



THURBER ENGINEERING LTD.

**SOIL AND GROUNDWATER CORROSIVITY ASSESSMENT
HIGHWAY 401 BRIDGES OVER GO PARKING LOT
AND LESLIE STREET
HIGHWAY 401 AND LESLIE STREET INTERCHANGE
CITY OF TORONTO
W.P. 2061-13-00, SITE: 37-2060 and 37-206/5**

GEOCRES NO.: 30M14-441

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the proposed replacement of the Highway 401 bridges over the Oriole GO Station parking lot and Leslie Street in the City of Toronto, Ontario. Both structures are part of the proposed reconstruction and rehabilitation of the Highway 401 and Leslie Street interchange.

The purpose of this investigation was to collect soil and groundwater samples and conduct analytical testing to assess whether the soil and groundwater surrounding the existing piles and caissons are corrosive in nature and could result in deterioration of the steel and concrete. This investigation has been performed in conjunction with foundation investigations for the other structures associated with the Highway 401 and Leslie Street interchange.

Thurber was retained by MMM Group Limited (MMM) to carry out the foundation investigation at this site on behalf of the Ministry of Transportation Ontario (MTO) under Agreement No. 2013-E-0032.

2 SITE AND PROJECT DESCRIPTION

The site is located within the existing Highway 401 and Leslie Street interchange area in the City of Toronto, Ontario. At this location, Highway 401 crosses over Leslie Street and the Oriole GO Station parking lot to the west of Leslie Street. The existing bridge structure(s) are supported on steel piles and concrete caissons.

It is understood that the existing bridges are to be rehabilitated and may utilize the existing foundations. Therefore, this soil and groundwater assessment was conducted in order to assess

whether there is a potential for the existing foundations to be in a deteriorated condition due to exposure to corrosive soil and groundwater.

The site lies within an area of industrial and commercial lands and the terrain is generally flat. Overall, this physiographic region is slightly undulating and decreases in elevation in a southerly direction toward Lake Ontario.

According to the Physiography of Southern Ontario by L.J. Chapman and D.F. Putnam, 1984, the project site is located within the physiographic region known as the South Slope. The South Slope is a smooth and drumlinized till plain that has formed as a result of glacial action and deposition of till materials just south of the Oak Ridges Moraine. The South Slope contains a variety of soils that have developed over till. The depth of the overburden in the general area can be expected to be more than 50 m. Within and adjacent to the Don River valley, the site area is underlain by glacio-lacustrine sands, silts, silty clay and glacial till deposits.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried out from December 1 to 23, 2015. A total of seven boreholes were drilled at the site. Two boreholes (numbered C15-01 and C15-02) were drilled at the west side of the GO parking lot, two boreholes (numbered C15-03 and C15-04) were drilled at the east side of the GO parking lot, and three boreholes (numbered C15-05 to C15-07) were drilled on the southbound left lane of Leslie Street, adjacent to the central pier. Boreholes C15-02 and C15-07 were drilled to depths of 24.5 and 18.9 m respectively, and the remaining boreholes were drilled to 6.7 m deep.

The approximate locations of the boreholes drilled during the current investigation are shown on a Borehole Location Plan drawing in Appendix A. The coordinates of the boreholes are given on the drawings and on the individual Record of Borehole Sheets in Appendix B. The borehole coordinates and ground surface elevations were surveyed and provided by MMM.

The borehole locations were initially established in the field by Thurber relative to existing site features. Utility clearance was obtained at all borehole locations prior to drilling.

During the current investigation, rubber-track mounted and truck-mounted D25 drill rigs were used in conjunction with solid-stem and hollow-stem augers to advance the boreholes. At locations in the GO parking lot where headroom is restricted, low headroom equipment (including half-mast drilling) was used. Soil samples were obtained at selected intervals using a 50 mm nominal diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT). The sampler was washed after every sample to minimize the risk of cross-contamination.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions were observed in the open boreholes during and upon completion of the drilling operations. Monitoring wells consisting of a 50 mm diameter Schedule 40 PVC pipe with a 3.0 m long slotted screen were installed within a column of filter sand in two selected boreholes to permit longer term groundwater level monitoring and collection of groundwater samples. The completion details of the monitoring wells and boreholes are summarized in Table 3.1.

Table 3.1 – Monitoring Well and Borehole Completion Details

Borehole Number	Well Tip Depth / Elevation (m)	Completion Details
C15-01	None installed	Backfilled with bentonite holeplug and auger cuttings to 0.1 m, and cement to ground surface.
C15-02	24.5/118.6	Backfilled with filter sand from 24.5 to 17.5 m, bentonite holeplug from 17.5 to 0.3 m, and cement from 0.3 m to ground surface.
C15-03	None installed	Backfilled with bentonite holeplug and auger cuttings to 0.1 m, and cement to ground surface.
C15-04	None installed	Backfilled with bentonite holeplug and auger cuttings to 0.1 m, and asphalt to ground surface.
C15-05	6.7/129.6	Backfilled with filter sand from 6.7 to 2.7 m, bentonite holeplug from 2.7 to 0.15 m, and cement from 0.15 m to ground surface.
C15-06	None installed	Backfilled with bentonite holeplug and auger cuttings to 0.1 m, and concrete to ground surface.
C15-07	None installed	Backfilled with bentonite holeplug and auger cuttings to 0.2 m, and asphalt to ground surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to visual identification and to natural moisture content determination. Thirty-four (34) of the recovered soil samples were submitted to an analytical laboratory for analysis of corrosivity parameters including sulphide, chloride, sulphate, pH, electrical conductivity (EC), resistivity, redox potential, and sodium adsorption ratio (SAR). Groundwater samples were subsequently collected from the monitoring wells at Boreholes C15-02 and C15-05 and were also submitted to the laboratory to test for a suite of corrosivity parameters. The results of the analytical laboratory testing are shown on the Certificates of Analysis included in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in these records. General description of the stratigraphy is given in the following paragraphs. The factual information established at the borehole locations governs any interpretation of the site conditions.

In general, the stratigraphy at the site typically consists of surficial asphalt and concrete underlain by sand, silt and clay fill, overlying native silty sand and silty clay.

5.1 Asphalt and Concrete

Within the GO parking lot, a 50 to 100 mm thick layer of asphalt was encountered at the ground surface in Boreholes C15-01 to C15-04.

In the boreholes on Leslie Street (C15-05 to C15-07), a 25 to 90 mm thick asphalt layer was encountered at the ground surface, which was underlain by a 200 to 275 mm thick layer of concrete.

The asphalt and concrete thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

5.2 Sand and Silt Fill

Layers of sand and silt fill ranging in composition from sand with trace gravel to sandy silt with some clay and trace gravel were encountered below the asphalt and concrete in all of the boreholes. The thickness of the sand and silt fill layers ranges from 0.7 to 3.9 m. The depth to the base of the sand and silt fill varied from 1.5 to 4.0 m (Elev. 141.6 to 134.7 m).

The SPT 'N' values measured in the sand and silt fill typically ranged from 11 to 45 blows per 0.3 m of penetration indicating a compact to dense condition. SPT 'N' values of 7 and 9 blows per 0.3 m of penetration indicate the presence of a loose zone in Boreholes C15-01, which contained some silty clay seams. The moisture content in the sand and silt fill ranged from 2% to 19%.

5.3 Silty Clay Fill

Layers of silty clay fill were encountered within and below the sand and silt fill layers in Boreholes C15-01 to C15-04. The silty clay fill contained some sand to sandy, trace gravel, trace roots and rootlets, and occasional cobbles. The silty clay fill was brown to dark brown in colour, with occasional topsoil staining. The thickness of the silty clay fill ranged from 0.6 to 2.4 m, and the depth to the base of the silty clay fill ranged from 1.6 to 4.6 m (Elev. 139.2 to 136.9 m).

SPT 'N' values in the silty clay fill varied from 3 to 21 blows per 0.3 m of penetration, indicating a soft to very stiff consistency. The moisture contents ranged from 8% to 18%.

5.4 Silty Sand

Underlying the fill layers, a native deposit of silty sand with trace gravel and trace clay was encountered in Boreholes C15-01, C15-02, and C15-04 to C15-07. Borehole C15-01 was terminated within the silty sand deposit at a depth of 6.7 m (Elev. 136.7 m). Where the deposit was fully penetrated, the thickness ranged from 2.2 to 6.3 m. The depth to the base of the silty sand

ranged from 3.7 to 10.2 m (Elev. 134.3 to 132.3 m). A deeper layer of silty sand ranging to sandy silt was also encountered in Borehole C15-02 from 15.3 to 18.3 m depth (Elev. 127.8 to 124.8 m).

SPT ‘N’ values of the silty sand ranged from 1 to 53 blows per 0.3 m of penetration, with most values lying between 10 and 30 blows, indicating a typically compact state. The moisture contents varied from 5% to 28%.

5.5 Silty Clay

An extensive deposit of brown to grey silty clay containing trace to some sand and trace gravel was encountered below the fill and/or silty sand layers in Boreholes C15-02 to C15-07. Boreholes C15-03 to C15-06 were terminated within the silty clay deposit at a depth of 6.7 m (Elev. 134.7 to 129.5 m). Borehole C15-07 was terminated within the deposit at a depth of 18.9 m (Elev. 117.3 m). The combined thickness of the deposit was 9.4 m in Borehole C15-02, where the silty clay extended to a depth of 22.6 m (Elev. 120.5 m). In Borehole C15-02, the deposit was also interrupted by a 3 m thick silty sand to sandy silt layer as described in Section 5.4.

SPT ‘N’ values of 1 to 12 blows per 0.3 m of penetration, indicating a very soft to stiff consistency, were measured within the silty clay deposit. The moisture contents of the silty clay ranged from 8% to 43%.

5.6 Silty Clay Till

Borehole C15-02 was terminated within a silty clay till deposit below the silty clay at a depth of 24.5 m (Elev. 118.6 m). The silty clay contained some sand and trace gravel. SPT ‘N’ values measured in the till were 26 and 61 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The moisture content was measured at 7% to 11%.

5.7 Groundwater Level

Water levels were observed in the open boreholes upon completion of drilling operations. Two monitoring wells were installed to measure the groundwater levels after completion of drilling and for collection of groundwater samples. The water levels measured in the wells are summarized in Table 5.1 which also includes water levels observed in the open boreholes upon completion of drilling.

Table 5.1 – Water Level Measurements

Borehole Number	Date	Water Levels		Comment
		Depth (m)	Elevation (m)	
C15-01	December 21, 2015	Dry at 6.7	Dry at 136.7	Open borehole
C15-02	January 16, 2016	0.6	142.5	Monitoring Well
C15-03	December 21, 2015	Dry at 6.7	Dry at 134.7	Open borehole
C15-04	December 21, 2015	4.5	135.9	Open borehole
C15-05	January 16, 2016	2.1	134.2	Monitoring Well
C15-06	December 3, 2015	3.2	133.0	Open borehole
C15-07	December 4, 2015	4.0	132.2	Open borehole

The groundwater readings presented above are short term observations. Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at higher elevations after the spring snowmelt or after periods of heavy rainfall.

6 CORROSIVITY TEST RESULTS

Ten (10) samples of the existing fill soils and twenty-four (24) samples of the native soils were submitted for analytical corrosivity testing and SAR. Two (2) samples of the groundwater were also submitted for analytical testing of a corrosivity package. The results of the analytical laboratory tests are shown on the Certificates of Analysis included in Appendix C.

7 MISCELLANEOUS

The borehole locations on site were initially established by Thurber. Underground utility clearances were obtained for the borehole locations prior to drilling. The northing and easting coordinates and elevation at each as-drilled borehole location were provided by MMM.

The drilling and sampling equipment was supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The field work was supervised on a full time basis by Ms. Eckie Siu of Thurber.

Geotechnical laboratory testing was carried out at Thurber's Toronto area, MTO approved, high complexity laboratory. Analytical laboratory testing was carried out by AGAT Laboratories, a CALA approved laboratory in Mississauga, Ontario.

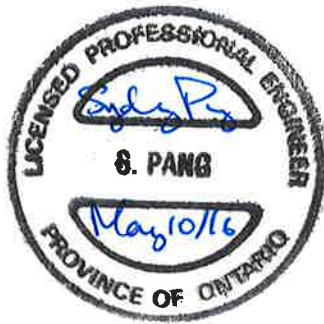
Overall supervision of the field program was conducted by Mr. Stephane Loranger, C.E.T. of Thurber. Compilation of data and preparation of the report were carried out by Mr. Mark Farrant, P.Eng. and Mr. Sydney Pang, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

THURBER ENGINEERING LTD.



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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

8 GENERAL

This report provides an interpretation of the analytical test data in the factual report, and an assessment of the corrosion potential of the soils and groundwater surrounding the steel piles and concrete caissons supporting the Highway 401 bridges over the GO parking lot and Leslie Street. These bridges and their foundations were constructed during the 1950s to 1970s and it is understood that consideration is being given to continuing the use of the existing foundations as part of the rehabilitation scheme. Accordingly, MTO has requested an assessment to determine whether there is a potential that the existing foundations may have deteriorated due to contact with corrosive soils and groundwater.

The discussions and recommendations presented in this report are based on the factual data obtained during the course of this investigation. The plan drawing used for preparation of this report was provided by MMM.

9 CORROSION POTENTIAL

The results of the corrosivity testing conducted on the soil and groundwater samples collected during the field investigation are included in the laboratory Certificates of Analysis in Appendix C, and summarized on Tables 1 and 2 (for the GO Parking Lot Area and Leslie Street respectively), following the text of this report. As shown on Tables 1 and 2, the test results were compared to corrosion potential criteria to assess the potential for soil and groundwater to cause corrosion and deterioration of several materials including steel/metal, concrete, and cast iron. The California Department of Transportation (Caltrans) Corrosion Guidelines, as well as guidelines from the American Water Works Association (AWWA) were used for comparison. The Caltrans guidelines

define a corrosive environment for structures if one or more of the following conditions exist in soil and/or groundwater samples collected at the site:

- Chloride concentration is 500 ppm or greater;
- Sulfate concentration is 2000 ppm or greater;
- pH is 5.5 or less

The AWWA guidelines utilize a 10-point system to evaluate the potential for soil corrosion to cast iron. Point values are assigned based on the range of concentrations in samples tested for the parameters sulphide, pH, resistivity, redox potential, and moisture content. If the sum is 10 points or more, the soil is considered to be corrosive to cast iron.

The electrical conductivity (EC) and sodium adsorption ratio (SAR) test results were also compared to the standards established in Ontario Regulation 153/04, as amended (O.Reg. 153/04), to assess whether elevated concentrations of these parameters (due to road de-icing salt) may contribute to the corrosion potential. The results were compared to the O.Reg. 153/04 Table 1 Full Depth Background Site Condition Standards for all types of property use except for agricultural, and the Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Groundwater Condition for Industrial, Commercial, and Community property use, which is applicable to the highway interchange site.

GO Parking Lot Area:

The analytical test results for soil and groundwater samples tested in Boreholes C15-01 to C15-04 in the GO parking lot area are summarized in Table 1 following the text and indicate the following:

- The fill and native soils within the upper 6.7 m were found to be potentially corrosive to steel, cast iron, and other metals, which is mainly due to the low resistivity of the soils.
- The fill and native soils within the upper 6.7 m were found to be potentially corrosive to structural elements (steel reinforcement in concrete), due to high chloride concentrations in the soils.
- The EC and SAR soil concentrations generally exceed the Table 1 background standards within the upper 6.7 m, and the Table 3 standards within the upper 1.4 to 5.2 m.
- The low concentrations of sulphate in the soils and groundwater indicate that there is a low potential for sulphate attack on concrete to occur.
- The soils tested below 6.7 m in the deeper boreholes did not exhibit the potential to cause corrosion.
- The groundwater tested in the 24.5 m deep monitoring well at Borehole C15-02 did not exhibit the potential to cause corrosion. This test result is likely representative of

groundwater present in deeper soil deposits below 17 m, where the well screen and filter pack were installed.

Leslie Street:

The analytical test results for soil and groundwater samples tested in Boreholes C15-05 to C15-07 on Leslie Street are summarized in Table 2 following the text and indicate the following:

- The fill and native soils within the upper 4.4 m were found to be potentially corrosive to steel, cast iron, and other metals, which is mainly due to the low resistivity of the soils.
- The fill and native soils within the upper 4.4 m were found to be potentially corrosive to structural elements (steel reinforcement in concrete), due to high chloride concentrations in the soils.
- The groundwater tested in the 6.7 m deep monitoring well at Borehole C15-05 was found to be potentially corrosive to structural elements (steel reinforcement in concrete), due to a high chloride concentration. This test result is likely representative of groundwater present in shallower soil deposits between 2.5 and 6.7 m deep, where the well screen and filter pack were installed.
- The EC and SAR soil concentrations generally exceed the Table 1 background standards within the upper 4.4 m. The Table 3 standards were exceeded within the upper 2.9 m in Borehole C15-07 only.
- The low concentrations of sulphate in the soils and groundwater indicate that there is a low potential for sulphate attack on concrete to occur.
- The soils tested below 4.4 m in the deeper boreholes did not exhibit the potential to cause corrosion.

In general, the results from both the GO parking lot area and Leslie Street indicate that the soils and groundwater are considered to be potentially corrosive where the EC and SAR soil concentrations exceed the O.Reg. 153/04 Table 1 background standards. Road-salting operations may have contributed to the corrosive nature of the upper fills and subsurface soils in these areas.

10 ASSESSMENT OF FOUNDATION CONDITION

Corrosion of structural materials is more likely to occur in areas that are exposed to corrosive soils as well as the presence of moisture and oxygen. Deeper soils have no access to oxygen, resulting in a low corrosion potential.

Based on the corrosive nature identified in the soils and groundwater within the upper 4.4 to 6.7 m in the Leslie Street and GO parking lot areas, if sufficient oxygen and water were available, there is a potential that deterioration of steel and/or concrete may have occurred at the bridge foundations

at this site over 50 to 70 years. Caltrans uses the following corrosion rates for steel piling exposed to such environments:

- Soil Embedded Zone 0.025 mm per year
- Immersed Zone 0.100 mm per year
- Scour Zone 0.125 mm per year

The presence of corrosive soils and groundwater do not necessarily result in corrosion of bridge foundations however, and the extent of actual deterioration of steel and concrete cannot be readily assessed without visual observation and in situ testing of the steel and concrete. Therefore, it is recommended that test areas of the steel and concrete foundations be exposed to observe and measure the actual extent of deterioration, and if necessary conduct in situ testing to assess the condition of these foundation elements. An initial field program consisting of excavating test pits adjacent to two (2) steel piles and two (2) concrete caissons is recommended. These test pits should be located near the areas where the lowest resistivity and highest chloride concentrations were found. A structural/concrete engineer, experienced in the assessment of these materials, should be present during the test pit operation in order to visually inspect the foundations, make measurements and conduct in situ testing. The test pits should expose the upper 2 m portion of the piles / caissons below the pile cap.

For steel piles, visual inspection should be done to identify deterioration such as surface rusting and pitting. If the steel appears to have significant deterioration, caliper measurements of the steel thickness, as well as ultrasonic probe testing should be done to measure the effective thickness of the steel.

For concrete caissons, visual inspection should be done to identify deterioration such as spalling, and impact hammer tests should be conducted. If significant deterioration is observed, additional in situ tests may be conducted including:

- Collecting core samples for strength testing of concrete;
- Covermeter tests to measure thickness of concrete over reinforcing steel;
- Chloride content tests; and
- Half Cell Tests to measure active corrosion of steel. These tests require exposing steel rebar within the concrete.

Based on the observations and test results from the initial test pit investigation, and in conjunction with the analytical test results obtained in the current investigation, an assessment may then be made regarding areas where deterioration of the foundations is likely to have occurred.

11 CLOSURE

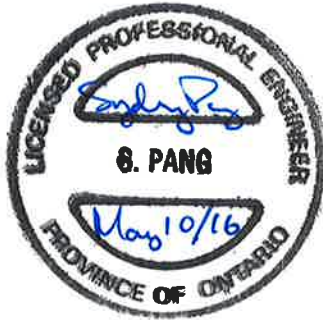
Corrosivity assessment and report preparation was carried out by Mr. Mark Farrant, P.Eng. and Dr. Sydney Pang, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Table 1: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

GO Parking Lot Area

Test Parameter	Sample ID: Material Type: Date Sampled: Lab ID Number: Unit	C15-01 SS1a (2'6"-4'2") Points / Assessment	C15-01 SS4 (10'-12') Points / Assessment	C15-01 SS5 (12'6"-14'6") Points / Assessment	C15-01 SS7 (20'-22') Points / Assessment	C15-02 SS1 (2'6"-4'6") Points / Assessment	C15-02 SS3 (7'6"-9'6") Points / Assessment
		Sand Fill 12/21/2015 7311589	Sandy Silt Fill 12/21/2015 7311593	Silty Clay Fill 12/21/2015 7311595	Silty Sand 12/21/2015 7311597	Sand Fill 12/23/2015 7311614	Silty Clay Fill 12/23/2015 7311616
Steel / Other Metal							
Resistivity	ohm.cm	495 very severe	667 very severe	1030 severe	935 very severe	565 very severe	662 very severe
Structural Elements (Concrete/Steel)							
Chloride	µg/g (ppm)	1270 corrosive	1250 corrosive	980 corrosive	662 corrosive	1020 corrosive	851 corrosive
Sulphate	µg/g (ppm)	66 not corrosive	124 not corrosive	100 not corrosive	43 not corrosive	123 not corrosive	119 not corrosive
pH	pH Units	8.46 not corrosive	7.88 not corrosive	7.83 not corrosive	8.25 not corrosive	8.26 not corrosive	8.06 not corrosive
Gray & Ductile Cast Iron							
Sulfide	%	0.02 2	<0.01 2	0.01 2	<0.01 2	0.02 2	<0.01 2
pH	pH Units	8.46 0	7.88 0	7.83 0	8.25 0	8.26 0	8.06 0
Resistivity	ohm.cm	495 10	667 10	1030 5	935 8	565 10	662 10
Redox Potential	mV	328 0	336 0	322 0	323 0	317 0	318 0
Moisture (poor, fair or good drainage)	N/A	good 0	fair 1	poor 2	fair 1	good 0	poor 2
Total =		12 corrosive	13 corrosive	9 not corrosive	11 corrosive	12 corrosive	14 corrosive
Other Results Compared to O.Reg. 153/04							
Electrical Conductivity	mS/cm	2.020 1.40	1.500 1.40	0.967 1.40	1.070 1.40	1.770 1.40	1.510 1.40
Sodium Adsorption Ratio	N/A	23.400 12	5.360 12	3.670 12	6.620 12	21.100 12	11.900 12
Electrical Conductivity	mS/cm	2.020 0.57	1.500 0.57	0.967 0.57	1.070 0.57	1.770 0.57	1.510 0.57
Sodium Adsorption Ratio	N/A	23.400 2.4	5.360 2.4	3.670 2.4	6.620 2.4	21.100 2.4	11.900 2.4

Legend:
Corrosive / Exceeds Standard = Example

Table 1: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

GO Parking Lot Area

Sample ID: Material Type: Date Sampled: Lab ID Number:		C15-02 SS5 (12'6"-14'6")	Points / Assessment	C15-02 SS6 (15'-17')	Points / Assessment	C15-02 SS7 (20'-22')	Points / Assessment	C15-02 SS10 (35'-37')	Points / Assessment	C15-02 SS13 (50'-52')	Points / Assessment	C15-02 SS16 (65'-67')	Points / Assessment
Test Parameter		Unit											
Steel / Other Metal													
Resistivity	ohm.cm	1210	severe	870	very severe	1090	severe	3660	moderate	6990	mild	5130	mild
Structural Elements (Concrete/Steel)													
Chloride	µg/g (ppm)	405	not corrosive	687	corrosive	558	corrosive	62	not corrosive	5	not corrosive	4	not corrosive
Sulphate	µg/g (ppm)	79	not corrosive	58	not corrosive	35	not corrosive	22	not corrosive	15	not corrosive	27	not corrosive
pH	pH Units	7.77	not corrosive	8.20	not corrosive	8.48	not corrosive	8.08	not corrosive	8.14	not corrosive	8.28	not corrosive
Gray & Ductile Cast Iron													
Sulfide	%	0.01	2	0.03	2	<0.01	2	0.02	2	0.04	2	0.04	2
pH	pH Units	7.77	0	8.20	0	8.48	0	8.08	0	8.14	0	8.28	0
Resistivity	ohm.cm	1210	2	870	8	1090	5	3660	0	6990	0	5130	0
Redox Potential	mV	330	0	311	0	314	0	324	0	307	0	298	0
Moisture (poor, fair or good drainage)	N/A	fair	1	fair	1	fair	1	poor	2	fair	1	poor	2
Total =			5		11		8		4		3		4
		not corrosive		corrosive		not corrosive		not corrosive		not corrosive		not corrosive	
Other Results Compared to O.Reg. 153/04		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:	
Electrical Conductivity	mS/cm	0.826	1.40	1.150	1.40	0.919	1.40	0.273	1.40	0.143	1.40	0.195	1.40
Sodium Adsorption Ratio	N/A	4.720	12	7.640	12	7.200	12	0.893	12	0.629	12	0.897	12
		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:	
Electrical Conductivity	mS/cm	0.826	0.57	1.150	0.57	0.919	0.57	0.273	0.57	0.143	0.57	0.195	0.57
Sodium Adsorption Ratio	N/A	4.720	2.4	7.640	2.4	7.200	2.4	0.893	2.4	0.629	2.4	0.897	2.4

Legend:
Corrosive / Exceeds Standard = **Example**

Table 1: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

GO Parking Lot Area

Test Parameter	Sample ID: Material Type: Date Sampled: Lab ID Number:	C15-02 SS19 (78'6"-80'6") Silty Clay Till 12/23/2015 7311628	Points / Assessment	C15-03 SS2 (5'-7') Sand Fill 12/21/2015 7311599	Points / Assessment	C15-03 SS4 (10'-12') Silty Clay Fill 12/21/2015 7311601	Points / Assessment	C15-03 SS6 (15'-17') Silty Clay 12/21/2015 7311603	Points / Assessment	C15-04 SS1 (2'6"-4'6") Silty Clay Fill 12/21/2015 7311605	Points / Assessment	C15-04 SS3 (7'6"-9'6") Silty Sand 12/21/2015 7311607	Points / Assessment
	Unit												
Steel / Other Metal													
Resistivity	ohm.cm	4630	moderate	365	very severe	362	very severe	610	very severe	685	very severe	746	very severe
Structural Elements (Concrete/Steel)													
Chloride	µg/g (ppm)	16	not corrosive	2010	corrosive	1820	corrosive	1010	corrosive	800	corrosive	869	corrosive
Sulphate	µg/g (ppm)	44	not corrosive	75	not corrosive	69	not corrosive	70	not corrosive	53	not corrosive	32	not corrosive
pH	pH Units	8.34	not corrosive	7.75	not corrosive	7.86	not corrosive	7.93	not corrosive	8.30	not corrosive	8.28	not corrosive
Gray & Ductile Cast Iron													
Sulfide	%	0.24	3.5	0.01	2	0.01	2	<0.01	2	0.02	2	<0.01	2
pH	pH Units	8.34	0	7.75	0	7.86	0	7.93	0	8.30	0	8.28	0
Resistivity	ohm.cm	4630	0	365	10	362	10	610	10	685	10	746	8
Redox Potential	mV	298	0	336	0	339	0	334	0	292	0	315	0
Moisture (poor, fair or good drainage)	N/A	poor	2	good	0	poor	2	poor	2	poor	2	fair	1
Total =			6		12		14		14		14		11
			not corrosive		corrosive		corrosive		corrosive		corrosive		corrosive
Other Results Compared to O.Reg. 153/04													
Electrical Conductivity	mS/cm	0.216	Table 3 criteria: 1.40	2.740	1.40	2.760	1.40	1.640	1.40	1.460	1.40	1.340	1.40
Sodium Adsorption Ratio	N/A	3.490	12	6.240	12	6.930	12	3.580	12	17.900	12	9.840	12
			Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:
Electrical Conductivity	mS/cm	0.216	0.57	2.740	0.57	2.760	0.57	1.640	0.57	1.460	0.57	1.340	0.57
Sodium Adsorption Ratio	N/A	3.490	2.4	6.240	2.4	6.930	2.4	3.580	2.4	17.900	2.4	9.840	2.4

Legend:
Corrosive / Exceeds Standard = **Example**

Table 1: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

GO Parking Lot Area

Sample ID: Material Type: Date Sampled: Lab ID Number:		C15-04 SS5 (12'6"-14'6")	Points / Assessment	C15-04 SS7 (20'-22')	Points / Assessment	15-02	Points / Assessment
Silty Sand 12/21/2015 7311610				Silty Clay 12/21/2015 7311612		Groundwater 2016-01-17 7336202	
Test Parameter	Unit						
Steel / Other Metal							
Resistivity	ohm.cm	4520	moderate	2000	severe	865	N/A
Structural Elements (Concrete/Steel)							
Chloride	µg/g (ppm)	103	not corrosive	276	not corrosive	123	not corrosive
Sulphate	µg/g (ppm)	6	not corrosive	16	not corrosive	164	not corrosive
pH	pH Units	8.60	not corrosive	7.94	not corrosive	8.56	not corrosive
Gray & Ductile Cast Iron							
Sulfide	%	<0.01	2	0.02	2	<0.000005	N/A
pH	pH Units	8.60	3	7.94	0	8.56	N/A
Resistivity	ohm.cm	4520	0	2000	0	865	N/A
Redox Potential	mV	313	0	326	0	253	N/A
Moisture (poor, fair or good drainage)	N/A	fair	1	poor	2		
Total =			6		4		
			not corrosive		not corrosive		
Other Results Compared to O.Reg. 153/04			Table 3 criteria:		Table 3 criteria:		Table 3 criteria:
Electrical Conductivity	mS/cm	0.221	1.40	0.499	1.40	1.160	N/A
Sodium Adsorption Ratio	N/A	2.260	12	3.160	12		
			Table 1 criteria:		Table 1 criteria:		Table 1 criteria:
Electrical Conductivity	mS/cm	0.221	0.57	0.499	0.57	1.160	N/A
Sodium Adsorption Ratio	N/A	2.260	2.4	3.160	2.4		

Legend:
Corrosive / Exceeds Standard = Example

Table 2: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

Leslie Street

Test Parameter	Sample ID: Material Type: Date Sampled: Lab ID Number:	C15-05 SS1 (2'6"-4'6") Silty Sand Fill 12/02/2015 7267471	Points / Assessment	C15-05 SS3 (7'6"-9'6") Silty Sand 12/02/2015 7267486	Points / Assessment	C15-05 SS5 (12'6"-14'6") Silty Clay 12/02/2015 7267488	Points / Assessment	C15-05 SS7 (20'-22') Silty Clay 12/02/2015 7267490	Points / Assessment	C15-06 SS2 (5'-7') Silty Sand 12/02/2015 7267492	Points / Assessment	C15-06 SS4 (10'-12') Silty Sand 12/02/2015 7267494	Points / Assessment
	Unit												
Steel / Other Metal													
Resistivity	ohm.cm	909	very severe	935	very severe	1070	severe	5650	mild	877	very severe	1120	severe
Structural Elements (Concrete/Steel)													
Chloride	µg/g (ppm)	535	corrosive	653	corrosive	516	corrosive	15	not corrosive	695	corrosive	514	corrosive
Sulphate	µg/g (ppm)	130	not corrosive	60	not corrosive	33	not corrosive	12	not corrosive	33	not corrosive	46	not corrosive
pH	pH Units	10.9	not corrosive	9.06	not corrosive	8.12	not corrosive	8.50	not corrosive	8.90	not corrosive	8.67	not corrosive
Gray & Ductile Cast Iron													
Sulfide	%	0.02	2	0.02	2	0.04	2	0.05	2	0.02	2	0.04	2
pH	pH Units	10.9	3	9.06	3	8.12	0	8.50	0	8.90	3	8.67	3
Resistivity	ohm.cm	909	8	935	8	1070	5	5650	0	877	8	1120	5
Redox Potential	mV	157	0	267	0	250	0	228	0	238	0	242	0
Moisture (poor, fair or good drainage)	N/A	fair	1	fair	1	poor	2	poor	2	fair	1	fair	1
Total =			14		14		9		4		14		11
			corrosive		corrosive		not corrosive		not corrosive		corrosive		corrosive
Other Results Compared to O.Reg. 153/04			Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:
Electrical Conductivity	mS/cm	1.10	1.40	1.07	1.40	0.938	1.40	0.177	1.40	1.14	1.40	0.892	1.40
Sodium Adsorption Ratio	N/A	9.77	12	9.68	12	4.21	12	0.533	12	9.92	12	5.55	12
			Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:
Electrical Conductivity	mS/cm	1.10	0.57	1.07	0.57	0.938	0.57	0.177	0.57	1.14	0.57	0.892	0.57
Sodium Adsorption Ratio	N/A	9.77	2.4	9.68	2.4	4.21	2.4	0.533	2.4	9.92	2.4	5.55	2.4

Legend:
Corrosive / Exceeds Standard = **Example**

Table 2: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

Leslie Street

Test Parameter	Sample ID: Material Type: Date Sampled: Lab ID Number:	C15-06 SS6 (15'-17')	Points / Assessment	C15-07 SS1 (2'6"-4'6")	Points / Assessment	C15-07 SS3 (7'6"-9'6")	Points / Assessment	C15-07 SS5 (12'6"-14'6")	Points / Assessment	C15-07 SS7 (20'-22')	Points / Assessment	C15-07 SS9 (30'-32')	Points / Assessment
	Unit	Silty Clay 12/02/2015 7267496		Silty Sand Fill 12/02/2015 7267498		Silty Sand 12/02/2015 7267511		Silty Clay 12/02/2015 7267513		Silty Clay 12/02/2015 7267515		Silty Clay 12/02/2015 7267517	
Steel / Other Metal													
Resistivity	ohm.cm	4760	moderate	278	very severe	556	very severe	2910	moderate	6450	mild	6990	mild
Structural Elements (Concrete/Steel)													
Chloride	µg/g (ppm)	49	not corrosive	2389	corrosive	1130	corrosive	112	not corrosive	8	not corrosive	3	not corrosive
Sulphate	µg/g (ppm)	14	not corrosive	65	not corrosive	35	not corrosive	30	not corrosive	16	not corrosive	14	not corrosive
pH	pH Units	8.37	not corrosive	9.70	not corrosive	8.61	not corrosive	8.27	not corrosive	8.47	not corrosive	8.54	not corrosive
Gray & Ductile Cast Iron													
Sulfide	%	0.02	2	0.02	2	0.01	2	0.03	2	0.04	2	0.04	2
pH	pH Units	8.37	0	9.70	3	8.61	3	8.27	0	8.47	0	8.54	3
Resistivity	ohm.cm	4760	0	278	10	556	10	2910	0	6450	0	6990	0
Redox Potential	mV	246	0	202	0	252	0	231	0	219	0	213	0
Moisture (poor, fair or good drainage)	N/A	poor	2	fair	1	fair	1	poor	2	poor	2	poor	2
	Total =		4		16		16		4		4		7
			not corrosive		corrosive		corrosive		not corrosive		not corrosive		not corrosive
Other Results Compared to O.Reg. 153/04			Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:		Table 3 criteria:
Electrical Conductivity	mS/cm	0.210	1.40	3.60	1.40	1.80	1.40	0.344	1.40	0.155	1.40	0.143	1.40
Sodium Adsorption Ratio	N/A	0.268	12	77.0	12	10.3	12	1.33	12	0.361	12	0.495	12
			Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:		Table 1 criteria:
Electrical Conductivity	mS/cm	0.210	0.57	3.60	0.57	1.80	0.57	0.344	0.57	0.155	0.57	0.143	0.57
Sodium Adsorption Ratio	N/A	0.268	2.4	77.0	2.4	10.3	2.4	1.33	2.4	0.361	2.4	0.495	2.4

Legend:
Corrosive / Exceeds Standard = **Example**

Table 2: Summary of Corrosivity Test Results
Highway 401 Bridges over GO Parking Lot and Leslie Street

Leslie Street

		C15-07 SS12 (45'-47')	Points / Assessment	C15-07 SS15 (60'-62')	Points / Assessment	15-05 Groundwater 2016-01-30 7365755	Points / Assessment
Test Parameter	Sample ID: Material Type: Date Sampled: Lab ID Number: Unit						
Steel / Other Metal							
Resistivity	ohm.cm	7750	mild	7190	mild	103	N/A
Structural Elements (Concrete/Steel)							
Chloride	µg/g (ppm)	<2	not corrosive	<2	not corrosive	3120	corrosive
Sulphate	µg/g (ppm)	12	not corrosive	17	not corrosive	199	not corrosive
pH	pH Units	8.77	not corrosive	8.63	not corrosive	7.87	not corrosive
Gray & Ductile Cast Iron							
Sulfide	%	0.03	2	0.04	2	<0.000005	N/A
pH	pH Units	8.77	3	8.63	3	7.87	N/A
Resistivity	ohm.cm	7750	0	7190	0	103	N/A
Redox Potential	mV	203	0	219	0	319	N/A
Moisture (poor, fair or good drainage)	N/A	poor	2	poor	2		
	Total =		7		7		
			not corrosive		not corrosive		
Other Results Compared to O.Reg. 153/04			Table 3 criteria:		Table 3 criteria:		Table 3 criteria:
Electrical Conductivity	mS/cm	0.129	1.40	0.139	1.40	9.750	N/A
Sodium Adsorption Ratio	N/A	0.435	12	0.415	12		
			Table 1 criteria:		Table 1 criteria:		Table 1 criteria:
Electrical Conductivity	mS/cm	0.129	0.57	0.139	0.57	9.750	N/A
Sodium Adsorption Ratio	N/A	0.435	2.4	0.415	2.4		

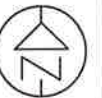
Legend:
Corrosive / Exceeds Standard = **Example**

Appendix A

Borehole Location Plan

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 2061-13-00

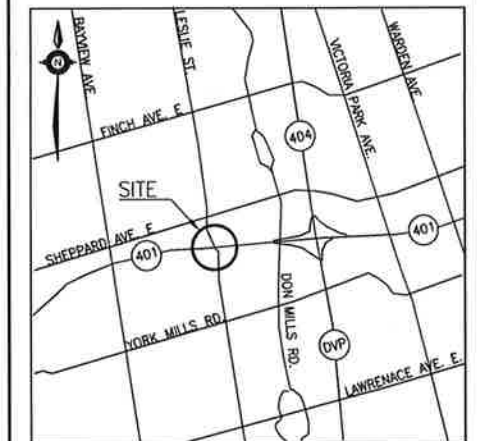


SHEET |

COROSIVITY TESTING
HWY 401 BRIDGES OVER
GO PARKING LOT AND LESLIE ST
BOREHOLE LOCATION PLAN



THURBER ENGINEERING LTD.



KEYPLAN
LEGEND

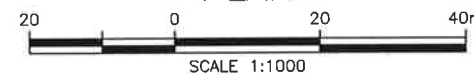
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REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	MEF	CHK	PKC	CODE	LOAD		DATE	MAY 2016	
DRAWN	MEF	CHK	MEF	SITE	STRUCT		IDWG	1	

FILENAME: H:\Drafting\10000\10656\TED-10656-BHPL.dwg
PLOTDATE: 5/11/2016 10:14 AM



PLAN



Appendix B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 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	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No C15-01

1 OF 1

METRIC

W.P. 2061-13-00 LOCATION N 4 847 380.0 E 315 697.5 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.21 - 2015.12.21 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L							
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)				
								20 40 60 80 100	20 40 60							
143.4	GROUND SURFACE															
0.0	ASPHALT :(50mm)															
	SAND , trace gravel Dense Brown Moist (FILL)		1	GS			143					○				
			1	SS	31							○				
142.1																
1.3	Sandy SILT to Silty SAND , some clay and clay seams, trace gravel Loose Brown Moist (FILL)						142					○				
			2	SS	9							○				
			3	SS	7		141					○				
	Compact															
			4	SS	17		140					○				
139.4																
4.0	Silty CLAY , some sand, trace gravel, trace roots and rootlets, topsoil stained Very Stiff Dark Brown Moist (FILL)		5	SS	21		139					○				
138.8																
4.6			6	SS	26							○				
	Silty SAND , trace clay, trace gravel, occasional cobbles Compact to Dense Brown Moist						138									
			7	SS	31		137					○				
136.7																
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN CEMENT TO SURFACE.															

ONTMT4S 10656.GPJ 2015TEMPLATE(MTO).GDT 5/9/16

RECORD OF BOREHOLE No C15-02

1 OF 3

METRIC

W.P. 2061-13-00 LOCATION N 4 847 359.9 E 315 706.6 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.22 - 2015.12.23 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
143.1	GROUND SURFACE												
0.0	ASPHALT:(50mm)						143						
	SAND, trace gravel Brown Moist (FILL)		1	GS									
142.3													
0.8	SAND, some silt, trace gravel Compact Brown Moist (FILL)		1	SS	28		142						
141.6													
1.5	Silty CLAY, some sand to sandy, trace gravel Firm to Soft Brown Moist (FILL)		2	SS	5		141						
			3	SS	3								
			4	SS	17		140						
	trace rootlets Very Stiff Dark Brown												
139.2			5	SS	20		139						
3.9	Silty SAND, trace clay, trace gravel Compact Brown Moist		6	SS	20		138						
			7	SS	21		137						
			8	SS	15		136						
							135						
	Loose		9	SS	8		134						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C15-02

2 OF 3

METRIC

W.P. 2061-13-00 LOCATION N 4 847 359.9 E 315 706.6 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.22 - 2015.12.23 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		w _p		w		w _L			GR	SA	SI	CL
								20 40 60 80 100												
Continued From Previous Page								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)										
132.9							133													
10.2	Silty CLAY , trace sand, trace gravel Firm to Very Stiff Grey Wet		10	SS	4		132													
							131													
			11	SS	2		130													
							129													
			12	SS	1		128													
							127													
127.8							126													
15.3	Silty SAND to Sandy SILT , trace gravel Very Loose to Compact Grey Wet		13	SS	1		125													
							124													
			14	SS	15															
124.8																				
18.3	Silty CLAY , trace sand, trace gravel Stiff to Firm Grey Wet		15	SS	8															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C15-02

3 OF 3

METRIC

W.P. 2061-13-00 LOCATION N 4 847 359.9 E 315 706.6 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.22 - 2015.12.23 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page		16	SS	4												
			17	SS	4												
120.5																	
22.6	Silty CLAY , some sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		18	SS	26												
			19	SS	61												
118.6																	
24.5	END OF BOREHOLE AT 24.5m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.01.16 0.6 142.5																

RECORD OF BOREHOLE No C15-03

1 OF 1

METRIC

W.P. 2061-13-00 LOCATION N 4 847 404.7 E 315 778.3 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.21 - 2015.12.21 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	W P	W	W L				
								20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE							
141.4	GROUND SURFACE															
0.0	ASPHALT:(50mm)															
	SAND, trace gravel Dense Brown Moist (FILL)		1	GS			141									
			1	SS	30		140									
			2	SS	36											
	Compact		3	SS	11		139									
138.4																
3.0	Silty CLAY , sandy, trace gravel, occasional cobbles Very Stiff to Stiff Brown Moist (FILL)		4	SS	17		138									
			5	SS	8											
136.9							137									
4.5	Silty CLAY , trace to some sand, trace gravel Stiff Brown Moist		6	SS	8											
							136									
			7	SS	9		135									
134.7																
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN CEMENT TO SURFACE.															

ONTMT4S 10656.GPJ 2015TEMPLATE(MTO).GDT 5/9/16

RECORD OF BOREHOLE No C15-04

1 OF 1

METRIC

W.P. 2061-13-00 LOCATION N 4 847 345.1 E 315 812.3 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.21 - 2015.12.21 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
								SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
WATER CONTENT (%)													
PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT													
140.4	GROUND SURFACE												
0.0 0.1	ASPHALT:(100mm)												
	SAND, some gravel Brown Damp (FILL)		1	GS			140						
139.6													
0.8	Silty CLAY, some sand, trace gravel, topsoil stained Very Stiff Brown to Dark Brown Moist (FILL)		1	SS	18		139						
138.8													
1.6	SAND, trace gravel, trace silt Compact Brown Moist (FILL)		2	SS	22								
138.1													
2.3	Silty SAND, trace clay Compact Brown Moist (FILL)		3	SS	15		138						
			4	SS	24		137						
			5	SS	22								
							136						
			6	SS	14								
							135						
134.3													
6.1	Silty CLAY, trace sand Stiff Grey Wet		7	SS	12		134						
133.7													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND WATER LEVEL AT 4.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN CONCRETE TO SURFACE.												

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C15-05

1 OF 1

METRIC

W.P. 2061-13-00 LOCATION N 4 847 396.0 E 315 827.2 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.01 - 2015.12.02 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
136.3	GROUND SURFACE							20	40	60	80	100		
0.0 136.0	ASPHALT:(25mm)													
0.3	CONCRETE:(275mm)													
	Silty SAND , trace gravel Compact Brown Moist (FILL)		1	SS	21									
134.8														
1.5	Silty SAND , trace gravel Compact Brown Moist		2	SS	26									
			3	SS	13									
			4	SS	11									
132.6														
3.7	Silty CLAY , trace sand, trace gravel Firm Grey Wet		5	SS	4									
			6	SS	4									
			7	SS	5									
129.6														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2016.01.16 2.1 134.2													






ONTMT4S 10656.GPJ 2015TEMPLATE(MTO).GDT 5/9/16

RECORD OF BOREHOLE No C15-06

1 OF 1

METRIC

W.P. 2061-13-00 LOCATION N 4 847 378.0 E 315 837.4 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.03 - 0201.12.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIMIT LIQUID CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L				
136.2	GROUND SURFACE					▽	20	40	60	80	100	20	40	60	
0.0	ASPHALT:(90mm)						20	40	60	80	100	20	40	60	
135.9	CONCRETE:(200mm)						20	40	60	80	100	20	40	60	
0.3	Silty SAND , trace gravel Compact Brown Moist (FILL)		1	SS	26		20	40	60	80	100	20	40	60	
134.7							20	40	60	80	100	20	40	60	
1.5	Silty SAND , trace gravel Very Dense to Compact Brown Moist to Wet		2	SS	53		20	40	60	80	100	20	40	60	
							20	40	60	80	100	20	40	60	
			3	SS	16		20	40	60	80	100	20	40	60	
							20	40	60	80	100	20	40	60	
			4	SS	15		20	40	60	80	100	20	40	60	
132.5						20	40	60	80	100	20	40	60		
3.7	Silty CLAY , trace sand, trace gravel Soft Grey Wet		5	SS	3	20	40	60	80	100	20	40	60		
						20	40	60	80	100	20	40	60		
			6	SS	3	20	40	60	80	100	20	40	60		
						20	40	60	80	100	20	40	60		
						20	40	60	80	100	20	40	60		
129.5			7	SS	2	20	40	60	80	100	20	40	60		
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 3.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.														

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C15-07

1 OF 2

METRIC

W.P. 2061-13-00 LOCATION N 4 847 360.3 E 315 847.2 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.03 - 2015.12.04 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								WATER CONTENT (%) W _P W W _L							
136.2	GROUND SURFACE						20	40	60	80	100				
0.0	ASPHALT:(65mm)														
135.9	CONCRETE:(225mm)														
0.3	Silty SAND, trace gravel Dense Brown Moist (FILL)		1	SS	45										
134.7															
1.5	Silty SAND, trace gravel Dense to Loose Brown Moist to Wet		2	SS	32										
			3	SS	9										
			4	SS	17										
132.3															
3.9	Silty CLAY, trace sand, trace gravel Soft to Very Stiff Grey Wet		5	SS	2										
			6	SS	1										
			7	SS	3										
			8	SS	4										
	Occasional gravel seams		9	SS	4										

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C15-07

2 OF 2

METRIC

W.P. 2061-13-00 LOCATION N 4 847 360.3 E 315 847.2 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2015.12.03 - 2015.12.04 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page																
	Silty CLAY , trace sand, trace gravel Soft Grey Wet																
			10	SS	4												
			11	SS	4												
			12	SS	6												
	Firm																
			13	SS	6												
			14	SS	7												
			15	SS	8												
117.3																	
18.9	END OF BOREHOLE AT 18.9m. WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.																

ONTMT4S 10656.GPJ 2015TEMPLATE(MTO).GDT 5/9/16

Appendix C

Analytical Test Results

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: Sydney Pang

PROJECT: 10656 Hwy 401 Leslie St

AGAT WORK ORDER: 15T056028

SOIL ANALYSIS REVIEWED BY: Sofka Pehlyova, Senior Analyst

DATE REPORTED: Jan 06, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

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



Certificate of Analysis

AGAT WORK ORDER: 15T056028

PROJECT: 10656 Hwy 401 Leslie St

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY: ECKIE SIU

Corrosivity Package

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-06

		C15-01 SS1a (2'6"-4'2")		C15-01 SS4 (10'-12')		C15-01 SS5 (12'6"-14'6")		C15-01 SS7 (20'-22')		C15-03 SS2 (5'-7')		C15-03 SS4 (10'-12')	
SAMPLE DESCRIPTION:		Soil		Soil		Soil		Soil		Soil		Soil	
SAMPLE TYPE:		Soil		Soil		Soil		Soil		Soil		Soil	
DATE SAMPLED:		12/21/2015		12/21/2015		12/21/2015		12/21/2015		12/21/2015		12/21/2015	
Parameter	Unit	G / S	RDL	7311589	7311593	RDL	7311595	7311597	RDL	7311599	7311601		
Sulfide	%		0.01	0.02	<0.01	0.01	0.01	<0.01	0.01	0.01	0.01		
Chloride (2:1)	µg/g		8	1270	1250	4	980	662	8	2010	1820		
Sulphate (2:1)	µg/g		8	66	124	4	100	43	8	75	69		
pH (2:1)	pH Units		NA	8.46	7.88	NA	7.83	8.25	NA	7.75	7.86		
Electrical Conductivity (2:1)	mS/cm		0.005	2.02	1.50	0.005	0.967	1.07	0.005	2.74	2.76		
Resistivity (2:1)	ohm.cm		1	495	667	1	1030	935	1	365	362		
Redox Potential (2:1)	mV		5	328	336	5	322	323	5	336	339		
		C15-03 SS6 (15'-17')		C15-04 SS1 (2'6"-4'6")		C15-04 SS3 (7'6"-9'6")		C15-04 SS5 (12'6"-14'6")		C15-04 SS7 (20'-22')		C15-02 SS1 (2'6"-4'6")	
SAMPLE DESCRIPTION:		Soil		Soil		Soil		Soil		Soil		Soil	
SAMPLE TYPE:		Soil		Soil		Soil		Soil		Soil		Soil	
DATE SAMPLED:		12/21/2015		12/21/2015		12/21/2015		12/21/2015		12/21/2015		12/23/2015	
Parameter	Unit	G / S	RDL	7311603	7311605	7311607	RDL	7311610	7311612	RDL	7311614		
Sulfide	%		0.01	<0.01	0.02	<0.01	0.01	<0.01	0.02	0.01	0.02		
Chloride (2:1)	µg/g		4	1010	800	869	2	103	276	4	1020		
Sulphate (2:1)	µg/g		4	70	53	32	2	6	16	4	123		
pH (2:1)	pH Units		NA	7.93	8.30	8.28	NA	8.60	7.94	NA	8.26		
Electrical Conductivity (2:1)	mS/cm		0.005	1.64	1.46	1.34	0.005	0.221	0.499	0.005	1.77		
Resistivity (2:1)	ohm.cm		1	610	685	746	1	4520	2000	1	565		
Redox Potential (2:1)	mV		5	334	292	315	5	313	326	5	317		

Certified By:

Sofra Pehlyora



Certificate of Analysis

AGAT WORK ORDER: 15T056028

PROJECT: 10656 Hwy 401 Leslie St

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY: ECKIE SIU

Corrosivity Package

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-06

		C15-02 SS3 (7'6"-9'6")		C15-02 SS5 (12'6"-14'6")		C15-02 SS7 (20'-22')		C15-02 SS10 (35'-37')		C15-02 SS13 (50'-52')		C15-02 SS16 (65'-67')		C15-02 SS19 (78'6"-80'6")	
SAMPLE DESCRIPTION:		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
SAMPLE TYPE:		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
DATE SAMPLED:		12/23/2015		12/23/2015		12/23/2015		12/23/2015		12/23/2015		12/23/2015		12/23/2015	
Parameter	Unit	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL
Sulfide	%		0.01		<0.01		0.01		<0.01		0.02		0.04		0.24
Chloride (2:1)	µg/g		4		851		2		405		558		62		16
Sulphate (2:1)	µg/g		4		119		2		79		35		22		44
pH (2:1)	pH Units		NA		8.06		NA		7.77		8.48		8.08		8.14
Electrical Conductivity (2:1)	mS/cm		0.005		1.51		0.005		0.826		0.919		0.273		0.143
Resistivity (2:1)	ohm.cm		1		662		1		1210		1090		3660		6990
Redox Potential (2:1)	mV		5		318		5		330		314		324		307
		C15-02 SS6 (15'-17')													
SAMPLE DESCRIPTION:		Soil													
SAMPLE TYPE:		Soil													
DATE SAMPLED:		12/23/2015													
Parameter	Unit	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL
Sulfide	%		0.01		0.03										
Chloride (2:1)	µg/g		4		687										
Sulphate (2:1)	µg/g		4		58										
pH (2:1)	pH Units		NA		8.20										
Electrical Conductivity (2:1)	mS/cm		0.005		1.15										
Resistivity (2:1)	ohm.cm		1		870										
Redox Potential (2:1)	mV		5		311										

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

7311589-7311630 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Elevated RDLs for Anions indicate the degree of sample dilutions prior to analyses to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instrument.

Certified By:

Sofia Pehlyova



Certificate of Analysis

AGAT WORK ORDER: 15T056028

PROJECT: 10656 Hwy 401 Leslie St

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY: ECKIE SIU

SAR (Soil)										
DATE RECEIVED: 2015-12-23					DATE REPORTED: 2016-01-06					
		C15-01 SS1a		C15-01 SS4	C15-01 SS5	C15-01 SS7	C15-03 SS2	C15-03 SS4	C15-03 SS6	C15-04 SS1
SAMPLE DESCRIPTION:		(2'6"-4'2")		(10'-12')	(12'6"-14'6")	(20'-22')	(5'-7')	(10'-12')	(15'-17')	(2'6"-4'6")
SAMPLE TYPE:		Soil		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:		12/21/2015		12/21/2015	12/21/2015	12/21/2015	12/21/2015	12/21/2015	12/21/2015	12/21/2015
Parameter	Unit	G / S	RDL	7311589	7311593	7311595	7311597	7311599	7311601	7311603
Sodium Adsorption Ratio	NA		NA	23.4	5.36	3.67	6.62	6.24	6.93	3.58
		C15-04 SS3		C15-04 SS5	C15-04 SS7	C15-02 SS1	C15-02 SS3	C15-02 SS5	C15-02 SS7	C15-02 SS10
SAMPLE DESCRIPTION:		(7'6"-9'6")		(12'6"-14'6")	(20'-22')	(2'6"-4'6")	(7'6"-9'6")	(12'6"-14'6")	(20'-22')	(35'-37')
SAMPLE TYPE:		Soil		Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:		12/21/2015		12/21/2015	12/21/2015	12/23/2015	12/23/2015	12/23/2015	12/23/2015	12/23/2015
Parameter	Unit	G / S	RDL	7311607	7311610	7311612	7311614	7311616	7311618	7311620
Sodium Adsorption Ratio	NA		NA	9.84	2.26	3.16	21.1	11.9	4.72	7.20
		C15-02 SS13		C15-02 SS16	C15-02 SS19	C15-02 SS6				
SAMPLE DESCRIPTION:		(50'-52')		(65'-67')	(78'6"-80'6")	(15'-17')				
SAMPLE TYPE:		Soil		Soil	Soil	Soil				
DATE SAMPLED:		12/23/2015		12/23/2015	12/23/2015	12/23/2015				
Parameter	Unit	G / S	RDL	7311624	7311626	7311628	7311630			
Sodium Adsorption Ratio	NA		NA	0.629	0.897	3.49	7.64			

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

7311589-7311630 SAR was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).

Certified By:

Sofra Pehlyora

Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 10656 Hwy 401 Leslie St

SAMPLING SITE:

AGAT WORK ORDER: 15T056028

ATTENTION TO: Sydney Pang

SAMPLED BY: ECKIE SIU

Soil Analysis

RPT Date: Jan 06, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Corrosivity Package

Sulfide	7311589	7311589	0.02	0.01	NA	< 0.01	82%	80%	120%						
Chloride (2:1)	7311589	7311589	1270	1300	2.3%	< 2	107%	80%	120%	103%	80%	120%	105%	70%	130%
Sulphate (2:1)	7311589	7311589	66	67	1.5%	< 2	94%	80%	120%	101%	80%	120%	101%	70%	130%
pH (2:1)	7311589	7311589	8.46	8.52	0.7%	NA	NA	90%	110%	NA			NA		
Electrical Conductivity (2:1)	7311589	7311589	2.02	2.08	2.9%	< 0.005	94%	90%	110%	NA			NA		
Redox Potential (2:1)	7311589	7311589	328	323	1.5%	< 5	108%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

SAR (Soil)

Sodium Adsorption Ratio	7311589	7311589	23.4	24.4	4.2%	NA	NA			NA			NA		
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Comments: NA signifies Not Applicable.

Certified By:



Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 15T056028

PROJECT: 10656 Hwy 401 Leslie St

ATTENTION TO: Sydney Pang

SAMPLING SITE:

SAMPLED BY: ECKIE SIU

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide			GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES



15 cooler

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax 905.712.5122
web@th.agatlabs.com

Chain of Custody Record

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

Report Information:

Company: Thurber Eng.
Contact: Sydney Roney
Address: 103-200 Winston Park Dr.
Ottawa, ON
Phone: 905 829 8146 Fax: 905 829 1146
Reports to be sent to:
1. Email: spring@thurber.ca
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table Indicate One
☐ Sewer Use
☐ Sanitary
☐ CCME
☐ Res/Park
☐ Storm
☐ Agriculture
☐ Prov. Water Quality Objectives (PWWO)
☐ Other Indicate One
Soil Texture (Check One)
☐ Coarse
☐ Fine
Region Indicate One

Project Information:

Project: Hwy 401 Leslie St Project # 10656
Site Location: Toronto
Sampled By: Eric Sin
AGAT Quote #:
PO:
Please note: If quotation number is not provided, client will be billed full price for analysis

Invoice Information:

Company: Bill To Same: Yes ☒ No ☐
Contact:
Address:
Email:

Sample Matrix Legend

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

Is this submission for a Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☐ Yes ☐ No

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: <input type="checkbox"/> B-HWS <input type="checkbox"/> Cl <input type="checkbox"/> CN <input type="checkbox"/> Cr6+ <input type="checkbox"/> EC <input type="checkbox"/> FOC <input type="checkbox"/> NO3-/NO2- <input type="checkbox"/> Total N <input type="checkbox"/> Hg <input type="checkbox"/> pH <input type="checkbox"/> SAR	Nutrients: <input type="checkbox"/> TP <input type="checkbox"/> NH3 <input type="checkbox"/> TKN <input type="checkbox"/> NO3 <input type="checkbox"/> NO2 <input type="checkbox"/> NO3-/NO2	Volatiles: <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
C15-01 551a (26-42)	21 DEC	12:00am	1	Soil																
C15-01 554 (10-12)	21 DEC	12:00am	1	Soil																
C15-01 555 (16-146)	21 DEC	12:00am	1	Soil																
C15-01 557 (20-22)	21 DEC	12:00	1	Soil																
C15-03 558 (5-7)	21 DEC	12:00	1	Soil																
C15-03 554 (10-12)	21 DEC	12:00	1	Soil																
C15-03 556 (15-17)	21 DEC	12:00	1	Soil																
C15-04 551 (26-46)	21 DEC	12:00	1	Soil																
C15-04 553 (76-98)	21 DEC	12:00	1	Soil																
C15-04 555 (16-146)	21 DEC	12:00	1	Soil																
C15-04 557 (20-22)	21 DEC	12:00	1	Soil																

Corrosivity Package
(sulphate, pH, EC
Redox potential,
Resistivity, Chloride
sulphide)

SAR

Laboratory Use Only

Work Order #: 1510560028

Cooler Quantity: 19.1 18.9 18.9 18.9

Arrival Temperature: 19.1 18.9 18.9 18.9

Custody Seal Intact: ☒ Yes ☐ No ☐ N/A

Notes: 15C

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT

*TAT is exclusive of weekends and statutory holidays

Samples Requisitioned By (Print Name and Sign):

Stephanie LeRanger [Signature]
Date: 23 DEC 15 Time: 08:00

Samples Received By (Print Name and Sign):

[Signature]
Date: 20/1/16 Time: 10:22

Date:

20/1/16 Time: 9:00

Page

1 of 2
No: T 018731

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: Sydney Pang

PROJECT: 10656 - HWY 401 Leslie St.

AGAT WORK ORDER: 15T050236

SOIL ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

DATE REPORTED: Dec 15, 2015

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

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



Certificate of Analysis

AGAT WORK ORDER: 15T050236

PROJECT: 10656 - HWY 401 Leslie St.

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2015-12-04

DATE REPORTED: 2015-12-15

				C15-05 SS1 (2'6"-4'6")	C15-05 SS3 (7'6"-9'6")	C15-05 SS5 (12'6"-14'6")	C15-05 SS7 (20'-22')			C15-06 SS2 (5'-7')	C15-06 SS4 (10'-12')
SAMPLE DESCRIPTION:				Soil	Soil	Soil	Soil			Soil	Soil
SAMPLE TYPE:				Soil	Soil	Soil	Soil			Soil	Soil
DATE SAMPLED:				12/2/2015	12/2/2015	12/2/2015	12/2/2015			12/2/2015	12/2/2015
Parameter	Unit	G / S	RDL	7267471	7267486	7267488	7267490	RDL		7267492	7267494
Sulfide	%		0.01	0.02	0.02	0.04	0.05	0.01		0.02	0.04
Chloride (2:1)	µg/g	2	535	653	516	15	4	695	2	514	
Sulphate (2:1)	µg/g	2	130	60	33	12	4	33	2	46	
pH (2:1)	pH Units	NA	10.9	9.06	8.12	8.50	NA	8.90	NA	8.67	
Electrical Conductivity (2:1)	mS/cm	0.005	1.10	1.07	0.938	0.177	0.005	1.14	0.005	0.892	
Resistivity (2:1)	ohm.cm	1	909	935	1070	5650	1	877	1	1120	
Redox Potential (2:1)	mV	5	157	267	250	228	5	238	5	242	
				C15-06 SS6 (15'-17')			C15-07 SS1 (2'6"-4'6")	C15-07 SS3 (7'6"-9'6")		C15-07 SS5 (12'6"-14'6")	C15-07 SS7 (20'-22')
SAMPLE DESCRIPTION:				Soil			Soil	Soil		Soil	Soil
SAMPLE TYPE:				Soil			Soil	Soil		Soil	Soil
DATE SAMPLED:				12/2/2015			12/2/2015	12/2/2015		12/2/2015	12/2/2015
Parameter	Unit	G / S	RDL	7267496	RDL	7267498	RDL	7267511	RDL	7267513	7267515
Sulfide	%		0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.03	0.04
Chloride (2:1)	µg/g	2	49	8	2389	4	1130	2	112	8	
Sulphate (2:1)	µg/g	2	14	2	65	4	35	2	30	16	
pH (2:1)	pH Units	NA	8.37	NA	9.70	NA	8.61	NA	8.27	8.47	
Electrical Conductivity (2:1)	mS/cm	0.005	0.210	0.005	3.60	0.005	1.80	0.005	0.344	0.155	
Resistivity (2:1)	ohm.cm	1	4760	1	278	1	556	1	2910	6450	
Redox Potential (2:1)	mV	5	246	5	202	5	252	5	231	219	

Certified By:





AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T050236

PROJECT: 10656 - HWY 401 Leslie St.

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2015-12-04

DATE REPORTED: 2015-12-15

		C15-07 SS9		C15-07 SS12	C15-07 SS15
SAMPLE DESCRIPTION:		(30'-32')		(45'-47')	(60'-62')
SAMPLE TYPE:		Soil		Soil	Soil
DATE SAMPLED:		12/2/2015		12/2/2015	12/2/2015
Parameter	Unit	G / S	RDL	7267517	7267520
Sulfide	%		0.01	0.04	0.03
Chloride (2:1)	µg/g		2	3	<2
Sulphate (2:1)	µg/g		2	14	12
pH (2:1)	pH Units		NA	8.54	8.77
Electrical Conductivity (2:1)	mS/cm		0.005	0.143	0.129
Resistivity (2:1)	ohm.cm		1	6990	7750
Redox Potential (2:1)	mV		5	213	203

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

7267471-7267490 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

7267492 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Elevated RDLs indicate the degree of sample dilutions prior to analyses to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instruments.

7267494-7267496 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

7267498-7267511 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Elevated RDLs indicate the degree of sample dilutions prior to analyses to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instruments.

7267513-7267522 * Sulphide analyses were performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Certified By:





AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T050236

PROJECT: 10656 - HWY 401 Leslie St.

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: Sydney Pang

SAMPLED BY:

SAR (Soil)											
DATE RECEIVED: 2015-12-04						DATE REPORTED: 2015-12-15					
				C15-05 SS1	C15-05 SS3	C15-05 SS5	C15-05 SS7	C15-06 SS2	C15-06 SS4	C15-06 SS6	C15-07 SS1
SAMPLE DESCRIPTION:				(2'6"-4'6")	(7'6"-9'6")	(12'6"-14'6")	(20'-22')	(5'-7')	(10'-12')	(15'-17')	(2'6"-4'6")
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015
Parameter	Unit	G / S	RDL	7267471	7267486	7267488	7267490	7267492	7267494	7267496	7267498
Sodium Adsorption Ratio (2:1)	N/A		N/A	9.77	9.68	4.21	0.533	9.92	5.55	0.268	77.0
				C15-07 SS3	C15-07 SS5	C15-07 SS7	C15-07 SS9	C15-07 SS12	C15-07 SS15		
SAMPLE DESCRIPTION:				(7'6"-9'6")	(12'6"-14'6")	(20'-22')	(30'-32')	(45'-47')	(60'-62')		
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil		
DATE SAMPLED:				12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015	12/2/2015		
Parameter	Unit	G / S	RDL	7267511	7267513	7267515	7267517	7267520	7267522		
Sodium Adsorption Ratio (2:1)	N/A		N/A	10.3	1.33	0.361	0.495	0.435	0.415		

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

Certified By:





Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 10656 - HWY 401 Leslie St.

SAMPLING SITE:

AGAT WORK ORDER: 15T050236

ATTENTION TO: Sydney Pang

SAMPLED BY:

Soil Analysis

RPT Date: Dec 15, 2015			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

Corrosivity Package

Sulfide	7267494	7267494	0.03	0.04	NA	< 0.01	103%	80%	120%						
Chloride (2:1)	7267486	7267486	653	643	1.5%	< 2	94%	80%	120%	94%	80%	120%	98%	70%	130%
Sulphate (2:1)	7267486	7267486	60	60	0.0%	< 2	97%	80%	120%	99%	80%	120%	102%	70%	130%
pH (2:1)	7267486	7267486	9.06	8.98	0.9%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	7267486	7267486	1.07	1.08	0.9%	< 0.005	99%	90%	110%	NA			NA		
Redox Potential (2:1)	7267486	7267486	267	264	1.1%	< 5	107%	70%	130%	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.

SAR (Soil)

Sodium Adsorption Ratio (2:1)	7267486	7267486	9.68	9.66	0.2%	NA	NA			NA			NA		
-------------------------------	---------	---------	------	------	------	----	----	--	--	----	--	--	----	--	--

Comments: NA signifies Not Applicable.

Certified By: _____



Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 15T050236

PROJECT: 10656 - HWY 401 Leslie St.

ATTENTION TO: Sydney Pang

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide			GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE
Sodium Adsorption Ratio (2:1)	INOR 1007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES



145 cooler

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.742.5100 Fax: 905.742.5122
web@agatlabs.com

Chain of Custody Record

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

Report Information:

Company: Thurber Eng. Ltd.
Contact: Sydney Pang
Address: 103-2210 Winston Park Dr
Oakville, ON L6H 5R7
Phone: 905 829 8666 Fax: 905 829 1166
Reports to be sent to: Spang@thurber.ca
1. Email:
2. Email:

Project Information:

Project: Hydro 401 Leslie St. Project # 10656
Site Location: 10656
Sampled By: Eckle SW
AGAT Quote #: PO:

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

Invoice Information:

Company: Bill To Same: Yes ☒ No ☐
Contact:
Address:
Email:

Regulatory Requirements:

(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
☐ Regulation 558
☐ CCME
☐ Prox. Water Quality Objectives (PWQO)
☐ Other
Region Indicate One

Is this submission for a Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☐ Yes ☐ No

Sample Matrix Legend

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

Comments/Special Instructions

Metals and Inorganics

Metal Scan

Hydride Forming Metals

Client Custom Metals

ORPs: ☐ B-HWS ☐ Cl ☐ CN
☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ NO₃/NO₂
☐ Total N ☐ Hg ☐ pH ☐ SAR

Nutrients: ☐ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃/NO₂

Volatiles: ☐ VOC ☐ BTEX ☐ THM

CCME Fractions 1 to 4

ABNs

PAHs

Chlorophenols

PCBs

Organochlorine Pesticides

TCLP Metals/Inorganics

Sewer Use

Corrosivity Package
(sulphate, pH, EC,
Redox Potential,
Resistivity, Chloride,
sulphide)

SAR

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/Special Instructions
C15-05 551 (216-48)	02 DEC	2:00 AM	1	Soil	
C15-05 553 (176-91)	02 DEC	2:00 AM	1	Soil	
C15-05 555 (176-14)	02 DEC	2:00 AM	1	Soil	
C15-05 557 (201-22)	02 DEC	2:00 AM	1	Soil	
C15-06 552 (51-71)	03 DEC	2:00 AM	1	Soil	
C15-06 554 (101-12)	03 DEC	2:00 AM	1	Soil	
C15-06 556 (151-17)	03 DEC	2:00 AM	1	Soil	
C15-07 551 (216-48)	03 DEC	4:00 AM	1	Soil	
C15-07 553 (176-91)	03 DEC	4:00 AM	1	Soil	
C15-07 555 (126-14)	03 DEC	4:00 AM	1	Soil	
C15-07 557 (201-22)	03 DEC	4:00 AM	1	Soil	

Laboratory Use Only

Work Order #: 15T050236
Cooler Quantity: 11.9
Arrival Temperatures: 11.9
Custody Seal Intact: 9.9
Notes: 9.9
☒ Yes ☐ No ☐ N/A

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT

*TAT is exclusive of weekends and statutory holidays

Samples Relinquished By (Print Name and Sign):

Sample Relinquished By (Print Name and Sign):

Document ID: 015-74251010

Date: 04 DEC 15 Time: 0900

Date: 04 DEC 15 Time: 1030

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Date: 20/11/14 Time: 9:30

Date: 20/11/14 Time: 9:30

Page 1 of 2

No: T 018988



AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
web@agatlabs.com

Chain of Custody Record

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

Report Information:

Company: Thurber Eng
Contact: Sidney Pung
Address: 103-2010 Warden Park Dr
Oakville, ON L6H 5R7
Phone: 905 829 8866 Fax: 905 829 1160
Reports to be sent to: Spongy & Thurber.ca
1. Email: _____
2. Email: _____

Project Information:

Project: Hwy 401 Leslie St
Site Location: 100000
Sampled By: Eckie Siv
AGAT Quote #: _____
PO: 10656

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

Invoice Information:

Company: _____
Contact: _____
Address: _____
Email: _____
Bill To Same: Yes ☒ No ☐

Sample Matrix Legend

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

Regulatory Requirements:

(Please check all applicable boxes)
☐ Regulation 153/04
Table: _____
☐ Sewer Use
☐ Sanitary
☐ Res/Park
☐ Agriculture
☐ Storm
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
☐ Regulation 558
☐ CCME
☐ Other
☐ Fine
☐ Coarse
☐ Other
☐ Region: _____
☐ Indicate One

Is this submission for a Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☐ Yes ☐ No

Laboratory Use Only

Work Order #: _____
Cooler Quantity: _____
Arrival Temperatures: 11.9 12.0 12.0
Custody Seal/Print: Yes ☐ Yes ☐ No ☐ N/A
Notes: Ice

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: <input type="checkbox"/> B-HWS <input type="checkbox"/> Cl <input type="checkbox"/> CN <input type="checkbox"/> Cr ⁶⁺ <input type="checkbox"/> EC <input type="checkbox"/> FOC <input type="checkbox"/> NO ₃ /NO ₂ <input type="checkbox"/> Total N <input type="checkbox"/> Hg <input type="checkbox"/> pH <input type="checkbox"/> SAR	Nutrients: <input type="checkbox"/> TP <input type="checkbox"/> NH ₃ <input type="checkbox"/> TKN <input type="checkbox"/> NO ₃ <input type="checkbox"/> NO ₂ <input type="checkbox"/> NO ₃ /NO ₂	Volatiles: <input type="checkbox"/> VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	
C15-07 589 (20'-32')	04 DEC	02:00 PM	1	Soil																	
C15-07 5512 (45'-47')	04 DEC	2:00 AM	1	Soil																	
C15-07 5515 (60'-62')	04 DEC	2:00 AM	1	Soil																	
Corrosivity Package (Sulphate, pH, EC, Redox Potential, Resistivity, Chloride Sulphide)																					
SAR																					

Samples Requisitioned By (Print Name and Sign): Stephane Lavigne Date: 04 DEC Time: 09:00 AM Samples Received By (Print Name and Sign): Stephane Lavigne Date: 04 DEC Time: 09:30

Samples Requisitioned By (Print Name and Sign): Stephane Lavigne Date: 04 DEC Time: 09:30 Samples Received By (Print Name and Sign): Stephane Lavigne Date: 04 DEC Time: 09:30

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

Page 2 of 2

No. T 018987

Date Issued: November 2, 2016

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: MARK FARRANT

PROJECT:

AGAT WORK ORDER: 16T064682

WATER ANALYSIS REVIEWED BY: Mike Muneswar, BSc (Chem), Senior Inorganic Analyst

DATE REPORTED: Feb 09, 2016

PAGES (INCLUDING COVER): 5

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: 16T064682

PROJECT:

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

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:

ATTENTION TO: MARK FARRANT

SAMPLED BY:

Corrosivity Package (Water)

DATE RECEIVED: 2016-02-01

DATE REPORTED: 2016-02-09

		SAMPLE DESCRIPTION:		15-02
		SAMPLE TYPE:		Water
		DATE SAMPLED:		1/30/2016
Parameter	Unit	G / S	RDL	7365755
Sulphide	mg/L		0.05	<0.05
Chloride	mg/L	790	0.50	123
Sulphate	mg/L		0.50	164
pH	pH Units		NA	8.56
Electrical Conductivity	uS/cm		2	1160
Resistivity	ohms.cm			865
Redox Potential	mV		5	253

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Ground Water - All Types of Property Uses

Certified By:

Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T064682

PROJECT:

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Water Analysis															
RPT Date: Feb 09, 2016			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
Corrosivity Package (Water)															
Sulphide	7363952		<0.05	<0.05	NA	< 0.05	99%	80%	120%	100%	85%	115%	102%	70%	130%
Chloride	7366225		56.9	67.8	17.5%	< 0.10	91%	90%	110%	110%	90%	110%	105%	80%	120%
Sulphate	7366225		91.5	91.3	0.2%	< 0.10	94%	90%	110%	106%	90%	110%	99%	80%	120%
pH	7365755	7365755	8.56	8.60	0.5%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity	7365755	7365755	1160	1160	0.0%	< 2	96%	80%	120%	NA			NA		
Redox Potential	7365755	7365755	253	245	3.2%	< 5	111%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:





Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T064682

PROJECT:

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Sulphide	INOR-93-6054	SM 4500 S2- D	SPECTROPHOTOMETER
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
Resistivity		SM 2510 B	EC METER
Redox Potential		SM 2510 B	REDOX POTENTIAL ELECTRODE



1

LABORATORY USE ONLY

Arrival Condition: ☐ Good ☐ Poor (complete "notes")

Arrival Temperature: 8.5, 9.1 AGAT WO # 16T 064682

Notes:

Client Information

Report Information - reports to be sent to:

Regulatory Requirements

Report Format

☒ Single Sample per page

☐ Multiple Samples per page

☐ Results by fax

Turnaround Time (TAT) Required *

Regular TAT: ☒ 5 to 7 Working Days

Rush TAT: (please provide prior notification)

Rush Surcharges Apply

☐ 3 to 5 Working Days

☐ 1 to 3 Working Days

☐ 1 Working Day

OR

DATE REQUIRED (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Defining Water: Myth or Multiple Record?

Metals and Inorganics
Metal Scan (excludes Hg, B, Cr6)
CCME Fractions 1 to 4
VOCs
PAHs
PCBs
TCLP Metals/Inorganics
TCLP
Storm Sewer Use

Corrosivity Pkg
pH, Sulphate, EC ,
redox resistivity,
chloride, sulphate

**LABORATORY
USE ONLY**

Page 5 of 5

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666

ATTENTION TO: MARK FARRANT

PROJECT: 10656

AGAT WORK ORDER: 16T060765

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

DATE REPORTED: Jan 27, 2016

PAGES (INCLUDING COVER): 6

VERSION*: 1

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

*NOTES

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



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 16T060765

PROJECT: 10656

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

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2016-01-19

DATE REPORTED: 2016-01-27

		SAMPLE DESCRIPTION:		15-05
		SAMPLE TYPE:		Water
		DATE SAMPLED:		1/17/2016
Parameter	Unit	G / S	RDL	7336202
pH	pH Units		NA	7.87
Electrical Conductivity	uS/cm		2	9750
Redox Potential	mV		5	319
Resistivity	ohms.cm			103
Chloride	mg/L	2300	10	3120
Sulphate	mg/L		10	199
Sulphide	mg/L		0.05	<0.05

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 - Non-Potable Ground Water - All Types of Property Uses - Coarse Textured Soils

7336202 The RDLs were elevated for Anions to indicate dilution of the sample in order to reduce matrix interference and to keep the analytes within a valid calibration range of the instrument.

Certified By:

Elizabeth Potokowska



AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 16T060765

PROJECT: 10656

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

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: MARK FARRANT

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7336202	15-05	ON T3 NPGW CT	Inorganic Chemistry (Water)	Chloride	2300	3120

Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 10656

SAMPLING SITE:

AGAT WORK ORDER: 16T060765

ATTENTION TO: MARK FARRANT

SAMPLED BY:

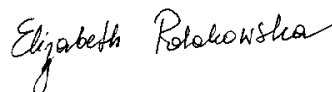
Water Analysis

RPT Date: Jan 27, 2016			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
Inorganic Chemistry (Water)															
pH	7338113		7.83	7.85	0.3%	NA	99%	90%	110%	NA			NA		
Electrical Conductivity	7338113		330	326	1.2%	< 2	102%	80%	120%	NA			NA		
Redox Potential	7336202	7336202	319	323	1.2%	< 5	112%	70%	130%	NA			NA		
Chloride	7335553		19.6	19.6	0.0%	< 0.10	94%	90%	110%	109%	90%	110%	109%	80%	120%
Sulphate	7335553		3.04	2.76	9.7%	< 0.10	98%	90%	110%	108%	90%	110%	108%	80%	120%
Sulphide	7349360		<0.05	<0.05	NA	< 0.05	100%	80%	120%	101%	85%	115%	100%	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:





Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 16T060765

PROJECT: 10656

ATTENTION TO: MARK FARRANT

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
Redox Potential		SM 2510 B	REDOX POTENTIAL ELECTRODE
Resistivity		SM 2510 B	EC METER
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphide	INOR-93-6054	SM 4500 S2- D	SPECTROPHOTOMETER



AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario: L4Z 1Y2
Phone: 905-712-5100; Fax: 905-712-5122
Toll free: 800-856-6261
www.agatlabs.com http://webearth.agatlabs.com

CHAIN OF CUSTODY RECORD

Client Information

Company: Thurber Engineering Ltd.
Contact: Mark Farrant
Address: 103-2010 Winston Park Dr.
Oakville, ON L6H 5R7
Phone: 905-829-8666 Fax: 905-829-1166
Project: 1056 PO: _____
AGAT Quotation #: _____
Please note, if quotation number is not provided, client will be billed full price for analysis.
Invoice To Same as Above? (Yes) No (circle)
Company: _____
Contact: _____
Address: _____
Phone: _____ Fax: _____

Report Information - reports to be sent to:

1. Name: Mark Farrant
Email: m.farrant@thurber.ca
2. Name: Sydney Dang
Email: sydney.dang@thurber.ca

Regulatory Requirements

☒ Regulation 153 ☐ Sewer Use
(Indicate one)
Table _____ Region _____
☒ Ind/Com ☐ CCME
☐ Res/Park ☐ Sanitary ☐ Other (indicate)
☐ Storm
Soil Texture (check one) ☐ Coarse ☐ Med/Fine
☐ Prov. Water Quality Objectives (PWQO)
☐ Drinking Water (circle one) 170/243/252
Is this a drinking water sample (potable water intended for human consumption)?
☐ Yes ☐ No (if "Yes" please use the Drinking Water Chain of Custody Record)

Report Format

☒ Single Sample per page
☐ Multiple Samples per page
☐ Results by fax

Turnaround Time (TAT) Required *

Regular TAT: ☒ 5 to 7 Working Days
Rush TAT: (please provide prior notification)
Rush Surcharges Apply
☐ 3 to 5 Working Days
☐ 1 to 3 Working Days
☐ 1 Working Day
OR
DATE REQUIRED (Rush surcharges may apply): _____
*TAT is exclusive of weekends and statutory holidays

LABORATORY USE ONLY

Arrival Condition: ☐ Good ☐ Poor (complete "notes")
Arrival Temperature: 7.1-6.9-6.9 AGAT WO #: 161060765
Notes: 6.8-6.7-6.7

Sample Identification
Date Sampled: Jan 17/16
Time Sampled: _____
Sample Matrix: Water

of Containers: 2
Site/ Sample Information

Metals and Inorganics	Metal Scan (excl. Hg, B, Cr6)	CCME Fractions 1 to 4	VOCs	PAHs	PCBs	TCLP Metals/Inorganics	TCLP	Storm Sewer Use	Sanitary Sewer Use	LABORATORY USE ONLY
										LAB SAMPLE ID

Conductivity Pkg
(pH, sulphate EC,
redox, resistivity,
chloride, sulphide)

Samples Relinquished By (print name & sign) Mark Farrant Date/Time 10/26/19
Samples Received By (print name & sign) Mark Farrant Date/Time 8:40
Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT
PAGE _____ of _____
NO: 112849