cumulative ESALs on the existing and widened pavement on Coleraine Drive for a 20-year design life are estimated to be approximately 7,900,000.

7.3.2 Pavement Structural Design

The structural design analysis for the existing pavement rehabilitation and new pavement construction was carried out in accordance with the American Association of State Highway and Transportation Officials (AASHTO) design methodology, as detailed in their 1993 “Guide for Design of Pavement Structures”. The parameter values that were used for the structural design analysis were as shown in Table 8.

Table 8: Parameter Values for Pavement Structural Design Analysis

Parameter		Value
Design ESALs		7,900,000
Reliability		90%
Standard Deviation		0.45
Subgrade Resilient Modulus		35 MPa
Initial Serviceability		4.5
Terminal Serviceability		2.5
Structural Coefficient	Existing Hot Mix Asphalt (HMA)	0.30
	Existing Granular Material	0.08
	New HMA	0.44
	New Granular A	0.14
	New Granular B, Type I	0.09
Drainage Coefficient	Existing HMA	1.0
	Existing Granular Material	0.9
	New HMA	1.0
	New Granular A	1.0
	New Granular B, Type I	1.0

Based on the parameter values listed in Table 8, it was determined that the rehabilitated and new pavement on Coleraine Drive is required to have a structural number of 132 mm and that the existing pavement has an effective structural number of 116 mm. Therefore, an increase in structural number of 16 mm is required. The following sections of this report provide pavement structural designs for the rehabilitation of the existing pavement and pavement widening of Coleraine Drive, within the project limits.

7.3.3 Existing Pavement Rehabilitation

The following design was developed for the rehabilitation of the pavement on Section A and Section B of Coleraine Drive:

- Mill 120 mm of the existing asphalt;
- Inspect the milled surface and repair any cracks that are of medium to high severity;

- Apply and cure a layer of tack coat on the milled surface;
- Place 70 mm of binder course asphalt;
- Apply and cure a layer of tack coat on the surface of the binder course; and
- Place 50 mm of surface course asphalt.

7.3.4 Pavement Widening

The following design was developed for the pavement widening;

- Excavate the existing granular materials and subgrade soils in the proposed widening area to a depth of the top of subgrade in the adjacent pavement (approximately 950 mm), or 800 mm from the top of the final pavement surface, whichever is greater;
- Regrade and recompact the expose subgrade soils;
- Proofroll the prepared subgrade soils and repair any soft spots that are identified;
- Place and compact Granular ‘B’ Type I to a depth of 300 mm below the final pavement surface grade, with individual lift thicknesses not exceeding 150 mm;
- Place and compact 150 mm of Granular ‘A’;
- Place 100 mm of binder course asphalt, in two lifts, and apply tack coat between the lifts;
- Apply and cure tack coat of the surface of the binder course; and
- Place 50 mm of surface course asphalt.

7.3.5 Construction and Detail Design Considerations

The Granular ‘A’ and Granular ‘B’ Type I should be in accordance with Ontario Provincial Standard Specification, OPSS.MUNI 1010. Each lift of the granular layers should be compacted to 100 per cent of the materials Standard Proctor Maximum Dry Density (SPMDD).

The binder course asphalt layers should be constructed using a SuperPave, SP 19.0 asphalt mix, and the surface course asphalt layer should be constructed using an SP 12.5 FC1 asphalt mix. Both the binder and surface course asphalt mixes should be designed for Traffic Category C and should incorporate a PG (performance grade) 64-28 polymer modified asphalt cement. The asphalt cement shall meet the requirements of OPSS.MUNI 1101, and the asphalt mixes shall meet the requirements of OPSS.MUNI 1151. Each of the surface and binder course asphalt layers should be compacted to a minimum of 92 per cent of the materials Maximum Relative Density (MRD).

The pavement structural designs presented in this report can be carried through to detail design; however, depending on the project timeline, the condition of the existing pavement may need to be re-evaluated prior to finalizing the detail design. The surface condition should be reviewed and FWD testing can be completed to evaluate changes in the structural condition.

During the rehabilitation and new construction positive drainage should be provided throughout the project length.

8.0 EXCESS SOIL CHARACTERIZATION

This section of the report provides preliminary soil management considerations for excavated soils that may be generated during the construction. The comments regarding the potential suitability of the material for reuse are based on its environmental quality only and do not consider constraints related to the geotechnical or other properties of the material.

It is understood that management options for the excavated materials may include reuse on-site for backfill or site grading purposes, transport off-site to land based sites requiring fill or disposal as waste at a licensed landfill facility.

Samples of the soils obtained from the site during the field investigation were submitted for chemical analyses to provide background information for assessment of the chemical quality of the soils at the site. The summary tables of analytical laboratory reports and Certificate of Analysis are included in *Appendix D*.

A Phase I Environmental Site Assessment to identify areas of potential environmental concern (APECs) at the site was carried out previously by Golder and submitted under a separate report ("*Phase I Environmental Site Assessment, Coleraine Drive, Caledon, Ontario*" dated February 2020). A Phase Two Environmental Site Assessment to determine the environmental (chemical) aspects of the subsurface conditions was outside the terms of reference for this project and has not been carried out by Golder. Therefore, the results of the limited chemical testing described in this section of the report should not be construed as indicating that chemical impacts to the site soils, beyond those described herein, do not exist at the site.

No statement made herein should be construed as relieving the Contractor of the duty to comply with all applicable regulations related to disposal of the excess soil (and discharge of groundwater, if any). At the time of preparing this report, detail design level information was not available. As such, it will be necessary to review the scope of environmental testing and confirm recommendations during detail design, and to undertake any environmental testing that may be required to support the detailed design and proposed excavations.

8.1 Applicable Regulatory Standards

The analytical data for the soil samples submitted for analysis were compared to the Soil Quality Standards provided under O. Reg. 153/04 in the Ministry of the Environment, Conservation and Parks (MECP), "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", April 15, 2011.

Golder compared the analytical results to the Table 1 Soil Background Standards for property uses other than for agricultural; and the Table 2 Standards for industrial, commercial and community property uses in a potable groundwater setting with fine textured soils.

The comparison to the Table 1 Soil Background Standards (for non-agricultural property use) was used as an initial assessment on whether soil may be transferred to another site for reuse as inert fill. These soil standards are considered background values derived from the Ontario Typical Range values for the specified land uses and are considered representative of upper limits of typical province-wide background concentrations in soils that are not contaminated by point sources. The Table 2 Standards are applicable for evaluating the environmental quality of excavated materials from the subject property to remain on site for reuse.

8.2 Chemical Testing Protocol

A total of ten soil samples were collected from Boreholes BH17-01 to BH17-16 and were submitted for chemical analyses during the 2017 subsurface exploration. The samples were selected to provide areal coverage of some of the existing fill and native materials that were encountered at the borehole locations.

The soil samples consisted of brown sand and gravel and brown to grey silty clay with no olfactory evidence of impact. Headspace gas concentrations measured in the air within the sample containers using an RKI Eagle 2 gas instrument calibrated to hexane gas (for measurements of combustible gases with methane response disengaged) and calibrated to isobutylene (for measurement of organic vapours) were 0 ppm for the samples collected in the boreholes. The soil samples were submitted to an independent accredited laboratory (AGAT Laboratories in Mississauga, Ontario) that meets the requirements of Section 47 of O.Reg.153/04 for bulk analysis of metals and inorganics (M&I), petroleum hydrocarbons (PHCs), benzene, toluene, ethylbenzene and xylene (BTEX), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and Toxicity Characteristic Leaching Procedure (TCLP).

Table 9: Analytical Testing Parameters

Borehole Number	Sample No. (Environmental Designation)	Depth (m bgs)	Material Type	Chemical Bulk Analyses
BH17-01	SA6	3.8 to 4.4	Native – Grey Silty Clay (TILL)	M&I
BH17-02	SA3	1.5 to 2.1	Fill - Brown Silty Clay	M&I
BH17-04	SA3	1.5 to 2.1	Native – Brown to Grey Silty Clay (TILL)	M&I
BH17-06	SA2	0.8 to 1.4	Fill – Dark Grey Silty Clay, contains Organics	M&I
BH17-09	SA5	3.0 to 3.7	Native – Brown Silty Clay	M&I, PAHs, PHCs/BTEX and VOCs
BH17-10	SA3	1.5 to 2.1	Native – Brown Silty Clay	M&I
BH17-12	SA2B	0.8 to 1.0	Fill - Brown Sand and Gravel	M&I
BH17-13	SA7	4.6 to 5.2	Native – Grey Silty Clay	M&I, PAHs, PHCs/BTEX and VOCs
BH17-14	SA4	2.3 to 2.9	Native – Brown to Grey Silty Clay (TILL)	M&I
BH17-16	SA6	3.8 to 4.4	Native – Brown Silty Clay (TILL)	M&I

8.3 Soil Analytical Data

The Certificates of Analysis for the chemical testing carried out for this assessment is included in *Appendix D* of this report. The analytical results are summarized in Table D-1 (M&I), Table D-2 (PAHs). Table D-3 (PHCs), Table D-4 (VOCs), and Table D-5 (Toxicity Characteristic Leaching Procedures (TCLP)).

Based on a review of the soil analytical results, the concentrations of metal and inorganic parameters, PHCs, VOCs including BTEX, and PAHs were below the respective MECP 2011 Table 1 and Table 2 Standards, with the exception of electrical conductivity (EC), which exceeded the Table 1 Standards in six of the samples, and Table 2 Standards in five of those samples, and sodium absorption ratio (SAR), which exceeded Table 1 and Table 2 Standards in five of the samples. The PHC, VOC and PAH concentrations were below the MECP 2011 Table 1 Standards in all of the samples tested. The locations of samples containing parameters that did not meet Table 1 Standards and/or Table 2 Standards, and the values of the parameters at the locations, are shown on Figure 2.

8.3.1 MECP 2011 Table 1 Standard Exceedances

The SAR results in five of the ten samples submitted for analysis were above the MECP Table 1 Standards. The EC values in six of the ten samples submitted for analysis were above the MECP Table 1 Standards. The PHC, VOC and PAH results in all ten samples submitted were below the MECP Table 1 Standards.

8.3.2 MECP 2011 Table 2 Standard Exceedances

The EC values in five of the ten samples submitted for analysis were above the MECP Table 2 Standards. The PHC, VOC and PAH results in all samples submitted were below the MECP Table 2 Standards.

8.4 Soil Management Options

The presence of EC and SAR at levels that exceed Table 1 Standards and EC at levels that exceed Table 2 Standards is likely related to winter applications of de-icing salts for the safety of vehicular or pedestrian traffic at the site. Evidence also supports that the Site has never been used, for manufacturing, processing, or bulk storage of salt. Thus, under Section 49.1 of O. Reg. 153/04, as amended, the environmental condition standards for EC and SAR in soil at the site are deemed not to be exceeded. Consequently, the environmental condition of the soil is compatible with soil reuse at the Site. Since the work was completed at the Site, the Ontario On-Site and Excess Soil Management Regulation (O. Reg. 406/19) came into effect on January 1, 2021. Although the environmental condition of the soil at the Site can be used as a basis for preliminary discussions with potential receiving sites for off-site reuse of soils, the management and documentation of excess soil management will need to be consistent with the requirements of O. Reg. 406/19.

During excavation, if soils are encountered that are not consistent with the tested samples or exhibit visual or olfactory evidence of environmental impact (i.e., staining or odours), the soils will need to be screened using a soil gas field screening instrument and segregated into separate stockpiles. The stockpiled materials will need to be tested by the contractor and reassessed to confirm their suitability for reuse or designation and management as wastes. Additional sampling and testing of any stockpiled materials should meet the minimum requirements in Table 2 of Schedule E of O.Reg.153/04.

A composite sample from borehole 17-03 for TCLP testing was analyzed for metals and inorganics, benzo(a) pyrene, polychlorinated biphenyls (PCBs), VOCs and ignitability. The TCLP results for the composite sample met the limits defined in Schedule 4 of O. Reg. 558, and the soil would be classified as non-hazardous waste for the purposes of disposal, if a beneficial use cannot be found for the excess soil materials.

8.5 Limitations of the Excess Soil Characterization

The soil management options provided in this report are specific to this project and the analytical data should not be used by any third party to manage the site-specific soils for other projects.

The environmental interpretation of the analytical results presented herein is intended to provide an assessment of the environmental conditions of the site within limited portions and areas of the proposed works. The soil contamination levels were assessed according to the chemical analysis results for a limited number of parameters and samples. The nature and extent of contamination between the sampling points can vary in terms of the conditions encountered at the locations where the analyzed samples were taken. The findings are based on conditions as they were observed at the time of the investigation, and to a large degree, on interpretation of data obtained from boreholes and selected soil samples. No assurance can be provided with respect to the potential changed physical and/or chemical characteristics of the soil between or beyond the tested locations or the effects of subsequent activities on site. With respect to regulatory compliance issues, regulatory statutes and the interpretation of regulatory statutes are also subject to change over time.

No matter how thorough an investigation may be, findings derived from the sampling and testing are limited and Golder cannot know or state for an absolute fact that areas of the property, or neighboring properties, or portions thereof, are unaffected by contaminants. The property owner bears risk that such contaminants may be present on or may migrate to or off the property after the study is complete.

9.0 ADDITIONAL WORK DURING DETAIL DESIGN

Additional geotechnical investigation will be required during detail design. It is recommended that additional boreholes be advanced within the footprints of foundation elements, along any proposed retaining walls and any cut or high fill.

10.0 CLOSURE

We trust that this report meets your present requirements. If you have any questions or require additional information, please do not hesitate to contact this office.

Signature Page

Golder Associates Ltd.

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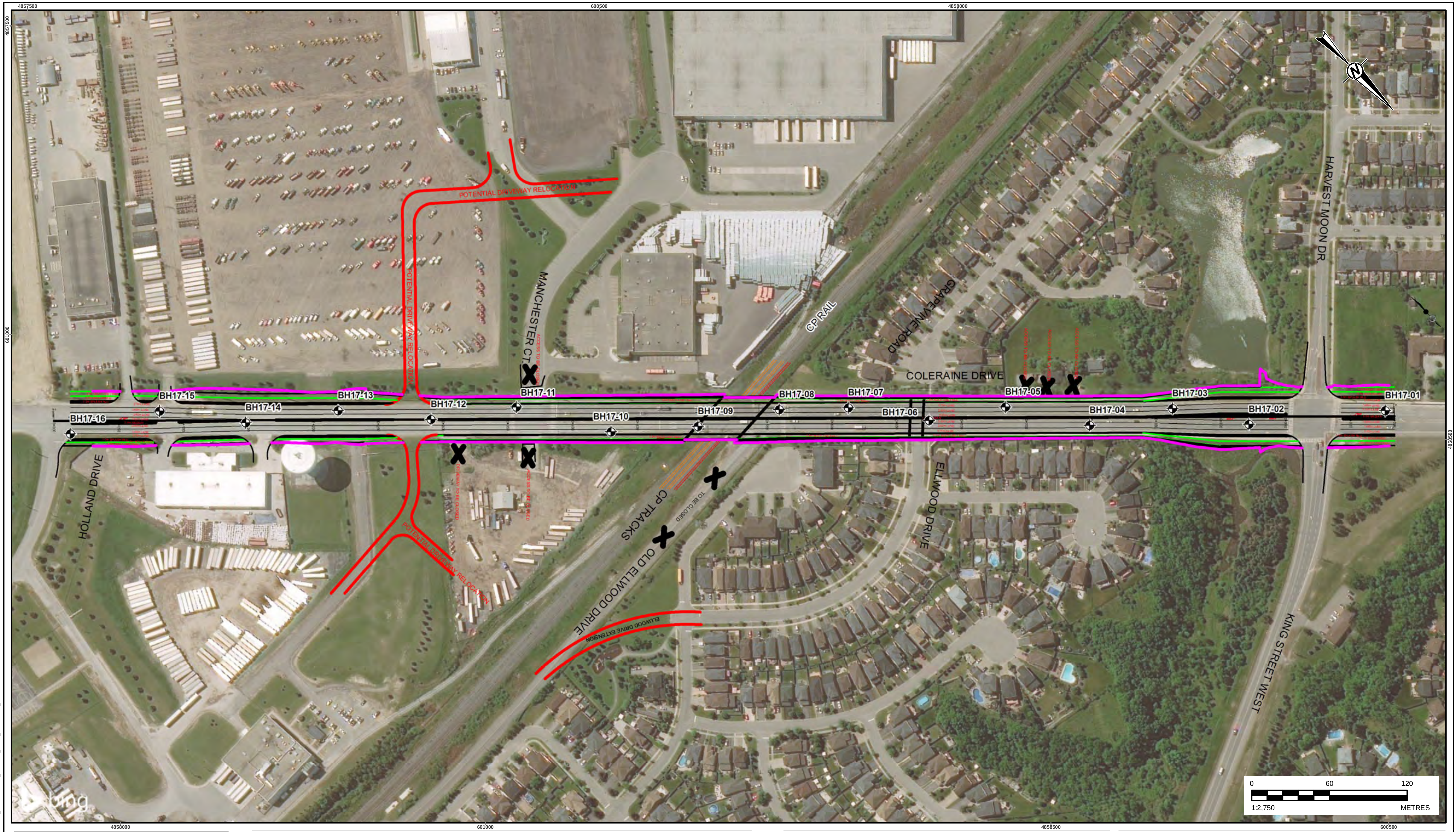
FIGURES

Figure 1 - Borehole Location Plan

Figure 2 - Sample Locations for Environmental Quality of Soil



LEGEND

⌖ APPROXIMATE BOREHOLE LOCATION

— ROAD ALIGNMENT

— CP TRACKS

REFERENCES

BASE DATA - MNRF LIO, OBTAINED 2016
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ROAD ALIGNMENT - PROVIDED BY REGION OF PEEL, 2017

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

NOTES

CLIENT
CIMA+

CONSULTANT
GOLDER

YYYY-MM-DD	2017-10-02
PREPARED	PR
DESIGN	PR
REVIEW	CD
APPROVED	-

PROJECT
COLERAINE DRIVE, CALEDON, ONTARIO

TITLE
BOREHOLE LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1665649	0003	0	**1**

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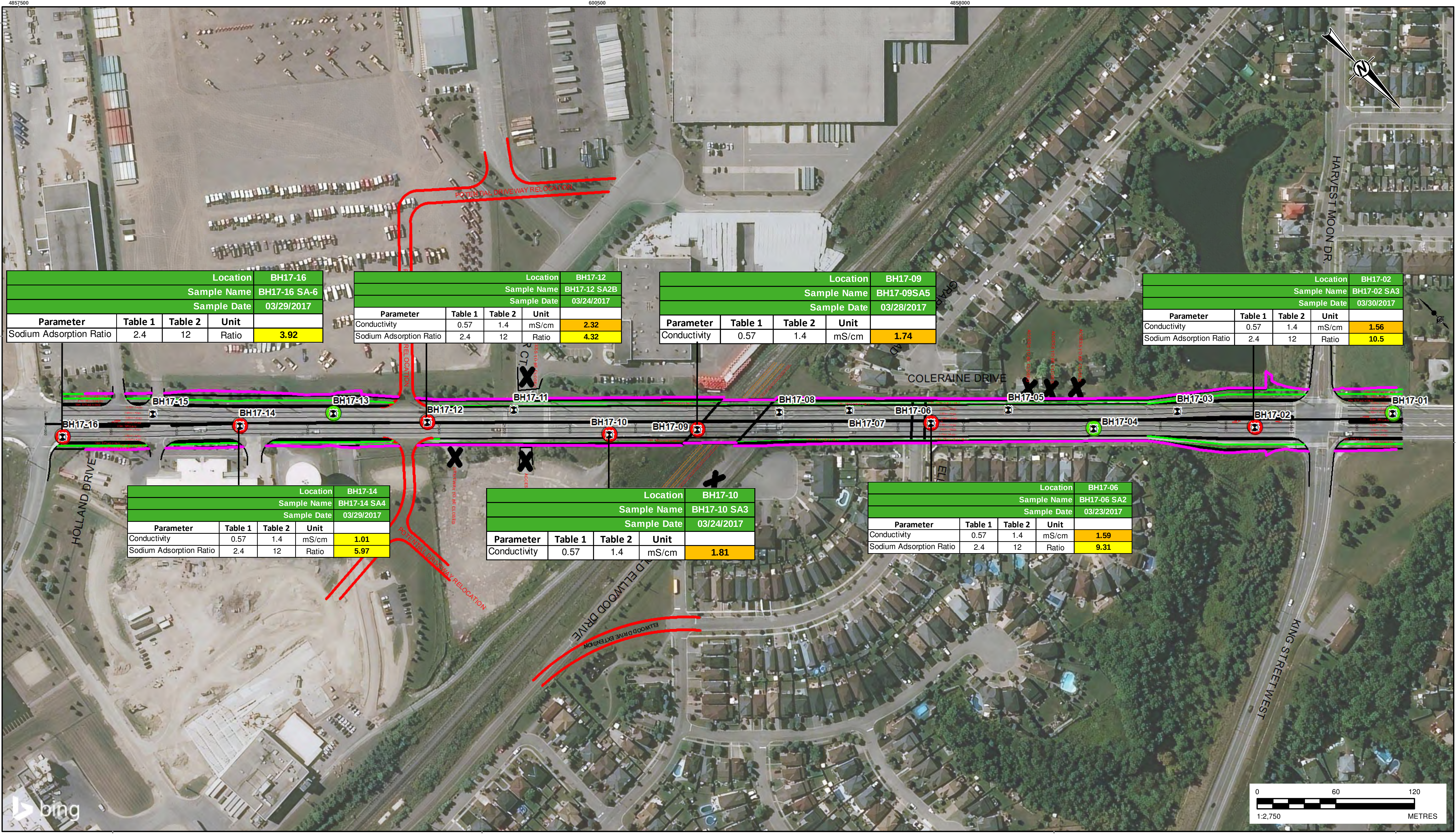

			Location	BH17-16
			Sample Name	BH17-16 SA-6
			Sample Date	03/29/2017
Parameter	Table 1	Table 2	Unit	
Sodium Adsorption Ratio	2.4	12	Ratio	3.92

			Location	BH17-12
			Sample Name	BH17-12 SA2B
			Sample Date	03/24/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	2.32
Sodium Adsorption Ratio	2.4	12	Ratio	4.32

			Location	BH17-09
			Sample Name	BH17-09SA5
			Sample Date	03/28/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	1.74

			Location	BH17-02
			Sample Name	BH17-02 SA3
			Sample Date	03/30/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	1.56
Sodium Adsorption Ratio	2.4	12	Ratio	10.5

			Location	BH17-14
			Sample Name	BH17-14 SA4
			Sample Date	03/29/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	1.01
Sodium Adsorption Ratio	2.4	12	Ratio	5.97

			Location	BH17-10
			Sample Name	BH17-10 SA3
			Sample Date	03/24/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	1.81

			Location	BH17-06
			Sample Name	BH17-06 SA2
			Sample Date	03/23/2017
Parameter	Table 1	Table 2	Unit	
Conductivity	0.57	1.4	mS/cm	1.59
Sodium Adsorption Ratio	2.4	12	Ratio	9.31

LEGEND

⌖	APPROXIMATE BOREHOLE LOCATION
—	ROAD ALIGNMENT
—	CP TRACKS
🔴	SAMPLE EXCEEDS TABLE 1 AND/OR TABLE 2
🟢	SAMPLE MEETS TABLE 1 AND/OR TABLE 2

REFERENCES

BASE DATA - MNRF LIO, OBTAINED 2016
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NOTES

1. MS/CM = MILLISIEMENS PER CENTIMETRE
2. TABLE 1 STANDARDS, ONTARIO MINISTRY OF THE ENVIRONMENT (MOE; NOW ONTARIO MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS OR MECP), "SOIL, GROUNDWATER AND SEDIMENT STANDARDS FOR USE UNDER PART XV.1 OF THE ENVIRONMENTAL PROTECTION ACT", TABLE 1: FULL DEPTH GENERIC SITE CONDITION STANDARDS IN BACKGROUND CONDITION FOR RESIDENTIAL / PARKLAND / INSTITUTIONAL / INDUSTRIAL / COMMERCIAL / COMMUNITY PROPERTY USE. APRIL 15, 2011 FOR COARSE-TEXTURED SOILS.
3. TABLE 2 STANDARDS, ONTARIO MINISTRY OF THE ENVIRONMENT (MOE; NOW ONTARIO MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS OR MECP), "SOIL, GROUNDWATER AND SEDIMENT STANDARDS FOR USE UNDER PART XV.1 OF THE ENVIRONMENTAL PROTECTION ACT", TABLE 2: FULL DEPTH GENERIC SITE CONDITION STANDARDS IN A POTABLE GROUND WATER CONDITION FOR INDUSTRIAL / COMMERCIAL / COMMUNITY PROPERTY USE. APRIL 15, 2011 FOR COARSE-TEXTURED SOILS.
4. **EXCEED** = EXCEEDS TABLE 1 STANDARDS
5. **EXCEED** = EXCEEDS TABLE 1 AND TABLE 2 STANDARDS

	TABLE 1	TABLE 2
ELECTRICAL CONDUCTIVITY	0.57	1.4
SODIUM ADSORPTION RATIO	2.4	12

CLIENT
CIMA+

CONSULTANT
GOLDER

YYYY-MM-DD	2017-10-02
PREPARED	PR
DESIGN	PR
REVIEW	CD
APPROVED	DS

PROJECT
COLERAINE DRIVE, CALEDON, ONTARIO

TITLE
SAMPLE LOCATIONS FOR ENVIRONMENTAL QUALITY OF SOIL

PROJECT NO.	CONTROL	REV.	FIGURE
1665649	0003	0	2

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

APPENDIX A

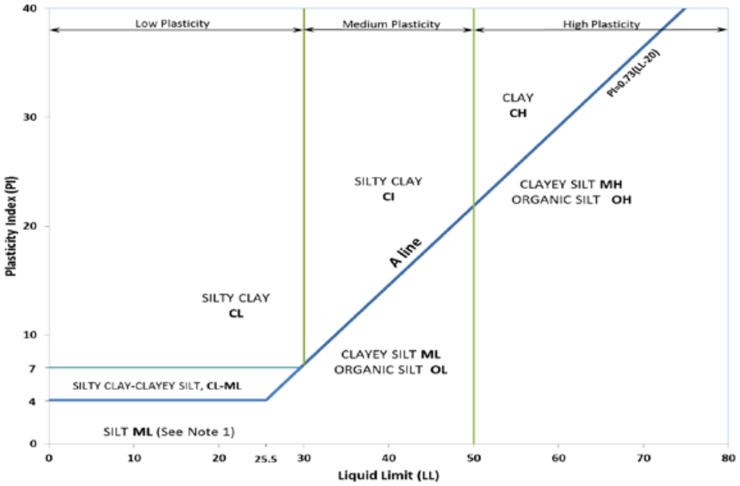
Method of Soil Classification
Abbreviations and Terms Used on Records of Boreholes and Test Pits
List of Symbols
Record of Borehole Sheets
(BH17-01 to BH17-16, inclusive)

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BORHEOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

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.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); 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.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
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
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness terms are based on SPT-'N' ranges as provided in Terzaghi, Peck and Mesri (1996) and correspond to typical average N_{60} values. Many factors affect the recorded SPT-'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), groundwater conditions, and grainsize. As such, the recorded SPT-'N' value(s) should be considered only an approximate guide to the compactness term. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index $= (w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT: 1665649

RECORD OF BOREHOLE: BH17-01

SHEET 1 OF 1

LOCATION: See Figure 1

BORING DATE: March 29, 2017

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected 20 40 60 80 / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10⁻⁶ 10⁻⁵ 10⁻⁴ 10⁻³ / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		257.60							
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (200mm)		0.00							
		FILL - (SP) gravelly SAND, some fines; brown; non-cohesive, moist, compact		257.40 0.20	1	SS	16	⊕□ ND	○	M	
					2A	SS	10	⊕□ ND			
1		(CL) SILTY CLAY, trace sand, trace gravel; brown, mottled; cohesive, w~PL, stiff to very stiff		256.53 1.07	2B			⊕□ ND			
					3	SS	22	⊕□ ND			
2		(CL) SILTY CLAY, some sand, trace gravel; grey (TILL); cohesive, w<PL, very stiff		255.40 2.20	4	SS	28	⊕□ ND	○		
3					5	SS	16	⊕□ ND			
4					6	SS	18	⊕□ ND			
5					7	SS	15	⊕□ ND	○		
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.		252.42 5.18							
6											
7											
8											
9											
10											

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-02

BORING DATE: March 20, 2017

SHEET 1 OF 1
DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

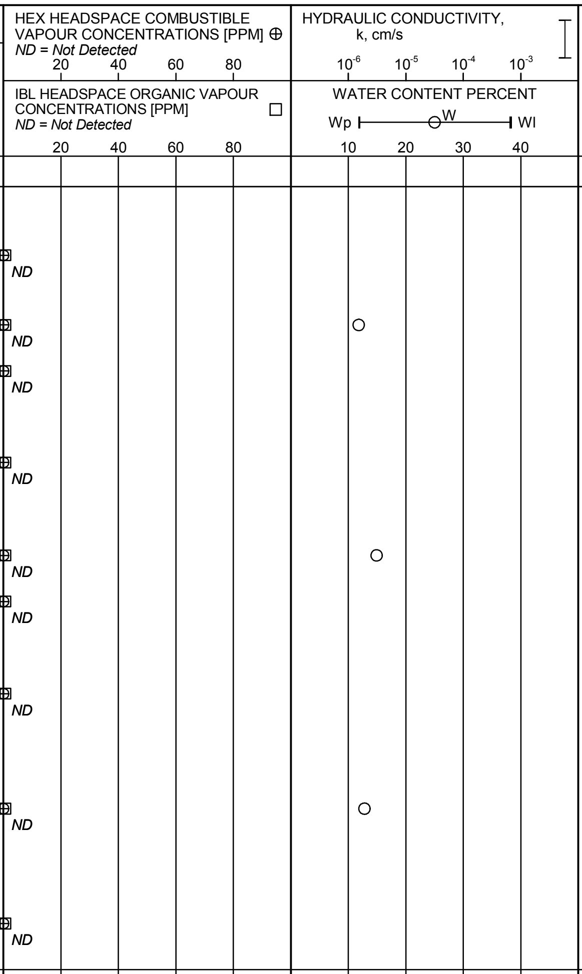
HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)
		GROUND SURFACE		256.60
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (240 mm)	■	0.00
		FILL - (SM) SILTY SAND, some gravel; brown; non-cohesive, moist, compact to dense	▨	256.36 0.24
1		FILL - (CL) SILTY CLAY, trace to some sand, trace to some gravel; grey to brown, mottled, containing organics and brick fragments; cohesive, w<PL, very stiff	▨	255.53 1.07
2.59		(CL) SILTY CLAY, trace sand, trace gravel; brown (TILL); cohesive, w~PL, very stiff to hard	▨	254.01 2.59
5.18		END OF BOREHOLE		251.42 5.18

NOTE:

1. Borehole dry upon completion of drilling.

SAMPLE NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕	ADDITIONAL LAB. TESTING
1	SS	39	ND	MH
2A	SS	17	ND	
2B			ND	
3	SS	16	ND	
4A	SS	25	ND	
4B			ND	
5	SS	29	ND	
6	SS	34	ND	
7	SS	32	ND	



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MC
CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-03

BORING DATE: March 19, 2017

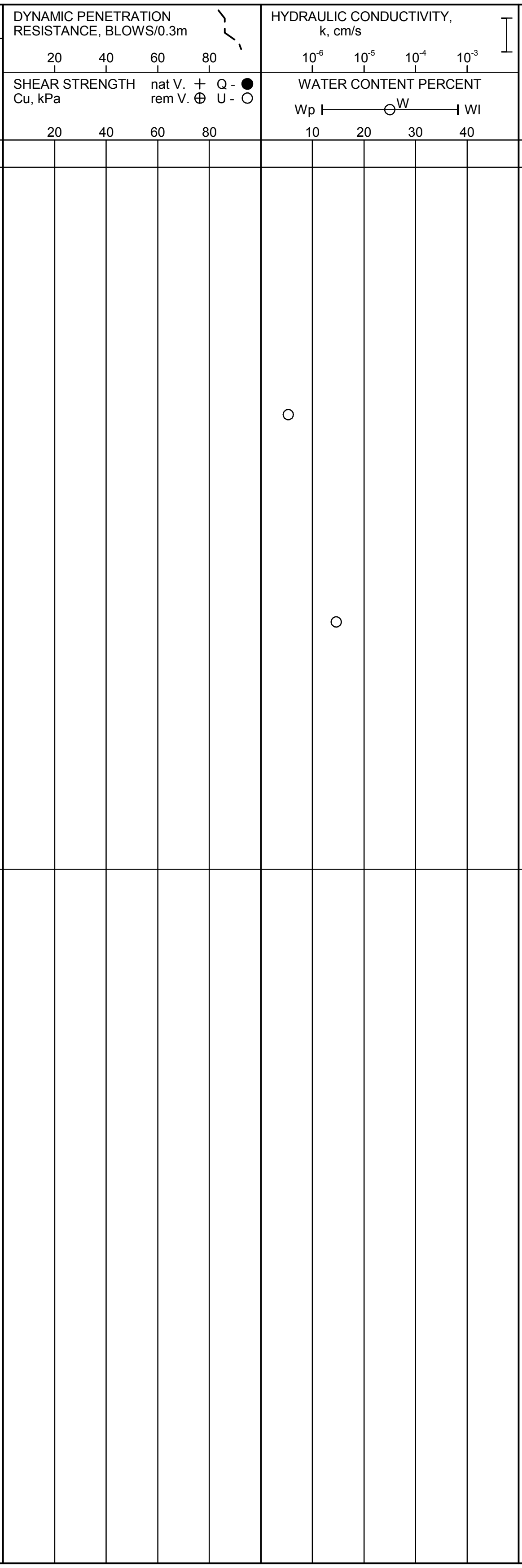
SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		256.00					
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (230 mm)		0.00 255.77					
		FILL - (SW/SM) SAND and GRAVEL to gravelly SAND to SILTY SAND and GRAVEL; brown to dark brown; non-cohesive, moist, compact to very dense - Layers of silty clay with organics encountered at a depth of 1.1 m		0.23	1	SS	56		
1					2A 2B	SS	31		
					3	SS	33		
2					4A 4B	SS	25		
3		FILL - SILTY CLAY, some sand, some gravel; brown to black; cohesive, with organics, w~PL, very stiff		253.03 2.97	5	SS	22		
4		(CL) SILTY CLAY, trace sand, trace gravel; brown, mottled (TILL); cohesive, w>PL, very stiff to hard		252.27 3.73	6	SS	32		
5					7	SS	31		
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.		250.82 5.18					
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-04

BORING DATE: March 24, 2017

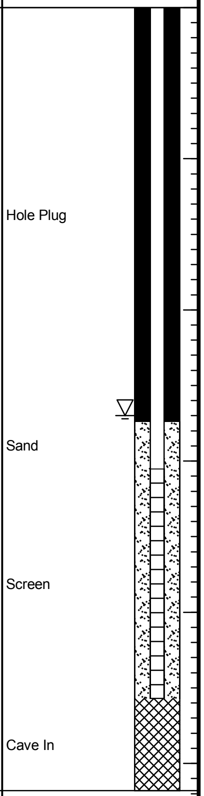
SHEET 1 OF 1
DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected (20, 40, 60, 80)
IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] ☐ ND = Not Detected (20, 40, 60, 80)
HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3})
WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40)
ADDITIONAL LAB. TESTING

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE [PPM]
		GROUND SURFACE		255.90				
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (200 mm)		0.00				
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact to dense		255.70 0.20	1	SS	45	ND
					2A			ND
1		(CL/CI) SILTY CLAY, trace sand, trace gravel; brown to grey (TILL); cohesive, w~PL to w>PL, very stiff to hard		254.99 0.91	2B	SS	15	ND
2					3	SS	23	ND
					4	SS	23	ND
3					5	SS	32	ND
4					6	SS	17	ND
5					7	SS	25	ND
		END OF BOREHOLE		250.72 5.18				

PIEZOMETER OR STANDPIPE INSTALLATION



NOTES:

1. Borehole dry upon completion of drilling.

2. Water level measured in monitoring well at a depth of about 2.7 m below ground surface on July 14, 2017.

DEPTH SCALE
1 : 50

LOGGED: MC
CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-05

BORING DATE: March 19, 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		256.60							
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (230 mm)	■	0.00							
		FILL - (SP) gravelly SAND; brown; non-cohesive, moist, compact	▨	256.37 0.23	1	SS	21		○	M	
1					2A 2B	SS	10				
		(CL/CI) SILTY CLAY, trace sand, trace gravel; brown to grey, mottled (TILL); w~PL to w>PL, stiff to very stiff	▨	255.53 1.07							
2					3	SS	22		○		
3					4	SS	24				
					5	SS	26				
4					6	SS	25		○		
5		- Grey below a depth of 4.9 m below ground surface			7	SS	27				
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.		251.42 5.18							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-06

BORING DATE: March 20, 2017

SHEET 1 OF 1
DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		257.30							
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (230 mm)	■	0.00							
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact		257.07 0.23	1	SS	28	⊕□ ND			
1		FILL - (CL) SILTY CLAY, trace to some sand, trace to some gravel; dark grey, containing organics; cohesive, w~PL, stiff to very stiff		256.54 0.76	2	SS	19	⊕□ ND	○		
					3	SS	13	⊕□ ND			
2		(CL/CI) SILTY CLAY, trace sand, trace gravel; brown to grey (TILL); cohesive, stiff to very stiff		255.10 2.20	4	SS	22/ 0.05				
3					5	SS	17	⊕□ ND			
4					6	SS	14	⊕□ ND			
5				252.12	7	SS	21	⊕□ ND			
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.		5.18							
6											
7											
8											
9											
10											

Chart scales: HEX HEADSPACE 20 40 60 80; HYDRAULIC CONDUCTIVITY 10^{-6} 10^{-5} 10^{-4} 10^{-3}; IBL HEADSPACE 20 40 60 80; WATER CONTENT PERCENT 10 20 30 40

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MC
CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-07

BORING DATE: March 30, 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

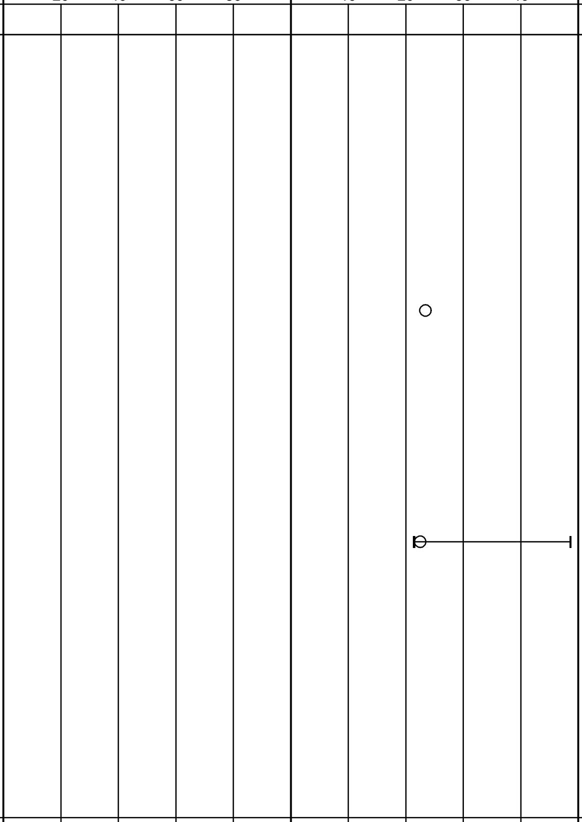
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
		GROUND SURFACE		258.60				
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (200 mm)	■	0.00				
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact to very dense	▨	258.40 0.20	1	SS	66	
1					2A	SS	11	
		FILL - (CI) SILTY CLAY, trace sand, trace gravel; brown to grey, containing organics; cohesive, firm to stiff	▨	257.53 1.07	2B			
2					3	SS	8	
		(CI) SILTY CLAY, trace sand; brown, mottled; cohesive, w~PL, stiff to very stiff	▨	256.39 2.21	4	SS	18	
3					5	SS	23	MH
4					6	SS	9	
5					7	SS	13	
		END OF BOREHOLE		253.42 5.18				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

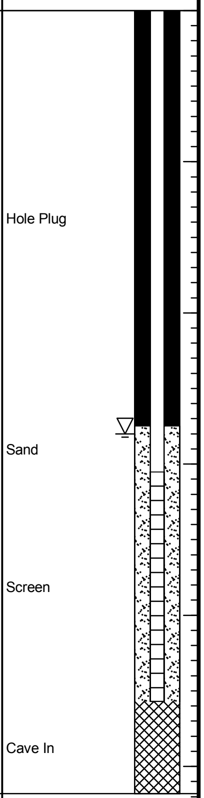
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION



NOTES:

1. Borehole dry upon completion of drilling.

2. Groundwater level measured in monitoring well at a depth of 2.8 m below ground surface on July 14, 2017.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-08

BORING DATE: March 27, 2017

SHEET 1 OF 3

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Power Auger; 83 mm I.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	259.10				
ASPHALT (240 mm)	0.00				
FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact	258.86 0.24	1	SS	20	
FILL - (CI) SILTY CLAY, trace sand, trace gravel; brown to grey, containing organics and brick fragments; cohesive, w~PL, firm	258.34 0.76	2	SS	7	
		3	SS	5	
(CL) SILTY CLAY, trace gravel; brown; cohesive, w~PL, very stiff	256.89 2.21	4	SS	18	
		5	SS	20	
(CL/CI) SILTY CLAY, trace sand to sandy, trace gravel; brown to grey (TILL); cohesive, w~PL to w>PL, very stiff to hard	255.37 3.73	6	SS	20	
		7	SS	22	
- Grey below a depth of about 6.5 m below ground surface		8	SS	32	
		9	SS	23	MH
		10	SS	24	

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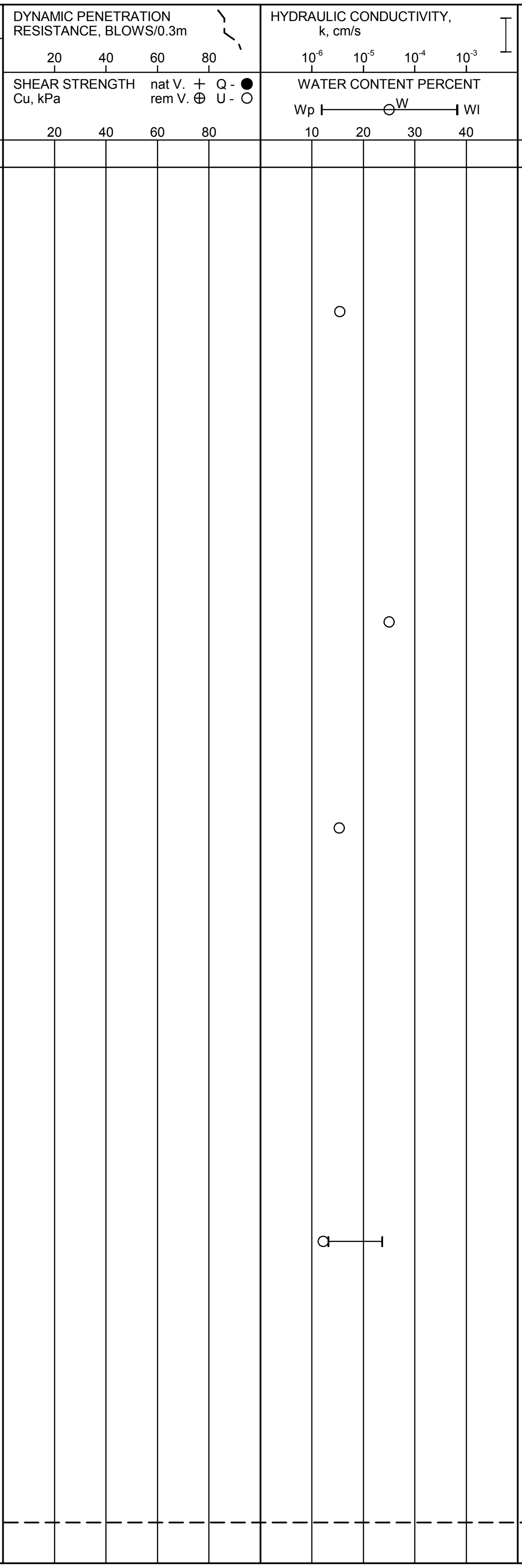


PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-08

BORING DATE: March 27, 2017

SHEET 2 OF 3

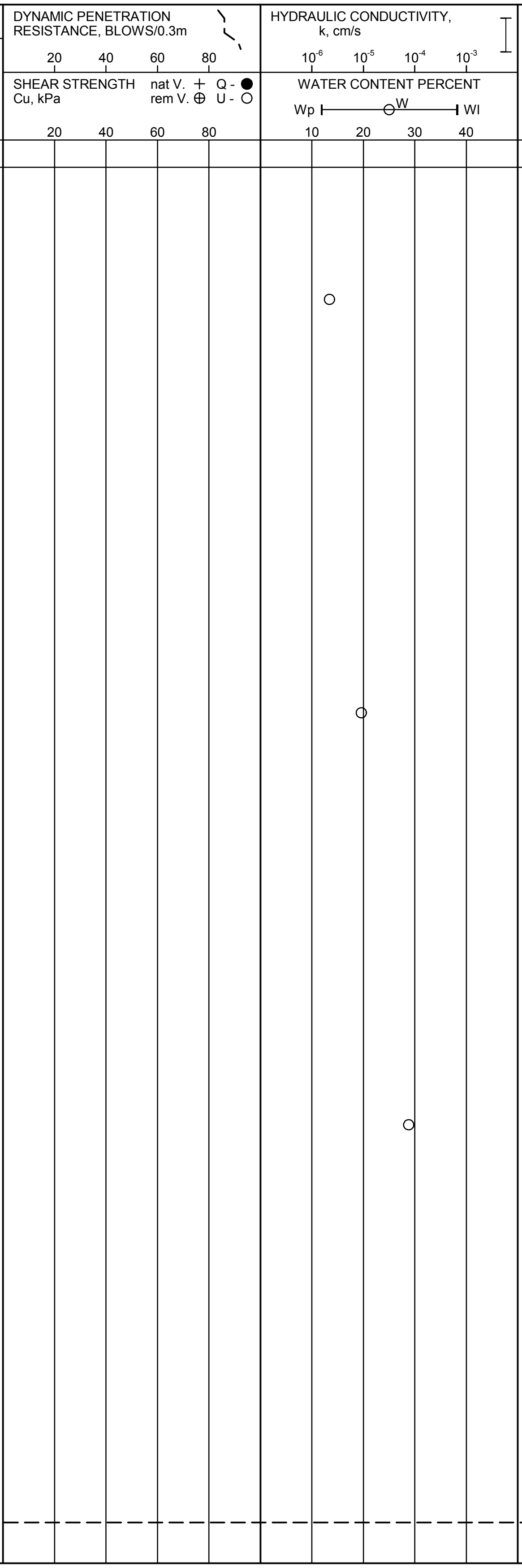
DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Power Auger 83 mm I.D. Hollow Stem Augers	(CL/CI) SILTY CLAY, trace sand to sandy, trace gravel; brown to grey (TILL); cohesive, w~PL to w>PL, very stiff to hard						
11				11	SS	32		
		(CL-ML) SILTY CLAY - CLAYEY SILT; grey; cohesive, w<PL, stiff to very stiff	247.35 11.75					
12				12	SS	11		
14				13	SS	24		
15.5				14	SS	18		
17				15	SS	11		
		(CL) SILTY CLAY; grey (TILL); cohesive, w~PL, very stiff to hard	241.35 17.75					
18.5				16	SS	16		
20				17	SS	32		



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DEPTH SCALE

1 : 50

LOGGED: MC

CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-08

BORING DATE: March 27, 2017

SHEET 3 OF 3
DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20		(CL) SILTY CLAY; grey (TILL); cohesive, w~PL, very stiff to hard	▨	238.68	17	SS	32				
		END OF BOREHOLE		20.42							
		NOTE:									
21		1. Borehole dry upon completion of drilling.									
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MC
CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-09

BORING DATE: March 28, 2017

SHEET 1 OF 3
DATUM: Local

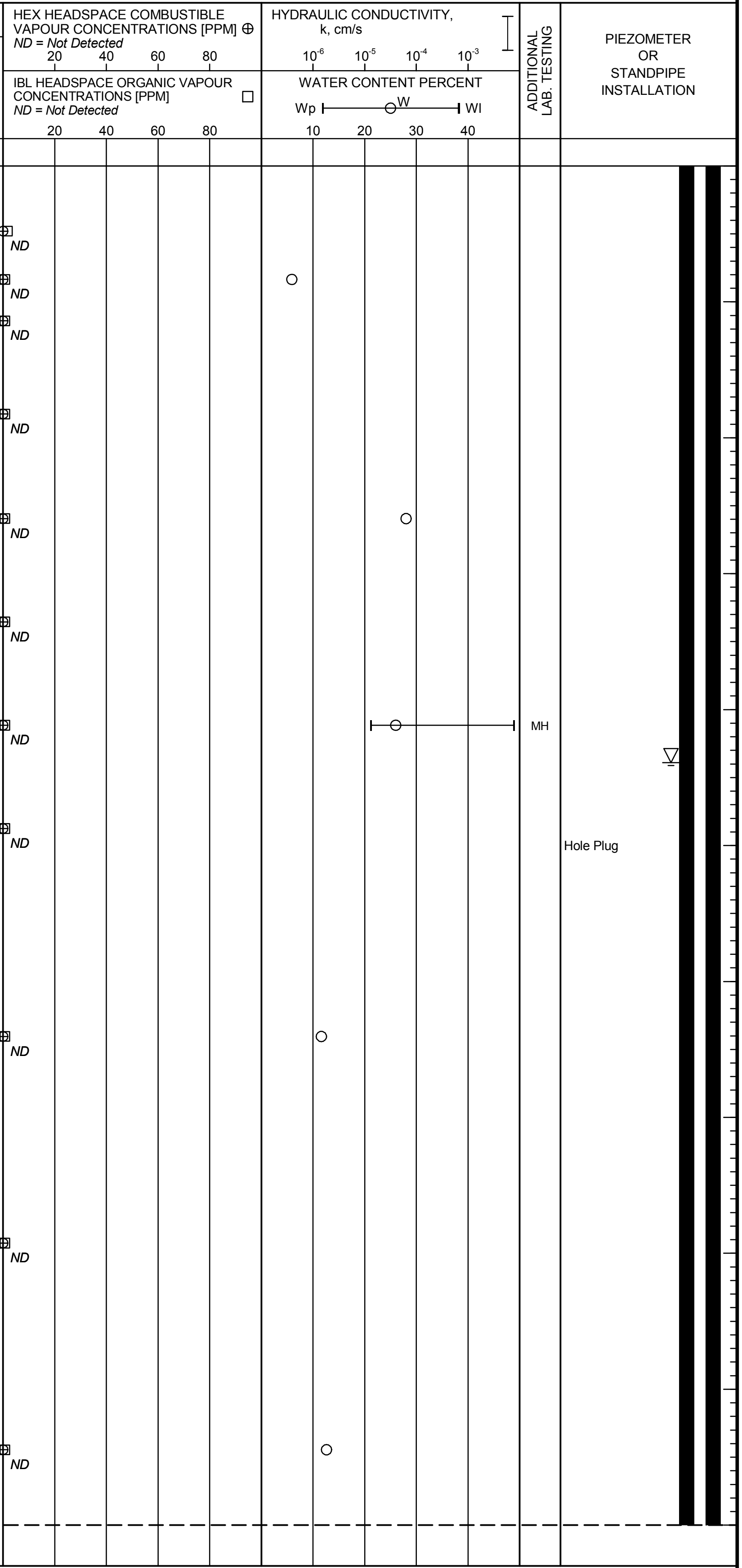
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Power Auger, 83 mm I.D. Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	259.10
0	ASPHALT (200 mm)	0.00 258.90 0.20
	FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, most, compact	
1	FILL - (CL) SILTY CLAY, trace sand, trace gravel; brown; cohesive, w~PL to w>PL, stiff	258.19 0.91
2	(CL) SILTY CLAY; brown; cohesive, w>PL to w~PL, stiff to very stiff	256.90 2.20
5	(CL) SILTY CLAY, trace sand, trace gravel; grey (TILL); cohesive, w~PL, stiff to very stiff	253.46 5.64
10	CONTINUED NEXT PAGE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	15
2A	SS	8
2B		
3	SS	14
4	SS	20
5	SS	17
6	SS	16
7	SS	14
8	SS	16
9	SS	13
10	SS	21



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MC
CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-09

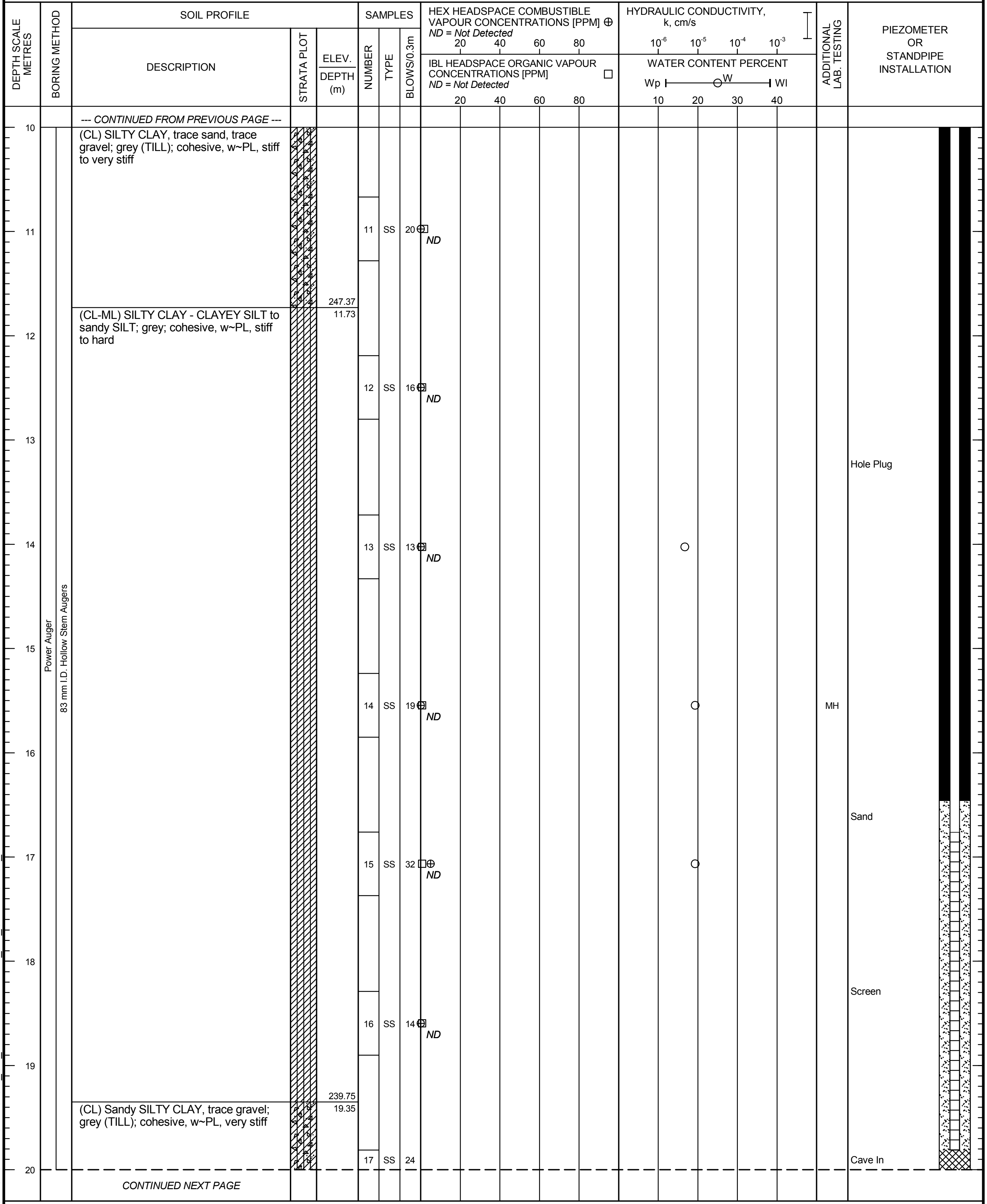
BORING DATE: March 28, 2017

SHEET 2 OF 3

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC



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DESCRIPTION	ELEV. DEPTH (m)
(CL) SILTY CLAY, trace sand, trace gravel; grey (TILL); cohesive, w~PL, stiff to very stiff	
(CL-ML) SILTY CLAY - CLAYEY SILT to sandy SILT; grey; cohesive, w~PL, stiff to hard	247.37 11.73
(CL) Sandy SILTY CLAY, trace gravel; grey (TILL); cohesive, w~PL, very stiff	239.75 19.35

NUMBER	TYPE	BLOWS/0.3m	HEADSPACE	ADDITIONAL LAB. TESTING
11	SS	20	⊕ ND	
12	SS	16	⊕ ND	
13	SS	13	⊕ ND	
14	SS	19	⊕ ND	MH
15	SS	32	□⊕ ND	
16	SS	14	⊕ ND	
17	SS	24		

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-09

BORING DATE: March 28, 2017

SHEET 3 OF 3

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected (20 40 60 80) / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] ☐ ND = Not Detected (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp ⊢ W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20		(CL) Sandy SILTY CLAY, trace gravel; grey (TILL); cohesive, w~PL, very stiff	▨	238.68	17	SS	24	⊕ *ND*	⊢○⊣	MH	Cave In
		END OF BOREHOLE		20.42							

NOTES:

1. Borehole dry upon completion of drilling.

2. Groundwater level measured in monitoring well at a depth of 4.4 m below ground surface on July 14, 2017.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-10

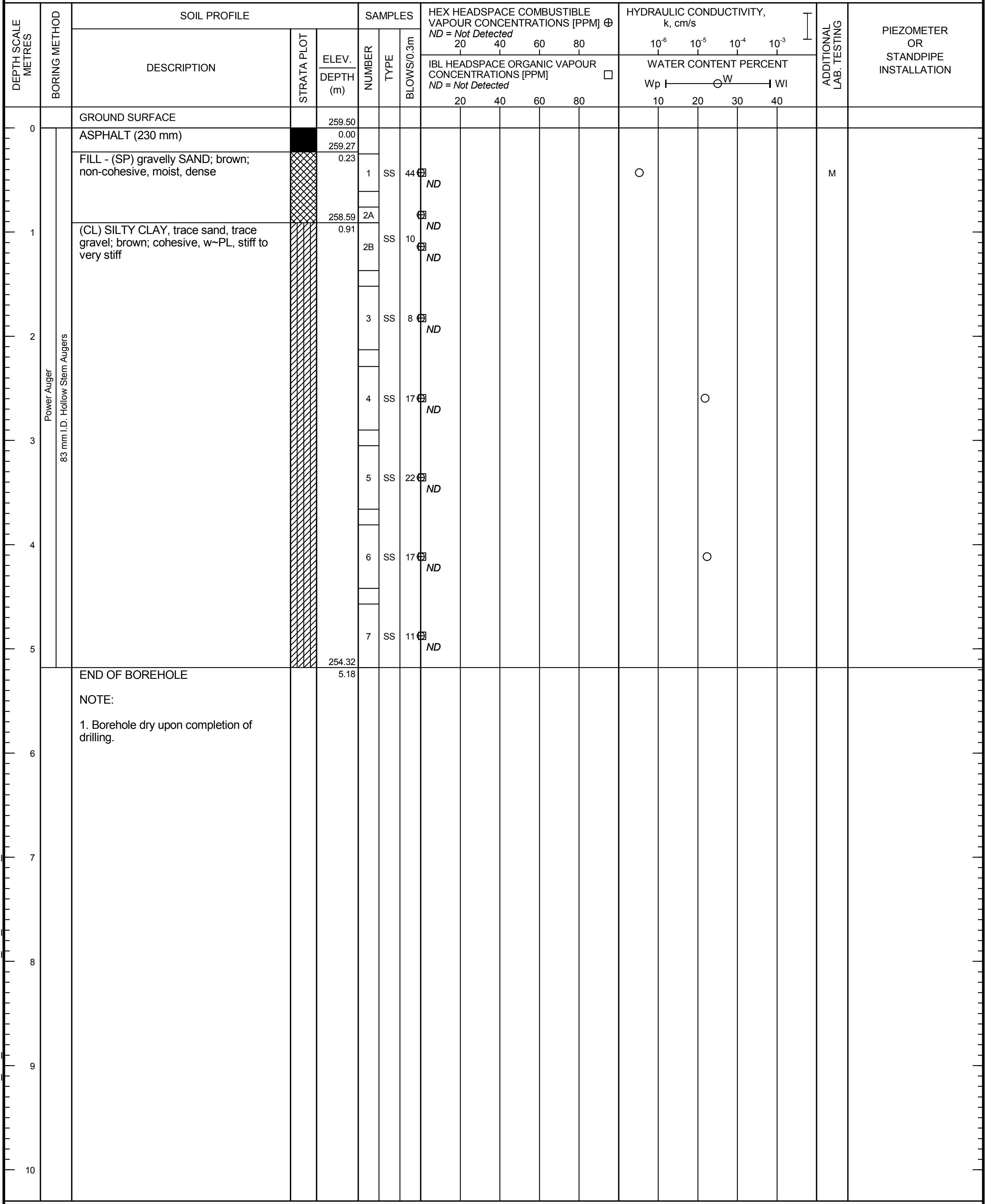
BORING DATE: March 24, 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE	ADDITIONAL LAB. TESTING
		GROUND SURFACE	259.50					
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (230 mm)	0.00					
		FILL - (SP) gravelly SAND; brown; non-cohesive, moist, dense	259.27 0.23	1	SS	44	ND	M
				2A	SS	10	ND	
1		(CL) SILTY CLAY, trace sand, trace gravel; brown; cohesive, w~PL, stiff to very stiff	258.59 0.91	2B			ND	
2				3	SS	8	ND	
				4	SS	17	ND	
3				5	SS	22	ND	
4				6	SS	17	ND	
5				7	SS	11	ND	
		END OF BOREHOLE	254.32 5.18					

NOTE:

1. Borehole dry upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-11

BORING DATE: March 30, 2017

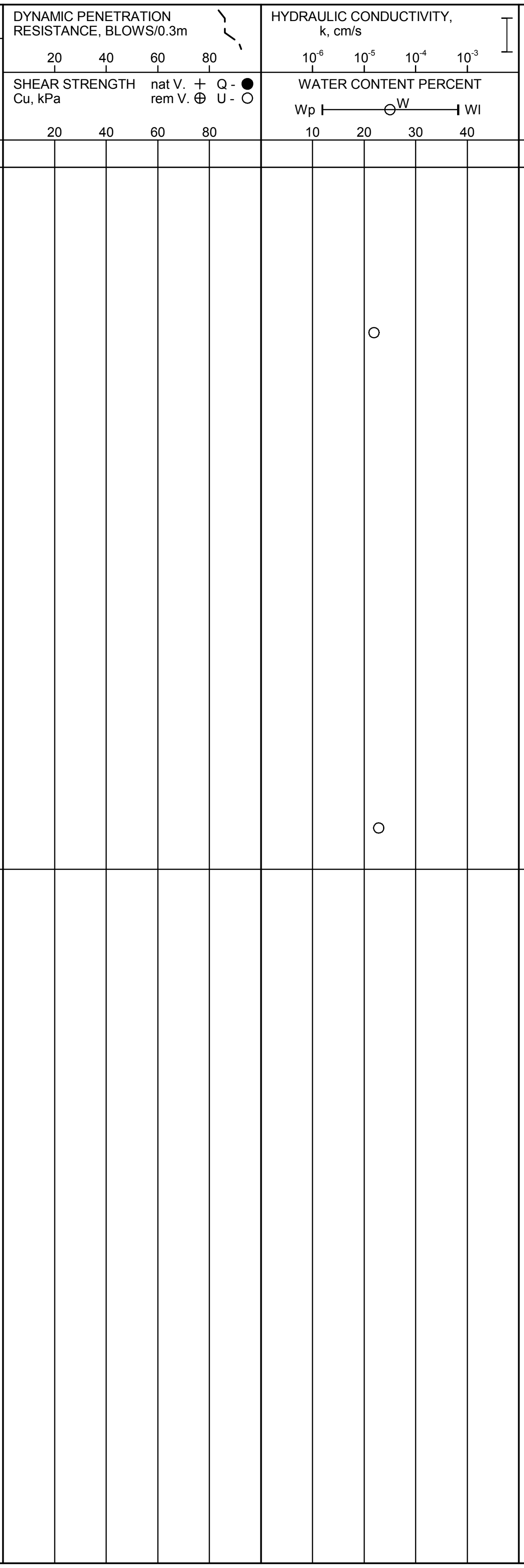
SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		260.00					
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (220 mm)	■	0.00 259.78					
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, loose to very dense	▩	0.22		SS	51		
1				258.93	2A	SS	6		
		FILL - (CL) SILTY CLAY. trace gravel; dark grey; cohesive, w~PL, firm	▩	1.07	2B				
		(CL) SILTY CLAY, trace sand, trace gravel; brown to grey; cohesive, w~PL, firm to very stiff	▨	258.50 1.50	3	SS	7		
2					4	SS	14		
3		- Grey below a depth of 3.0 m below ground surface.			5	SS	17		
4					6	SS	13		
5				254.82	7	SS	9		
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.		5.18					
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-12

BORING DATE: March 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Power Auger
83 mm I.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	260.30
ASPHALT (200 mm)	0.00 260.10
FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, loose to compact	0.20
(CL/CI) SILTY CLAY, trace sand, trace gravel; brown to grey; cohesive, w~PL, firm to very stiff	259.23 1.07
END OF BOREHOLE	255.12 5.18

NOTE:

1. Borehole dry upon completion of drilling.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □
1	SS	25	ND
2A	SS	6	ND
2B			ND
3	SS	11	ND
4	SS	16	ND
5	SS	19	ND
6	SS	13	ND
7	SS	12	ND

HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected 20 40 60 80

IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-13

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: Local

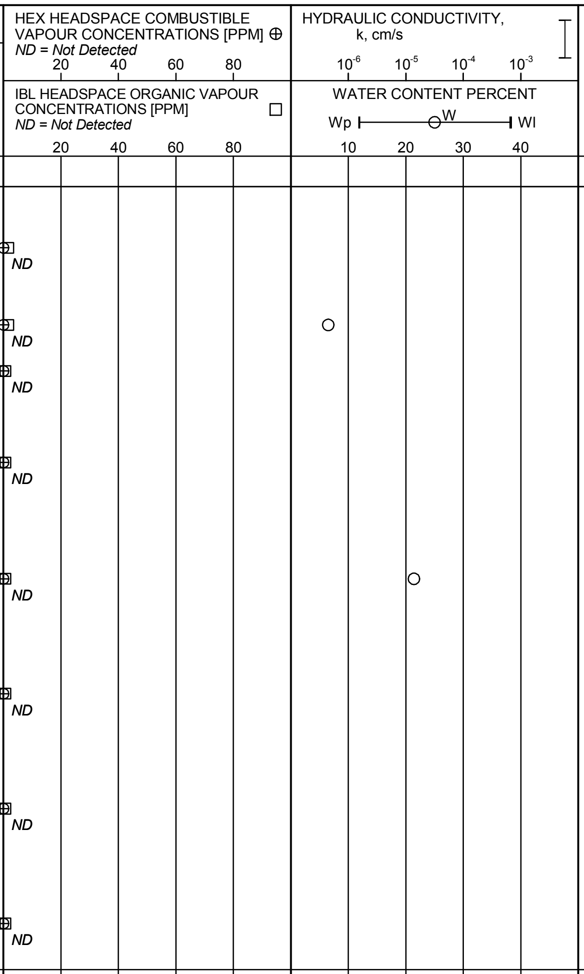
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Power Auger, 83 mm I.D. Hollow Stem Augers (0 to 5.18 m)

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		260.30
ASPHALT (200 mm)	■	0.00
FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact	▩	260.10 0.20
(CL/CI) SILTY CLAY, trace sand, trace gravel; brown to grey; cohesive, w~PL, stiff to very stiff	▨	259.23 1.07
END OF BOREHOLE		255.12 5.18

SAMPLES NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □
1	SS	28	ND
2A	SS	10	ND
2B			ND
3	SS	25	ND
4	SS	16	ND
5	SS	13	ND
6	SS	17	ND
7	SS	13	ND



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

NOTE:

1. Borehole dry upon completion of drilling.

DEPTH SCALE 1 : 50

LOGGED: MC

CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-14

BORING DATE: March 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected)	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	259.90							
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (180 mm)	0.00 259.72							
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact	0.18 259.29	1A	SS	13	ND			
		FILL - (CI) SILTY CLAY, trace sand, trace gravel; dark brown to grey; cohesive, w~PL, firm	0.61	1B			ND			
1				2	SS	5				Hole Plug
			258.07	3A	SS	5	ND			
2		(CI) SILTY CLAY, some sand, some gravel; brown to grey (TILL); cohesive, w~PL, stiff to very stiff	1.83	3B			ND			
				4	SS	15	ND		MH	
3										Sand
				5	SS	15	ND			
4				6	SS	19	ND			Screen
5			254.72	7	SS	16	ND			
		END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.	5.18							
6										
7										
8										
9										
10										

DEPTH SCALE

1 : 50

LOGGED: MC

CHECKED: EM

PROJECT: 1665649
LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-15

BORING DATE: March 2017

SHEET 1 OF 1
DATUM: Local

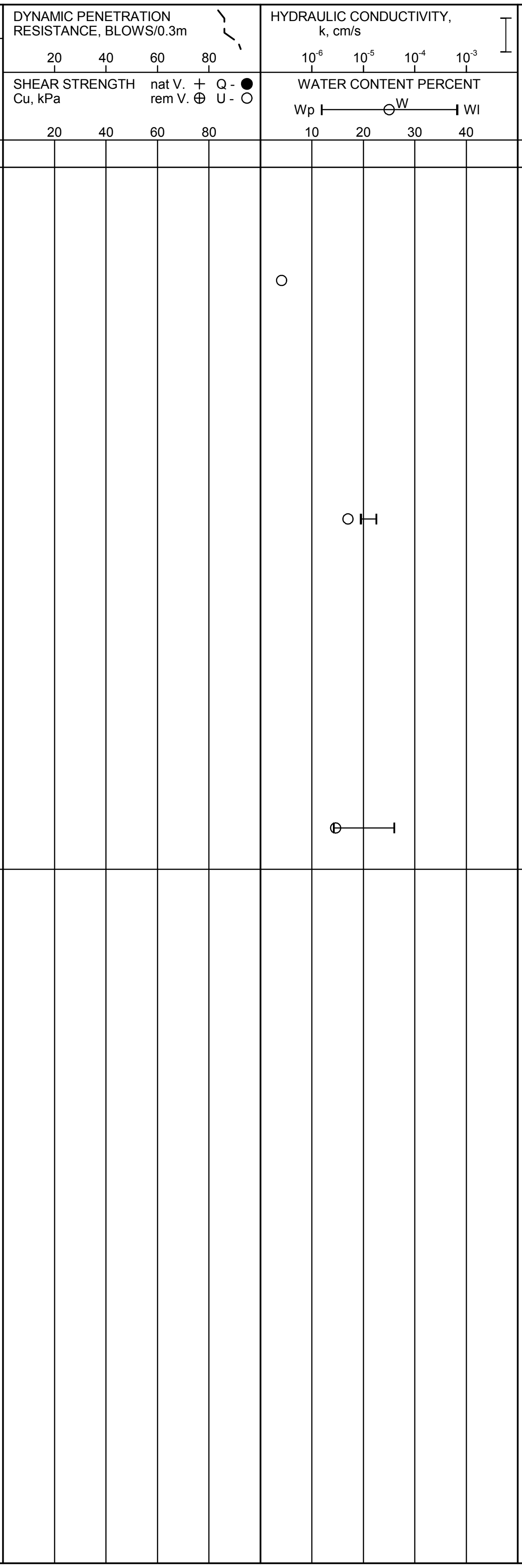
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		259.50					
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (180 mm)	■	0.00					
		FILL - (SM) gravelly SILTY SAND; brown; non-cohesive, moist, compact to very dense	▨	259.32 0.18	1	SS	67		
					2A			M	
1		(CL/CI) SILTY CLAY, trace sand, trace gravel; brown; cohesive, w<PL, very stiff	▨	258.59 0.91	2B	SS	19		
					3	SS	19		
2		(ML) SILT, trace sand, trace gravel; brown; non-cohesive, moist, compact to very dense	▥	257.29 2.21	4	SS	28		
3					5	SS	44		
4		(CL) sandy SILTY CLAY, trace gravel; grey (TILL); cohesive, stiff	▨	255.76 3.74	6A	SS	35		
					6B				
5					7	SS	14	MH	
		END OF BOREHOLE		254.32 5.18					

NOTE:

1. Borehole dry upon completion of drilling.



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MC
CHECKED: EM

PROJECT: 1665649

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH17-16

BORING DATE: March 29, 2017

SHEET 1 OF 1

DATUM: Local

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	HEX HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected / IBL HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT Wp W Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	259.20							
0	Power Auger 83 mm I.D. Hollow Stem Augers	ASPHALT (180 mm)	0.00							
		FILL - (SP/GP) SAND and GRAVEL; brown; non-cohesive, moist, compact to dense	259.02 0.18	1	SS	36	ND			
1				2A	SS	14	ND			
		(CI) SILTY CLAY, trace sand, trace gravel; brown (TILL); cohesive, w~PL to w>PL, very stiff	258.13 1.07	2B			ND			
2				3	SS	23	ND			
3				4	SS	23	ND			
				5	SS	23	ND			
4				6	SS	22	ND			
5				7	SS	23	ND			
		END OF BOREHOLE	254.02 5.18							

NOTE:

1. Borehole dry upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MC

CHECKED: EM

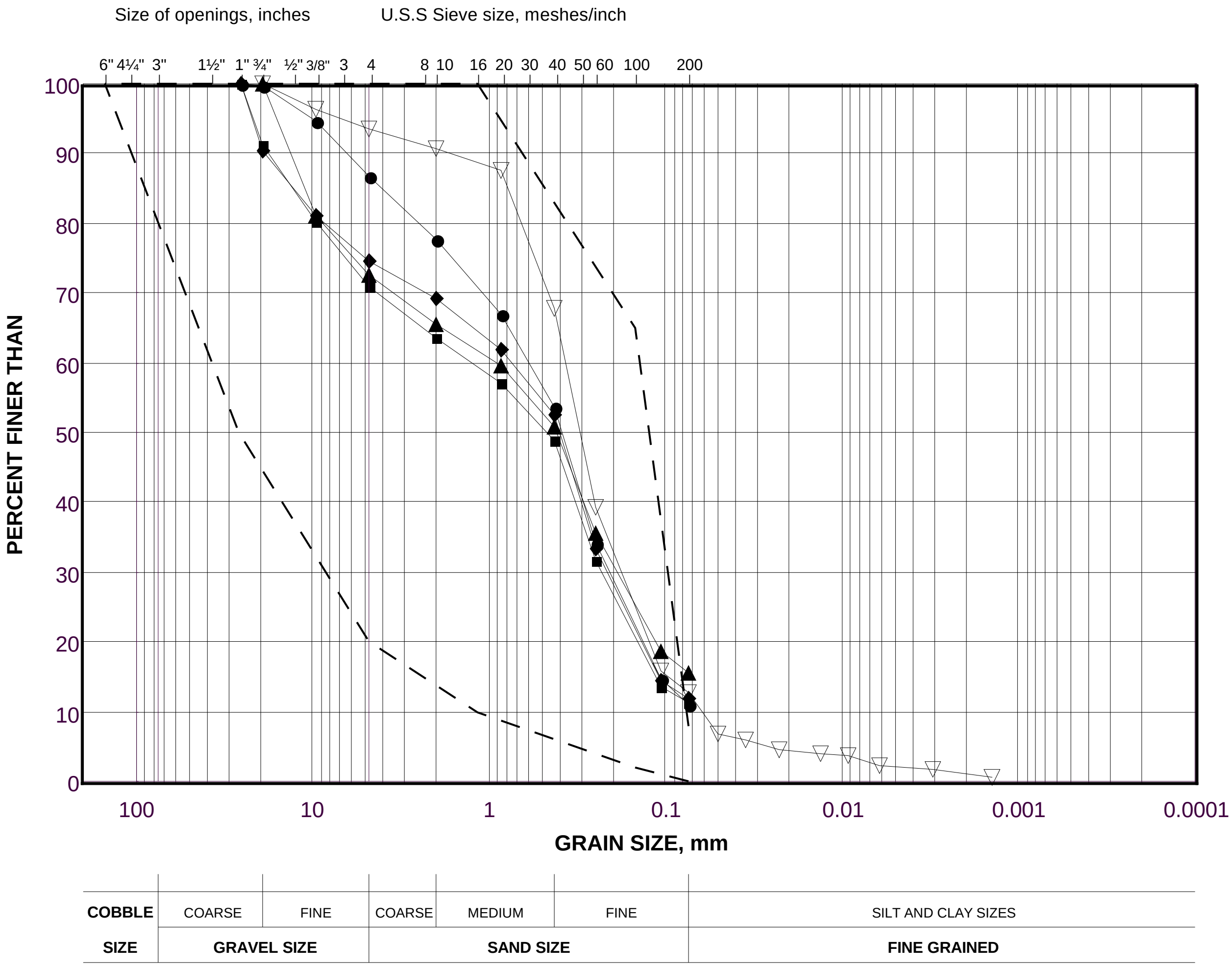
APPENDIX B

Geotechnical Laboratory Results

GRAIN SIZE DISTRIBUTION

FILL - (SP-SM) to (SM) GRAVELLY SAND TO SILTY SAND

FIGURE B1



LEGEND

SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	17-01	1	0.21 - 0.61
■	17-10	1/2 Combined	0.24 - 0.61
◆	17-05	1/2A Combined	0.24 - 1.07
□	17-15	2A	0.24 - 0.61
♦	17-02	2A	0.76 - 1.07

Project Number: 1665649 (1000)

Checked By:

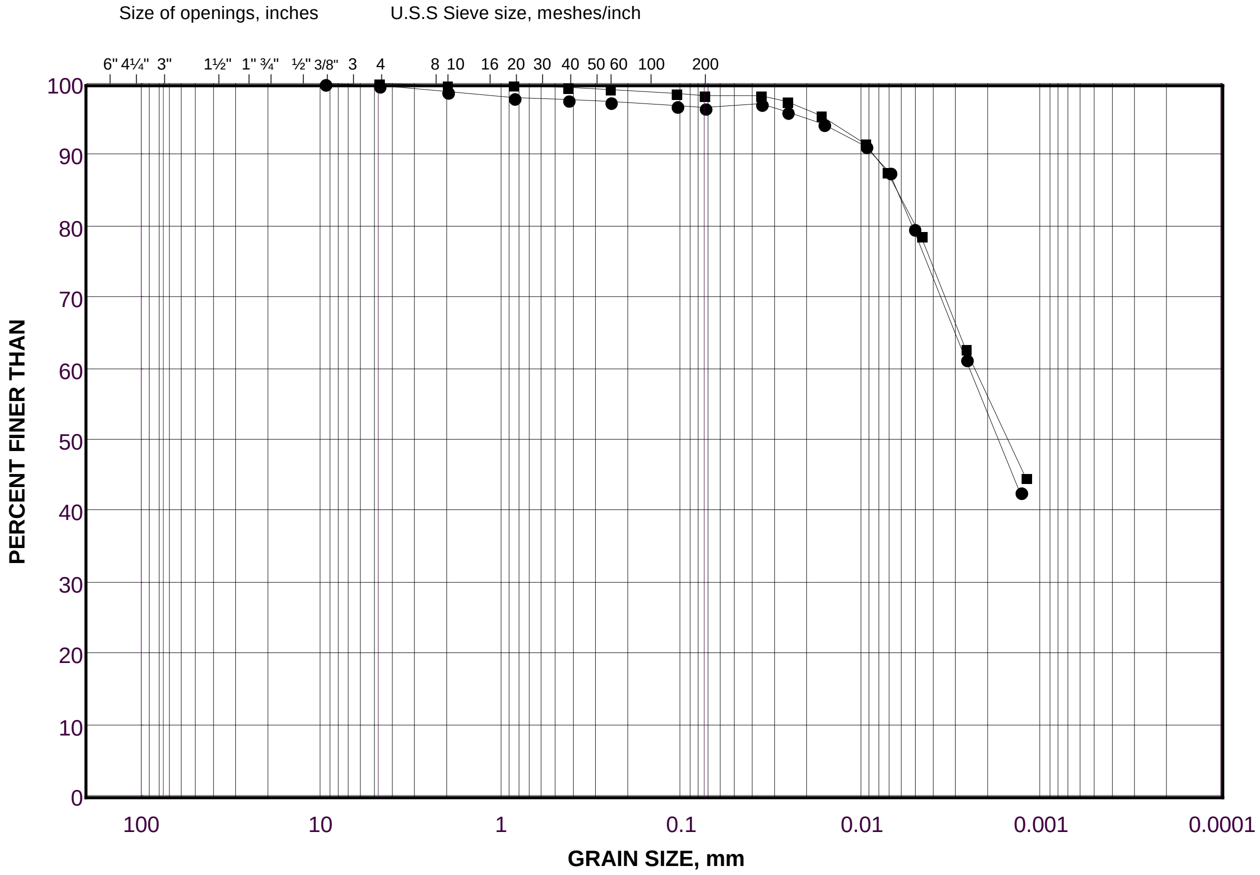
Golder Associates

Date: 05-Dec-17

GRAIN SIZE DISTRIBUTION

(CL/CI) SILTY CLAY - UPPER

FIGURE B2



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

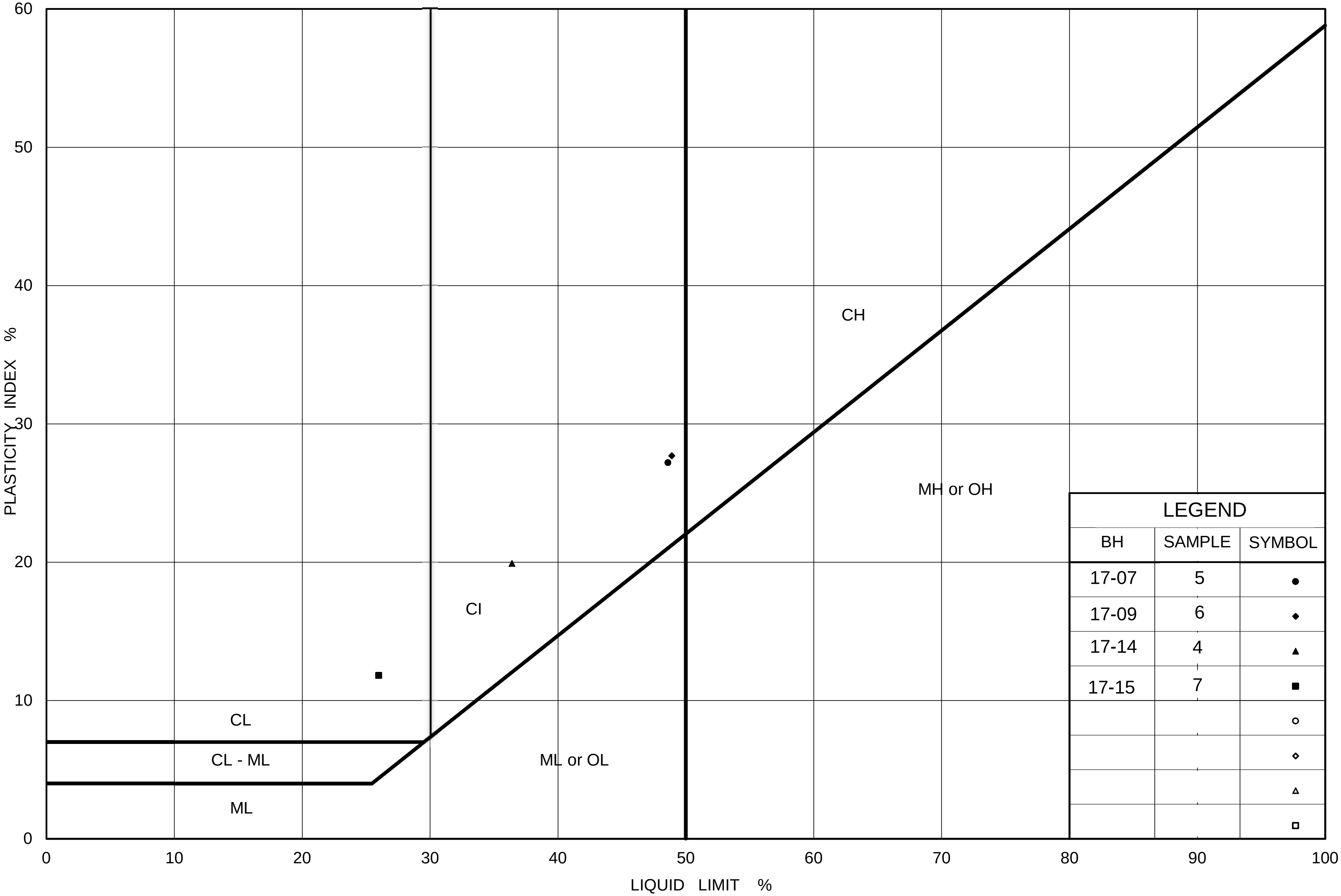
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	17-07	5	3.05 - 3.66
■	17-09	6	3.81 - 4.42

Project Number: 1665649 (1000)

Checked By:

Golder Associates

Date: 05-Dec-17



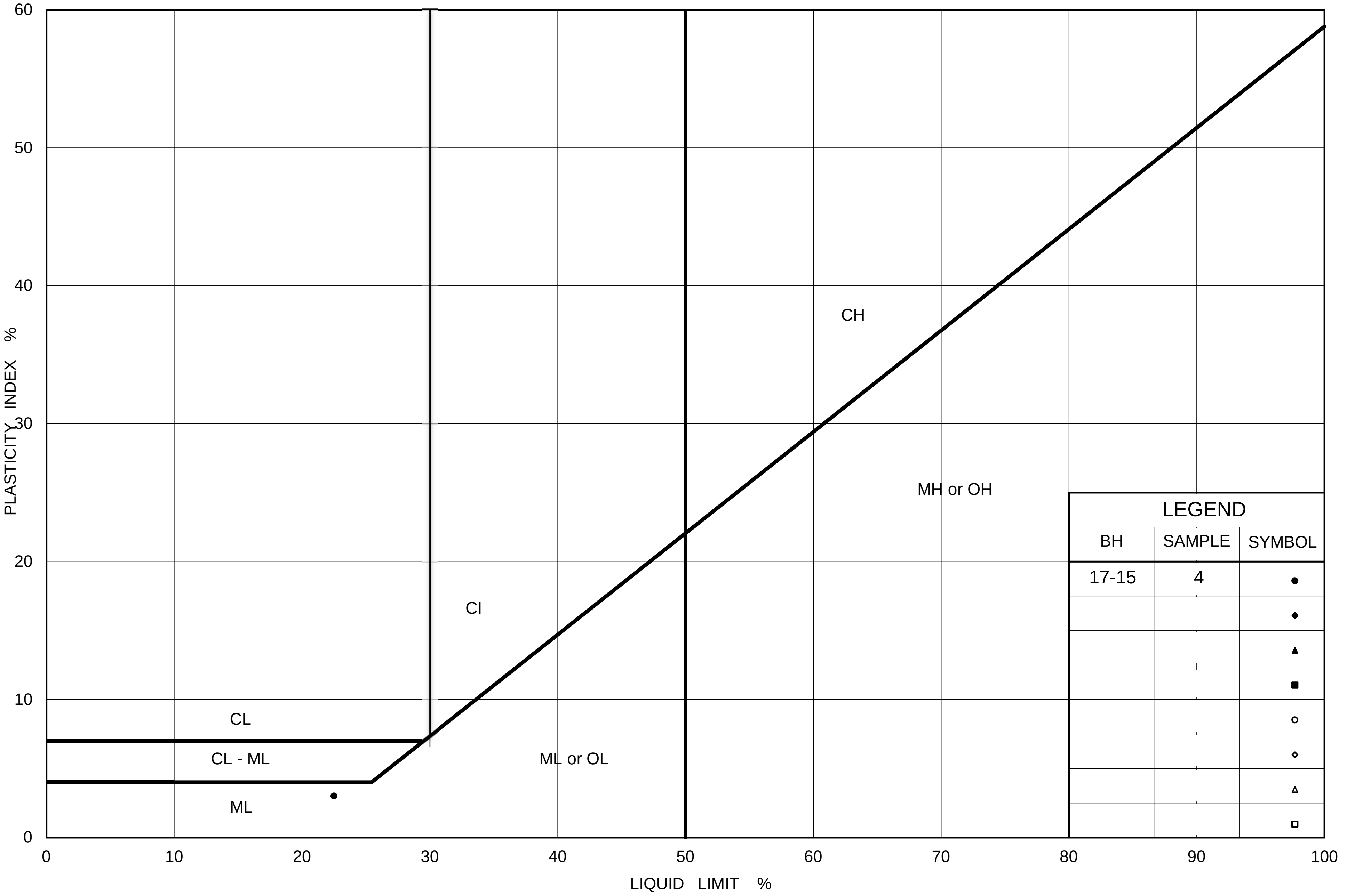
Golder Associates

PLASTICITY CHART
(CI/CL) SILTY CLAY - UPPER

Figure No. B3

Project No. 1665649 (1000)

Checked By: EM



PLASTICITY CHART
(ML) SILT

Figure No. B4

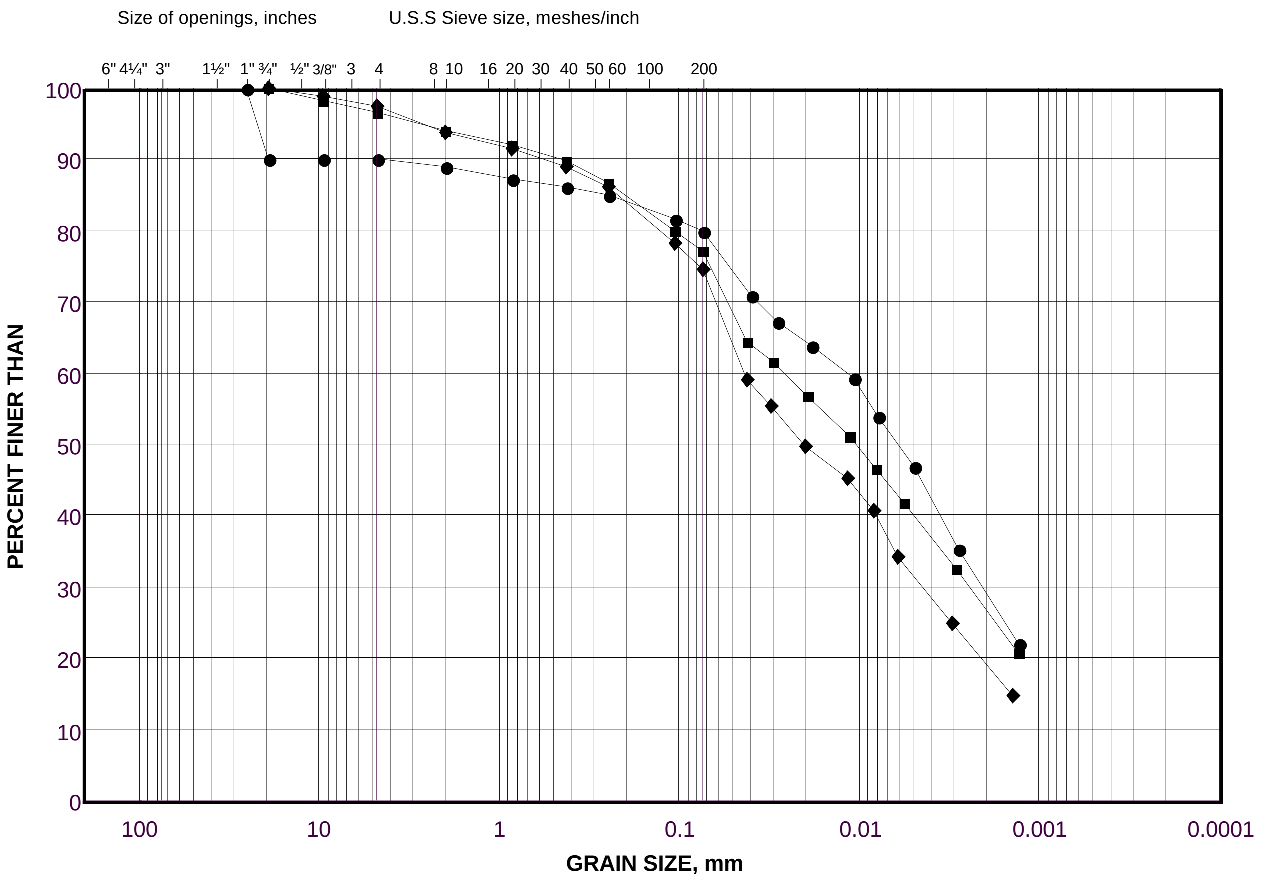
Project No. 1665649 (1000)

Checked By: AJ

GRAIN SIZE DISTRIBUTION

(CL/CI) sandy SILTY CLAY (TILL) - Upper

FIGURE B5



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

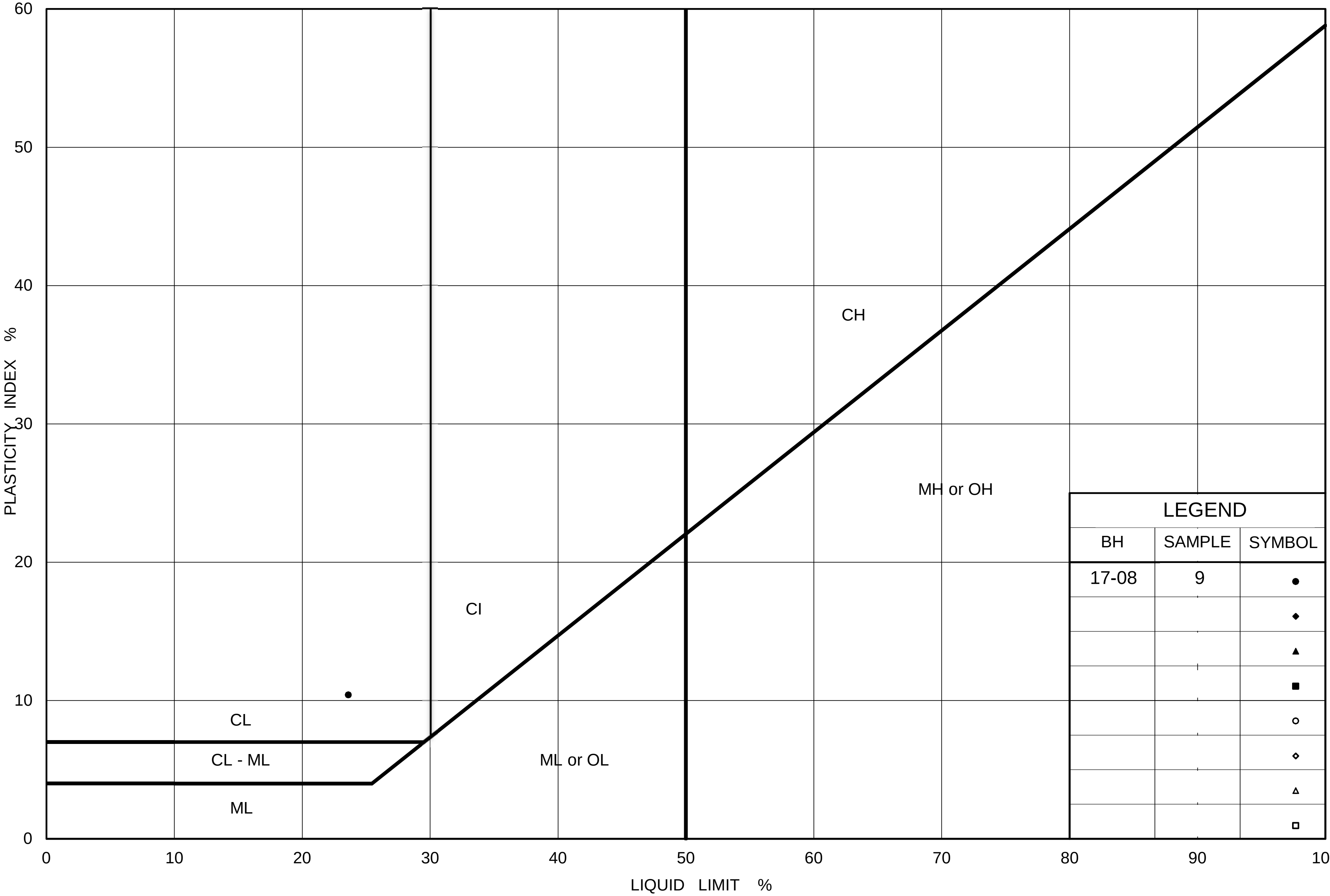
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	17-14	4	2.29 - 2.90
■	17-15	7	4.57 - 5.18
◆	17-08	9	7.62 - 8.23

Project Number: 1665649 (1000)

Checked By:

Golder Associates

Date: 05-Dec-17



Golder Associates

PLASTICITY CHART
(CL/CI) SILTY CLAY (Till) (Upper)

Figure No. B6

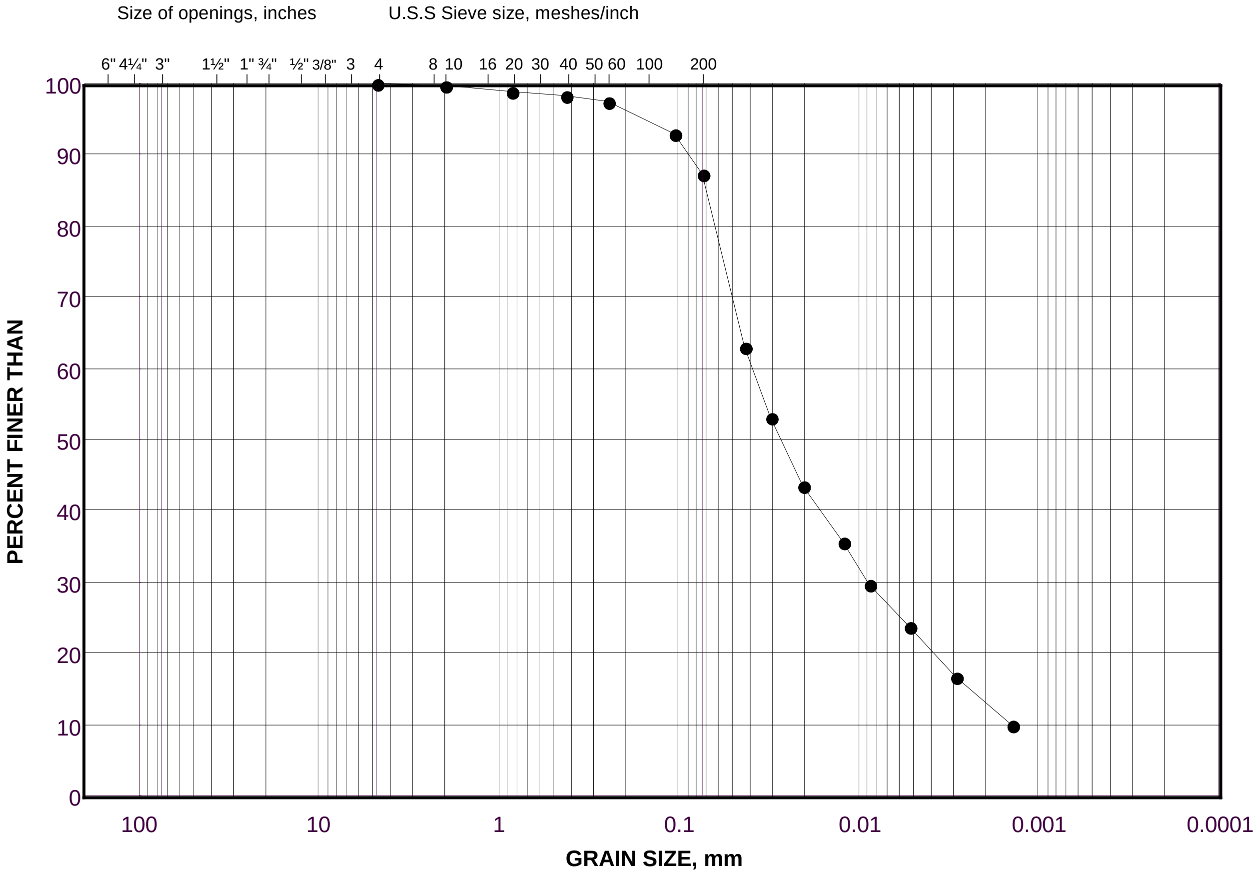
Project No. 1665649 (1000)

Checked By:

GRAIN SIZE DISTRIBUTION

(CL-ML) SILTY CLAY - CLAYEY SILT

FIGURE B7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	17-09	14	15.24 - 15.85

Project Number: 1665649 (1000)

Checked By:

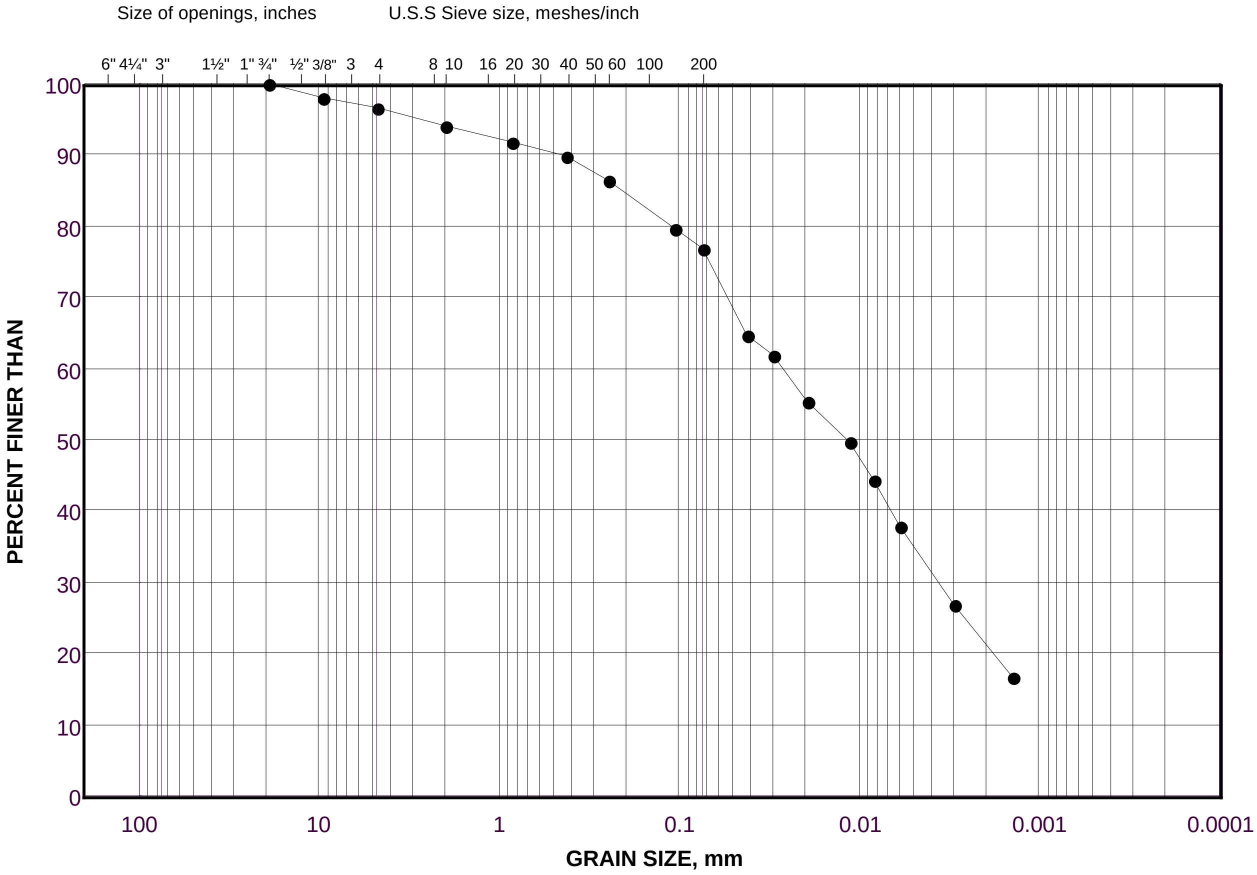
Golder Associates

Date: 05-Dec-17

GRAIN SIZE DISTRIBUTION

(CL/CI) sandy SILTY CLAY (TILL) - LOWER

FIGURE B8



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

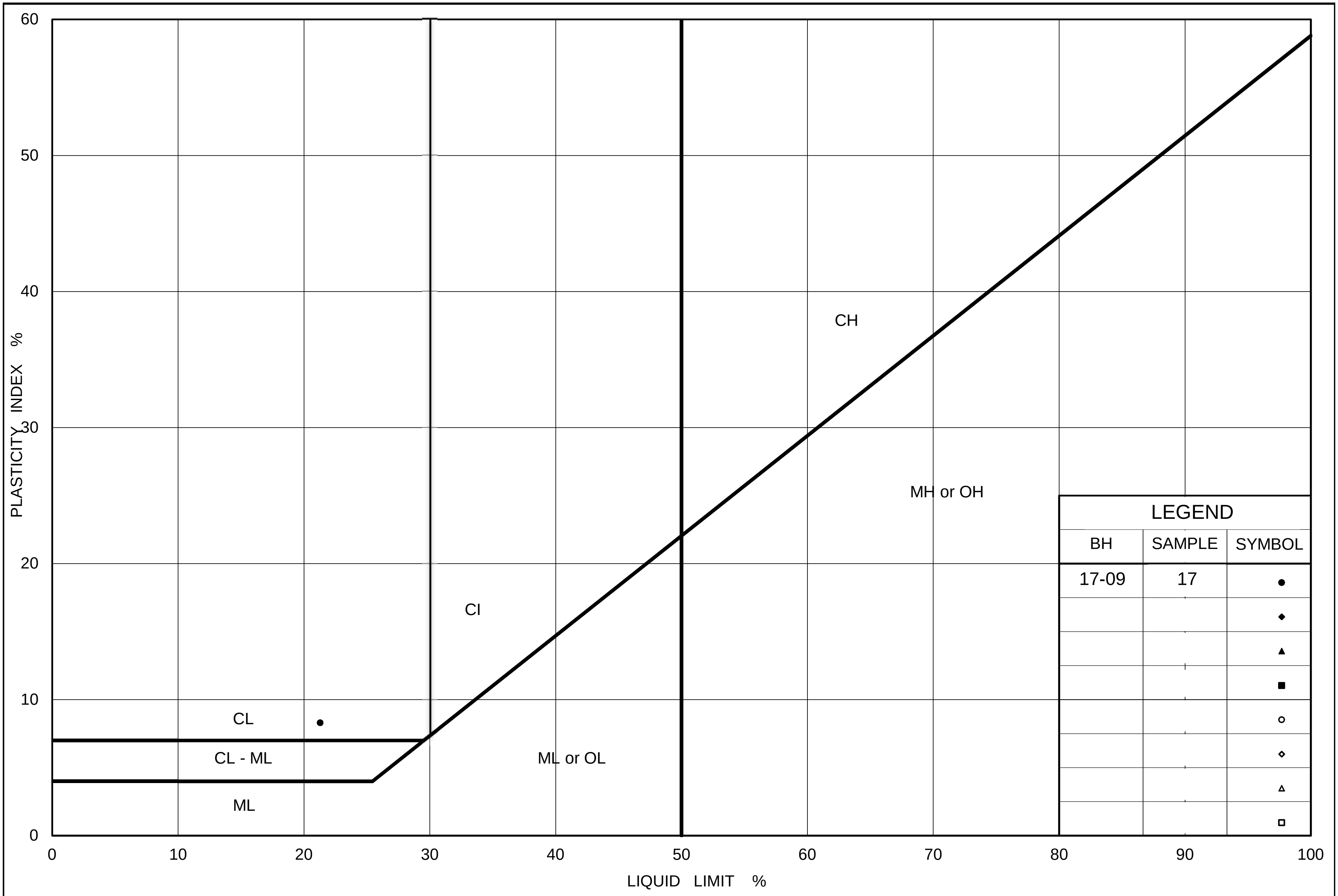
SYMBOL	Borehole	SAMPLE	DEPTH(m)
●	17-09	17	19.60 - 20.10

Project Number: 1665649 (1000)

Checked By:

Golder Associates

Date: 05-Dec-17



PLASTICITY CHART
(CL/CI) sandy SILTY CLAY (TILL) (LOWER)

Golder Associates

Figure No. B9

Project No. 1665649 (1000)

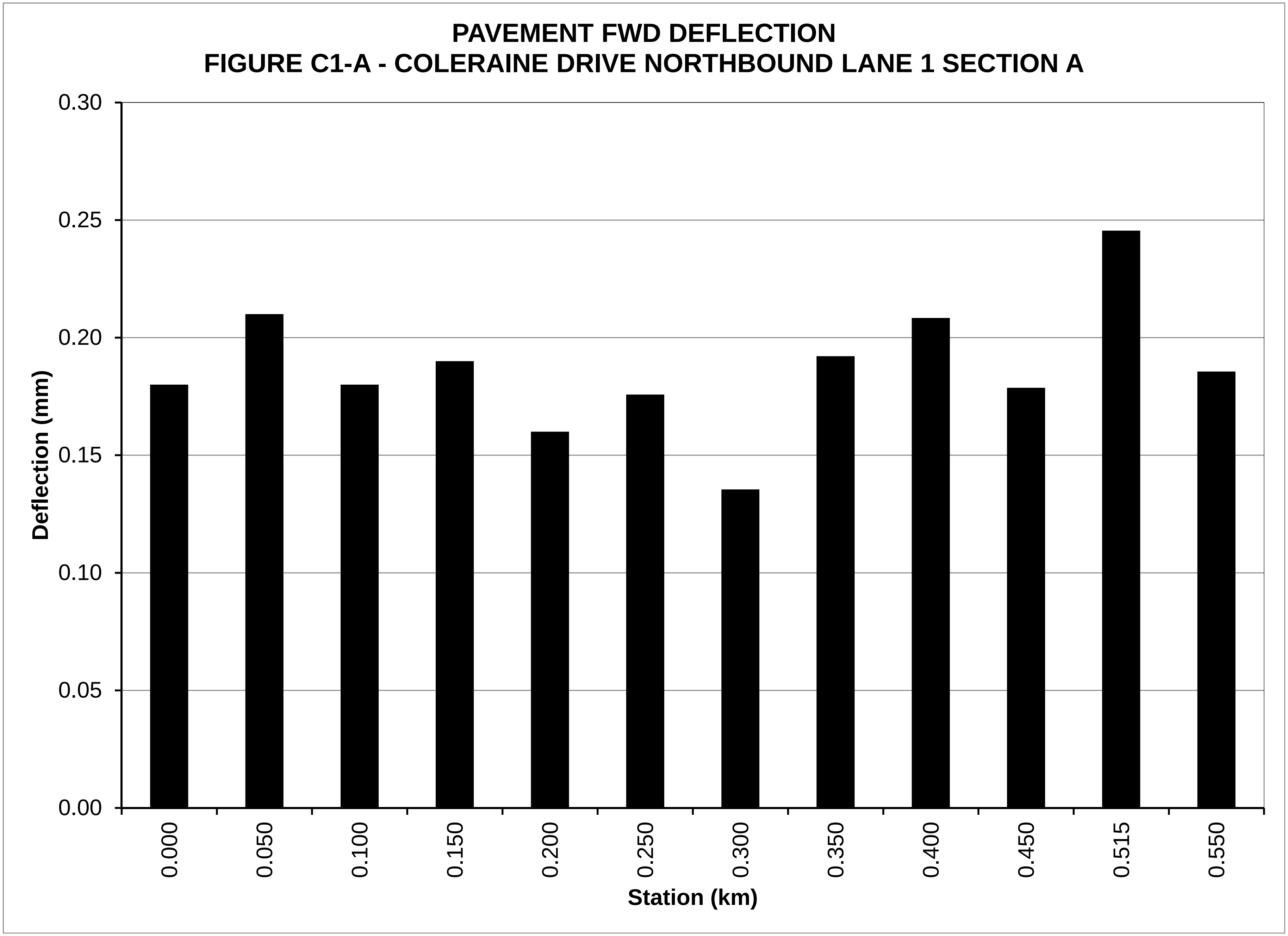
Checked By: EM

APPENDIX C

Falling Weight Deflectometer Testing Results

TABLE C1 - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION A
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	(mm)	(MPa)
0.000	0.18	828
0.050	0.21	709
0.100	0.18	828
0.150	0.19	784
0.200	0.16	931
0.250	0.18	836
0.300	0.14	1,085
0.350	0.19	765
0.400	0.21	705
0.450	0.18	823
0.515	0.25	599
0.550	0.19	792
Mean	0.19	807
Standard Deviation	0.03	116
Mean + 2SD	0.24	-
Static Deflection	0.38	-
Spring Deflection	0.57	-
Maximum Allowable Deflection	0.55	-



PAVEMENT FWD DEFLECTION
FIGURE C1-A - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION A

PAVEMENT SURFACE MODULUS
FIGURE C1-B - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION A

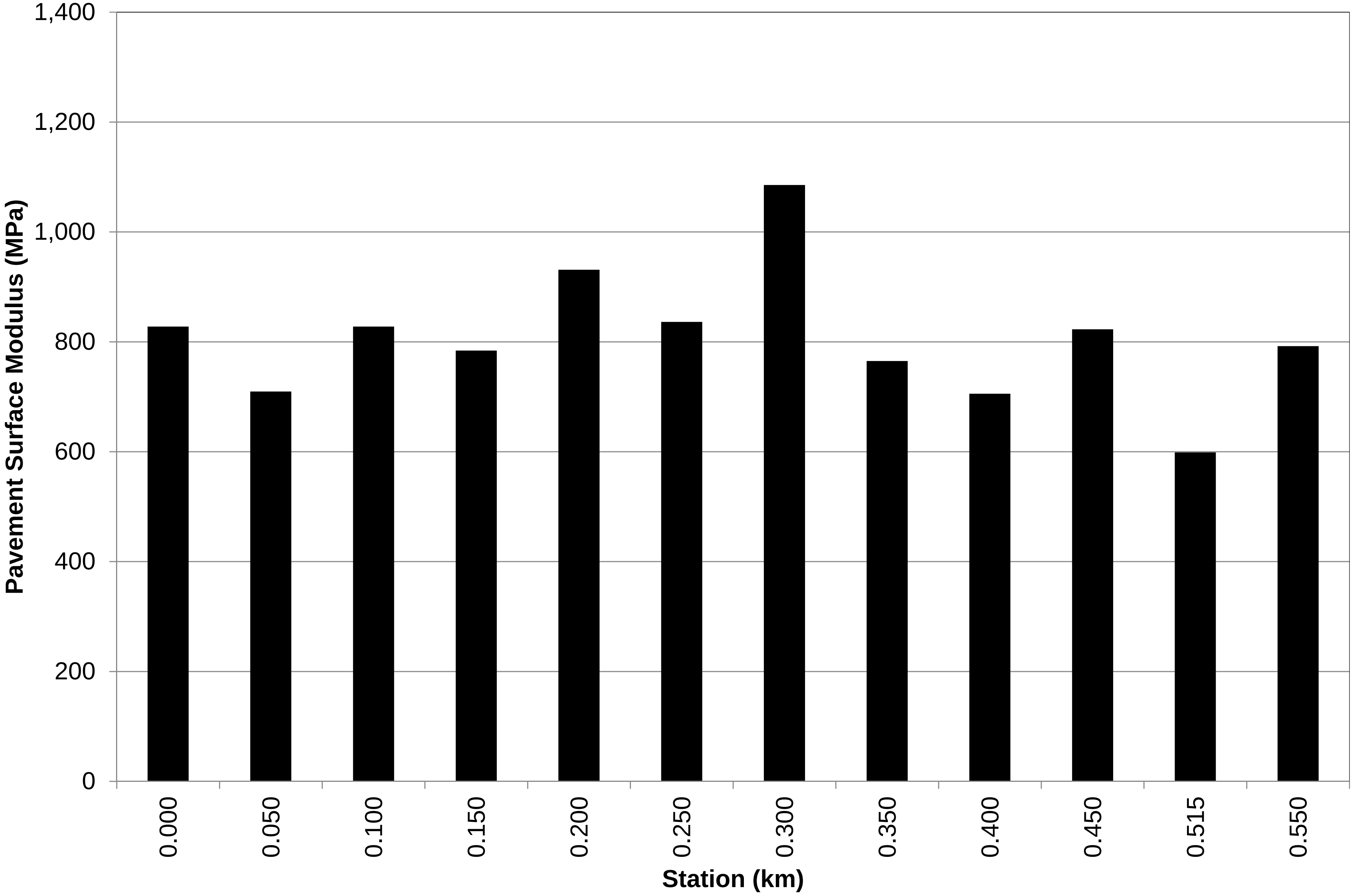
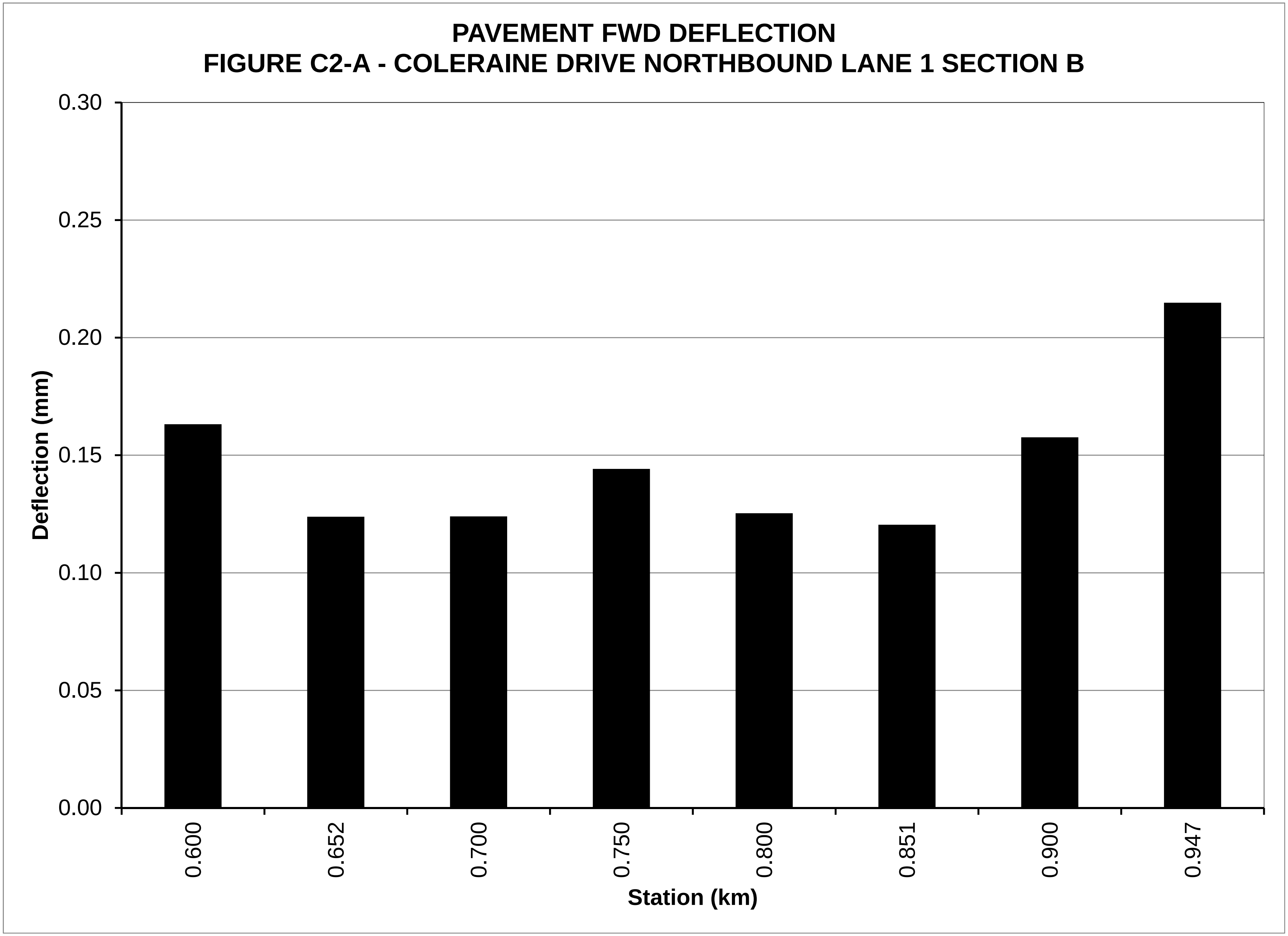


TABLE C2 - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION B
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	**(mm)**	**(MPa)**
0.600	0.16	901
0.652	0.12	1,187
0.700	0.12	1,186
0.750	0.14	1,020
0.800	0.13	1,173
0.851	0.12	1,221
0.900	0.16	933
0.947	0.21	684
Mean	0.15	1,038
Standard Deviation	0.03	177
Mean + 2SD	0.21	-
Static Deflection	0.33	-
Spring Deflection	0.50	-
Maximum Allowable Deflection	0.55	-


PAVEMENT FWD DEFLECTION
FIGURE C2-A - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION B
Deflection (mm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.600
0.652
0.700
0.750
0.800
0.851
0.900
0.947
Station (km)

PAVEMENT SURFACE MODULUS
FIGURE C2-B - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION B

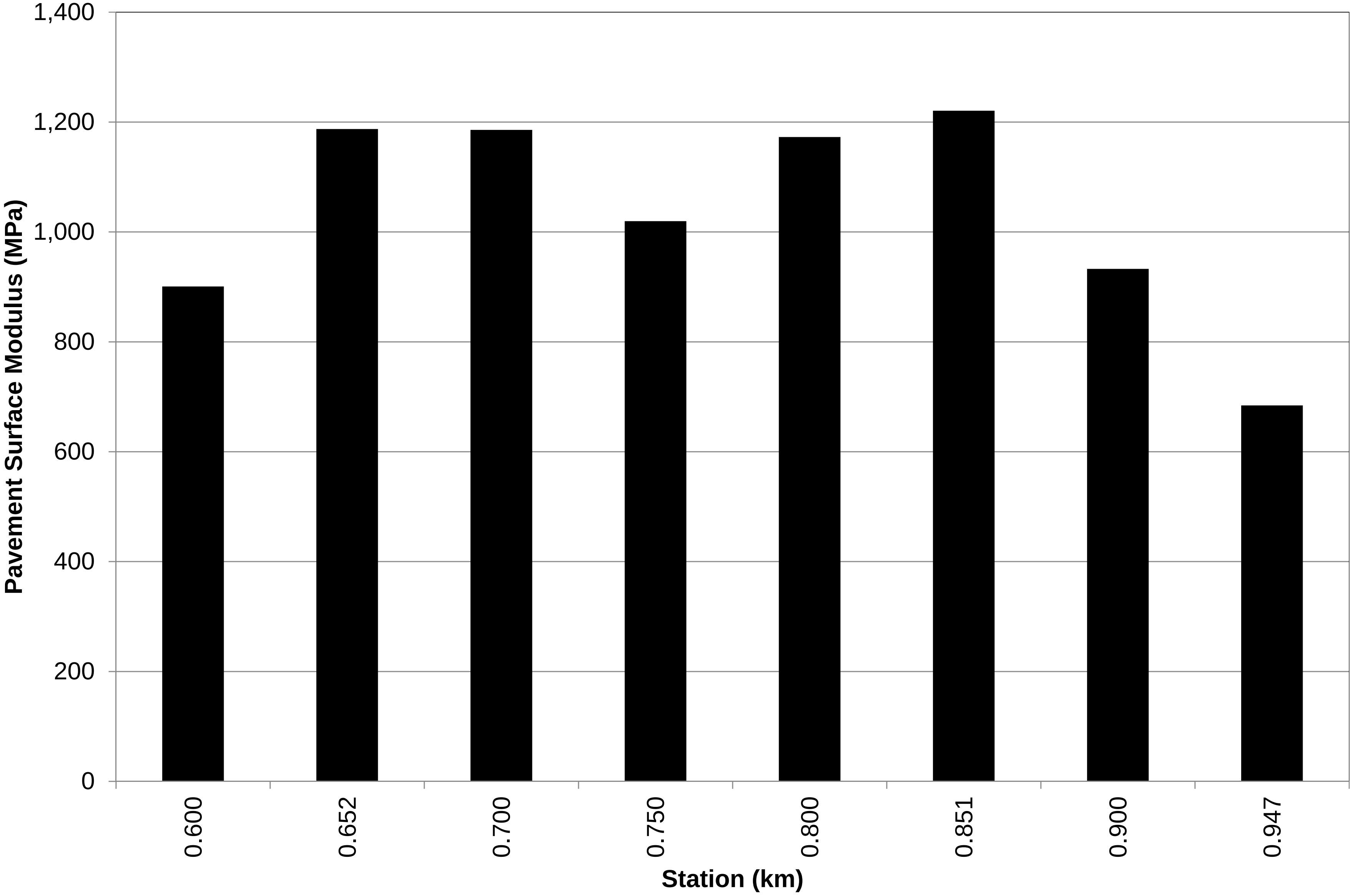
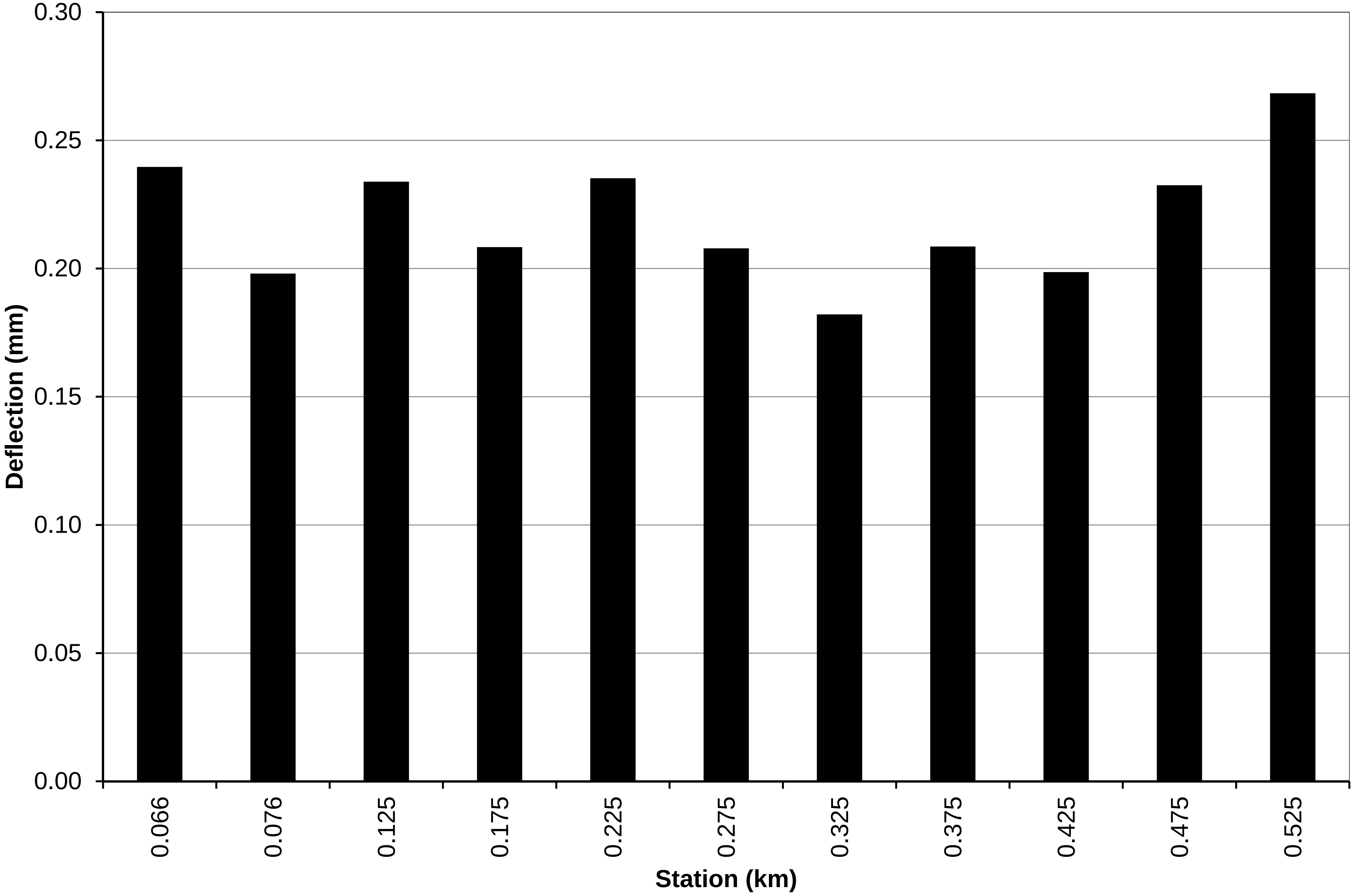


TABLE C3 - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION A
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	**(mm)**	**(MPa)**
0.066	0.24	613
0.076	0.20	742
0.125	0.23	629
0.175	0.21	705
0.225	0.24	625
0.275	0.21	707
0.325	0.18	807
0.375	0.21	705
0.425	0.20	740
0.475	0.23	632
0.525	0.27	548
Mean	0.22	678
Standard Deviation	0.02	71
Mean + 2SD	0.27	-
Static Deflection	0.43	-
Spring Deflection	0.64	-
Maximum Allowable Deflection	0.55	-



PAVEMENT FWD DEFLECTION
FIGURE C3-A - COLERAINE DRIVE NORTHBOUBD LANE 2 SECTION A

PAVEMENT SURFACE MODULUS
FIGURE C3-B - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION A

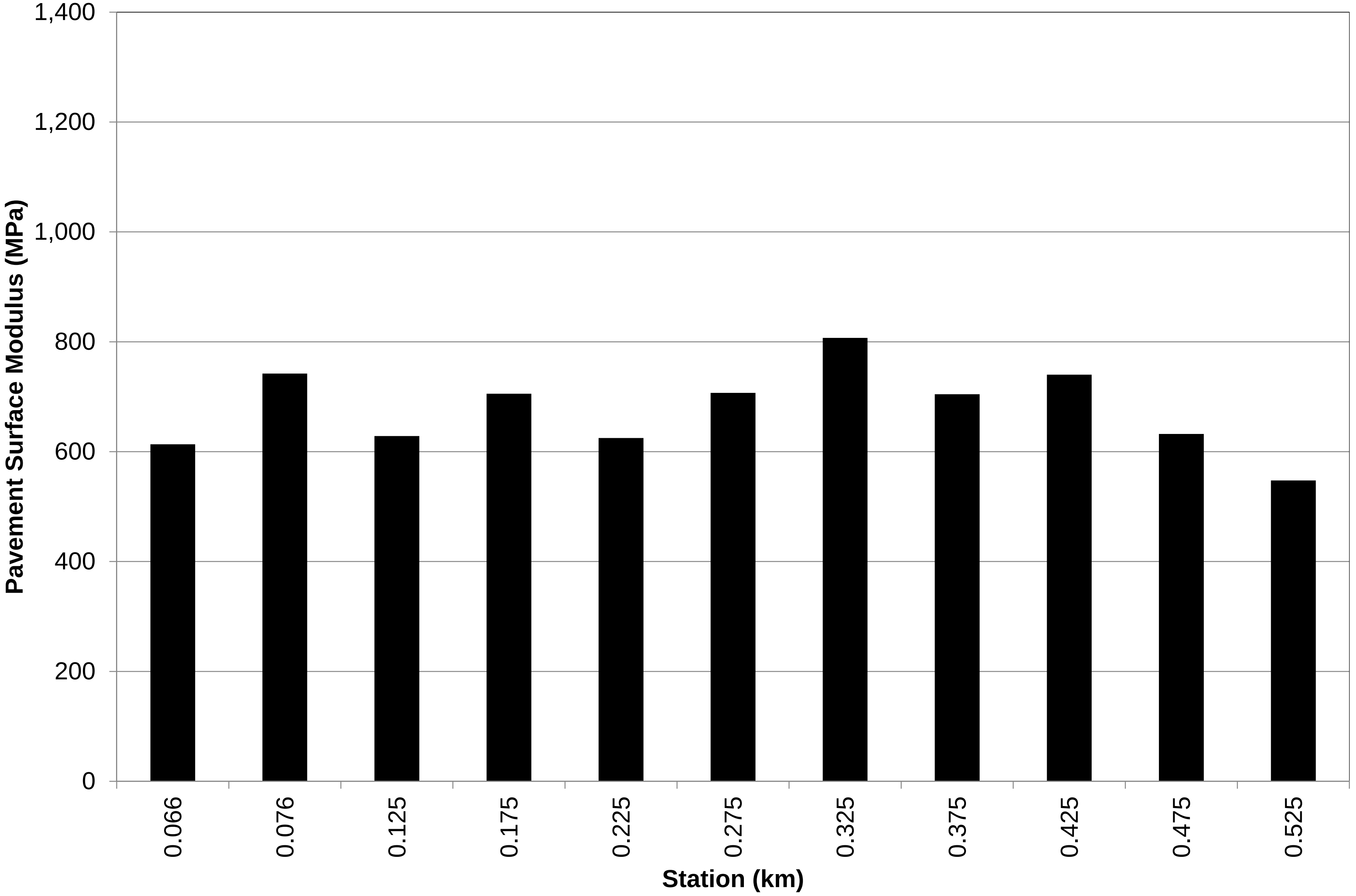
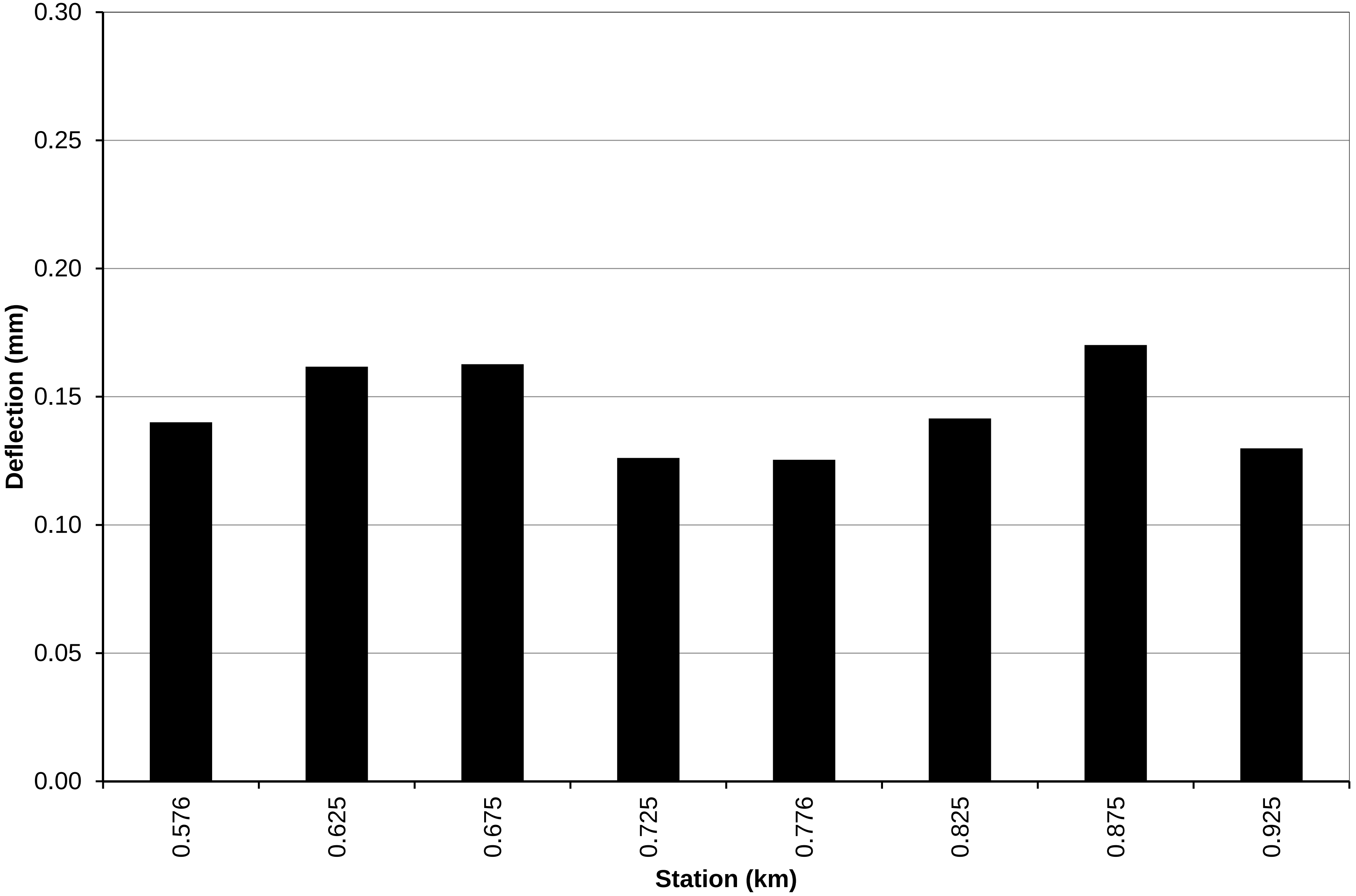


TABLE C4 - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION B
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	**(mm)**	**(MPa)**
0.576	0.14	1,050
0.625	0.16	909
0.675	0.16	903
0.725	0.13	1,165
0.776	0.13	1,172
0.825	0.14	1,039
0.875	0.17	864
0.925	0.13	1,132
Mean	0.14	1,029
Standard Deviation	0.02	116
Mean + 2SD	0.18	-
Static Deflection	0.28	-
Spring Deflection	0.43	-
Maximum Allowable Deflection	0.55	-

PAVEMENT FWD DEFLECTION
FIGURE C4-A - COLERAINE DRIVE NORTHBOUBD LANE 2 SECTION B



PAVEMENT SURFACE MODULUS
FIGURE C4-B - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION B

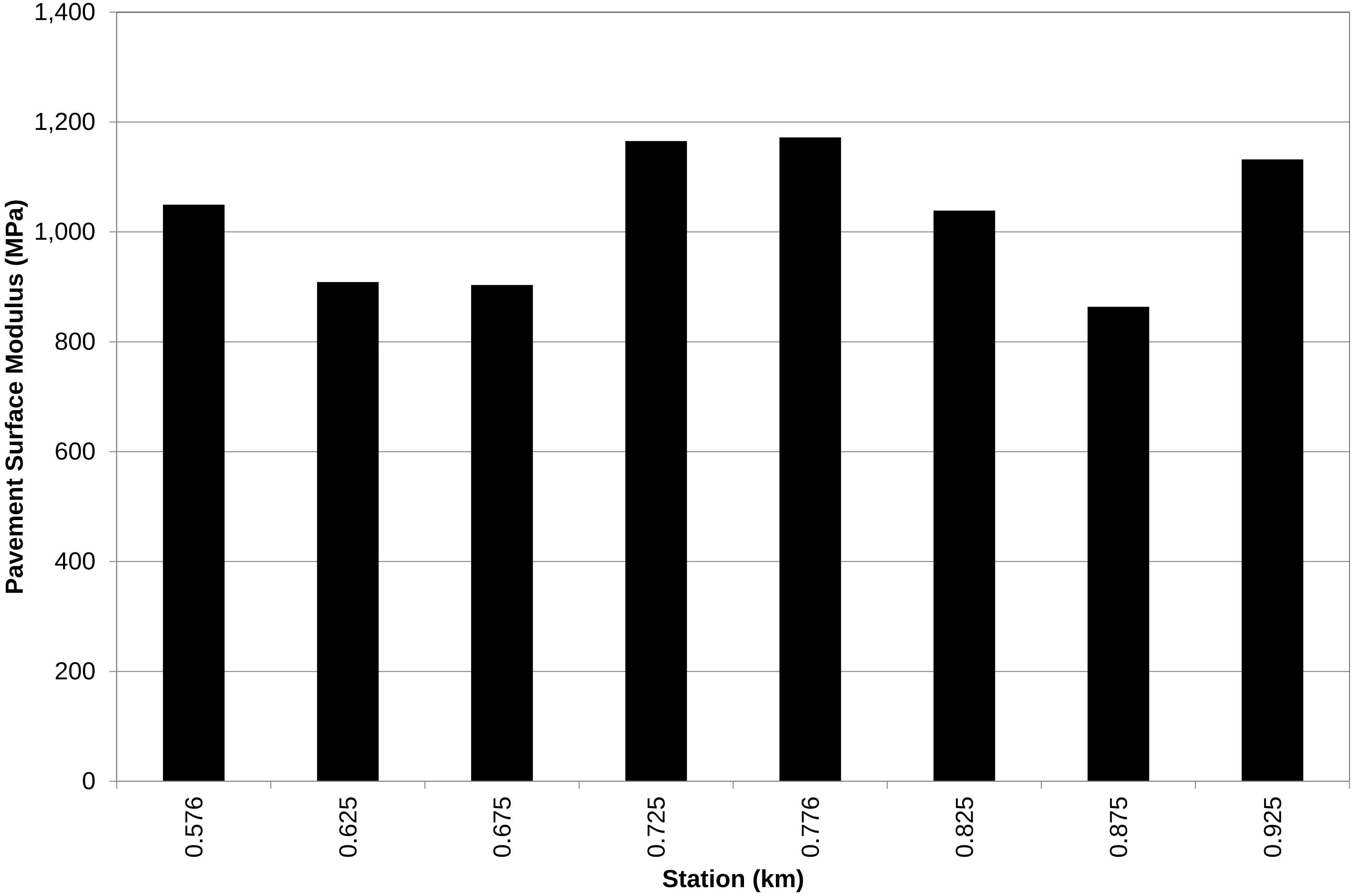
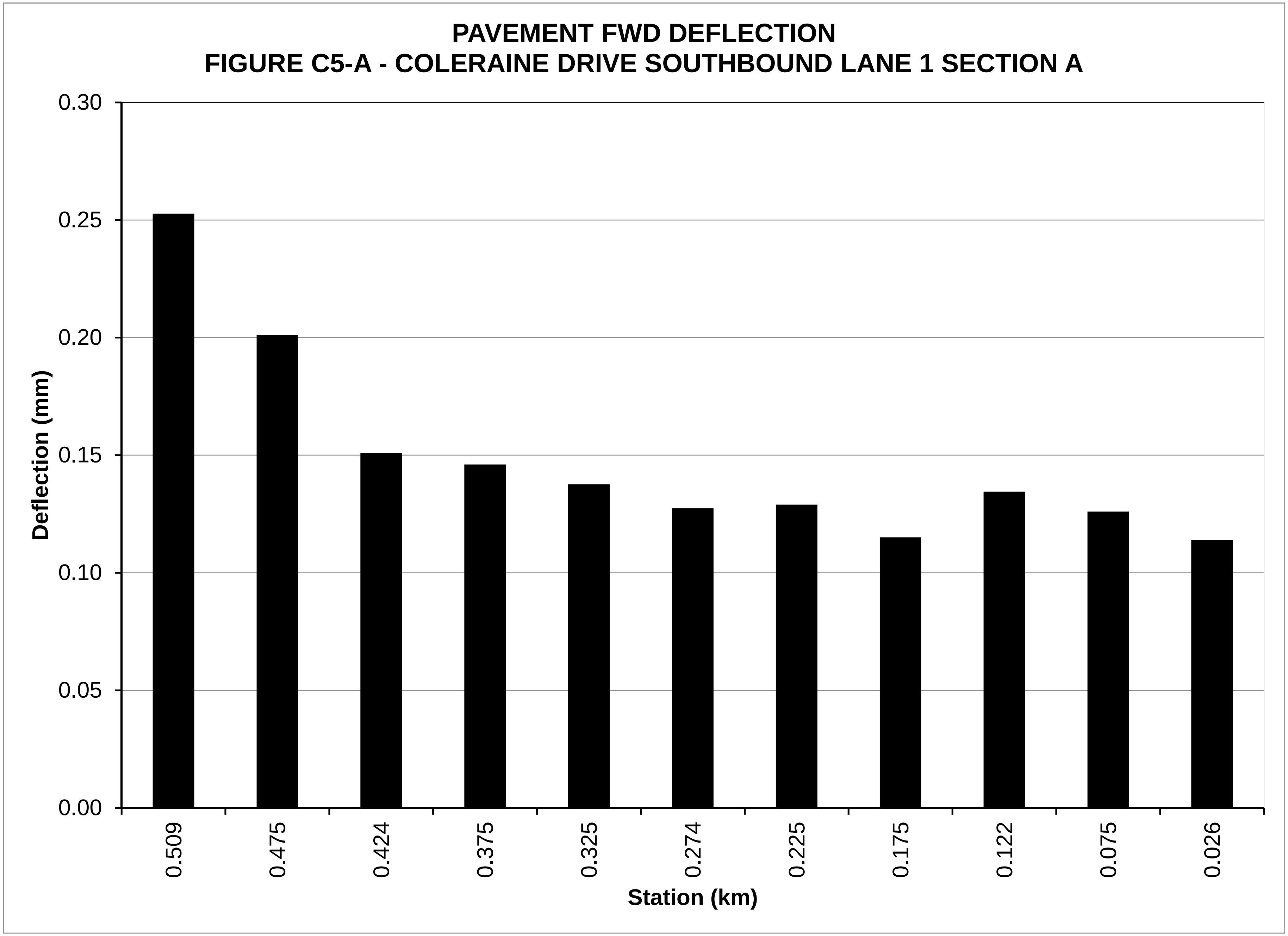


TABLE C5 - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION A
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	**(mm)**	**(MPa)**
0.509	0.25	582
0.475	0.20	731
0.424	0.15	974
0.375	0.15	1,007
0.325	0.14	1,068
0.274	0.13	1,154
0.225	0.13	1,140
0.175	0.12	1,278
0.122	0.13	1,093
0.075	0.13	1,166
0.026	0.11	1,289
Mean	0.15	1,044
Standard Deviation	0.04	207
Mean + 2SD	0.23	-
Static Deflection	0.37	-
Spring Deflection	0.55	-
Maximum Allowable Deflection	0.55	-



PAVEMENT FWD DEFLECTION
FIGURE C5-A - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION A

PAVEMENT SURFACE MODULUS
FIGURE C5-B - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION A

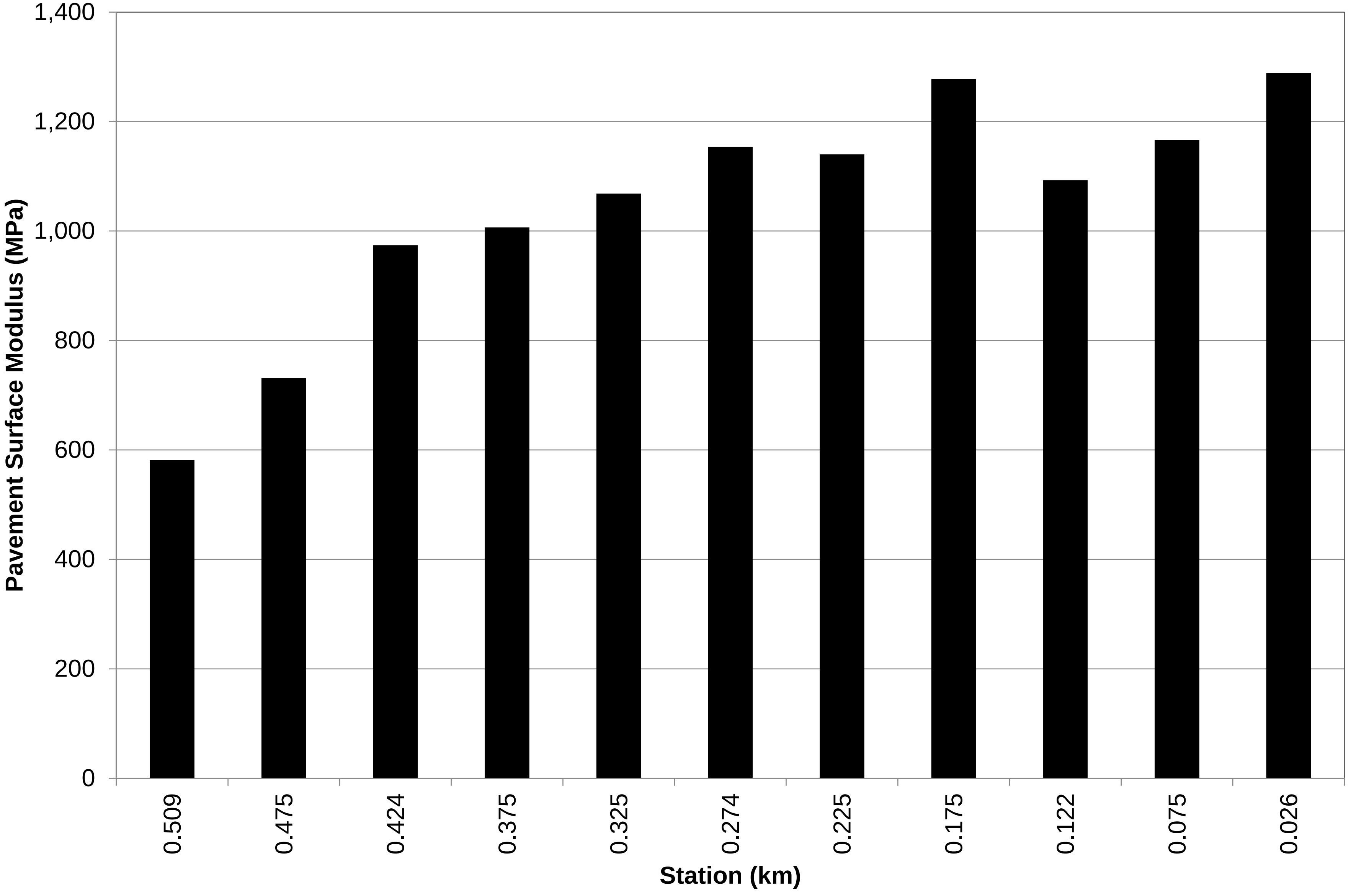
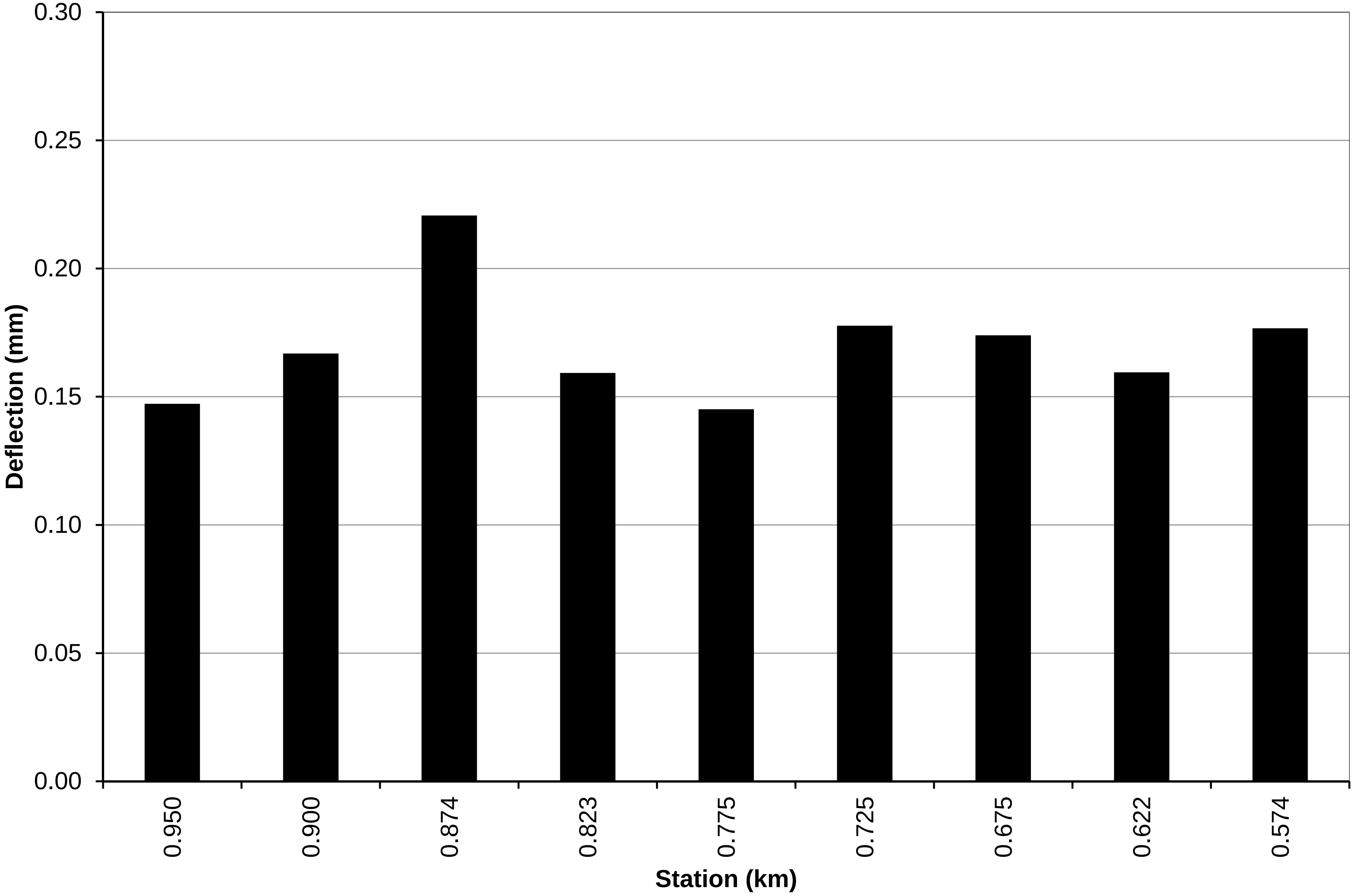


TABLE C6 - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION B
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	(mm)	(MPa)
0.950	0.15	998
0.900	0.17	881
0.874	0.22	666
0.823	0.16	923
0.775	0.15	1,013
0.725	0.18	827
0.675	0.17	845
0.622	0.16	921
0.574	0.18	832
Mean	0.17	878
Standard Deviation	0.02	98
Mean + 2SD	0.21	-
Static Deflection	0.34	-
Spring Deflection	0.51	-
Maximum Allowable Deflection	0.55	-

PAVEMENT FWD DEFLECTION
FIGURE C6-A - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION B



PAVEMENT SURFACE MODULUS
FIGURE C6-B - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION B

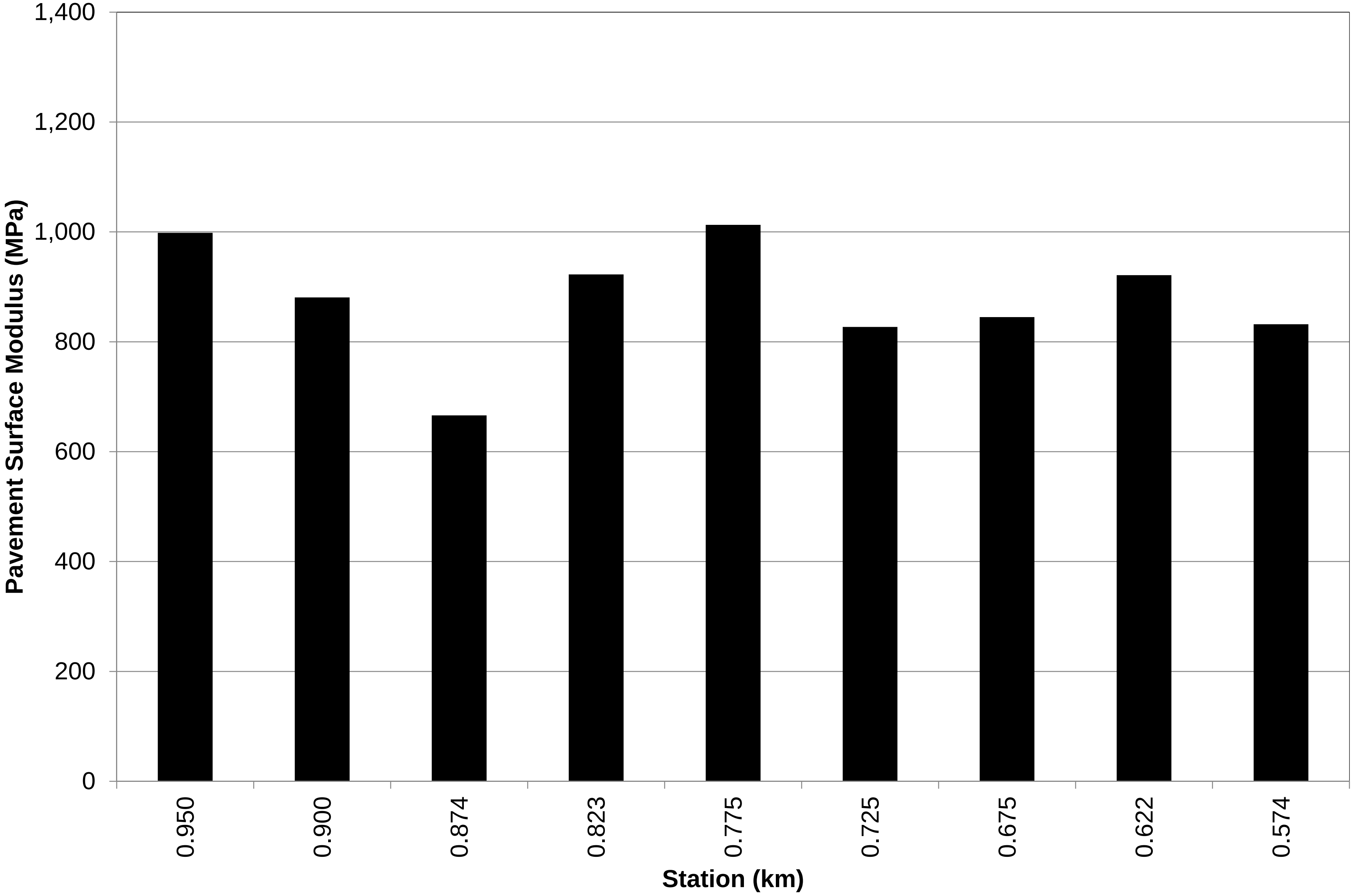
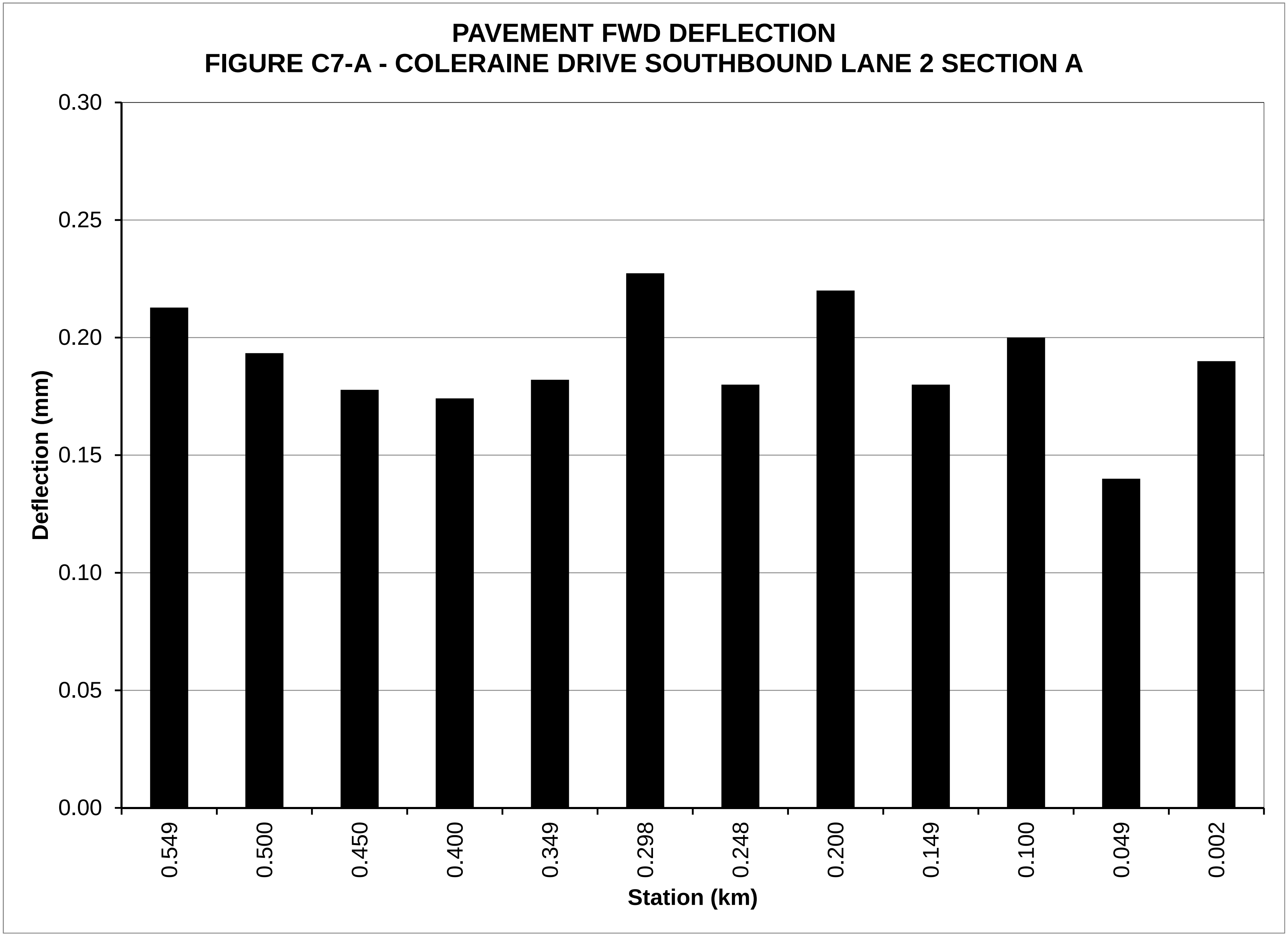


TABLE C7 - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION A
SUMMARY OF FWD DEFLECTION RESULTS

STATION	NORMALIZED DEFLECTION	PAVEMENT SURFACE MODULUS
(km)	(mm)	(MPa)
0.549	0.21	691
0.500	0.19	760
0.450	0.18	827
0.400	0.17	844
0.349	0.18	807
0.298	0.23	646
0.248	0.18	828
0.200	0.22	677
0.149	0.18	828
0.100	0.20	745
0.049	0.14	1,064
0.002	0.19	784
Mean	0.19	792
Standard Deviation	0.02	104
Mean + 2SD	0.23	-
Static Deflection	0.38	-
Spring Deflection	0.56	-
Maximum Allowable Deflection	0.55	-



PAVEMENT FWD DEFLECTION
FIGURE C7-A - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION A

PAVEMENT SURFACE MODULUS
FIGURE C7-B - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION A

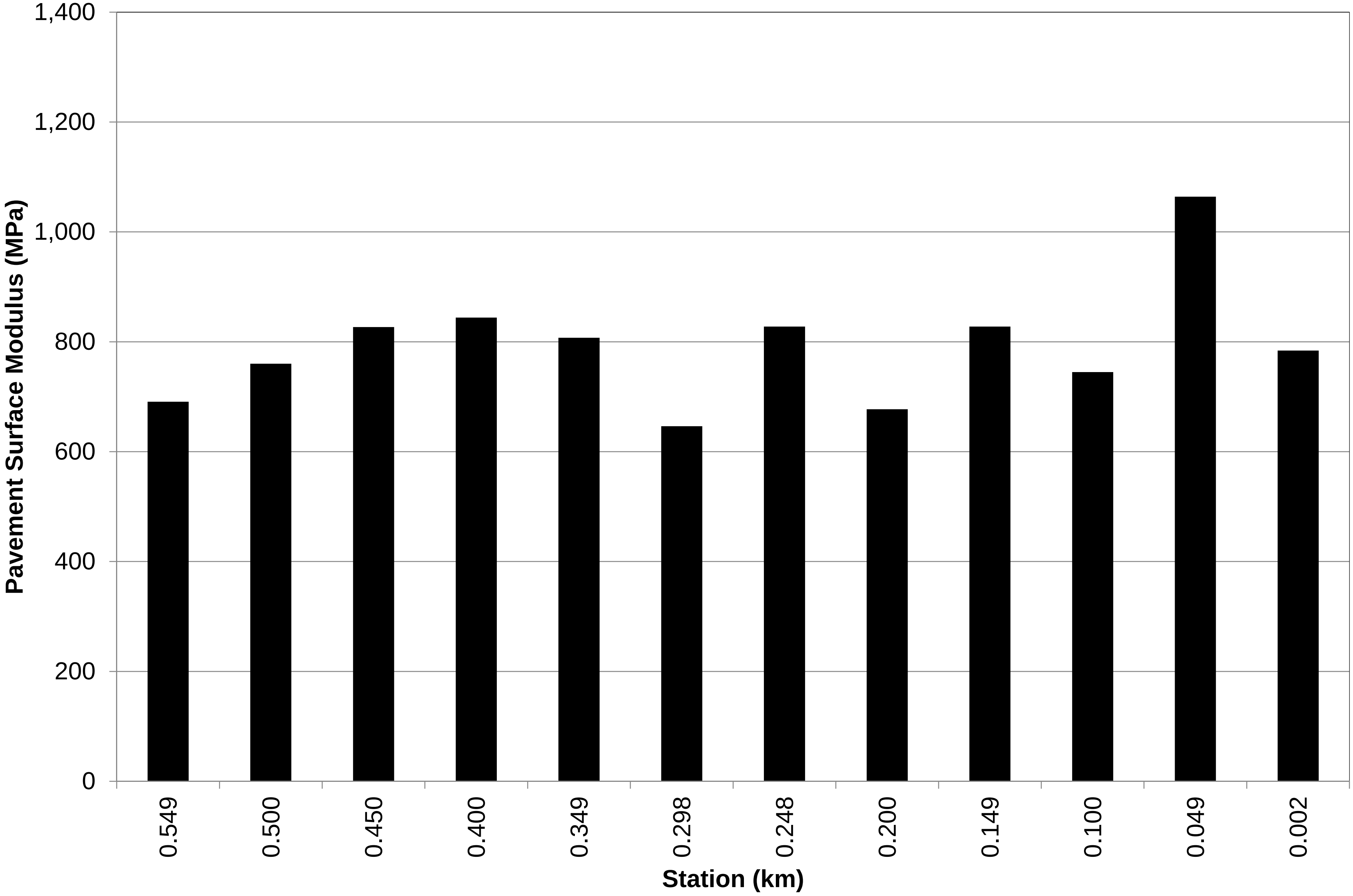
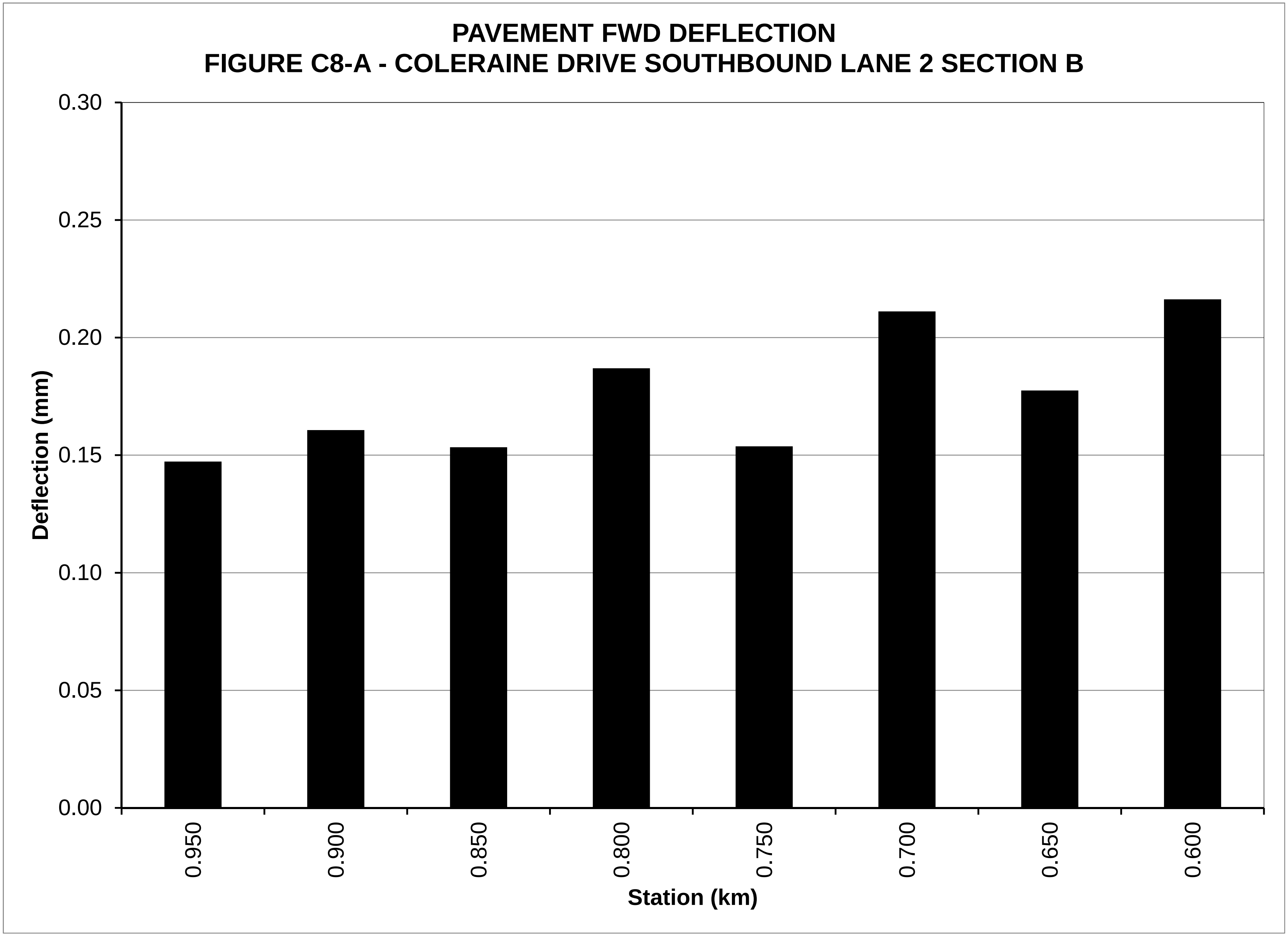


TABLE C8 - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION B
SUMMARY OF FWD DEFLECTION RESULTS

STATION (km)	NORMALIZED DEFLECTION (mm)	PAVEMENT SURFACE MODULUS (MPa)
0.950	0.15	998
0.900	0.16	915
0.850	0.15	958
0.800	0.19	786
0.750	0.15	956
0.700	0.21	696
0.650	0.18	828
0.600	0.22	680
Mean	0.18	852
Standard Deviation	0.03	115
Mean + 2SD	0.23	-
Static Deflection	0.36	-
Spring Deflection	0.54	-
Maximum Allowable Deflection	0.55	-


PAVEMENT FWD DEFLECTION
FIGURE C8-A - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION B
Deflection (mm)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.950
0.900
0.850
0.800
0.750
0.700
0.650
0.600
Station (km)

PAVEMENT SURFACE MODULUS
FIGURE C8-B - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION B

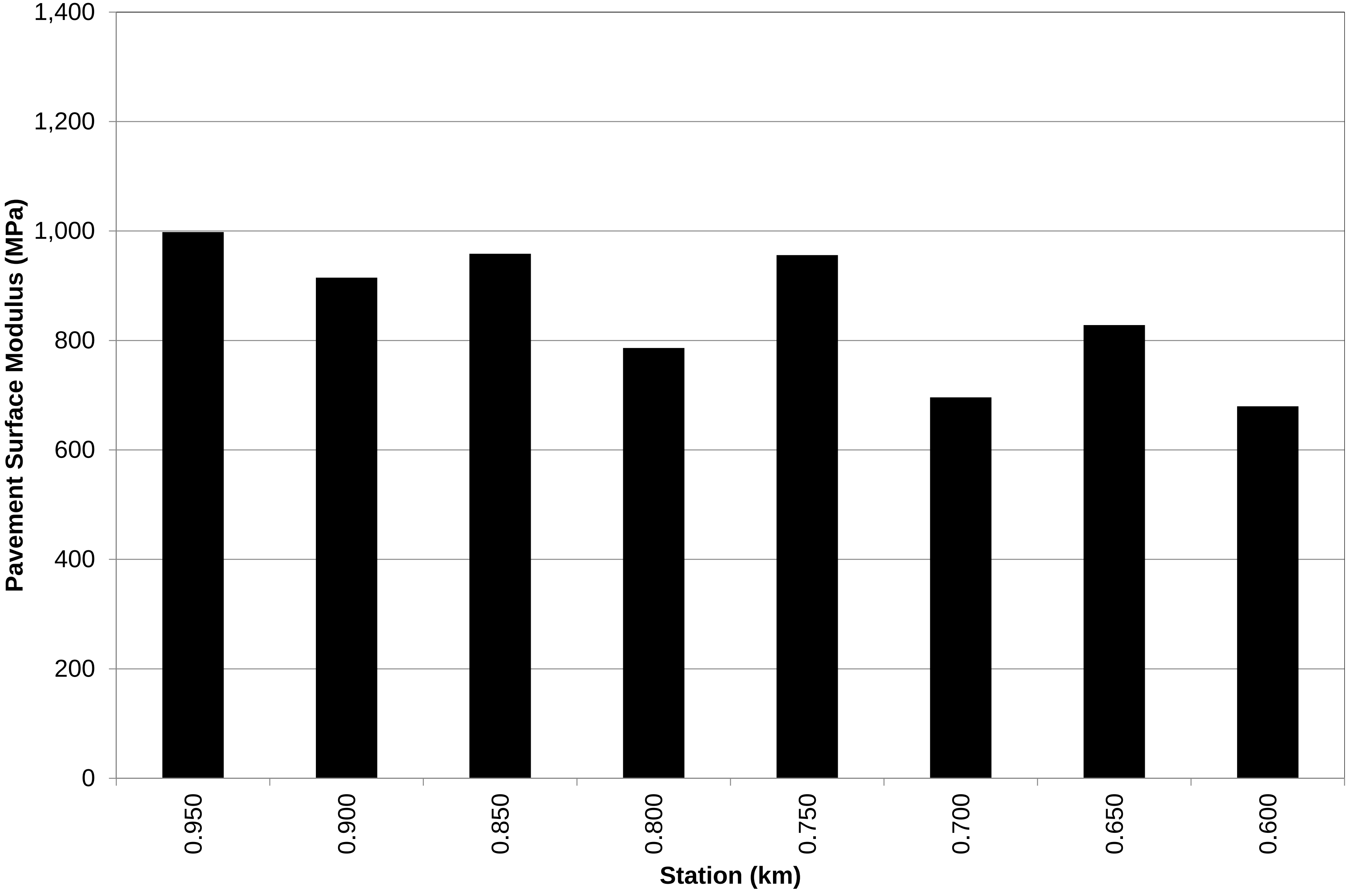


TABLE C9 - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION A
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.000	5,265	250	106
0.050	3,651	236	115
0.100	4,862	214	125
0.150	5,400	223	107
0.200	6,085	265	134
0.250	6,049	198	116
0.300	6,154	296	225
0.350	4,585	213	127
0.400	4,614	216	112
0.450	4,296	261	140
0.515	4,259	157	81
0.550	3,747	311	165
Mean	4,914	237	130
Standard Deviation	880	43	36
30th Percentile	4,383	215	113

TABLE C10 - COLERAINE DRIVE NORTHBOUND LANE 1 SECTION B
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.600	3,774	318	225
0.652	8,983	291	179
0.700	7,983	294	253
0.750	5,853	282	133
0.800	5,774	362	158
0.851	6,164	352	223
0.900	5,012	243	145
0.947	2,611	250	113
Mean	5,769	299	179
Standard Deviation	2,068	43	50
30th Percentile	5,088	283	147

TABLE C11 - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION A
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.066	3,902	189	92
0.076	5,787	193	89
0.125	4,229	174	85
0.175	5,918	167	107
0.225	3,760	192	103
0.275	5,961	167	116
0.325	6,293	219	119
0.375	5,047	172	114
0.425	6,308	179	110
0.475	3,889	174	92
0.525	3,997	124	88
Mean	5,008	177	101
Standard Deviation	1,065	23	12
30th Percentile	3,997	172	92

TABLE C12 - COLERAINE DRIVE NORTHBOUND LANE 2 SECTION B
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.576	9,699	276	165
0.625	6,480	263	130
0.675	5,726	295	141
0.725	8,767	334	143
0.776	6,763	332	207
0.825	6,063	302	128
0.875	4,360	283	140
0.925	7,740	275	183
Mean	6,950	295	155
Standard Deviation	1,721	26	28
30th Percentile	6,104	277	140

TABLE C13 - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION A
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.026	4,874	518	335
0.075	4,038	442	291
0.122	6,193	336	248
0.175	7,681	426	183
0.225	5,664	409	176
0.274	5,566	451	163
0.325	6,348	359	169
0.375	5,458	276	175
0.424	6,859	249	140
0.475	6,828	145	108
0.509	5,243	114	79
Mean	5,886	339	188
Standard Deviation	1,027	130	76
30th Percentile	5,458	276	163

TABLE C14 - COLERAINE DRIVE SOUTHBOUND LANE 1 SECTION B
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.574	6,359	229	129
0.622	6,779	243	150
0.675	4,189	258	156
0.725	4,244	235	130
0.775	5,113	313	151
0.823	3,793	306	185
0.874	2,635	188	176
0.900	4,281	260	137
0.950	5,005	298	178
Mean	4,711	259	154
Standard Deviation	1,278	41	21
30th Percentile	4,211	238	142

TABLE C15 - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION A
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.002	3,677	245	133
0.049	7,429	295	154
0.100	4,417	207	103
0.149	7,228	216	111
0.200	4,903	201	96
0.248	6,467	196	121
0.298	5,338	181	95
0.349	6,572	205	114
0.400	6,540	216	123
0.450	6,017	227	125
0.500	6,021	212	101
0.549	6,163	163	95
Mean	5,898	214	114
Standard Deviation	1,122	33	18
30th Percentile	5,542	202	101

TABLE C16 - COLERAINE DRIVE SOUTHBOUND LANE 2 SECTION B
SUMMARY OF BACKCALCULATED LAYER MODULI

Station	Asphalt Modulus (MPa)	Granular Modulus (MPa)	Subgrade Modulus (MPa)
0.600	4,219	172	103
0.650	5,530	225	149
0.700	4,051	203	112
0.750	8,449	190	114
0.800	3,856	225	125
0.850	5,759	236	172
0.900	6,475	228	121
0.950	5,395	253	188
Mean	5,467	216	136
Standard Deviation	1,519	26	31
30th Percentile	4,337	205	115

APPENDIX D

Tables D-1 to D-5

Certificates of Analysis

Table D-1
Environmental Quality of Soil Samples from Boreholes
Metals, Hydride Forming Metals and ORPs
Coleraine Drive, Caledon, ON

			Location	**BH17-01**	**BH17-02**	**BH17-04**	**BH17-06**
			Sample Name	**BH17-01 SA6**	**BH17-02 SA3**	**BH17-04 SA3**	**BH17-06 SA2**
			Sample Date	**27/Mar/17**	**30/Mar/17**	**29/Mar/17**	**23/Mar/17**
			Sample Depth (mbgs)	**3.8 - 4.4**	**1.5 - 2.1**	**1.5 - 2.1**	**0.8 - 1.4**
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**				
Other Regulated Parameters							
Boron (HWS)	NV	2	µg/g	0.15	0.28	0.11	0.15
Hexavalent Chromium	0.66	8	µg/g	<0.2	<0.2	<0.2	<0.2
Mercury	0.27	3.9	µg/g	<0.10	<0.10	<0.10	<0.10
Moisture Content	NV	NV	%	NA	NA	NA	NA
Electrical Conductivity (EC)	0.57	1.4	mS/cm	0.215	**1.56**	0.219	**1.59**
Sodium Adsorption Ratio	2.4	12	N/A	0.25	**10.5**	1.05	**9.31**
Free Cyanide	0.051	0.051	ug/g	<0.040	<0.040	<0.040	<0.040
pH	NV	NV	pH	7.84	7.6	7.64	7.7
Metals							
Barium	220	670	µg/g	80	87	84	81
Beryllium	2.5	8	µg/g	0.6	0.6	0.6	0.6
Boron	36	120	µg/g	11	9	10	8
Cadmium	1.2	1.9	µg/g	<0.5	<0.5	<0.5	<0.5
Chromium	70	160	µg/g	21	23	22	22
Cobalt	21	80	µg/g	9.5	9.1	11.6	10.1
Copper	92	230	µg/g	20	21	22	24
Lead	120	120	µg/g	8	11	10	13
Molybdenum	2	40	µg/g	<0.5	<0.5	<0.5	<0.5
Nickel	82	270	µg/g	19	19	22	21
Silver	0.5	40	µg/g	<0.2	<0.2	<0.2	<0.2
Thallium	1	3.3	µg/g	<0.4	<0.4	<0.4	<0.4
Uranium	2.5	33	µg/g	0.9	0.6	0.8	0.5
Vanadium	86	86	µg/g	27	30	28	29
Zinc	290	340	µg/g	44	48	47	48
Hydride-Forming Metals							
Antimony	1.3	40	µg/g	<0.8	<0.8	<0.8	<0.8
Arsenic	18	18	µg/g	3	3	3	3
Selenium	1.5	5.5	µg/g	<0.4	0.5	<0.4	<0.4

Notes:

µg/g = Micrograms per gram

mbgs = Metres below ground surface

NA = Not Available

NV = No Value

Table 1 Standards = O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

Table 2 Standards = O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

< = Indicates parameter was below laboratory equipment detection limit

Bold value exceeds the Table 1 Standard

Bold value exceeds the Table 3 Standard

Table D-1
Environmental Quality of Soil Samples from Boreholes
Metals, Hydride Forming Metals and ORPs
Coleraine Drive, Caledon, ON

Location				BH17-09	BH17-10	BH17-12	BH17-13
Sample Name				BH17-09SA5	BH17-10 SA3	BH17-12 SA2B	BH17-13 SA7
Sample Date				28/Mar/17	24/Mar/17	24/Mar/17	29/Mar/17
Sample Depth (mbgs)				3.0 - 3.7	1.5 - 2.1	0.8 - 1.0	4.6 - 5.2
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**				
Other Regulated Parameters							
Boron (HWS)	NV	2	µg/g	0.39	<0.10	<0.10	0.18
Hexavalent Chromium	0.66	8	µg/g	<0.2	<0.2	<0.2	<0.2
Mercury	0.27	3.9	µg/g	<0.10	<0.10	<0.10	<0.10
Moisture Content	NV	NV	%	23	NA	NA	13.8
Electrical Conductivity (EC)	0.57	1.4	mS/cm	**1.74**	**1.81**	**2.32**	0.262
Sodium Adsorption Ratio	2.4	12	N/A	1.26	2.09	**4.32**	0.351
Free Cyanide	0.051	0.051	ug/g	<0.040	<0.040	<0.040	<0.040
pH	NV	NV	pH	7.79	7.29	7.11	7.78
Metals							
Barium	220	670	µg/g	98	147	175	107
Beryllium	2.5	8	µg/g	1	1.1	1.2	0.5
Boron	36	120	µg/g	14	9	<5	11
Cadmium	1.2	1.9	µg/g	<0.5	<0.5	<0.5	<0.5
Chromium	70	160	µg/g	33	35	35	24
Cobalt	21	80	µg/g	16.4	16.7	13.3	10.5
Copper	92	230	µg/g	24	26	12	21
Lead	120	120	µg/g	13	16	13	9
Molybdenum	2	40	µg/g	<0.5	<0.5	<0.5	<0.5
Nickel	82	270	µg/g	36	39	31	22
Silver	0.5	40	µg/g	<0.2	<0.2	<0.2	<0.2
Thallium	1	3.3	µg/g	<0.4	<0.4	<0.4	<0.4
Uranium	2.5	33	µg/g	1.1	0.6	0.8	0.8
Vanadium	86	86	µg/g	40	46	48	32
Zinc	290	340	µg/g	63	63	51	46
Hydride-Forming Metals							
Antimony	1.3	40	µg/g	<0.8	<0.8	<0.8	<0.8
Arsenic	18	18	µg/g	4	4	4	3
Selenium	1.5	5.5	µg/g	0.6	<0.4	0.7	0.4

Notes:

µg/g	= Micrograms per gram
mbgs	= Metres below ground surface
NA	= Not Available
NV	= No Value
Table 1 Standards	= O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
Table 2 Standards	= O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
<	= Indicates parameter was below laboratory equipment detection lim

Bold value exceeds the Table 1 Standard

Bold value exceeds the Table 3 Standard

Table D-1
Environmental Quality of Soil Samples from Boreholes
Metals, Hydride Forming Metals and ORPs
Coleraine Drive, Caledon, ON

Location				BH17-14	BH17-16
Sample Name				BH17-14 SA4	BH17-16 SA-6
Sample Date				29/Mar/17	29/Mar/17
Sample Depth (mbgs)				2.3 - 2.9	3.8 - 4.4
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**		
Other Regulated Parameters					
Boron (HWS)	NV	2	µg/g	<0.10	<0.10
Hexavalent Chromium	0.66	8	µg/g	<0.2	<0.2
Mercury	0.27	3.9	µg/g	<0.10	<0.10
Moisture Content	NV	NV	%	NA	NA
Electrical Conductivity (EC)	0.57	1.4	mS/cm	**1.01**	0.363
Sodium Adsorption Ratio	2.4	12	N/A	**5.97**	**3.92**
Free Cyanide	0.051	0.051	ug/g	<0.040	<0.040
pH	NV	NV	pH	7.5	7.55
Metals					
Barium	220	670	µg/g	106	81
Beryllium	2.5	8	µg/g	0.7	0.6
Boron	36	120	µg/g	10	9
Cadmium	1.2	1.9	µg/g	<0.5	<0.5
Chromium	70	160	µg/g	25	21
Cobalt	21	80	µg/g	11.7	11.1
Copper	92	230	µg/g	20	21
Lead	120	120	µg/g	10	9
Molybdenum	2	40	µg/g	<0.5	<0.5
Nickel	82	270	µg/g	24	23
Silver	0.5	40	µg/g	<0.2	<0.2
Thallium	1	3.3	µg/g	<0.4	<0.4
Uranium	2.5	33	µg/g	0.7	0.6
Vanadium	86	86	µg/g	31	27
Zinc	290	340	µg/g	50	47
Hydride-Forming Metals					
Antimony	1.3	40	µg/g	<0.8	<0.8
Arsenic	18	18	µg/g	3	3
Selenium	1.5	5.5	µg/g	0.6	<0.4

Notes:

µg/g	= Micrograms per gram
mbgs	= Metres below ground surface
NA	= Not Available
NV	= No Value
Table 1 Standards	= O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
Table 2 Standards	= O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
<	= Indicates parameter was below laboratory equipment detection lim

Bold value exceeds the Table 1 Standard

Bold value exceeds the Table 3 Standard

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Table D-2
Environmental Quality of Soil Samples from Boreholes
Polycyclic Aromatic Hydrocarbons
Coleraine Drive, Caledon, ON

Location				BH17-09	BH17-13
Sample Name				BH17-09SA5	BH17-13 SA7
Sample Date				28/Mar/17	29/Mar/17
Sample Depth (mbgs)				3.0 - 3.7	4.6 - 5.2
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**		
Polycyclic Aromatic Hydrocarbons					
1- & 2-Methylnaphthalene	0.59	30	µg/g	<0.05	<0.05
Acenaphthene	0.072	21	µg/g	<0.05	<0.05
Acenaphthylene	0.093	0.15	µg/g	<0.05	<0.05
Anthracene	0.16	0.67	µg/g	<0.05	<0.05
Benzo[a]anthracene	0.36	96	µg/g	<0.05	<0.05
Benzo[a]pyrene	0.3	0.3	µg/g	<0.05	<0.05
Benzo[b]fluoranthene	0.47	0.96	µg/g	<0.05	<0.05
Benzo[g,h,i]perylene	0.68	9.6	µg/g	<0.05	<0.05
Benzo[k]fluoranthene	0.48	0.96	µg/g	<0.05	<0.05
Chrysene	2.8	9.6	µg/g	<0.05	<0.05
Dibenzo[a,h]anthracene	0.1	0.1	µg/g	<0.05	<0.05
Fluoranthene	0.56	9.6	µg/g	<0.05	<0.05
Fluorene	0.12	62	µg/g	<0.05	<0.05
Indeno[1,2,3-cd]pyrene	0.23	0.76	µg/g	<0.05	<0.05
Naphthalene	0.09	9.6	µg/g	<0.05	<0.05
Phenanthrene	0.69	12	µg/g	<0.05	<0.05
Pyrene	1	96	µg/g	<0.05	<0.05

Notes:

µg/g	= Micrograms per gram
mbgs	= Metres below ground surface
Table 1 Standards	= O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
Table 2 Standards	= O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition
<	= Indicates parameter was below laboratory equipment detection limit

Table to be read in conjunction with accompanying report

Borehole location plan is shown on Figure 1 and 2

Table D-3
Environmental Quality of Soil Samples from Boreholes
Petroleum Hydrocarbons
Coleraine Drive, Caledon, ON

			Location	**BH17-09**	**BH17-13**
			Sample Name	**BH17-09SA5**	**BH17-13 SA7**
			Sample Date	**28/Mar/17**	**29/Mar/17**
			Sample Depth (mbgs)	**3.0 - 3.7**	**4.6 - 5.2**
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**		
Petroleum Hydrocarbons and BTEX					
Petroleum Hydrocarbons - F1 (C6-C10)	25	55	µg/g	<5	<5
Petroleum Hydrocarbons - F2 (C10-C16)	10	230	µg/g	<10	<10
Petroleum Hydrocarbons - F3 (C16-C34)	240	1700	µg/g	<50	57
Petroleum Hydrocarbons - F4 (C34-C50)	120	3300	µg/g	<50	<50
Petroleum Hydrocarbons - F4 Gravimetric	120	3300	µg/g	NA	NA
Benzene	0.02	0.32	µg/g	<0.02	<0.02
Toluene	0.2	6.4	µg/g	<0.05	<0.05
Ethylbenzene	0.05	1.1	µg/g	<0.05	<0.05
Xylenes, Total	0.05	26	µg/g	<0.05	<0.05

Notes:

BTEX = Benzene, Ethylbenzene, Toluene, Xylenes

µg/g = Micrograms per gram

mbgs = Metres below ground surface

NV = No Value

Table 1 Standards = O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

Table 2 Standards = O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

< = Indicates parameter was below laboratory equipment detection limit

Table to be read in conjunction with accompanying report

Table D-4
Environmental Quality of Soil Samples from Boreholes
Volatile Organic Compounds
Coleraine Drive, Caledon, ON

			Location	BH17-09	BH17-13
			Sample Name	BH17-09SA5	BH17-13 SA7
			Sample Date	28/Mar/17	29/Mar/17
			Sample Depth (mbgs)	3.0 - 3.7	4.6 - 5.2
Parameter	**Table 1 Standards**	**Table 2 Standards**	**Unit**		
Volatile Organic Compounds					
1,1,1,2-Tetrachloroethane	0.05	0.087	ug/g	<0.04	<0.04
1,1,1-Trichloroethane	0.05	6.1	ug/g	<0.05	<0.05
1,1,2,2-Tetrachloroethane	0.05	0.05	ug/g	<0.05	<0.05
1,1,2-Trichloroethane	0.05	0.05	ug/g	<0.04	<0.04
1,1-Dichloroethane	0.05	0.47	ug/g	<0.02	<0.02
1,1-Dichloroethylene	0.05	0.064	ug/g	<0.05	<0.05
1,2-Dibromoethane	0.05	0.05	ug/g	<0.04	<0.04
1,2-Dichlorobenzene	0.05	1.2	ug/g	<0.05	<0.05
1,2-Dichloroethane	0.05	0.05	ug/g	<0.03	<0.03
1,2-Dichloropropane	0.05	0.16	ug/g	<0.03	<0.03
1,3-Dichlorobenzene	0.05	9.6	ug/g	<0.05	<0.05
1,3-Dichloropropene	0.05	0.059	µg/g	<0.04	<0.04
1,4-Dichlorobenzene	0.05	0.2	ug/g	<0.05	<0.05
Methyl Ethyl Ketone	0.5	70	ug/g	<0.50	<0.50
Methyl Isobutyl Ketone	0.5	31	ug/g	<0.50	<0.50
Acetone	0.5	16	ug/g	<0.50	<0.50
Bromodichloromethane	0.05	1.5	ug/g	<0.05	<0.05
Bromoform	0.05	0.05	ug/g	<0.05	<0.05
Bromomethane	0.05	1.9	ug/g	<0.05	<0.05
Carbon Tetrachloride	0.05	0.21	ug/g	<0.05	<0.05
Chlorobenzene	0.05	2.4	ug/g	<0.05	<0.05
Chloroform	0.05	0.47	ug/g	<0.04	<0.04
Cis- 1,2-Dichloroethylene	0.05	1.9	ug/g	<0.02	<0.02
Dibromochloromethane	0.05	2.3	ug/g	<0.05	<0.05
Dichlorodifluoromethane	0.05	16	µg/g	<0.05	<0.05
Methyl tert-butyl Ether	0.05	1.6	ug/g	<0.05	<0.05
Methylene Chloride	0.05	1.6	ug/g	<0.05	<0.05
n-Hexane	0.05	46	µg/g	<0.05	<0.05
Styrene	0.05	34	ug/g	<0.05	<0.05
Tetrachloroethylene	0.05	1.9	ug/g	<0.05	<0.05
Trans- 1,2-Dichloroethylene	0.05	1.3	ug/g	<0.05	<0.05
Trichloroethylene	0.05	0.55	ug/g	<0.03	<0.03
Trichlorofluoromethane	0.25	4	ug/g	<0.05	<0.05
Vinyl Chloride	0.02	0.032	ug/g	<0.02	<0.02

Notes:

µg/g = Micrograms per gram

mbgs = Metres below ground

NV = No Value

Table 1 Standards = O.Reg 153 (2011) Table 1 Standards for residential/ parkland/ institutional/ industrial/ commercial/ community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

Table 2 Standards = O.Reg 153 (2011) Table 2 Standards for industrial/commercial/community property use for coarse textured soil in full depth generic site condition in a potable groundwater condition

< = Indicates parameter was below laboratory equipment detection limit

Table to be read in conjunction with accompanying report

Borehole location plan is shown on Figure 1 and 2

Table D-5
Environmental Quality of Soil Samples from Boreholes
Toxicity Charateristic Leachate Preparation
Coleraine Drive, Caledon, ON

		Location	TCLP
		Sample Name	TCLPSA1
		Sample Date	23/Mar/17
Parameter	**O.Reg 558 Standards**	**Unit**	
Ignitability in Soil			
Ignitability		N/A	No
O.Reg. 558 Metals and Inorganics			
Arsenic Leachate	2.5	mg/L	<0.010
Barium Leachate	100	mg/L	0.625
Boron Leachate	500	mg/L	0.06
Cadmium Leachate	0.5	mg/L	<0.010
Chromium Leachate	5	mg/L	<0.010
Lead Leachate	5	mg/L	<0.010
Mercury Leachate	0.1	mg/L	<0.01
Selenium Leachate	1	mg/L	<0.010
Silver Leachate	5	mg/L	<0.010
Uranium Leachate	10	mg/L	<0.050
Fluoride Leachate	150	mg/L	0.22
Cyanide Leachate	20	mg/L	<0.05
(Nitrate + Nitrite) as N Leachate	1000	mg/L	<0.70
O. Reg. 558 - Benzo(a) pyrene			
Benzo(a)pyrene	0.001	mg/L	<0.001
O. Reg. 558 - PCBs			
Polychlorinated Biphenyls	0.005	mg/L	<0.005
O. Reg. 558 - VOCs			
Vinyl Chloride	0.2	mg/L	<0.030
1,1 Dichloroethene	1.4	mg/L	<0.020
Dichloromethane	5	mg/L	<0.030
Methyl Ethyl Ketone	200	mg/L	<0.090
Chloroform	10	mg/L	<0.020
1,2-Dichloroethane	0.5	mg/L	<0.020
Carbon Tetrachloride	0.5	mg/L	<0.020
Benzene	0.5	mg/L	<0.020
Trichloroethene	5	mg/L	<0.020
Tetrachloroethene	3	mg/L	<0.050
Chlorobenzene	8	mg/L	<0.010
1,2-Dichlorobenzene	20	mg/L	<0.010
1,4-Dichlorobenzene	0.5	mg/L	<0.010

Notes:

mg/L = Milligrams per litre
NA = Not Available
O.Reg 558 Standards O. Reg. 558 - Schedule IV Leachate Quality Criteria

GOLDER

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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CLIENT NAME: GOLDER ASSOCIATES LTD
140 RENFREW DR. SUITE 200
MARKHAM, ON L3R6B3
(905) 475-5591

ATTENTION TO: Kathryn Kendra

PROJECT: 1665649(3000)

AGAT WORK ORDER: 17T202234

SOIL ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Apr 11, 2017

PAGES (INCLUDING COVER): 15

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

Certificate of Analysis

AGAT WORK ORDER: 17T202234
PROJECT: 1665649(3000)

5835 COOPERS AVENUE
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CLIENT NAME: GOLDER ASSOCIATES LTD
SAMPLING SITE:

ATTENTION TO: Kathryn Kendra
SAMPLED BY:

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

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	BH17-09SA5	BH17-13 SA7	BH17-01 SA6	BH17-02 SA3	BH17-06 SA2	BH17-10 SA3	BH17-12 SA2B	BH17-14 SA4
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2017-03-28	2017-03-29	2017-03-27	2017-03-30	2017-03-23	2017-03-24	2017-03-24	2017-03-29
Parameter	Unit	G / S	RDL	8295653	8295659	8295664	8295666	8295667	8295668	8295669	8295670
Antimony	µg/g	40	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	4	3	3	3	3	4	4	3
Barium	µg/g	670	2	98	107	80	87	81	147	175	106
Beryllium	µg/g	8	0.5	1.0	0.5	0.6	0.6	0.6	1.1	1.2	0.7
Boron	µg/g	120	5	14	11	11	9	8	9	<5	10
Boron (Hot Water Soluble)	µg/g	2	0.10	0.39	0.18	0.15	0.28	0.15	<0.10	<0.10	<0.10
Cadmium	µg/g	1.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	160	2	33	24	21	23	22	35	35	25
Cobalt	µg/g	80	0.5	16.4	10.5	9.5	9.1	10.1	16.7	13.3	11.7
Copper	µg/g	230	1	24	21	20	21	24	26	12	20
Lead	µg/g	120	1	13	9	8	11	13	16	13	10
Molybdenum	µg/g	40	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	270	1	36	22	19	19	21	39	31	24
Selenium	µg/g	5.5	0.4	0.6	0.4	<0.4	0.5	<0.4	<0.4	0.7	0.6
Silver	µg/g	40	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	3.3	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	33	0.5	1.1	0.8	0.9	0.6	0.5	0.6	0.8	0.7
Vanadium	µg/g	86	1	40	32	27	30	29	46	48	31
Zinc	µg/g	340	5	63	46	44	48	48	63	51	50
Chromium VI	µg/g	8	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	3.9	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	1.4	0.005	**1.74**	0.262	0.215	**1.56**	**1.59**	**1.81**	**2.32**	1.01
Sodium Adsorption Ratio		12		1.26	0.351	0.250	10.5	9.31	2.09	4.32	5.97
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.79	7.78	7.84	7.60	7.70	7.29	7.11	7.50

Parvathi Malemath

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 17T202234

PROJECT: 1665649(3000)

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Kathryn Kendra

SAMPLING SITE:

SAMPLED BY:

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

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	BH17-16 SA-6	BH17-04 SA3
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2017-03-29	2017-03-29
Parameter	**Unit**	**G / S**	**RDL**	**8295671**	**8295673**
Antimony	µg/g	40	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	3	3
Barium	µg/g	670	2	81	84
Beryllium	µg/g	8	0.5	0.6	0.6
Boron	µg/g	120	5	9	10
Boron (Hot Water Soluble)	µg/g	2	0.10	<0.10	0.11
Cadmium	µg/g	1.9	0.5	<0.5	<0.5
Chromium	µg/g	160	2	21	22
Cobalt	µg/g	80	0.5	11.1	11.6
Copper	µg/g	230	1	21	22
Lead	µg/g	120	1	9	10
Molybdenum	µg/g	40	0.5	<0.5	<0.5
Nickel	µg/g	270	1	23	22
Selenium	µg/g	5.5	0.4	<0.4	<0.4
Silver	µg/g	40	0.2	<0.2	<0.2
Thallium	µg/g	3.3	0.4	<0.4	<0.4
Uranium	µg/g	33	0.5	0.6	0.8
Vanadium	µg/g	86	1	27	28
Zinc	µg/g	340	5	47	47
Chromium VI	µg/g	8	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	3.9	0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	1.4	0.005	0.363	0.219
Sodium Adsorption Ratio		12		3.92	1.05
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.55	7.64

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils

8295653-8295673 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:

CHARTERED
Parvathi Malemath
CHEMIST

Certificate of Analysis

AGAT WORK ORDER: 17T202234

PROJECT: 1665649(3000)

CLIENT NAME: GOLDER ASSOCIATES LTD

SAMPLING SITE:

ATTENTION TO: Kathryn Kendra

SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	BH17-09SA5	BH17-13 SA7
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2017-03-28	2017-03-29
Parameter	**Unit**	**G / S**	**RDL**	**8295653**	**8295659**
Naphthalene	µg/g	9.6	0.05	<0.05	<0.05
Acenaphthylene	µg/g	0.15	0.05	<0.05	<0.05
Acenaphthene	µg/g	96	0.05	<0.05	<0.05
Fluorene	µg/g	62	0.05	<0.05	<0.05
Phenanthrene	µg/g	12	0.05	<0.05	<0.05
Anthracene	µg/g	0.67	0.05	<0.05	<0.05
Fluoranthene	µg/g	9.6	0.05	<0.05	<0.05
Pyrene	µg/g	96	0.05	<0.05	<0.05
Benz(a)anthracene	µg/g	0.96	0.05	<0.05	<0.05
Chrysene	µg/g	9.6	0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g	0.96	0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g	0.96	0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g	0.3	0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g	0.76	0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g	0.1	0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g	9.6	0.05	<0.05	<0.05
2-and 1-methyl Naphthalene	µg/g	76	0.05	<0.05	<0.05
Moisture Content	%		0.1	23.0	13.8
Surrogate	**Unit**	**Acceptable Limits**			
Chrysene-d12	%	50-140		97	88

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils

8295653-8295659 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&(j)Fluoranthene isomers because the isomers co-elute on the GC column.

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 17T202234
PROJECT: 1665649(3000)

CLIENT NAME: GOLDER ASSOCIATES LTD
SAMPLING SITE:

ATTENTION TO: Kathryn Kendra
SAMPLED BY:

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

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	**BH17-09SA5**	**BH17-13 SA7**
			SAMPLE TYPE:	**Soil**	**Soil**
			DATE SAMPLED:	**2017-03-28**	**2017-03-29**
Parameter	**Unit**	**G / S**	**RDL**	**8295653**	**8295659**
F1 (C6 to C10)	µg/g	55	5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	55	5	<5	<5
F2 (C10 to C16)	µg/g	230	10	<10	<10
F2 (C10 to C16) minus Naphthalene	µg/g		10	<10	<10
F3 (C16 to C34)	µg/g	1700	50	<50	57
F3 (C16 to C34) minus PAHs	µg/g		50	<50	57
F4 (C34 to C50)	µg/g	3300	50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	3300	50	NA	NA
Moisture Content	%		0.1	23.0	13.8
Surrogate	**Unit**	**Acceptable Limits**			
Terphenyl	%	60-140		96	77

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils

8295653-8295659 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 and PAH 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.

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 17T202234
PROJECT: 1665649(3000)

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CLIENT NAME: GOLDER ASSOCIATES LTD
SAMPLING SITE:

ATTENTION TO: Kathryn Kendra
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	BH17-09SA5	BH17-13 SA7
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2017-03-28	2017-03-29
Parameter	**Unit**	**G / S**	**RDL**	**8295653**	**8295659**
Dichlorodifluoromethane	µg/g	16	0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.032	0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	4	0.05	<0.05	<0.05
Acetone	ug/g	16	0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.064	0.05	<0.05	<0.05
Methylene Chloride	ug/g	1.6	0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	1.3	0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	11	0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	17	0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	70	0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	55	0.02	<0.02	<0.02
Chloroform	ug/g	0.47	0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	6.1	0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.21	0.05	<0.05	<0.05
Benzene	ug/g	0.32	0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.16	0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.91	0.03	<0.03	<0.03
Bromodichloromethane	ug/g	18	0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	31	0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04
Toluene	ug/g	68	0.05	<0.05	<0.05
Dibromochloromethane	ug/g	13	0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	4.5	0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.087	0.04	<0.04	<0.04
Chlorobenzene	ug/g	2.4	0.05	<0.05	<0.05
Ethylbenzene	ug/g	9.5	0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05

Certified By:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2017-04-03

DATE REPORTED: 2017-04-11

			SAMPLE DESCRIPTION:	BH17-09SA5	BH17-13 SA7
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2017-03-28	2017-03-29
Parameter	**Unit**	**G / S**	**RDL**	**8295653**	**8295659**
Bromoform	ug/g	0.61	0.05	<0.05	<0.05
Styrene	ug/g	34	0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	9.6	0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.2	0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	6.8	0.05	<0.05	<0.05
Xylene Mixture	ug/g	26	0.05	<0.05	<0.05
1,3-Dichloropropene	µg/g	0.18	0.04	<0.04	<0.04
n-Hexane	µg/g	46	0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8	% Recovery	50-140		111	110
4-Bromofluorobenzene	% Recovery	50-140		100	100

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Industrial/Commercial/Community Property Use - Coarse Textured Soils

8295653-8295659 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:

Guideline Violation

AGAT WORK ORDER: 17T202234

PROJECT: 1665649(3000)

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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CLIENT NAME: GOLDER ASSOCIATES LTD **ATTENTION TO: Kathryn Kendra**

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8295653	BH17-09SA5	ON T3 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	1.4	1.74
8295666	BH17-02 SA3	ON T3 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	1.4	1.56
8295667	BH17-06 SA2	ON T3 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	1.4	1.59
8295668	BH17-10 SA3	ON T3 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	1.4	1.81
8295669	BH17-12 SA2B	ON T3 S ICC CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	1.4	2.32

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD

PROJECT: 1665649(3000)

SAMPLING SITE:

AGAT WORK ORDER: 17T202234

ATTENTION TO: Kathryn Kendra

SAMPLED BY:

Soil Analysis

RPT Date: Apr 11, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	8295653	8295653	<0.8	<0.8	NA	< 0.8	114%	70%	130%	103%	80%	120%	101%	70%	130%
Arsenic	8295653	8295653	4	3	NA	< 1	103%	70%	130%	96%	80%	120%	103%	70%	130%
Barium	8295653	8295653	98	85	14.2%	< 2	99%	70%	130%	101%	80%	120%	100%	70%	130%
Beryllium	8295653	8295653	1.0	0.9	NA	< 0.5	97%	70%	130%	95%	80%	120%	103%	70%	130%
Boron	8295653	8295653	14	14	NA	< 5	77%	70%	130%	99%	80%	120%	111%	70%	130%
Boron (Hot Water Soluble)	8295653	8295653	0.39	0.40	NA	< 0.10	104%	60%	140%	94%	70%	130%	94%	60%	140%
Cadmium	8295653	8295653	<0.5	<0.5	NA	< 0.5	107%	70%	130%	108%	80%	120%	107%	70%	130%
Chromium	8295653	8295653	33	32	3.1%	< 2	95%	70%	130%	100%	80%	120%	117%	70%	130%
Cobalt	8295653	8295653	16.4	17.2	4.8%	< 0.5	100%	70%	130%	99%	80%	120%	101%	70%	130%
Copper	8295653	8295653	24	23	4.3%	< 1	93%	70%	130%	99%	80%	120%	99%	70%	130%
Lead	8295653	8295653	13	12	8.0%	< 1	98%	70%	130%	98%	80%	120%	96%	70%	130%
Molybdenum	8295653	8295653	<0.5	<0.5	NA	< 0.5	99%	70%	130%	92%	80%	120%	103%	70%	130%
Nickel	8295653	8295653	36	36	0.0%	< 1	103%	70%	130%	104%	80%	120%	104%	70%	130%
Selenium	8295653	8295653	0.6	0.5	NA	< 0.4	111%	70%	130%	98%	80%	120%	99%	70%	130%
Silver	8295653	8295653	<0.2	<0.2	NA	< 0.2	95%	70%	130%	108%	80%	120%	107%	70%	130%
Thallium	8295653	8295653	<0.4	<0.4	NA	< 0.4	102%	70%	130%	106%	80%	120%	104%	70%	130%
Uranium	8295653	8295653	1.1	1.1	NA	< 0.5	100%	70%	130%	99%	80%	120%	101%	70%	130%
Vanadium	8295653	8295653	40	38	5.1%	< 1	96%	70%	130%	92%	80%	120%	111%	70%	130%
Zinc	8295653	8295653	63	60	4.9%	< 5	95%	70%	130%	98%	80%	120%	98%	70%	130%
Chromium VI	8295669	8295669	<0.2	<0.2	NA	< 0.2	97%	70%	130%	95%	80%	120%	100%	70%	130%
Cyanide	8295653	8295653	<0.040	<0.040	NA	< 0.040	105%	70%	130%	93%	80%	120%	105%	70%	130%
Mercury	8295653	8295653	<0.10	<0.10	NA	< 0.10	90%	70%	130%	89%	80%	120%	90%	70%	130%
Electrical Conductivity	8295653	8295653	1.74	1.72	1.2%	< 0.005	94%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8295653	8295653	1.26	1.24	1.6%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8295666	8295666	7.60	7.65	0.7%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), 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.

Parvathi Malemath

Certified By:

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: 1665649(3000)
SAMPLING SITE:

AGAT WORK ORDER: 17T202234
ATTENTION TO: Kathryn Kendra
SAMPLED BY:

Trace Organics Analysis

RPT Date: Apr 11, 2017			**DUPLICATE**			**Method Blank**	**REFERENCE MATERIAL**			**METHOD BLANK SPIKE**			**MATRIX SPIKE**		
PARAMETER	**Batch**	**Sample Id**	**Dup #1**	**Dup #2**	**RPD**		**Measured Value**	**Acceptable Limits**		**Recovery**	**Acceptable Limits**		**Recovery**	**Acceptable Limits**	
								Lower	**Upper**		**Lower**	**Upper**		**Lower**	**Upper**
O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)															
F1 (C6 to C10)	8293710		< 5	< 5	NA	< 5	79%	60%	130%	90%	85%	115%	83%	70%	130%
F2 (C10 to C16)	8296457		< 10	< 10	NA	< 10	94%	60%	130%	89%	80%	120%	76%	70%	130%
F3 (C16 to C34)	8296457		< 50	< 50	NA	< 50	107%	60%	130%	82%	80%	120%	79%	70%	130%
F4 (C34 to C50)	8296457		< 50	< 50	NA	< 50	97%	60%	130%	83%	80%	120%	71%	70%	130%
O. Reg. 153(511) - VOCs (Soil)															
Dichlorodifluoromethane	8293710		< 0.05	< 0.05	NA	< 0.05	111%	50%	140%	118%	50%	140%	100%	50%	140%
Vinyl Chloride	8293710		< 0.02	< 0.02	NA	< 0.02	119%	50%	140%	105%	50%	140%	76%	50%	140%
Bromomethane	8293710		< 0.05	< 0.05	NA	< 0.05	120%	50%	140%	107%	50%	140%	78%	50%	140%
Trichlorofluoromethane	8293710		< 0.05	< 0.05	NA	< 0.05	119%	50%	140%	108%	50%	140%	102%	50%	140%
Acetone	8293710		< 0.50	< 0.50	NA	< 0.50	111%	50%	140%	112%	50%	140%	101%	50%	140%
1,1-Dichloroethylene	8293710		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	99%	60%	130%	86%	50%	140%
Methylene Chloride	8293710		< 0.05	< 0.05	NA	< 0.05	95%	50%	140%	97%	60%	130%	80%	50%	140%
Trans- 1,2-Dichloroethylene	8293710		< 0.05	< 0.05	NA	< 0.05	75%	50%	140%	88%	60%	130%	77%	50%	140%
Methyl tert-butyl Ether	8293710		< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	74%	60%	130%	95%	50%	140%
1,1-Dichloroethane	8293710		< 0.02	< 0.02	NA	< 0.02	77%	50%	140%	90%	60%	130%	79%	50%	140%
Methyl Ethyl Ketone	8293710		< 0.50	< 0.50	NA	< 0.50	118%	50%	140%	77%	50%	140%	77%	50%	140%
Cis- 1,2-Dichloroethylene	8293710		< 0.02	< 0.02	NA	< 0.02	105%	50%	140%	77%	60%	130%	109%	50%	140%
Chloroform	8293710		< 0.04	< 0.04	NA	< 0.04	97%	50%	140%	122%	60%	130%	78%	50%	140%
1,2-Dichloroethane	8293710		< 0.03	< 0.03	NA	< 0.03	99%	50%	140%	113%	60%	130%	97%	50%	140%
1,1,1-Trichloroethane	8293710		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	98%	60%	130%	87%	50%	140%
Carbon Tetrachloride	8293710		< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	88%	60%	130%	81%	50%	140%
Benzene	8293710		< 0.02	< 0.02	NA	< 0.02	91%	50%	140%	98%	60%	130%	94%	50%	140%
1,2-Dichloropropane	8293710		< 0.03	< 0.03	NA	< 0.03	96%	50%	140%	77%	60%	130%	99%	50%	140%
Trichloroethylene	8293710		< 0.03	< 0.03	NA	< 0.03	86%	50%	140%	105%	60%	130%	100%	50%	140%
Bromodichloromethane	8293710		< 0.05	< 0.05	NA	< 0.05	77%	50%	140%	85%	60%	130%	77%	50%	140%
Methyl Isobutyl Ketone	8293710		< 0.50	< 0.50	NA	< 0.50	114%	50%	140%	83%	50%	140%	83%	50%	140%
1,1,2-Trichloroethane	8293710		< 0.04	< 0.04	NA	< 0.04	106%	50%	140%	103%	60%	130%	100%	50%	140%
Toluene	8293710		< 0.05	< 0.05	NA	< 0.05	96%	50%	140%	97%	60%	130%	97%	50%	140%
Dibromochloromethane	8293710		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	87%	60%	130%	80%	50%	140%
Ethylene Dibromide	8293710		< 0.04	< 0.04	NA	< 0.04	97%	50%	140%	96%	60%	130%	91%	50%	140%
Tetrachloroethylene	8293710		< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	107%	60%	130%	106%	50%	140%
1,1,1,2-Tetrachloroethane	8293710		< 0.04	< 0.04	NA	< 0.04	81%	50%	140%	78%	60%	130%	79%	50%	140%
Chlorobenzene	8293710		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	103%	60%	130%	105%	50%	140%
Ethylbenzene	8293710		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	91%	60%	130%	94%	50%	140%
m & p-Xylene	8293710		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	96%	60%	130%	101%	50%	140%
Bromoform	8293710		< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	93%	60%	130%	87%	50%	140%
Styrene	8293710		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	84%	60%	130%	95%	50%	140%
1,1,2,2-Tetrachloroethane	8293710		< 0.05	< 0.05	NA	< 0.05	121%	50%	140%	106%	60%	130%	96%	50%	140%
o-Xylene	8293710		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	100%	60%	130%	106%	50%	140%

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: 1665649(3000)
SAMPLING SITE:

AGAT WORK ORDER: 17T202234
ATTENTION TO: Kathryn Kendra
SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Apr 11, 2017			**DUPLICATE**			**Method Blank**	**REFERENCE MATERIAL**			**METHOD BLANK SPIKE**			**MATRIX SPIKE**		
PARAMETER	**Batch**	**Sample Id**	**Dup #1**	**Dup #2**	**RPD**		**Measured Value**	**Acceptable Limits**		**Recovery**	**Acceptable Limits**		**Recovery**	**Acceptable Limits**	
								Lower	**Upper**		**Lower**	**Upper**		**Lower**	**Upper**
1,3-Dichlorobenzene	8293710		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	97%	60%	130%	106%	50%	140%
1,4-Dichlorobenzene	8293710		< 0.05	< 0.05	NA	< 0.05	111%	50%	140%	110%	60%	130%	115%	50%	140%
1,2-Dichlorobenzene	8293710		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	106%	60%	130%	111%	50%	140%
1,3-Dichloropropene	8293710		< 0.04	< 0.04	NA	< 0.04	94%	50%	140%	94%	60%	130%	96%	50%	140%
n-Hexane	8293710		< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	104%	60%	130%	98%	50%	140%
O. Reg. 153(511) - PAHs (Soil)															
Naphthalene	8295728		< 0.05	< 0.05	NA	< 0.05	95%	50%	140%	96%	50%	140%	97%	50%	140%
Acenaphthylene	8295728		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	96%	50%	140%	98%	50%	140%
Acenaphthene	8295728		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	94%	50%	140%	98%	50%	140%
Fluorene	8295728		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	102%	50%	140%	101%	50%	140%
Phenanthrene	8295728		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	96%	50%	140%	93%	50%	140%
Anthracene	8295728		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	102%	50%	140%	93%	50%	140%
Fluoranthene	8295728		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	96%	50%	140%	98%	50%	140%
Pyrene	8295728		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	97%	50%	140%	100%	50%	140%
Benz(a)anthracene	8295728		< 0.05	< 0.05	NA	< 0.05	114%	50%	140%	97%	50%	140%	115%	50%	140%
Chrysene	8295728		< 0.05	< 0.05	NA	< 0.05	112%	50%	140%	93%	50%	140%	99%	50%	140%
Benzo(b)fluoranthene	8295728		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	77%	50%	140%	81%	50%	140%
Benzo(k)fluoranthene	8295728		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	79%	50%	140%	82%	50%	140%
Benzo(a)pyrene	8295728		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	91%	50%	140%	90%	50%	140%
Indeno(1,2,3-cd)pyrene	8295728		< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	82%	50%	140%	96%	50%	140%
Dibenz(a,h)anthracene	8295728		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	85%	50%	140%	102%	50%	140%
Benzo(g,h,i)perylene	8295728		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	88%	50%	140%	93%	50%	140%
2-and 1-methyl Naphthalene	8295728		< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	94%	50%	140%	99%	50%	140%

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:

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD **AGAT WORK ORDER: 17T202234**

PROJECT: 1665649(3000) **ATTENTION TO: Kathryn Kendra**

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

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD **AGAT WORK ORDER: 17T202234**

PROJECT: 1665649(3000) **ATTENTION TO: Kathryn Kendra**

SAMPLING SITE: **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluorene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Phenanthrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benz(a)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(a)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
2-and 1-methyl Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Moisture Content	ORG-91-5106	EPA SW-846 3541 & 8270	BALANCE
Chrysene-d12	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34) minus PAHs	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	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
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: 1665649(3000)
SAMPLING SITE:

AGAT WORK ORDER: 17T202234
ATTENTION TO: Kathryn Kendra
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

AGAT Laboratories

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

1Lg.

Chain of Custody Record

Laboratory Use Only

Arrival Temperature: 17T202234

AGAT WO #: 5^{4} 4^{6} 4^{3}

Lab Temperature:

Notes:

Client Information

Company: GOLDER ASSOCIATES
Contact: Kathryn Kendra
Address: 140 Renfrew Drive
Suite 200, Markham
Phone: 905-475-5591 x 6031
Project: 1665649 (3000P):
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☒ Regulation 153/04 (reg. 511 Amend.)
Table 3 (Indicate one)
☒ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture (*check one*)
☒ Coarse ☐ Fine

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

☐ Regulation 558
☐ CCME
☐ Other (*specify*)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time (TAT) Required*

Regular TAT
☒ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR

Date Required (Rush surcharges may apply):

**TAT is exclusive of weekends and statutory holidays*

Invoice To

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample?
(potable water intended for human consumption)
☐ Yes ☒ No

If "Yes", please use the
Drinking Water Chain of Custody Form

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: Kathryn Kendra
Email: kathryn_kendra@golder.com
2. Name:
Email:

	Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO₃/NO₂ ☐ N- Total ☐ Hg ☐ pH	Nutrients: ☐ TP ☐ NH₃ ☐ TKN ☐ NO₃ ☐ NO₂ ☐ NO₃/NO₂	VOC: ☒ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
✓	BH17-09 SA5	MAR28/17	PM	SD	4		X						X	X		X					
✓	BH17-13 SA7	MAR29/17	PM	SD	4		X						X	X		X					
✓	BH17-01 SA6	MAR27/17	AM	SD	2		X														
✓	BH17-02 SA3	MAR30/17	AM	SD	1		X														
✓	BH17-06 SA2	MAR23/17	PM	SD	1		X														
✓	BH17-10 SA3	MAR24/17	PM	SD	1		X														
✓	BH17-12 SA2B	MAR24/17	PM	SD	1		X														
✓	BH17-14 SA4	MAR29/17	PM	SD	1		X														
✓	BH17-16 SA6	MAR29/17	AM	SD	2		X														
✓	BH17-04 SA3	MAR29/17	AM	SD	1		X														

Samples Relinquished By (Print Name and Sign): Polly Chen
Date/Time: 17/4/3 4:12 pm
Samples Received By (Print Name and Sign): Simon
17/4/3
Date/Time: 4:12
Samples Relinquished By (Print Name and Sign):
Date/Time
Samples Received By (Print Name and Sign):
Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 1

Nº: 32011

Document ID: DIV 78 1511.008
Date Issued: May 31, 2013

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

CLIENT NAME: GOLDER ASSOCIATES LTD
140 RENFREW DR. SUITE 200
MARKHAM, ON L3R6B3
(905) 475-5591

ATTENTION TO: Kathryn Kendra

PROJECT: 1665649(3000)

AGAT WORK ORDER: 17T199187

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

DATE REPORTED: Mar 30, 2017

PAGES (INCLUDING COVER): 10

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.

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CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Kathryn Kendra

SAMPLING SITE:

SAMPLED BY:Mathias

Ignitability in Soil

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-30

			SAMPLE DESCRIPTION:	TCLPSA1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-03-23
Parameter	Unit	G / S	RDL	8278504
Ignitability				N

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8278504 N = Non-Flammable Solid
Wet soil sample with pebbles.

Certified By: Amanjot Bhela

Certificate of Analysis

AGAT WORK ORDER: 17T199187
PROJECT: 1665649(3000)

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CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Kathryn Kendra

SAMPLING SITE:

SAMPLED BY:Mathias

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-30

			SAMPLE DESCRIPTION:	TCLPSA1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-03-23
Parameter	Unit	G / S	RDL	8278504
Arsenic Leachate	mg/L	2.5	0.010	<0.010
Barium Leachate	mg/L	100	0.100	0.625
Boron Leachate	mg/L	500	0.050	0.060
Cadmium Leachate	mg/L	0.5	0.010	<0.010
Chromium Leachate	mg/L	5	0.010	<0.010
Lead Leachate	mg/L	5	0.010	<0.010
Mercury Leachate	mg/L	0.1	0.01	<0.01
Selenium Leachate	mg/L	1	0.010	<0.010
Silver Leachate	mg/L	5	0.010	<0.010
Uranium Leachate	mg/L	10	0.050	<0.050
Fluoride Leachate	mg/L	150	0.05	0.22
Cyanide Leachate	mg/L	20	0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria

Certified By: Amanjot Bhela

Certificate of Analysis

AGAT WORK ORDER: 17T199187

PROJECT: 1665649(3000)

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CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Kathryn Kendra

SAMPLING SITE:

SAMPLED BY:Mathias

O. Reg. 558 - Benzo(a) pyrene

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-30

			SAMPLE DESCRIPTION:	TCLPSA1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-03-23
Parameter	Unit	G / S	RDL	8278504
Benzo(a)pyrene	mg/L	0.001	0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria

8278504 The sample was leached according to Regulation 558 protocol. Analysis was performed on the leachate.

Certified By: NPopukolof

Certificate of Analysis

AGAT WORK ORDER: 17T199187
PROJECT: 1665649(3000)

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CLIENT NAME: GOLDER ASSOCIATES LTD
SAMPLING SITE:

ATTENTION TO: Kathryn Kendra
SAMPLED BY:Mathias

O. Reg. 558 - PCBs

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-30

			SAMPLE DESCRIPTION:	TCLPSA1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-03-23
Parameter	Unit	G / S	RDL	8278504
Polychlorinated Biphenyls	mg/L	0.3	0.005	<0.005
Surrogate	Unit	Acceptable Limits		
Decachlorobiphenyl	%	60-130		119

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Regulation 558

8278504 The soil sample was leached using the Regulation 558 procedure. Analysis was performed on the leachate.

Certified By: NPopukolof

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17T199187
PROJECT: 1665649(3000)

CLIENT NAME: GOLDER ASSOCIATES LTD
SAMPLING SITE:

ATTENTION TO: Kathryn Kendra
SAMPLED BY:Mathias

O. Reg. 558 - VOCs

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-30

			SAMPLE DESCRIPTION:	TCLPSA1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-03-23
Parameter	Unit	G / S	RDL	8278504
Vinyl Chloride	mg/L	0.2	0.030	<0.030
1,1 Dichloroethene	mg/L	1.4	0.020	<0.020
Dichloromethane	mg/L	5.0	0.030	<0.030
Methyl Ethyl Ketone	mg/L	200	0.090	<0.090
Chloroform	mg/L	10.0	0.020	<0.020
1,2-Dichloroethane	mg/L	0.5	0.020	<0.020
Carbon Tetrachloride	mg/L	0.5	0.020	<0.020
Benzene	mg/L	0.5	0.020	<0.020
Trichloroethene	mg/L	5.0	0.020	<0.020
Tetrachloroethene	mg/L	3.0	0.050	<0.050
Chlorobenzene	mg/L	8.0	0.010	<0.010
1,2-Dichlorobenzene	mg/L	20.0	0.010	<0.010
1,4-Dichlorobenzene	mg/L	0.5	0.010	<0.010
Surrogate	Unit	Acceptable Limits		
Toluene-d8	% Recovery	60-130		96

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
8278504 Sample was prepared using Regulation 558 protocol and a zero headspace extractor.

Certified By:

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: 1665649(3000)
SAMPLING SITE:

AGAT WORK ORDER: 17T199187
ATTENTION TO: Kathryn Kendra
SAMPLED BY:Mathias

Soil Analysis

RPT Date: Mar 30, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	8277793		<0.010	<0.010	NA	< 0.010	101%	90%	110%	103%	80%	120%	103%	70%	130%
Barium Leachate	8277793		0.552	0.557	0.9%	< 0.100	92%	90%	110%	95%	80%	120%	99%	70%	130%
Boron Leachate	8277793		0.129	0.127	NA	< 0.050	99%	90%	110%	97%	80%	120%	92%	70%	130%
Cadmium Leachate	8277793		<0.010	<0.010	NA	< 0.010	100%	90%	110%	101%	80%	120%	106%	70%	130%
Chromium Leachate	8277793		0.018	0.018	NA	< 0.010	98%	90%	110%	113%	80%	120%	105%	70%	130%
Lead Leachate	8277793		<0.010	<0.010	NA	< 0.010	104%	90%	110%	99%	80%	120%	99%	70%	130%
Mercury Leachate	8277793		<0.01	<0.01	NA	< 0.01	108%	90%	110%	97%	80%	120%	87%	70%	130%
Selenium Leachate	8277793		<0.010	<0.010	NA	< 0.010	101%	90%	110%	102%	80%	120%	102%	70%	130%
Silver Leachate	8277793		<0.010	<0.010	NA	< 0.010	99%	90%	110%	108%	80%	120%	104%	70%	130%
Uranium Leachate	8277793		<0.050	<0.050	NA	< 0.050	102%	90%	110%	94%	80%	120%	94%	70%	130%
Fluoride Leachate	8277793		4.40	4.42	0.5%	< 0.05	100%	90%	110%	106%	90%	110%	73%	70%	130%
Cyanide Leachate	8277793		<0.05	<0.05	NA	< 0.05	102%	90%	110%	108%	90%	110%	110%	70%	130%
(Nitrate + Nitrite) as N Leachate	8277793		<0.70	<0.70	NA	< 0.70	99%	80%	120%	97%	80%	120%	98%	70%	130%

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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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: 1665649(3000)
SAMPLING SITE:

AGAT WORK ORDER: 17T199187
ATTENTION TO: Kathryn Kendra
SAMPLED BY:Mathias

Trace Organics Analysis

RPT Date: Mar 30, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 - VOCs															
Vinyl Chloride	8270169		< 0.030	< 0.030	NA	< 0.030	109%	60%	140%	122%	60%	140%	NA	60%	140%
1,1 Dichloroethene	8270169		< 0.020	< 0.020	NA	< 0.020	97%	70%	130%	116%	70%	130%	NA	60%	140%
Dichloromethane	8270169		< 0.030	< 0.030	NA	< 0.030	111%	70%	130%	115%	70%	130%	NA	60%	140%
Methyl Ethyl Ketone	8270169		< 0.090	< 0.090	NA	< 0.090	82%	70%	130%	90%	70%	130%	NA	60%	140%
Chloroform	8270169		< 0.020	< 0.020	NA	< 0.020	93%	70%	130%	110%	70%	130%	NA	60%	140%
1,2-Dichloroethane	8270169		< 0.020	< 0.020	NA	< 0.020	98%	70%	130%	96%	70%	130%	NA	60%	140%
Carbon Tetrachloride	8270169		< 0.020	< 0.020	NA	< 0.020	88%	70%	130%	113%	70%	130%	NA	60%	140%
Benzene	8270169		< 0.020	< 0.020	NA	< 0.020	104%	70%	130%	112%	70%	130%	NA	60%	140%
Trichloroethene	8270169		< 0.020	< 0.020	NA	< 0.020	82%	70%	130%	88%	70%	130%	NA	60%	140%
Tetrachloroethene	8270169		< 0.050	< 0.050	NA	< 0.050	81%	70%	130%	97%	70%	130%	NA	60%	140%
Chlorobenzene	8270169		< 0.010	< 0.010	NA	< 0.010	75%	70%	130%	86%	70%	130%	NA	60%	140%
1,2-Dichlorobenzene	8270169		< 0.010	< 0.010	NA	< 0.010	106%	70%	130%	108%	70%	130%	NA	60%	140%
1,4-Dichlorobenzene	8270169		< 0.010	< 0.010	NA	< 0.010	86%	70%	130%	97%	70%	130%	NA	60%	140%
O. Reg. 558 - PCBs															
Polychlorinated Biphenyls	8273726		< 0.005	< 0.005	NA	< 0.005	107%	60%	130%	98%	60%	130%	NA	60%	130%
O. Reg. 558 - Benzo(a) pyrene															
Benzo(a)pyrene	8278504	8278504	< 0.001	< 0.001	NA	< 0.001	99%	70%	130%	100%	70%	130%	NA	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: NPopukolof

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Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD	AGAT WORK ORDER: 17T199187
PROJECT: 1665649(3000)	ATTENTION TO: Kathryn Kendra
SAMPLING SITE:	SAMPLED BY:Mathias

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Ignitability		EPA SW-846 1030	BURN MOLD
Arsenic Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Barium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Boron Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cadmium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Chromium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Lead Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Mercury Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Selenium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Silver Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Uranium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Fluoride Leachate	INOR-93-6018	EPA SW-846-1311 & SM4500-F- C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA SW-846-1311 & MOE 3015 & SM 4500 CN- I	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & SM 4500 - NO3- I	LACHAT FIA
Trace Organics Analysis			
Benzo(a)pyrene	ORG-91-5114	EPA SW846 3540 & 8270	GC/MS
Polychlorinated Biphenyls	ORG-91-5112	Regulation 558, EPA SW846 3510C/8082	GC/ECD
Decachlorobiphenyl	ORG-91-5112	EPA SW846 3510C/8082	GC/ECD
Vinyl Chloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,1 Dichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Dichloromethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Trichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS

AGAT Laboratories

SR6

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
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Laboratory Use Only

Work Order #: 17T199187

Cooler Quantity:

Arrival Temperatures: 13.3 | 13.1 | 13.0

(No/ie)

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Golder Associates Ltd.
Contact: Kathryn Kendra
Address: 140 Renfrew dr. Suite 200
Markham, Ont.
Phone: 905 475 5591 Fax:
Reports to be sent to:
1. Email: Kathryn_Kendra@golder.Com.
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

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

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ______ *Indicate One*
☐ MISA

☑ 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: 1665649 (3000)
Site Location: Coleraine Dr.
Sampled By: Mathias Cawthra.
AGAT Quote #: 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 ☐ 153 Metals (Incl. Hydrides)	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	TCLP PAH's	TCLP Ignitability.				
TCLPSA1	March 23/17	3:15	5	Soil															✓		✓	✓				

Samples Relinquished By (Print Name and Sign): Mathias Cawthra | Date | Time
Samples Received By (Print Name and Sign): | Date 3/23/17 | Time 4:40pm
Samples Relinquished By (Print Name and Sign): | Date | Time
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): | Date | Time

Page ______ of ______

Nº: T 048212

Document ID: DIV-78-1511.014

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Date Issued: February 22, 2017

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