Foundation Investigation and Design Report

Bradford South Servicing

Watermain Crossing of Highway 400 at Line 5

Bradford West Gwillimbury, County of Simcoe, Ontario

Prepared For:
Town of Bradford West Gwillimbury
c/o MMM Group Limited
RFP #: P-14-48

SPL Project No.: 10000792
Report Date: April 7, 2015

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1. INTRODUCTION

SPL Consultants Limited (SPL) was retained by MMM Group Limited (MMM) on behalf of the Town of Bradford West Gwillimbury to undertake a geotechnical investigation associated with a proposed 400mm dia. watermain crossing Highway 400 along Line 5 in the Town of Bradford West Gwillimbury, within the County of Simcoe, Ontario. Reference should be made to SPL's Geotechnical Investigation Report for Bradford South Servicing (Reference 2). This report, however, deals only with that part of the project where the watermain crosses the Highway 400 corridor.

We understand that the watermain will be installed by means of trenchless construction methods along an approximately 140m long section on Line 5, most of which will pass under the Highway 400 corridor. **Drawing No. 1** shows the site/borehole location and geological section along the watermain alignment.

The objectives of the investigation were to determine the subsurface conditions at the location of the proposed watermain by means of four (4) exploratory boreholes, and to provide geotechnical recommendations for the crossing. In addition, the construction conditions were also to be evaluated to assist MMM in the preparation of the contract specifications.

2. SITE AND REGIONAL GEOLOGY

The land within the site slopes gently to the west with elevations varying from 229.8±m at the east side of Highway 400 to about 222.4±m at the west side of Highway 400.

Based on the Physiography of Southern Ontario (1984) (Reference 3), the surficial geology of the project site is relatively consistent, typically consisting of Schomberg Clay overlying Late Wisconsinan Age drumlinized glacial till of brown to grey, gritty silty clay to clayey silt till. The average depth of the clay deposits is about 5 metres, but deeper deposits are also known to exist. The texture of the glacial till is primarily low plasticity silty clay or less cohesive, but well-consolidated sandy silt with some rock fragments. Where the upper deposit is a sheet of till, its surface was often reshaped. Smooth oval-shaped hills known as drumlins were formed. Drumlins may vary from impressive size hills with steep sides to hardly noticeable undulations. Smaller drumlins are usually completely covered by the clay deposits, but many of the large ones escaped complete burial in the Bradford (Bond Head) area.

3. AVAILABLE GEOTECHNICAL INFORMATION

In 2014, a geotechnical investigation for the proposed Line 5 bridge structure over Highway 400 was conducted by Thurber Engineering Ltd., in which eight (8) boreholes (BH13-19 to BH13-22, BH13-27 to BH13-30) were drilled 20 to 40m offset north of the proposed watermain alignment. These boreholes were drilled from 8.2 to 35.7m below existing ground surface. The findings of that investigation were documented in Thurber Memorandum of The Foundation Investigation and Design of The Proposed Highway 400 / 5th Line Bridge and Its Immediate Approaches, dated March 2014 (Reference 1). The approximate locations and borehole log sheets of these previous boreholes are enclosed in **Appendix A** of this report. SPL assumes no responsibility for the accuracy of work performed by others.

4. METHOD OF INVESTIGATION

4.1 Field Work

The field investigation for the watermain crossing consisted of putting down four (4) boreholes (BH14-149, BH14-150, BH14-151 and BH14-152) to depths of 11.3 to 17.4m below existing ground surface at the approximate locations shown on the attached **Drawing No. 1**. The ground surface geodetic elevations and coordinates at the location of the boreholes are shown on the borehole logs. They were surveyed by SPL using differential GPS based on Station 00819690978 (UTM-17 NAD83 coordinates: N4881069.247, E610102.684) located at the south west quadrant of the intersection of Highway 400 and Line 5, and Station 00819708008 (CGVD-1928:1978 Elevation: 242.984m) located at the east side of County Road 27, about 0.5km south of Line 5.

The field investigation work (borehole drilling) was undertaken between January 26 and January 28, 2015 by Terex Drilling Solutions under subcontract to SPL. Borehole logging services were provided by the engineering staff of SPL. The boreholes were advanced with power auger drilling machines equipped with hollow stem augers. The soil stratigraphy was recorded by observing the quality and changes of augered materials which were retrieved from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows (SPT 'N'-values) required to drive the sampler 0.3m depth into the undisturbed soil gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the borehole log sheets (Refer to **Appendix A**). Soil samples were visually classified in the field and later re-evaluated in our laboratory.

Six (6) in-situ field vane shear tests were carried out at selected depths in clayey soils using the tapered vane shear test apparatus. The test results are shown on the borehole log sheets attached in **Appendix A**.

Monitoring wells were installed in Boreholes BH14-149 and BH14-152 for the longer-term monitoring of groundwater levels. The groundwater levels in the monitoring wells were measured on February 6 and again on February 20, 2015. These data are summarized at the bottom of the borehole log sheets and also in Table 5.4.

4.2 Geotechnical Laboratory Testing

The soil samples were taken to our laboratory where they were re-examined. Representative samples were selected for geotechnical index testing. The testing program consisted of the measurement of the natural moisture content of all available soil samples, grain size analyses on seventeen (17) selected samples and consistency (Atterberg) limits for seventeen (17) soil samples. Test results are shown on the individual borehole logs presented in **Appendix A**. The grain size analysis curves and results of the consistency (Atterberg) limit tests are plotted on Figures 1 to 4 attached to this report in **Appendix B**.

4.3 Environmental and Chemical Soil Quality Analyses

A number of soil samples were selected for environmental and chemical analyses to determine their environmental quality. Two (2) samples were analyzed for O. Reg. 153 Soil Standards For Use Under Part XV.1 of the Environmental Protection Act (general and inorganic parameters); two (2) soil samples were analyzed for Petroleum Hydrocarbons (PHC) (CCME F1 to F4) and Volatile Organic Compounds (VOCs) including Benzene, Toluene, Ethylbenzene, and Xylene (BTEX); two (2) soil samples were tested for soil corrosivity indicator parameters and water soluble sulphates. The test results are attached in **Appendix C**.

5. SUMMARY OF SUBSURFACE CONDITIONS

5.1 Overview

The boreholes revealed the presence of two main soil types: fill and native cohesive silty clay. The typical stratigraphic sequence consists of fill overlying silty clay followed by silty clay glacial till. Bedrock was not encountered within the depths of the boreholes explored. Groundwater in the monitoring wells was recorded at depths 9.3 to 9.5m below the ground surface (Elev. 219.8 to 220.5m).

For details of the subsurface conditions encountered at the borehole locations, reference should be made to the individual borehole log sheets presented in **Appendix A**. The properties of the main soil types encountered in the boreholes are described briefly in the following sections.

5.2 Pavement Structure and Fill

Boreholes BH14-150, BH14-151 and BH14-152 were drilled on the roadway of Line 5 where they encountered pavement structure at the surface. The pavement structure consisted of 105 to 120mm of asphaltic concrete underlain by 450 to 760mm of granular base/sub base. Borehole BH14-149 was drilled on the road shoulder of Line 5 and encountered granular fill materials at ground surface to a depth of about 0.31m below existing grade. The granular fill is composed mainly of sand and gravel with trace silt.

Fine grained fill materials consisting of silty clay to clayey silt were found to underlie the pavement structure or granular fill to depths ranging from 4.1 to 7.0m below existing grade (Elev. 224.0 to 225.7m). The consistency of the fill was found to be stiff to very stiff but generally stiff, as inferred from SPT 'N' values of 8 to 24 and an average value of 13 blows per 0.3m penetration. The natural moisture contents ranged from 10% to 33%.

5.3 Silty Clay / Clayey Silt and Silty Clay Till

Cohesive clayey soils of both lacustrine and glacial till origin were encountered below the fill in all boreholes. They occupy the entire soil profile and all of the boreholes were terminated in these deposits. Two types of these clayey soils were identified: silty clay / silty clay till and clayey silt. Of

these, silty clay and silty clay till dominate. The silty clay (till) was also encountered in all of Thurber's boreholes.

5.3.1 Silty Clay, Silty Clay Till

These cohesive, clay deposits were present in every borehole extending to the termination depths of the boreholes. The results of sixteen (16) grain size analyses (See Figures 1 & 1A) indicate 0 - 5% gravel; 0 - 19% sand; 49 - 73% silt and 21-41% clay size particles. From the seventeen (17) Atterberg limits tests the following consistency limits were obtained: Liquid Limit of 19 - 35% (average = 27%); Plastic Limit of 12 - 19% (average = 15%); and Plasticity Index of 7 - 16% (average = 12%). Based on these values the soil is classified as clay of low plasticity [CL] in the Unified Soil Classification System. Natural water contents were measured between 10 and 33%.

SPT 'N' values of 5 to 18 were recorded and an average value of 11 was calculated. These indicate firm to very stiff but generally stiff consistency. The measured bulk unit weights of thirteen (13) samples were between 19.8 and 22.2 kN/m^3. In-situ field vane tests (6) yielded undrained shear strengths (Cu) of 63 to more than 100 kPa. The sensitivity was typically 2.5 but ranged from 1.5 to 3.0 (including the Thurber data).

5.3.2 Clayey Silt

This lower plasticity soil, was found in Borehole BH14-150, as a 1.5m thick layer with upper surface at Elev. 218.1m. One grain size analysis shows that this soil consist of 0% gravel; 1% sand; 81% silt and 18 % clay (See Figure 2). An Atterberg limits test gave a Liquid Limit of 22%; Plastic Limit of 16%; and Plasticity Index of 6%. These properties indicate a clayey silt [CL-ML] in the Unified Soil Classification System (USCS). Water contents in the test samples range from 13% to 14%.

Two SPT 'N' values recorded in the clayey silt were 10 and 14 corresponding to a stiff consistency.

5.4 Groundwater Conditions

Monitoring wells were installed in two boreholes with screened intervals positioned approximately within the zone of the tunnel, for the longer-term monitoring of groundwater levels.

The groundwater levels in the monitoring wells installed ranged from 9.3 to 9.5m below existing grade (Elev. 219.8 to 220.5m). The presently observed ground water levels may not indicate equilibrium conditions since the previous investigation by Thurber indicated higher piezometric levels. Over the long term, seasonal fluctuations in the groundwater level are expected.

Groundwater measurements in the monitoring wells are shown on the attached borehole logs and are also summarized on Table 5.4.

Table 5.4 - Measured Water Levels in Monitoring Wells

BH No.	Ground Surface Elev. (m)	Soil Type at Screen Location (Depth, m)	Depth / Water Level Elevation (m)	
			Feb. 6/2015	Feb. 20/2015
14-149	229.3	Silty Clay Till (9.1 – 10.6)	10.1 / 219.2	9.5 / 219.8
14-152	229.8	Silty Clay Till (9.1 – 10.6)	9.9 / 219.9	9.3 / 220.5

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WATERMAIN CROSSING OF HIGHWAY 400 AT LINE 5
BRADFORD WEST GWILLIMBURY, COUNTY OF SIMCOE, ONTARIO

6. GEOTECHNICAL INTERPRETATION AND RECOMMENDATIONS

Presented in this report are the interpretation of the results of the Foundation Investigation Report carried out by SPL Consultants Limited (SPL) at the request of MMM Group Limited (MMM) on behalf of the Town of Bradford West Gwillimbury (The Town), forming part of their Bradford South Servicing Watermain construction project (the Project). This report, however, deals only with that part of the project where a proposed watermain will cross the Highway 400 corridor on the alignment of Line 5, by trenchless methods.

6.1 Description of the Proposed Works

Details of the proposed crossing were provided to SPL by MMM and are shown on their Drawing No PP4; Project Number: 10-14035, dated August 2014. The aforementioned drawing shows a 400mm diameter watermain housed within a 900 mm diameter primary liner crossing the highway.

The total length of the crossing is about 140 m, most of which is within the highway corridor. The 900mm dia. steel liner will be installed by tunneling between invert elevations of about 219.5m and 218m on the east and west sides of the highway at the launching / receiving shaft locations. The approximate depth of soil cover above the obvert of the 900mm dia. liner is 5.3m below the highway pavement and approximately 3.3m to 3.8m at the east and west highway ditch inverts respectively. The MMM drawing also shows that the line of the tunnel will lie between two bridge structures. To the south of the watermain line is the old bridge carrying the existing Line 5 traffic over the Highway 400 and to the north is the replacement structure, presently under construction. The clear horizontal separation of the tunnel from these bridges is 8 m from the existing bridge and 18 m from the new structure.

In this report, the geotechnical conditions existing at the site are reviewed as relevant to the trenchless installation of the pipes and recommendations are given for the design. Construction-related comments in the report should not be regarded as suggestions or recommendations to contractors since the comments do not address all aspects of construction, such as scheduling, type of equipment, rate of production, etc. Contractors should, therefore, evaluate the factual information presented in the appendices of the Foundation Investigation Report (borehole logs, laboratory test results etc.), and supplement these where It appears to be needed and should base their bid on their own interpretation of the data presented, coupled with their experience with similar projects in a similar geological environment.

6.2 Overview of the Subsurface Conditions

The boreholes revealed a relatively simple and uniform stratigraphy comprising a surficial layer of fill extending to between Elev. 224m and Elev. 225.7m where it is underlain by the native soil of silty clay and silty clay till. On the average the cohesive native soils have a stiff to occasionally firm consistency. Bedrock was not encountered within the depths of the boreholes. Groundwater in the monitoring wells

was recorded at about Elev. 219.8 to 220.5m, however, nearby Thurber monitoring wells show piezometric levels to Elev. 225m.

The characteristics and relevant properties of the main soil types are described in the Foundation Investigation Report and reference should be made to that report, as well to the individual borehole logs and the laboratory test data found in the appendices.

6.3 Anticipated Ground Behavior

Available borehole information suggests that at the proposed zone of tunneling, which can be broadly defined as being in the elevations range of 218 m to 220.5 m the tunnels will be advanced within a zone of firm to stiff silty clay and silty clay till. For the purpose of evaluating the tunneling conditions, the anticipated behavior of these silty clay and silty clay till deposit is relevant.

Using Terzaghi's Classification for Soils in Tunneling (1950), the silty clay can be classified as "firm" ground. However, due to the presence of seams or thin layers of silt the clay may behave in places as a "slow raveling" soil type. The consistency of this cohesive, clayey soil ranges from firm to stiff as inferred from SPT 'N' values of 6 to 14 and an average 'N' value of 11. Its undrained shear strength, C_U, inferred from field vane shear tests and inferred from SPT 'N' values is expected to be ranged in the zone of tunneling from 63 to over 100 kPa. The Stability Factor, $N_C = \sigma_O / C_U$, where σ_O is the effective overburden pressure at the tunnel spring line and C_U is the undrained shear strength, is approximately 1.3 or less where the earth cover is less than 5 m. Squeezing ground conditions at the tunnel face, which occur at Stability Factor values of 5 or greater, are therefore not expected. Thus, squeezing is not considered to be significant factor. However, the silty clay is plastic in nature and will impart considerable adhesion. The silty clay will behave as a sticky material.

Although cobbles and boulders were not problematic in the advancement of the boreholes, the possibility of these being present in the soils but particularly in the glacial till deposits should be expected. The choice of the tunneling equipment including cutterheads and muck conveyance equipment must, therefore, be capable dealing with these.

6.4 Alternative Trenchless Crossing Methods

Giving consideration to the ground conditions that exist at the site, within Table 6.4, we have summarized the technical merits / drawbacks of various trenchless crossing alternatives. The colour-coding indicates the degree of suitability of the method to the technical issue under consideration.

Table 6.4 – Comparison of Technical Issues Associated with Trenchless Methods

Degree of suitability to this project: : Good : Fair : Poor	Length of Drive & Diameter	Control of Line & Grade	Control of Ground Surface Displacement	Ability to Deal with Mixed Face Ground Conditions	Ability to Deal with Flowing / Unstable Face Conditions	Ability to Deal with Cobbles & Boulders
Jacking and Boring	-Typical drive lengths are 40 to 60m -Diameters up to 1.5m are feasible -The current project drive length is considered excessive for this method	-Typical poor control of line and grade -Ability to steer and to correct a falling grade is limited -Where weak or dilatant soils exist at invert, it may be impossible to adjust grade	-Fair -Fair in firm to stiff cohesive soils	-Poor -Mixed face conditions will likely cause line and grade deviations to occur -Overmining may result when augering is laboured due to hard ground	-Poor -No ability to deal with flowing / unstable face conditions	-For bores >900mm, auger removal and personnel entry is needed to break up boulders, however the tunnel face must be cohesive for this to be safely conducted
Horizontal Directional Drilling (HDD)	-Drive pullback lengths of several hundred metres are feasible -In Southern Ontario, HDD diameters less than 750mm are fairly commonplace but larger bores add risk, complexity and considerable cost	-Specialized tracker system is needed to control line and grade below a highway	-Fair -Ground heave and hydro fracturing may result from excessive rates of pullback Bore stability relies on good quality control and circulation of drilling mud	-Fair to good -Mixed ground may interfere with line and grade control	-Fair to good -Bore wall stability can be maintained with suitably viscous drilling fluid and filter cake buildup on bore wall -Risk of pipe jamming during pullback if stones / cobbles become dislodged from crown of bore	-Fair to poor -Cobbles may jam pipe in bore during pullback -Boulders will result in a failed bore
Pipe Ramming	-Generally best suited to short watercourse crossings where risks imposed by ground surface heave are low -30 to 60m drives are typical -Diameters of 1500mm to 1800mm are technically feasible with a large hammer, however, the stability / integrity of the soil plug in the lead pipe segment is less certain with larger diameters	- Poor	-Poor -Risk of ground heave is moderate to high -If soil plug in lead pipe segment washes out or is breached, then excessive ground loss and settlement will occur	-Fair -Mixed face conditions will likely deviate the line and grade	-Fair -The ability to retain flowing ground depends entirely on maintaining a soil plug in the lead pipe segment. If the plug breaches, then the bore may fail	-Fair to poor -May require removal of soil plug to remove / breakup boulder which could compromise tunnel stability
Micro-Tunneling	-Drive lengths of 300m are typical, provided that Intermediate Jacking Stations (IJS) are launched every 75m -Microtunnels up to 1500mm dia. can be readily constructed in Ontario	-Good -Line and grade control to within ±25mm to ±40mm is feasible over 300m drive -	-Good -Slurry shield MTBM can balance earth pressures in the shield to a variety of ground and groundwater conditions -Full and immediate ground support by means of jacking pipe	-Good -See Control of Ground Surface Displacements -High pressure water jets are necessary to breakdown cohesive clays	-Good -See control of Ground Surface Displacements -Slurry shield MTBMs are better suited to flowing ground conditions than any other trenchless method	-Fair to good -Combination of disk and pick cutters is needed

Based on the evaluation criterion outlined in Table 6.4 and in terms of greatest reliability of success, SPL recommends that microtunneling be given priority consideration for this crossing.

6.5 Ground Movements

Invariably there is almost always some ground movement, deformation and settlement associated with tunneling regardless of the method used. With the right method, equipment and good workmanship these movements can be kept to a minimum.

At the proposed invert levels the earth cover above the tunnel obvert will be about 5.3m below the highway pavement and approximately 3.3m to 3.8m at the east and west highway ditch inverts respectively. These correspond to approximately to 3 to 6 tunnel diameters. Of this height of cover along the lengths of the tunnels, about 3 to 5 tunnel diameters will be in competent native soil. The magnitude of anticipated settlements above the tunnel were evaluated by the empirical relationship established by R.B. Peck (1969) between the volume of ground loss, the depth and size of the tunnel bore and soil types. Assuming a maximum bore size of 900 mm for the steel liner and a maximum 2% ground loss during tunneling, these deformations at ground surface above the center line of the tunnel was estimated to range between 3 mm and 4 mm. These settlements are considered to be acceptable. In our experience, using modern MTBM equipment with good installation practices, ground loss percentage can be maintained at less than 0.75%.

The effect of the tunneling on the bridge structures and of these on the tunnel was also examined. Information on the bridges was provided by MMM who made available to us the MTO drawings of the old and new structures. The abutments of the existing single span bridge are supported on spread footings at a depth of about 1.2 m below the present grade (Elev. 225 m) of the highway. The new two span structure on the other hand is supported on driven steel-H piles with their tips established at or below Elev. 195 m.

The total width of the settlement trough (centered above the vertical axis of the tunnel) was calculated to be 6.75 m at the present grade of the highway. Given the horizontal separation of 8 m and vertical separation of 6 m between the abutments of the old bridge and the tunnel, the proposed tunneling will have no impact on the foundations of the existing bridge nor will the bridge transfer loads onto the tunnel.

Since the tip of the piles supporting the new bridge are a safe depth of 23 m below the invert of the tunnel, the proposed tunnel will have no impact on the foundations of this structure and reciprocally, the piles will not impose loads on the tunnel. The driving of the piles will be completed before the tunnel is built, hence there will be no adverse impact on the tunnel due to vibrations created by pile driving.

6.6 Settlement Monitoring

We recommend that the ground displacement be monitored by establishing surface monitoring markers (SMM) across the highway. Consistent with MTO requirements SMM should be installed at 5 m intervals above the centerline of the tunnel. In addition to these, Shallow (SSP) and Deep Settlement Points (DSP), details of which are shown in **Appendix D**, should be installed between the launching shaft

and the east and west edges of the pavement in order to monitor the ground movements before the tunnel reaches the paved portions of the highway. These will provide early indications of the ground movements above the tunnels and provide an opportunity to take corrective measures, if necessary.

Three (3) baseline readings should be taken on 2 consecutive days prior to tunnelling to provide a baseline against which all subsequent readings are compared to assess settlements of the ground, bridge and embankments.

The settlement points should be monitored at least three times a day during tunneling, including weekends, and then three times a week for the first month following the completion of the tunnel.

The criteria for the evaluation of the settlement readings are the following:

1) Review Level - A maximum value of 6 mm relative to the baseline or zero readings for SSP, SMM and DSP and 3mm for SMSP. If the Review Level is reached or exceeded, the Contractor shall immediately notify MMM, MMM's Geotechnical Monitoring Consultant, Town of Bradford West Gwillimbury and MTO, to review and discuss response actions. The Contractor shall submit a plan of action to prevent Alert Level from being reached. The frequency of monitoring may be increased at the discretion of MTO.

2) Alert Level - A maximum value of 12 mm relative to the baseline or zero readings for SSP, SMM and DSP and 7.5mm for SMSP. If the Alert Level is reached or exceeded, or lesser ground settlements cause or threaten to cause damage to utilities or the highway pavement, as indicated by monitoring instruments or direct observation, the Contractor shall cease any construction activities immediately, stabilize the tunnel face and inform MMM, MMM's Geotechnical Consultant, Town of Bradford West Gwillimbury and MTO. No construction shall take place until all of the following conditions are satisfied:

   - The cause of the settlement has been identified;
   - The Contractor submits a corrective/preventative plan;
   - Any corrective/preventative measure deemed necessary by the MTO / Municipality is implemented;
   - MMM, MMM's Geotechnical Monitoring Consultant, Town of Bradford West Gwillimbury and MTO deem it is safe to proceed.

6.7 Shafts

Shafts will be used to launch and receive the tunneling equipment. On completion of the tunneling work, the west shaft will house a permanent Drain Chamber. The shafts will likely be circular structures of about 4 m to 6 m in diameter or 6 m by 3 m rectangular pits. The permanent chamber will be smaller.

The base of the shafts will be between Elev. 217 m and 218 m. At these levels their base will be in stiff silty clay or silty clay till. The approximately 8.5 to 10 m deep excavations to reach the proposed base levels will penetrate through about 2 m to 3 m of stiff to very stiff predominantly clayey fill, stiff silty clay, and stiff silty clay till. The removal of these deposits should not present difficulties.

The design and construction of the temporary shaft support will be the responsibility of the contractor who must retain a specialist shoring design engineer. Shoring design must follow the requirements of the 4th Edition of the Canadian Foundation Engineering Design Manual. It is possible that the shafts will be supported by interlocking steel sheet piling in case of circular excavations or soldier piles and timber lagging in case of braced rectangular pits. It should be possible to install the sheet piling and the soldier piles by driving through the stiff clay but for increased toe resistance the soldier piles could be installed in pre-bored holes filled with concrete. The base of the sheet piles must extend to about Elev. 215 m into the stiff clay. The driving of the sheeting to these levels should not encounter excessive resistance. The purpose of extending the sheeting below the base of the excavation is to provide toe support to the sheeting.

The sheeting and the ring beams of the circular structure should be designed for a uniform radial pressure equal to:

$P = Ka (\gamma h + q) + \gamma_W h$

Where Ka = coefficient of lateral earth pressure = 0.36
γ = submerged unit weight of soil = 12 kN/m^3
γ_W = unit weight of water = 10 kN/m^3
h = depth below ground surface, m
q = Surcharge load at ground surface kN/m^2

Should the excavation be carried out by other methods, say a braced excavation with soldier piles and lagging, then the earth pressure and its distribution on the braced excavation can be taken as presented on **Drawing No.2**.

Some microtunneling contractors will elect to construct temporary shafts (which may serve as the permanent chamber as well) using sunk-in-place, cast-in-place reinforced concrete ring segments constructed top-down. If this method is used, the Ka value indicated in Section 6.8 for the permanent chamber should be adopted.

During freezing conditions the shored walls must be protected against frost penetration and the buildup of frost pressure behind the wall.

6.8 Chambers

A drain chamber will be installed in the tunnel shaft of the watermain on the west side of the crossing. Boreholes 14-149 and 150 show the expected conditions at the base of this structure.

Reference to the log of these boreholes indicate that at the base of the chamber, Elev. 218 m, the base will be in stiff silty clay where a factored bearing resistance of 250 kPa at ULS and 160 kPa at SLS can be used for the foundation design.

Before placing the base of the chamber the subgrade should be cleaned of all disturbed and soft or loose soil and any sub-excavated materials should be replaced by unshrinkable fill.

As the structure will likely weigh less than the earth removed and replaced by it, total settlements of less than 25 mm, are expected. Differential settlement will be less than 2/3rds this value.

The structure should be designed to resist uplift due to ground water pressure with a Factor of Safety of 1.2 when assuming the ground water at the ground surface and taking only the dead weight of the structure into consideration. Additional resistance, if needed, can be mobilized by extending the base of the chamber beyond the perimeter of the structure and adding the weight of the backfill above the base to the resisting forces. The design groundwater level for the buoyancy calculation should be taken as Elev. 225m.

The excavated soils taken from the shafts will be unsuitable (geotechnically) for re-use as compacted backfill. The annular space between the chamber wall and the temporary shoring should be backfilled with 0.4 MPa unshrinkable fill.

Lateral earth pressures on the permanent structures can be evaluated by the equation given in Section 6.7 of this report but the value of Ka should be taken as 0.5.

Based on the borehole data and Table 4.1.8.4.A of the OBC 2012 the project site for the can be classified as “Class D” for seismic site response.

6.9 Corrosivity Potential

The sulphate (SO4) resistance of the concrete in contact with the soil was evaluated by performing water-soluble sulphate tests on two (2) soil samples taken from Boreholes BH14-150 and BH14-151. The tests revealed that the sulphate concentration in the tested soil samples ranged from 32 to 43 µg/g or 0.0032 to 0.0043%. The analytical data is attached to this report in **Appendix C**. The category of severity of attack is “negligible” based on CSA Standard A23.1, Concrete Materials and Methods of Concrete Construction. The final selection of the type of concrete should be made by the Engineer taking into account all aspects of design considerations.

The corrosivity of soils was evaluated using the 10 point method which is based on five soil properties: sulphides, resistivity, pH, Redox potential and moisture content. Table 6.9 summarizes the ANSI/AWWA rating for the tested soil samples for their potential for corrosion towards buried ferrous metal. A score of ten (10) points or more indicates potential for corrosion.

Table 6.9 - ANSI/AWWA Soil Corrosivity Potential

Borehole	Sample	Depth, m (from - to)	Parameter Concentration (ANSI/AWWA Point Rating)					Total Points
			Resistivity (ohm·cm) (point)	pH (point)	Redox Pot. (mV) (point)	Sulphide (%) (point)	Moisture Cont. (%) (point)	
BH14-150	SS15	11.3 – 11.9	4020 (0)	8.28 (0)	247 (0)	0.09 (2)	21 (2)	**4**
BH14-151	SS12	9.1 – 9.7	5320 (0)	8.18 (0)	252 (0)	0.03 (2)	24 (2)	**4**

According to the ANSI/AWWA rating system, the tested soil samples are considered to pose low potential to be corrosive towards ductile iron pipe. Provision of recommendations for corrosion protection is outside of the scope of SPL's terms of reference.

Note that there may be other overriding factors in the assessment of corrosion potential, such as the application of de-icing salts on the roadway and subsequent leaching into the subsoil, stray currents, etc.

6.10 Environmental Quality of Excavated Soils

A number of soil samples were selected for environmental and chemical analyses to determine their environmental quality. Testing was conducted to assess the environmental quality of potential surplus soils requiring offsite disposal.

Two (2) soil samples were analyzed for O. Reg. 153 Soil Standards For Use Under Part XV.1 of the Environmental Protection Act (EPA) (April 15, 2011) (general and inorganic parameters); two (2) soil samples were analyzed for Petroleum Hydrocarbons (PHC) (CCME F1 to F4 and Volatile Organic Compounds (VOCs) including Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX). The test results are attached in **Appendix C**. A summary of the samples tested and the types of tests performed are listed in Table 6.10 below.

Table 6.10 - Summary of Soil Environmental Tests

BH No.	Sample No.	Depth (m) from - to	EPA (2011) Metal & Inorg.	PHC (F1 - F4) + VOC (BTEX)
BH14-150	SS15	11.3 – 11.9	√	√
BH14-151	SS12	9.1 – 9.7	√	√

The tested samples have parameter concentrations below the limits set out in the MOE "Table 1: Full depth Background Site Condition Standards All Other Types of Property Use" for inorganic and general parameters.

SPL makes no warranty, express or implied, as to whether or not excavated soils will be accepted by receivers. Off-site receivers will likely require additional testing prior to acceptance of any soils. They may also reject soils based on other criteria, such as presence of organic material, peat, topsoil, rubble, or elevated moisture content.

Notwithstanding the test results provided herein, vigilance must be kept on the excavated soils. Soils with any evidence of anomalous fill, staining or odours should be stockpiled separately, covered with tarps, and qualified professionals should be immediately contacted so that additional testing may be performed to reassess their environmental quality.

The purpose of this soil environmental quality testing was to chemically characterize the soils analyzed and does not constitute a Phase Two Environmental Site Assessment as defined in O. Reg. 153 as amended by O. Reg. 511.

7. LIMITATIONS OF REPORT

The Statement of Limitations, as provided in **Appendix E**, forms an integral part of this report.

SPL CONSULTANTS LIMITED

LICENSED PROFESSIONAL ENGINEER
C. C. TSENG
100184358
Apr. 7, 2015
PROVINCE OF ONTARIO

Chi Cheng (Dennis) Tseng, P.Eng.
Geotechnical Engineer

Ivan Lieszkowszky P.Eng., FEIC
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Senior Geotechnical Engineer

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Principal Engineer, MTO Designated Tunneling Contact

LICENSED PROFESSIONAL ENGINEER
S. M. PEAKER
April 7/15
PROVINCE OF ONTARIO

LIST OF REFERENCES

[1] Thurber Engineering Ltd. memorandum entitled "The Foundation Investigation and Design of The Proposed Highway 400 5th Line Underpass Bridge and Its Immediate Approaches, Town of Bradford West Gwillimbury, Ontario", Thurber file No. 19-4406-15, dated March 17, 2014.

[2] SPL Consultants Limited, Geotechnical Investigation Report, Bradford South Servicing for Forcemains, Gravity Sewers, Watermains and Pumping Stations along Line 5, Line 6, Side Road 5 and County Road 27, SPL Project No. 10000792, dated Mar. 30, 2015.

[3] Chapman L.J. and Putnam D.F.: "Physiography of Southern Ontario", Ontario Geological Survey, 3rd Edition dated 1984, ISBN 978-1-4249-5158-1.

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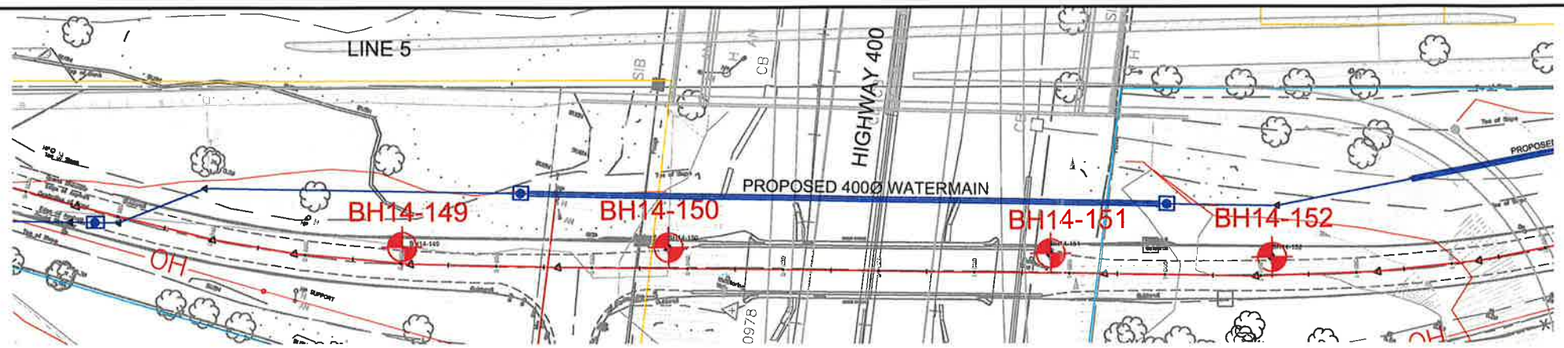
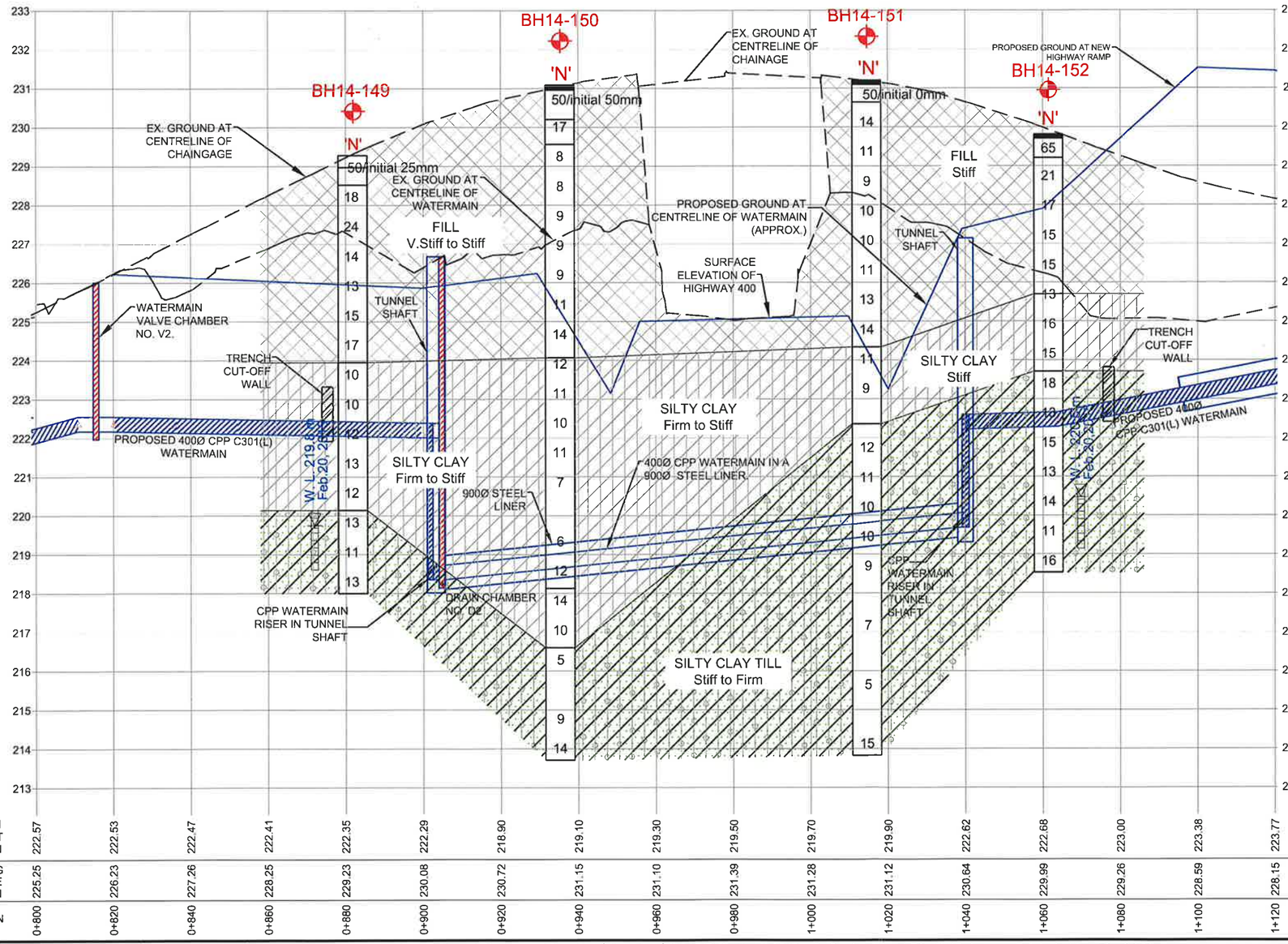
DRAWINGS

Borehole Location Plan and Geological section (Drawing No. 1)
Earth Pressure Distribution on Braced Excavation (Drawing No. 2)





WATERMAIN OBVERT ELEVATION	222.57	222.53	222.47	222.41	222.35	222.29	218.90	219.10	219.30	219.50	219.70	219.90	222.62	222.68	223.00	223.38	223.77						
EXISTING CHAINAGE ELEVATION	225.25	226.23	227.26	228.25	229.23	230.08	230.72	231.15	231.10	231.39	231.28	231.12	230.64	229.99	229.26	228.59	228.15						
STATION	0+800	0+820	0+840	0+860	0+880	0+900	0+920	0+940	0+960	0+980	1+000	1+020	1+040	1+060	1+080	1+100	1+120						

METRIC
DIMENSIONS ARE IN METRES
UNLESS OTHERWISE SHOWN

HIGHWAY 400 AT LINE 5
BOREHOLE LOCATION PLAN &
SOIL STRATA

SHEET

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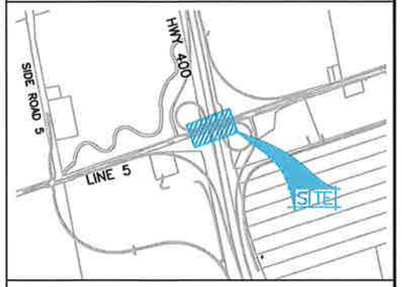


KEY PLAN
NOT TO SCALE

LEGEND

- Borehole
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- WL in Piezometer
- Piezometer

No	ELEVATION	NORTHING	EASTING
BH14-149	229.28	4881047.32	609995.23
BH14-150	231.08	4881077.48	610085.99
BH14-151	231.08	4881101.25	610162.37
BH14-152	229.81	4881115.02	610206.67

NOTES —

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

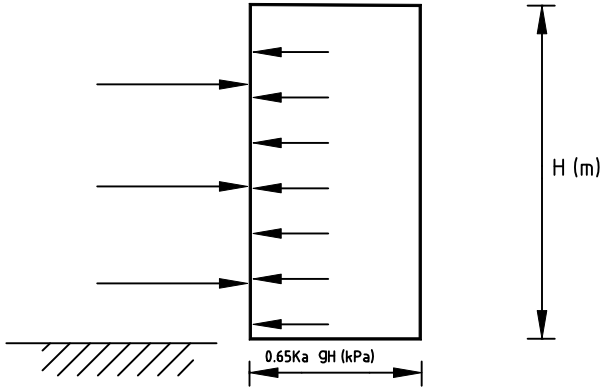
HOR 0 50 (m)
VERT 0 SCALE(m) 5 (m)

REVISIONS		
DATE	BY	DESCRIPTION

GEOCRES No

HWY No 400				DIST	Bradford
SUBM'D DT	CHECKED IL	DATE	Feb 25, 2015	SITE	
DRAWN ZMO	CHECKED IL	APPROVED	IL	DWG	1

\\SERVER\Geotech\10 GeoProjects\1-1000 Projects\10000792 - RFP-14-48 Line 5 and 6 Town of Bradford\Drawings\10000792-Hwy400@Line5-Profile-March30-2015.dwg Printed: Mar 30, 2015

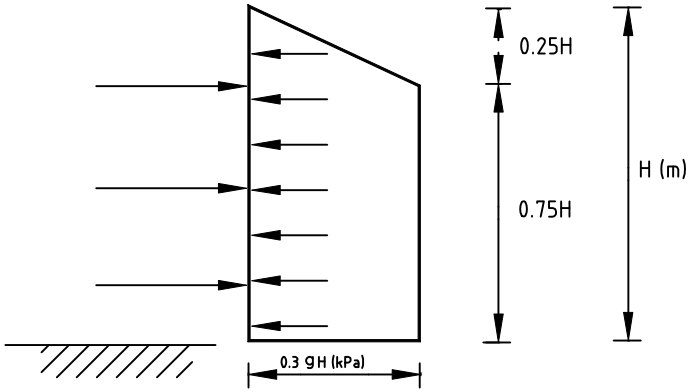


g = unit weight of soil = 21.0 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 11.2 kN/m^3

Ka = 0.3

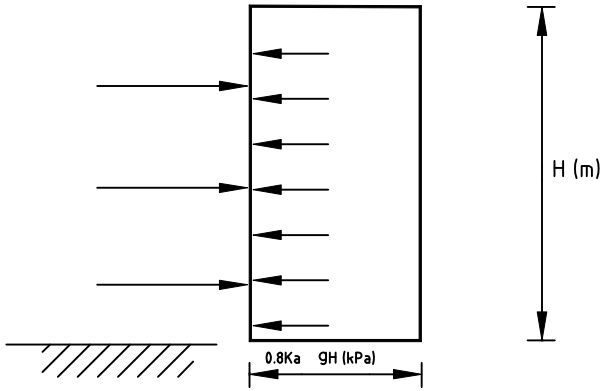
IN COMPACT TO VERY DENSE NON-COHESIVE SOILS (SANDS AND SILTS)



g = unit weight of soil = 21.5 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 11.7 kN/m^3

IN COHESIVE CLAYS OR CLAYEY SOILS

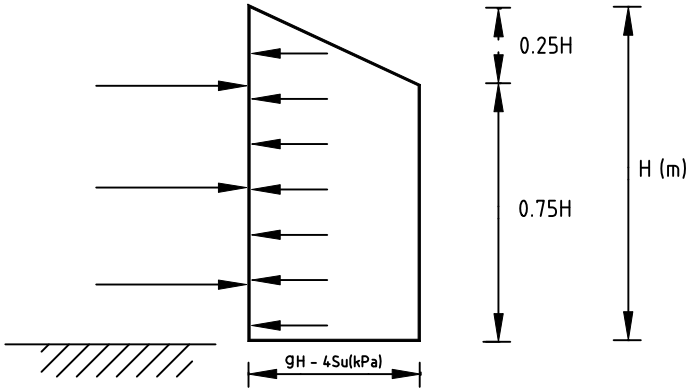


g = unit weight of soil = 19.0 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m^3

Ka = 0.36

IN LOOSE OR DISTURBED NON-COHESIVE SOILS (SANDS AND SILTS)



g = unit weight of soil = 19.0 kN/m^3

g' = submerged unit weight of soil (i.e. below ground water level)= 9.2 kN/m^3

Su = 10 KPa

IN VERY SOFT TO FIRM COHESIVE CLAYS OR CLAYEY SOILS

EARTH PRESSURE DISTRIBUTION ON BRACED EXCAVATIONS

Notes:
1. Check system for partial excavation condition.
2. If the free water level is above the base of the excavation, the hydrostatic pressure must be added to the above pressure distribution.
3. If surcharge loadings are present near the excavation, these must be included in the lateral pressure calculation.

Client:	**MMM Group Limited**			Project No.: **10000792**	Drawing No.: **2**
Drawn:	**ZMO**	Approved:	**DT**	Title:	**Earth Pressure Distribution on Braced Excavations**
Date:	**Feb 23, 2015**	Scale:	**N.T.S**	Project:	**Geotechnical Investigation – Highway 400 Crossing at Line 5 Bradford, Ontario**
Original Size:	**Letter**	Rev:	**N/A**		

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C:\Users\spl\Desktop\792-Jan15, 2015\792-Earth Pressure-Feb24-2015.dwg

APPENDIX A

Explanation of Terms Used in the Record of Borehole

Borehole Logs (BH14-149, BH14-150, BH151 and BH14-152)

Previous Thurber Engineering Ltd.'s Boreholes (BH14-19 to BH14-22, BH14-27 to BH14-30)

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Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance, N_d:

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

Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

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

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-40%
And (e.g. sand and gravel)	40-60%

Soil Description

a) Cohesive Soils

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

b) Cohesionless Soils

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

Soil Tests

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

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RECORD OF BOREHOLE No BH14-149

METRIC 1 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 609995.23, N 4881047.32 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/28/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
229.3											
0.0 / 229.0	**GRANULAR FILL:** 310mm sand and gravel, brown, moist, very dense(frozen).		1	AS	50/ initial 25mm		Concrete 229		○		
0.3 / 228.5	**FILL:** silty sand, trace clay, trace gravel, contains clayey silt seams, brown, moist, very dense.										
0.8	**FILL:** silty clay, some sand, trace gravel, trace organics, contains sand seams, brown, moist, very stiff to stiff.		2	SS	18		228		○		
1			3	SS	24				○		
2	contains organic silty clay seams/layers, greyish brown below 2.3m		4	SS	14		227		○		
3	trace straw between 3.0m to 3.6m		5	SS	13		226		○		
4			6	SS	15		225 Holeplug		○		
5			7	SS	17						
224.0							224				
5.3	**SILTY CLAY:** trace sand, contains silt seams/layers, greyish brown to brown, moist, stiff.		8	SS	10				○	21.1	73 27
6			9	SS	10		223		○		
7	brown below 6.9m trace gravel between 6.9m to 7.5m		10	SS	12		222		○	20.1	1 61 38
8	grey below 7.6m		11	SS	13				○		
9			12	SS	12		221 Sand		○	20.8	
220.1											
9.1	**SILTY CLAY TILL:** some sand, trace gravel, grey, moist, stiff.		13	SS	13		220 W. L. 219.8 m Feb 20, 2015 Screen		○		
10											

Continued Next Page

10000792

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

+ ³, × ³: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

ON-MTO-2014 10000792-LOG-MAR.30.2015_BH149-150-151-152.GPJ ON_MOT.GDT 3/30/15

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RECORD OF BOREHOLE No BH14-149

METRIC 2 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 609995.23, N 4881047.32 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/28/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY TILL: some sand, trace gravel, grey, moist, stiff. *(continued)*		14	SS	11		W. L. 219.2 m Feb 06, 2015			22.0	1 10 57 32
11 218.0			15	SS	13		Sand 218				
11.3	**END OF THE BOREHOLE**										

Notes:
1) Borehole was open and dry upon completion.
2) 50mm dia. monitoring well installed upon completion.

Water Level Readings:

Date	W. L. Depth (m)
Feb. 6, 2015	10.1m
Feb. 20, 2015	9.5m

ON-MTO-2014 10000792-LOG-MAR.30.2015_BH149-150-151-152.GPJ ON_MOT.GDT 3/30/15

10000792

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

$+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

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RECORD OF BOREHOLE No BH14-150

METRIC 1 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610085.99, N 4881077.48 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/27/2015 to Jan/28/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
231.1											
231.0	**ASPHALT:** 120mm						231				
0.1	**GRANULAR BASE / SUBBASE:** 760mm(frozen)		1	AS	50/ initial 50mm				○		
230.2											
1 0.9	**FILL:** silty sand , trace to some clay, trace gravel, trace organics, contains clayey silt pockets, brown, moist, compact.		2	SS	17		230		○		
229.6											
1.5	**FILL:** silty clay, trace sand, trace gravel, greyish brown to brown, moist, stiff. trace rootlets, contains organic clayey silt seams between 1.5m to 2.1m		3	SS	8				○		
2	contains silt seams below 2.3m		4	SS	8		229		○		
3	trace organic, trace rootlets below 3.0m		5	SS	9		228		○		
4			6	SS	9		227		○		
5			7	SS	9		226		○		
6	greyish brown below 6.1m		8	SS	11				○		
7 224.1			9	SS	14		225		○		
7.0	**SILTY CLAY:** trace sand, contains silt seams/layers, brown, moist, firm to stiff. trace rootlets between 7.0m to 8.2m		10	SS	12		224		○		
	trace gravel between 7.6m to 9.8m		11	SS	11		223		○	19.8	1 68 31
9			12	SS	10				○		
	brown to grey below 9.1m		13	SS	11		222		○		
10											

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ ³, × ³: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

10000792

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RECORD OF BOREHOLE No BH14-150

METRIC 2 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610085.99, N 4881077.48 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/27/2015 to Jan/28/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	occasional sand seams, grey, moist to wet below 9.9m		14	SS	7		221				59 41
	SILTY CLAY: trace sand, contains silt seams/layers, brown, moist, firm to stiff. *(continued)*										
11				VANE			220	>99			
			15	SS	6						
12							219				
			16	SS	12						
218.1											
13 13.0	**CLAYEY SILT:** trace sand, dilatant, grey, very moist, stiff.		17	SS	14		218				1 81 18
14			18	SS	10		217				
216.6											
14.5	**SILTY CLAY TILL:** trace to some sand, trace gravel, grey, very moist, firm to stiff.		19	SS	5						1 9 61 29
15							216				
			2	VANE				>99			
16			20	SS	9		215				
			21	SS	14		214				1 13 56 30
17 213.7											
17.4	**END OF THE BOREHOLE** Note: 1) Borehole was open and water level was at 16.2m upon completion.										

ON-MTO-2014 10000792-LOG-MAR.30,2015_BH149-150-151-152.GPJ ON_MOT.GDT 3/30/15

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ ³, × ³: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

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RECORD OF BOREHOLE No BH14-151

METRIC 1 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610162.37, N 4881101.25 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/26/2015 to Jan/27/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
231.2											
231.0	**ASPHALT:** 110mm										
0.1	**GRANULAR BASE / SUBBASE:** 450mm(frozen)		1	AS	50/ initial 0mm		231		○		
230.6											
0.6	**FILL:** silty clay, trace to some sand, trace gravel, brown, moist, stiff. trace organic silty clay seams between 0.8m to 1.4m		2	SS	14				○		
1							230				
			3	SS	11				○		
2							229				
			4	SS	9				○		
3	trace sand below 3.0m										
			5	SS	10		228		○		
4			6	SS	10		227		○		
	trace organics below 4.6m		7	SS	11				○		
5							226				
	brown to grey between 5.3m to 6.1m		8	SS	13				○		
6							225				
	greyish brown , moist to wet below 6.1m		9	SS	14				○		
224.3											
6.9	**SILTY CLAY:** trace sand, contains silt seams, brown, moist to very moist, stiff.		10	SS	11		224		○		
7											
			11	SS	9		223		○	20.7	4 64 32
8											
			1	VANE				+>99			
222.4											
8.8	**SILTY CLAY TILL:** some sand, trace gravel, contains silt seams, brown to grey, moist to very moist, stiff to firm.										
9			12	SS	12		222		○		
10											

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

10000792

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No BH14-151

METRIC 2 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610162.37, N 4881101.25 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/26/2015 to Jan/27/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	grey below 9.9m **SILTY CLAY TILL:** some sand, trace gravel, contains silt seams, brown to grey, moist to very moist, stiff to firm. *(continued)*		13	SS	11		221				
11			14	SS	10					21.8	2 14 59 25
	occasional sand seams between 11.4m to 12.0m		15	SS	10		220				
12			16	SS	9		219			21.4	1 15 60 24
13			2	VANE			218	>99			
14			17	SS	7					22.1	4 25 50 21
			3	VANE			217	2.1 63			
15			18	SS	5		216				
16			4	VANE			215	>99			
17	contains silty clay layers, moist below 16.8m		19	SS	15					22.1	1 12 61 26
213.8							214				
17.4	**END OF BOREHOLE** Note: 1) Borehole was open upon completion.										

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

$+^3, \times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

10000792

Ministry of Transportation
Ontario

SPL

RECORD OF BOREHOLE No BH14-152

METRIC 1 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610206.67, N 4881115.02 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/26/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
229.8											
229.7	**ASPHALT:** 105mm										
0.1	**GRANULAR BASE / SUBBASE:** 500mm		1	SS	65		Concrete				
229.2											
0.6	**FILL:** silty clay, trace to some sand, trace gravel, brown, moist, very stiff to stiff.		2	SS	21		229				
1			3	SS	17		228				
2	trace organic silty clay layers between 2.3m to 3.7m		4	SS	15		227				
3			5	SS	15		226				
4			6	SS	13		Holeplug				
225.7											
4.1	**SILTY CLAY:** trace sand, contains silt seams/layers, greyish brown, moist, stiff to very stiff. brown below 4.6m		7	SS	16		225			20.7	3 65 32
5	trace gravel below 5.3m		8	SS	15		224				
6											
223.7											
6.1	**SILTY CLAY TILL:** some sand, trace gravel, brown, moist to very moist, very stiff to firm. contains silty clay layer between 6.1m to 6.7m		9	SS	18					22.1	2 13 58 27
7	grey, moist to wet below 6.9m		10	SS	13		223				
8			11	SS	15		222				
			12	SS	13		Sand			22.2	5 19 53 23
9											
			13	SS	14		W. L. 220.5 m Feb 20, 2015				
10							220 Screen				

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

$+^3, \times^3$: Numbers refer to Sensitivity

○ $^{\varepsilon}$=3% Strain at Failure

10000792

Ministry of Transportation
Ontario

SPL

RECORD OF BOREHOLE No BH14-152

METRIC 2 OF 2

W.P. _____ LOCATION See Borehole Location Plan, E 610206.67, N 4881115.02 ORIGINATED BY HL

DIST _____ HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY BW

DATUM Geodetic DATE Jan/26/2015 CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	contains silty clay layers, moist between 9.9m to 10.5m		14	SS	11		W. L. 219.9 m Feb 06, 2015				
	SILTY CLAY TILL: some sand, trace gravel, brown, moist to very moist, very stiff to firm. *(continued)*										
11 218.5			15	SS	16		219 Sand			20.1	5 5 49 41
11.3	**END OF THE BOREHOLE**										

Notes:
1) Borehole was open and dry upon completion.
2) 50mm dia. monitoring well installed upon completion.

Water Level Readings:

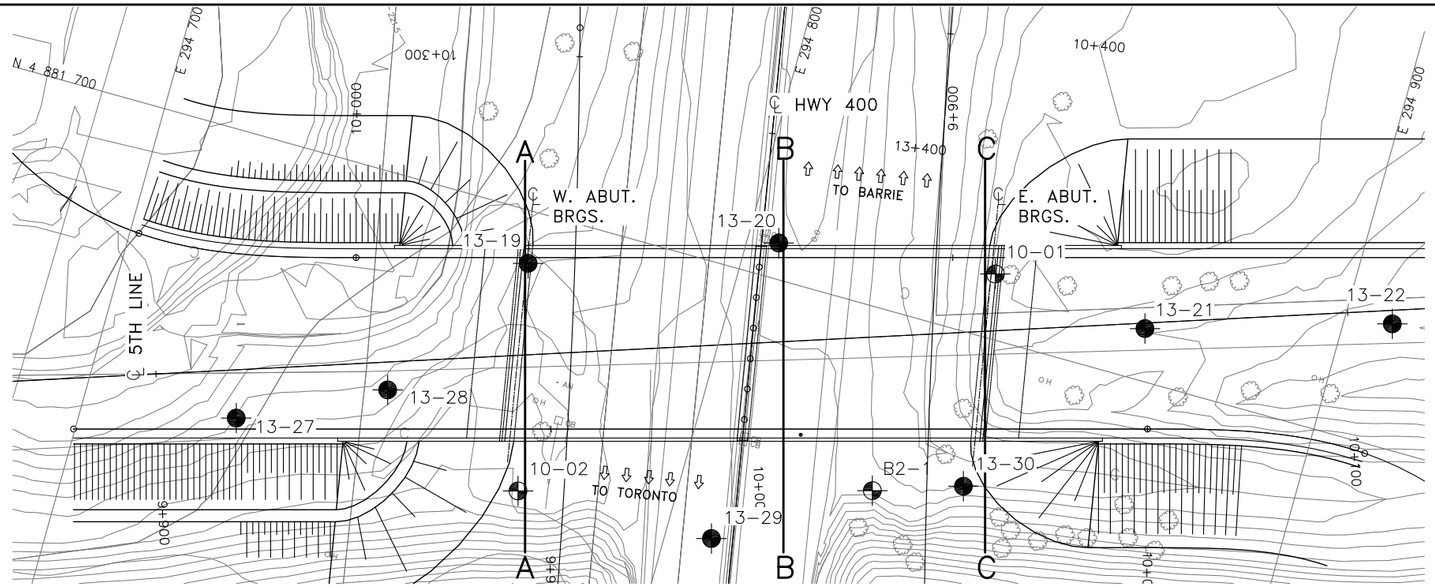
Date	W. L. Depth (m)
Feb. 6, 2015	9.9m
Feb. 20, 2015	9.3m

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

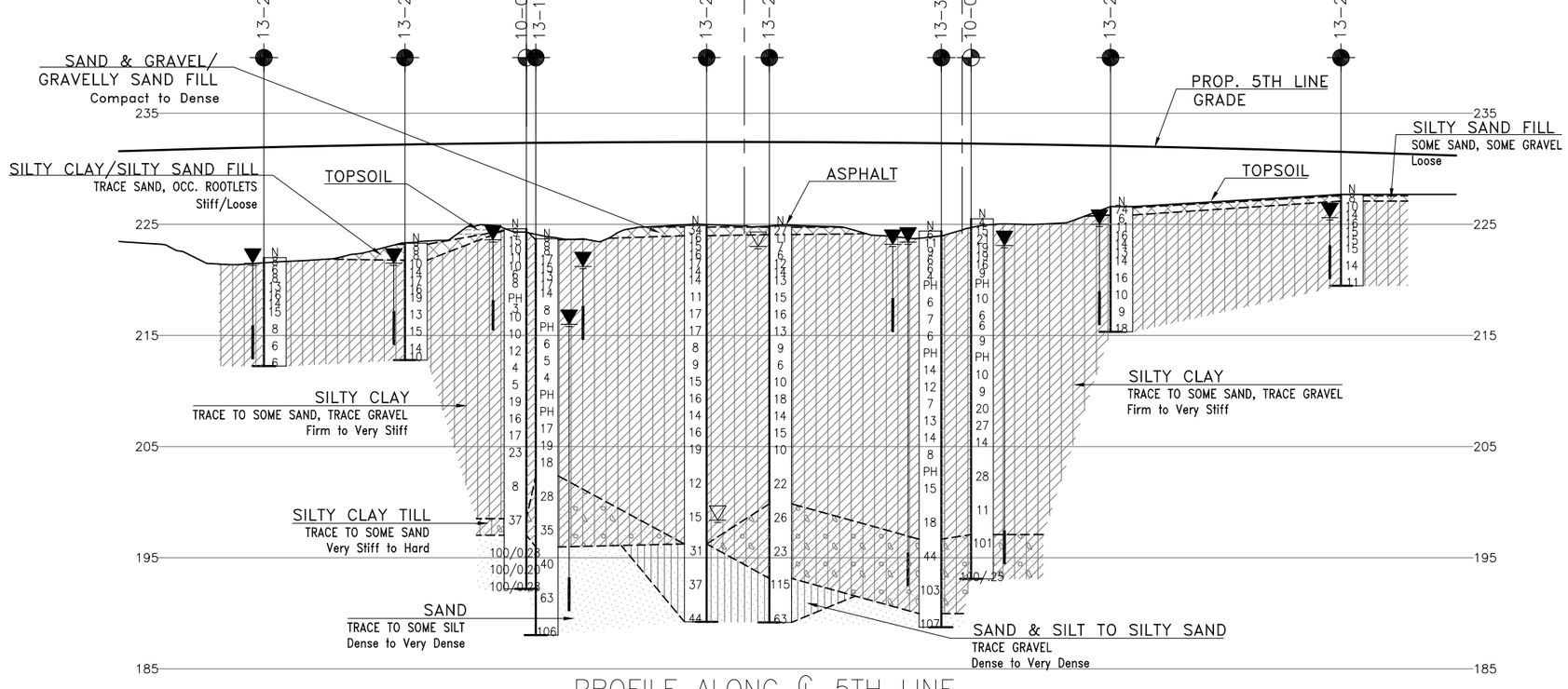
10000792

ON-MTO-2014 10000792-LOG-MAR.30.2015_BH149-150-151-152.GPJ ON_MOT.GDT 3/30/15



PLAN

20 0 20 40m



PROFILE ALONG ℄ 5TH LINE

20 0 20 40m

10 0 10 20m

DRAFT

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

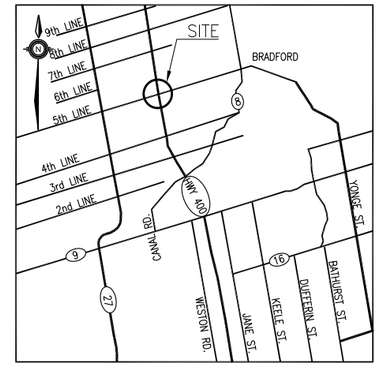
CONT No
WP No P-13-13

SHEET

HIGHWAY 400
AT 5TH LINE
UNDERPASS BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

URS

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole (Current Investigation)
⊕	Borehole (Previous Investigations)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level (Open Borehole)
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
10-01	225.5	4 881 710.7	294 841.6
10-02	224.6	4 881 654.2	294 774.3
13-19	223.7	4 881 691.4	294 765.7
13-20	224.9	4 881 705.9	294 805.2
13-21	226.6	4 881 708.6	294 868.2
13-22	227.7	4 881 720.5	294 907.9
13-27	222.0	4 881 653.3	294 725.5
13-28	223.3	4 881 664.6	294 748.7
13-29	224.9	4 881 655.2	294 807.7
13-30	224.4	4 881 675.0	294 846.0
B2-1	224.7	4 881 670.2	294 831.5

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN SKP	CHK KMY	CODE	LOAD
DRAWN AN	CHK SKP	SITE	STRUCT
		DATE MAR 2014	DWG 1

FILENAME: H:\Drafting\19\14061\15\tea0615-BoreholePlan&Profile.dwg
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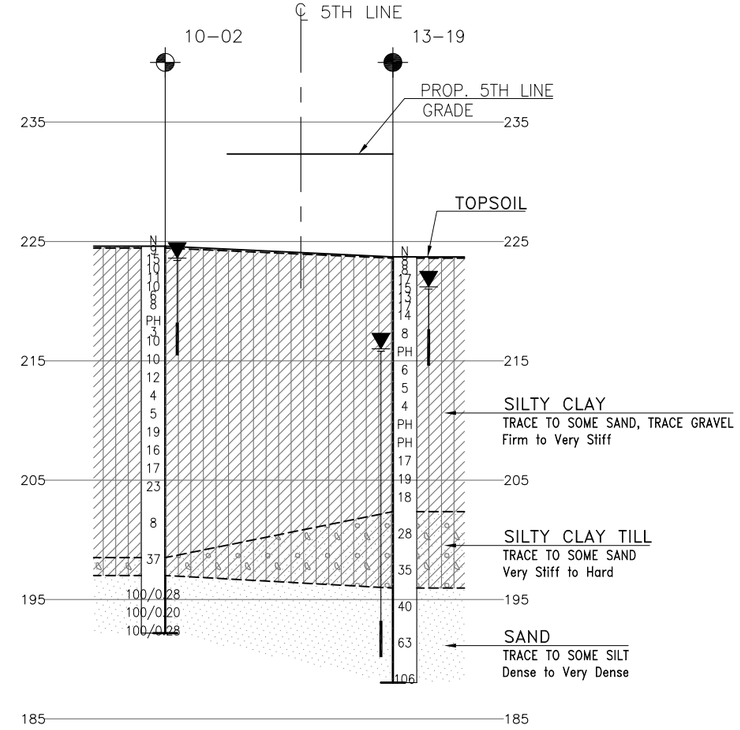
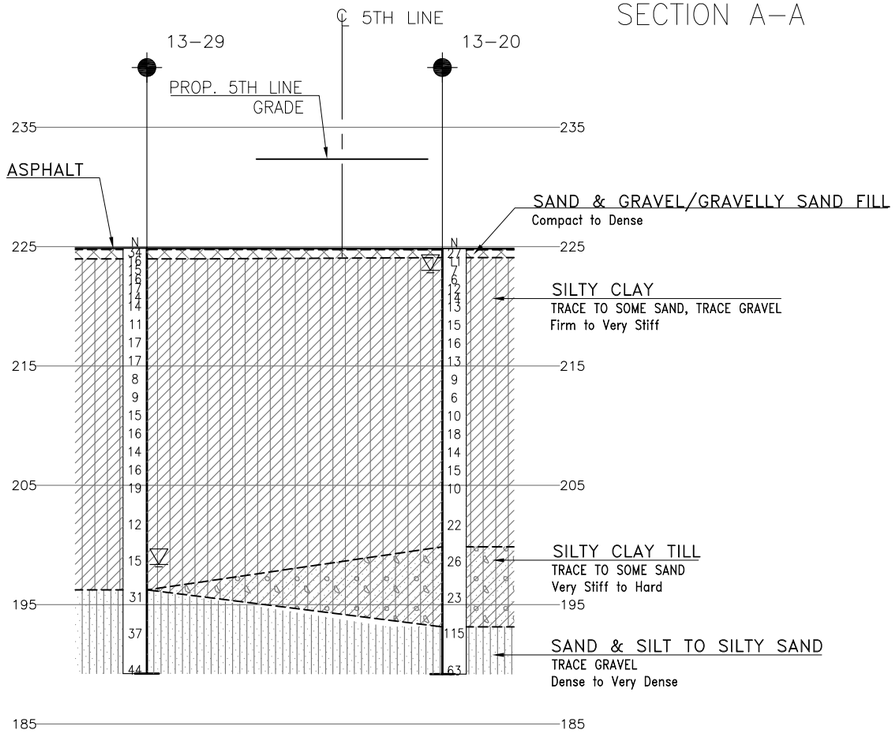
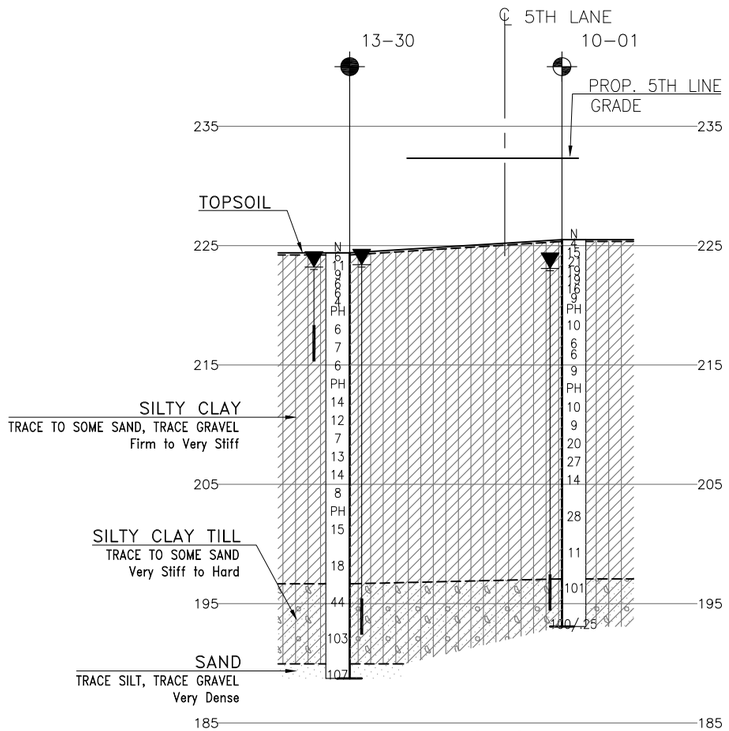


SECTION A–A



SECTION B–B



SECTION C–C

20 0 20 40m
10 0 10 20m

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

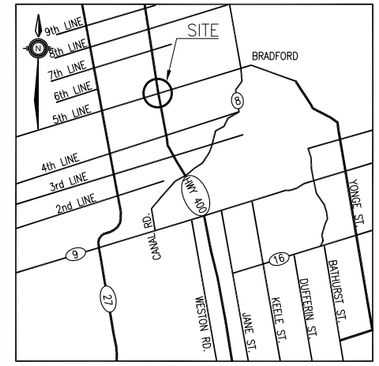
CONT No
WP No P–13–13

HIGHWAY 400
AT 5TH LINE
UNDERPASS BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

URS

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

⊕	Borehole (Current Investigation)
⊕	Borehole (Previous Investigations)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level (Open Borehole)
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
10–01	225.5	4 881 710.7	294 841.6
10–02	224.6	4 881 654.2	294 774.3
13–19	223.7	4 881 691.4	294 765.7
13–20	224.9	4 881 708.1	294 813.1
13–21	226.6	4 881 708.6	294 868.2
13–22	227.7	4 881 720.5	294 907.9
13–27	222.0	4 881 653.3	294 725.5
13–28	223.3	4 881 664.6	294 748.7
13–29	224.9	4 881 656.1	294 810.8
13–30	224.4	4 881 675.0	294 846.0
B2–1	224.7	4 881 670.2	294 831.5

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

DRAFT

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN SKP	CHK KMY	CODE	LOAD DATE MAR 2014
DRAWN AN	CHK SKP	SITE	STRUCT DWG 2

FILENAME: H:\Drafting\19\4406\15\ed0615–BoreholePlan&Profile.dwg
PLOTDATE: 3/14/2014 3:53 PM

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-19 1 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 691.4 E 294 765.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.24 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
223.7											
0.0	**TOPSOIL:** (100 mm)										
0.1	Silty **CLAY** Stiff to Very Stiff Brown Moist		1	SS	8		223				
			2	SS	8						0 0 51 49
			3	SS	17		222				
			4	SS	15	▼	221				
			5	SS	13						0 0 52 48
			6	SS	17		220				
219.1											
4.6	Trace to some sand, trace gravel Grey Moist to Wet		7	SS	14		219				
							218				
			8	SS	8						
						▼	217	>>2.0			
			1	TW	PH		216				Oedometer Test 2 19 47 32
							215	3.0			
			9	SS	6						
							214	2.5			

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-19 2 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 691.4 E 294 765.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.24 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Firm to Stiff Grey Wet						213				
			10	SS	5		212	3.0			
			11	SS	4		211				0 0 48 52
								3.0			
			2	TW	PH		210				0 0 62 38
							209				
			3	TW	PH		208				
207.4								2.0			
16.3	Very Stiff						207				
			12	SS	17		206				
			13	SS	19		205				0 5 55 40
							204				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-19 3 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 691.4 E 294 765.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.24 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Very Stiff Grey Wet		14	SS	18		203				
202.3											
21.3	Silty **CLAY**, trace to some sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		15	SS	28		202 201 200				0 14 54 32
			16	SS	35		199 198 197				
195.9											
27.7	**SAND**, trace silt Dense Grey Wet		17	SS	40		196 195 194				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 (20 / 10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-19 4 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 691.4 E 294 765.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.24 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	SAND, trace to some silt Very Dense Grey Wet						193				
							192				
			18	SS	63				○		0 84 16 (SI+CL)
							191				
							190				
							189				
188.0			19	SS	106				○		
35.7	END OF BOREHOLE AT 35.7 m. BOREHOLE OPEN TO 35.0m AND WATER LEVEL AT 19.4 m UPON COMPLETION. Piezometer installation consists of two 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen. WATER LEVEL READINGS (DEEP): DATE DEPTH (m) ELEV. (m) Feb 26/ 14 7.7 216.0 Mar 13/ 14 7.3 216.4 WATER LEVEL READINGS (SHALLOW): DATE DEPTH (m) ELEV. (m) Feb 26/ 14 2.5 221.2 Mar 13/ 14 2.6 221.1										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 + 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-20 1 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 705.9 E 294 805.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2013.12.19 - 2014.01.11 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.9											
0.0	**ASPHALT:** (100 mm)										
0.1	Gravelly **SAND**, some silt Compact Brown Moist		1	SS	27				○		20 61 19 (SI+CL)
224.1											
0.8	(FILL)										
	Silty **CLAY**, trace sand Firm to Stiff Brown Moist		2	SS	11		224		○		
			3	SS	7	▽	223		○		0 0 49 51
			4	SS	6		222		○		
			5	SS	12		221		○		
			6	SS	14		220		○		
			7	SS	13		219		○		
			8	SS	15		218		○		0 3 50 47
217.7											
7.2	Very Stiff		9	SS	16		217		○		
216.2											
8.7	Grey		10	SS	13		216		○		
							215				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 (20 10) 5 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-20 2 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 705.9 E 294 805.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2013.12.19 - 2014.01.11 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	Silty **CLAY** Stiff Grey Wet									
			11	SS	9		214			
			12	SS	6		213			0 0 51 49
			13	SS	10		212	1.5		
210.1 14.8	Very Stiff		14	SS	18		211			
			15	SS	14		210			
208.6 16.3			16	SS	15		209			0 0 52 48
							208			
							207			
							206			
							205			

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

15 (20 / 10) 5 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-20 3 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 705.9 E 294 805.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2013.12.19 - 2014.01.11 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY** Stiff to Very Stiff Grey Wet		17	SS	10		204		○		
			18	SS	22		202		○		
199.9 25.0	Silty **CLAY**, trace to some sand, trace gravel Very Stiff Grey Wet (TILL)		19	SS	26		199		○		0 4 62 34
			20	SS	23		196		○		
							195				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-20 4 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 705.9 E 294 805.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2013.12.19 - 2014.01.11 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
193.2	Silty **CLAY**, trace to some sand, trace gravel Very Stiff Grey Wet (TILL)						194				
31.7	Silty **SAND**, trace clay Very Dense Grey Wet		21	SS	115		193				
							192				
							191				
							190				
189.2			22	SS	63				o		0 64 26 10
35.7	END OF BOREHOLE AT 35.7 m. BOREHOLE OPEN TO 35.7 m AND WATER LEVEL AT 1.8 m. BOREHOLE BACKFILLED WITH BENTONITE, PARTIALLY MIXED WITH CUTTINGS TO 0.4 m, CONCRETE TO 0.2 m THEN ASPHALT PATCH TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-21 1 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 708.6 E 294 868.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.31 - 2014.01.31 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
226.6									
0.0	**TOPSOIL:** (100 mm)								
0.1	Silty **SAND**, some clay, some gravel, occasional rootlets Very Dense Brown Moist (FILL)		1	SS	74				
225.8									
0.8	Silty **CLAY**, occasional rootlets Firm Dark Brown Moist		2	SS	6				0 0 56 44
225.1									
1.4	Stiff to Very Stiff		3	SS	11		225		
			4	SS	16		224		
			5	SS	14				
			6	SS	13		223		0 0 62 38
			7	SS	14		222		
220.9									
5.6	Trace sand, trace gravel Grey Wet		8	SS	16		221		
							220		
			9	SS	10		219		
							218		
			10	SS	9		217		8 9 41 42

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

WATER CONTENT (%) 20 40 60

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 3/17/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-21 2 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 708.6 E 294 868.2 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.31 - 2014.01.31 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand, trace gravel Very Stiff Grey Wet						216				
215.3			11	SS	18				○		
11.3	END OF BOREHOLE AT 11.3 m. BOREHOLE OPEN TO 11.3 m AND DRY UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Feb 26/ 14 1.6 225.0 Mar 13/ 14 1.7 224.9										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-22 1 OF 1 METRIC

W.P. P-13-03 LOCATION N 4 881 720.5 E 294 907.9 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.30 - 2014.01.30 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
227.7											
0.0	**TOPSOIL:** (125 mm)										
0.1	Silty **SAND**, some clay, some gravel, occasional rootlets		1	SS	8						16 45 24 15
227.1	Loose										
0.6	Brown						227				
	Moist		2	SS	10						
	(FILL)										
	Silty **CLAY**, trace sand										
	Stiff										
	Brown										
	Moist		3	SS	14		226				0 9 43 48
225.5						▼					
2.2	Very Stiff										
			4	SS	16		225				
224.7											
3.0			5	SS	15						
							224				
	Grey		6	SS	15						
			7	SS	15		223				
							222				
			8	SS	14						
							221				
							220				
			9	SS	11						0 2 46 52
219.5											
8.2	END OF BOREHOLE AT 8.2 m. BOREHOLE OPEN TO 8.2 m AND DRY UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
Feb 26/ 14	2.1	225.6
Mar 13/ 14	2.2	225.5

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-27 1 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 653.3 E 294 725.5 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.0											
0.0	**TOPSOIL:** (100 mm)										
0.1	Silty **CLAY**, trace sand, occasional rootlets Firm to Stiff Brown Moist		1	SS	8		222				
			2	SS	6		221				0 8 60 32
	Occasional iron oxide staining		3	SS	8		220				
			4	SS	13						
219.0							219				
3.0	Trace gravel Very Stiff Grey		5	SS	16						
218.3							218				3 6 42 49
3.7			6	SS	14						
			7	SS	15		217				
			8	SS	8		216				
							215	2.0			
			9	SS	6		214				0 0 46 54
			10	SS	6		213				
212.2											
9.8	END OF BOREHOLE AT 9.8 m.										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \cdot 5}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-27 2 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 653.3 E 294 725.5 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
	BOREHOLE OPEN TO 9.8 m AND WATER LEVEL AT 6.4 m UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Feb 26/ 14 0.5 221.5 Mar 13/ 14 0.5 221.5										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-28 1 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 664.6 E 294 748.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.28 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
223.3											
0.0	**TOPSOIL:** (100 mm)										
0.1	Silty **CLAY**, trace sand, occasional rootlets		1	SS	8		223				
222.6	Stiff										
0.7	Brown										
	Moist		2	SS	8						8 68 24 (SI+CL)
	(FILL)						222				
	Silty **SAND**, trace gravel										
	Loose										
221.8	Brown										
1.5	Moist		3	SS	10	▼					
	(FILL)						221				
	Silty **CLAY**										
	Stiff to Very Stiff		4	SS	14						
	Brown										
	Moist		5	SS	17		220				0 0 50 50
219.6											
3.7	Grey										
	Wet		6	SS	16		219				
			7	SS	19						
							218				
			8	SS	13		217				
							216				
			9	SS	15		215				
214.6											
8.7	Some sand										
			10	SS	14		214				0 12 49 39

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 13-28 2 OF 2 METRIC

W.P. P-13-03 LOCATION N 4 881 664.6 E 294 748.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.28 - 2014.01.28 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
212.8			11	SS	10		213		○		
10.5	END OF BOREHOLE AT 10.5 m. BOREHOLE OPEN TO 9.9 m AND WATER LEVEL AT 5.1 m UPON COMPLETION. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Feb 26/ 14 1.8 221.5 Mar 13/ 14 1.8 221.5										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-29 1 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 655.2 E 294 807.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.13 - 2014.01.15 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.9											
0.0	**ASPHALT:** (125 mm)										
0.1	**SAND AND GRAVEL** Dense Brown Moist		1	SS	34						41 55 4 (SI+CL)
224.0	(FILL)						224				
0.9	Silty **CLAY**, trace to some sand, trace gravel Stiff to Very Stiff Brown Moist		2	SS	16						
			3	SS	15		223				
			4	SS	16						
			5	SS	17		222				0 0 39 61
	Grey		6	SS	14		221				
			7	SS	14		220				
			8	SS	11		219				
217.7							218	2.5 +			
7.2	Some sand		9	SS	17		217				
			10	SS	17		216				6 23 41 30
							215				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-29 2 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 655.2 E 294 807.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.13 - 2014.01.15 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace gravel, trace to some sand Stiff to Very Stiff Brown Moist		11	SS	8		214	2.5	○		
			12	SS	9		213		⊖		3 22 46 29
			13	SS	15		212	2.5	○		
			14	SS	16		211		○		
			15	SS	14		210		○		
			16	SS	16		209		○		
							208		○		
							207		○		
							206		○		
							205				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 13-29 3 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 655.2 E 294 807.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.13 - 2014.01.15 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Stiff to Very Stiff Grey Wet		17	SS	19						
			18	SS	12						
			19	SS	15	▽					0 0 72 28
196.2											
28.7	**SAND** and **SILT**, trace clay Dense Grey Wet		20	SS	31						0 45 53 2

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

15 (20, 10) 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-29 4 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 655.2 E 294 807.7 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2014.01.13 - 2014.01.15 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND and **SILT**, trace clay Dense Grey Wet						194 193 192 191 190				
			21	SS	37						
			22	SS	44						
189.2											
35.7	END OF BOREHOLE AT 35.7 m. BOREHOLE OPEN TO 35.1 m AND WATER LEVEL AT 26.5 m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.4 m, CONCRETE TO 0.2 m THEN ASPHALT PATCH TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 13-30 1 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 675.0 E 294 846.0 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.20 - 2014.01.23 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.4								20 40 60 80 100	20 40 60		
0.0	**TOPSOIL:** (175 mm)										
0.2	Silty **CLAY** Firm to Stiff Brown Moist		1	SS	6		224				
			2	SS	11		223				0 0 54 46
			3	SS	9						
			4	SS	6		222				
			5	SS	6		221				
			6	SS	4		220				
			1	TW	PH						Oedometer Test
218.8							219	2.5			
5.6	Trace to some sand Grey		7	SS	6		218				0 10 57 33
			8	SS	7		217				
215.7							216	2.5			
8.7	Trace gravel		9	SS	6		215				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-30 2 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 675.0 E 294 846.0 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.20 - 2014.01.23 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	NATURAL MOISTURE CONTENT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w_P — w — LIQUID LIMIT w_L	γ kN/m^3		GR	SA	SI	CL
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60						
	Silty **CLAY**, trace to some sand, trace to some gravel Stiff Grey Moist						214								
			2	TW	PH						11 12 45 32				
							213	2.0							
			10	SS	14		212								
							211								
			11	SS	12										
							210								
			12	SS	7		209				0 0 63 37				
								2.0							
							208								
			13	SS	13										
							207								
			14	SS	14		206								
							205								

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \quad 5}$ (%) STRAIN AT FAILURE
10

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THURBER

RECORD OF BOREHOLE No 13-30 3 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 675.0 E 294 846.0 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.20 - 2014.01.23 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace to some sand, trace gravel Stiff Grey Moist		15	SS	8		204				2 17 52 29
			3	TW	PH		203				
			16	SS	15		202				
199.7							201				
24.7	Very Stiff						200				
			17	SS	18		199				
							198				
196.7							197				
27.7	Silty **CLAY**, trace to some sand, trace gravel Hard Grey Moist (TILL)		18	SS	44		196				0 0 50 50
							195				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 13-30 4 OF 4 METRIC

W.P. P-13-03 LOCATION N 4 881 675.0 E 294 846.0 ORIGINATED BY GA

HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2014.01.20 - 2014.01.23 CHECKED BY KY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace to some sand, trace gravel Hard Brown Moist (TILL)						194				
							193				
			19	SS	103		192		○		0 0 50 50
							191				
190.0							190				
34.4	**SAND**, some silt, trace gravel Very Dense Grey Wet		20	SS	107		189		○		9 79 12 (SI+CL)
188.8											
35.7	END OF BOREHOLE AT 35.7 m. BOREHOLE OPEN TO 35.1 m AND WATER LEVEL AT 3.4 m UPON COMPLETION. Piezometer installation consists of two 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.										

WATER LEVEL READINGS (DEEP):

DATE	DEPTH (m)	ELEV. (m)
Feb 26/ 14	1.0	223.4
Mar 13/ 14	0.8	223.6

WATER LEVEL READINGS (SHALLOW):

DATE	DEPTH (m)	ELEV. (m)
Feb 26/ 14	1.2	223.2
Mar 13/ 14	0.7	223.7

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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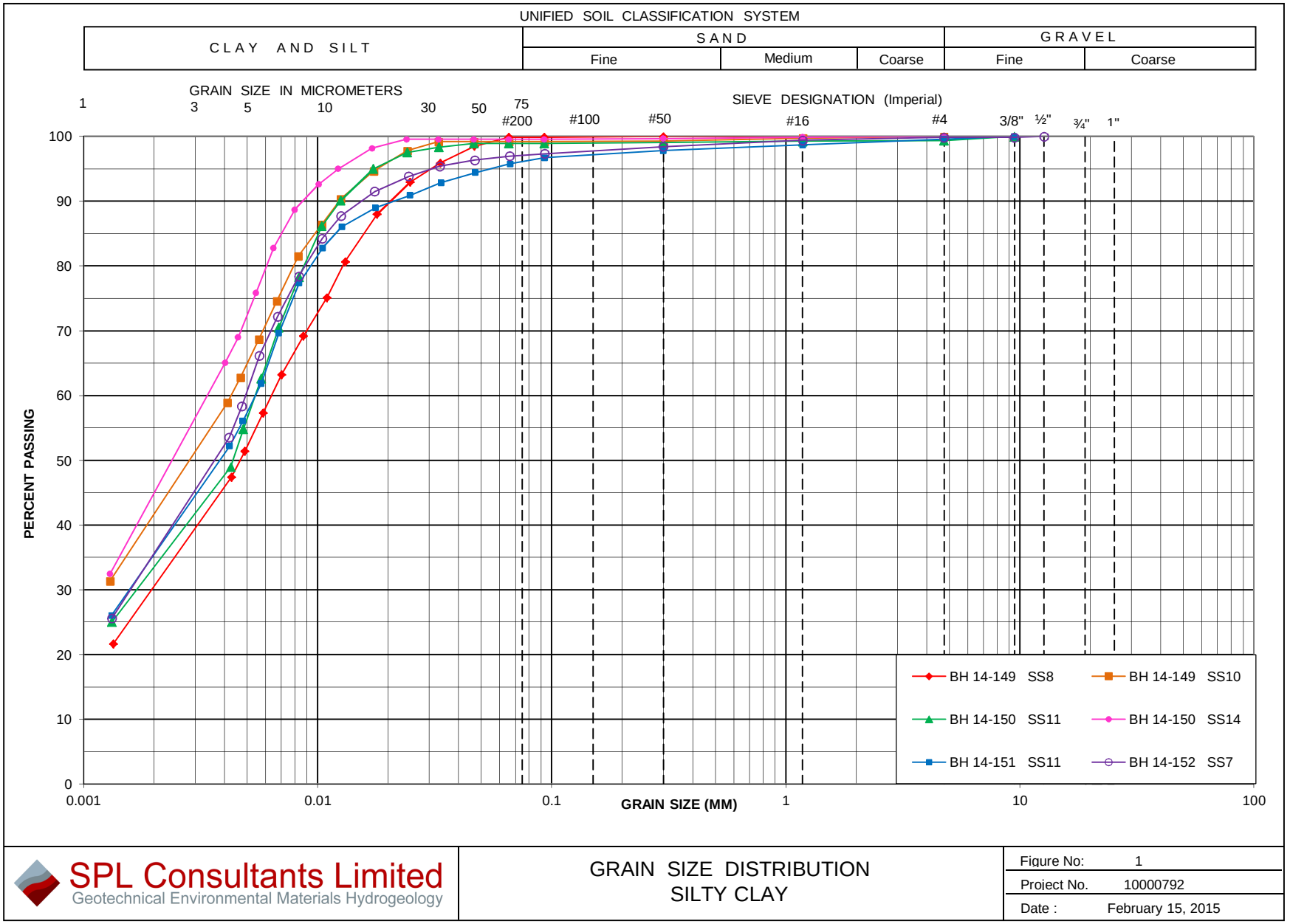
APPENDIX B

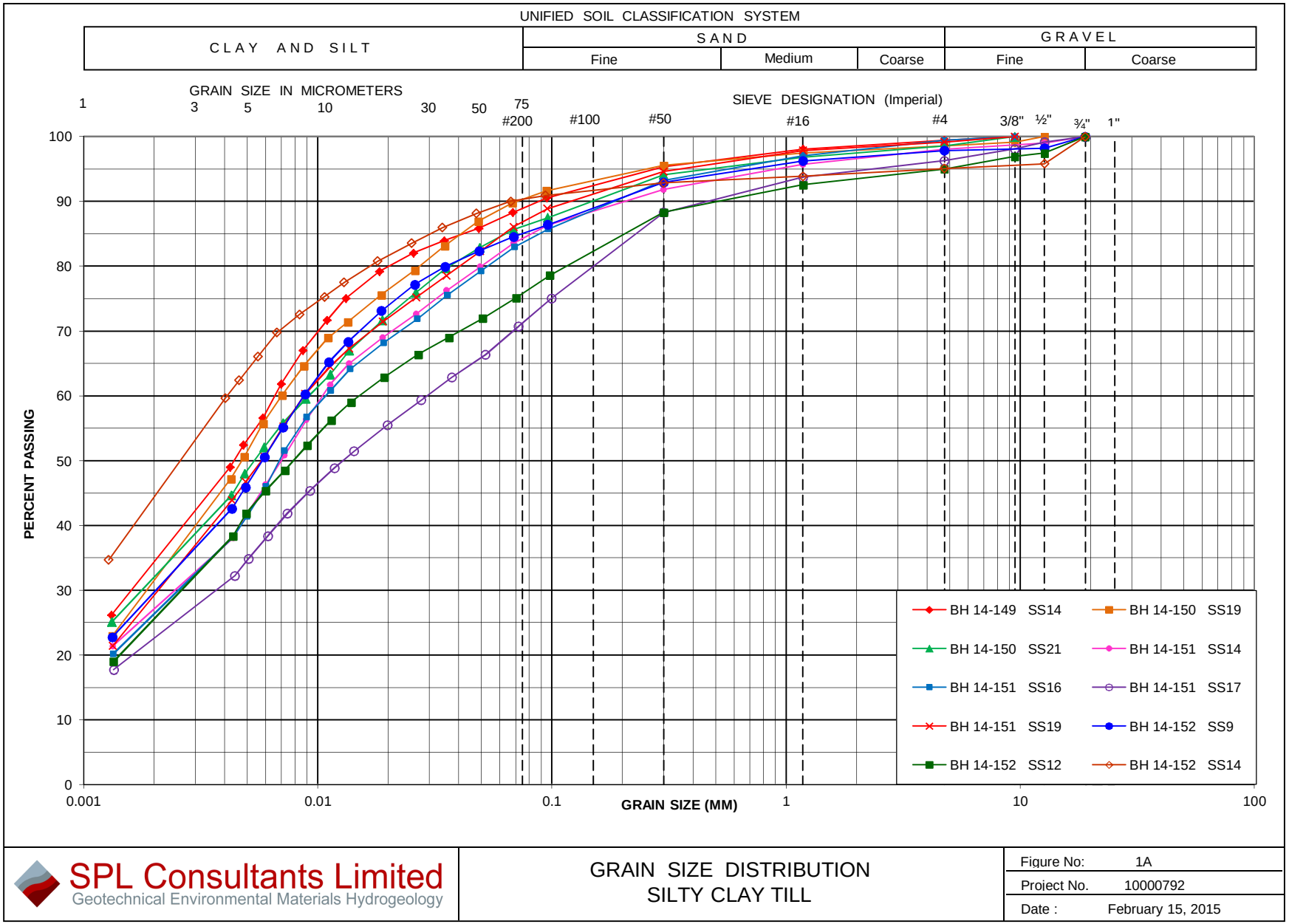
Grain Size Distribution Curves (Figures 1 to 2)
Plasticity Charts (Figures 3 to 4)



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION
SILTY CLAY

Figure No: 1
Project No. 10000792
Date : February 15, 2015



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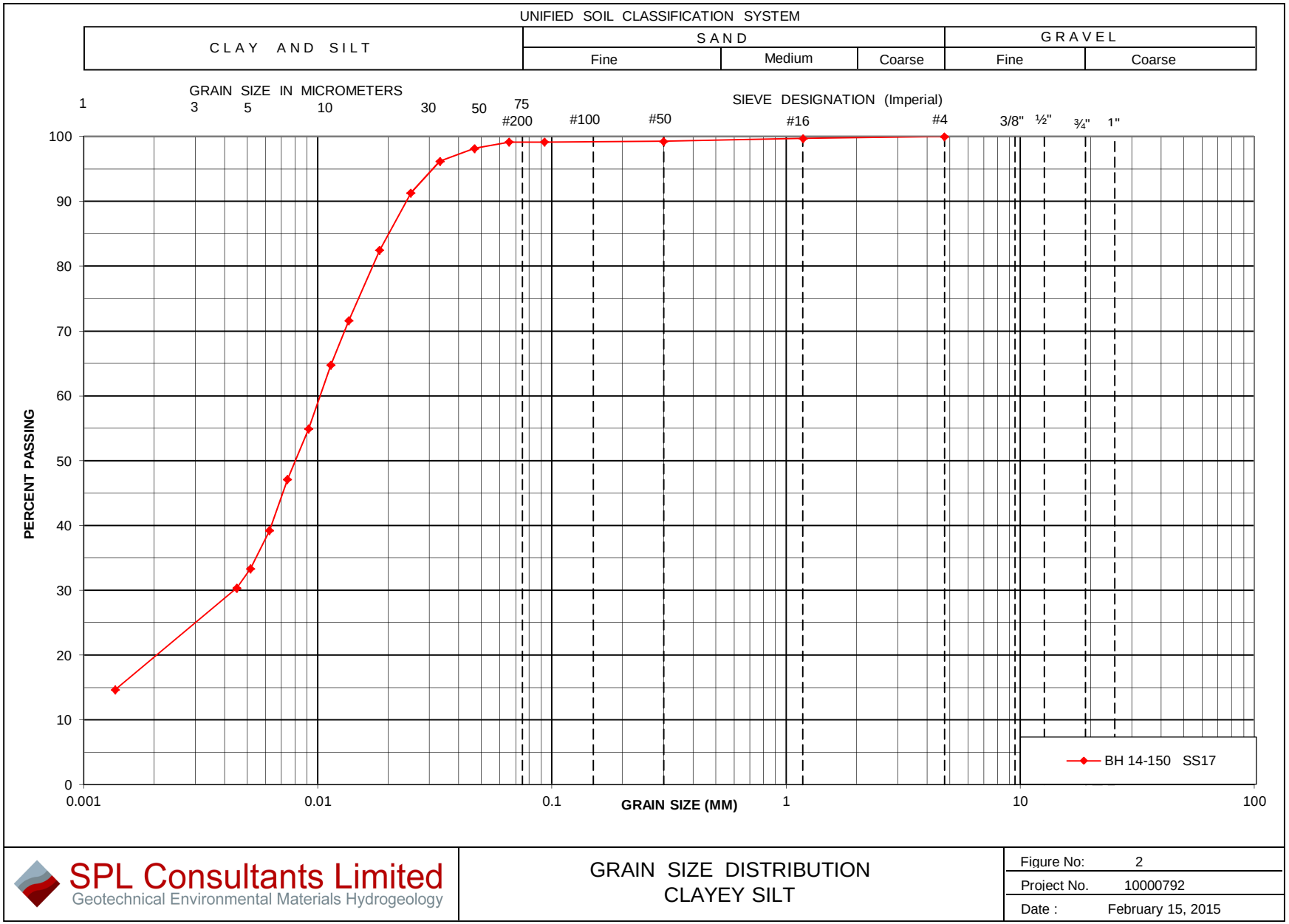
GRAIN SIZE DISTRIBUTION
SILTY CLAY TILL

Figure No: 1A
Project No. 10000792
Date : February 15, 2015



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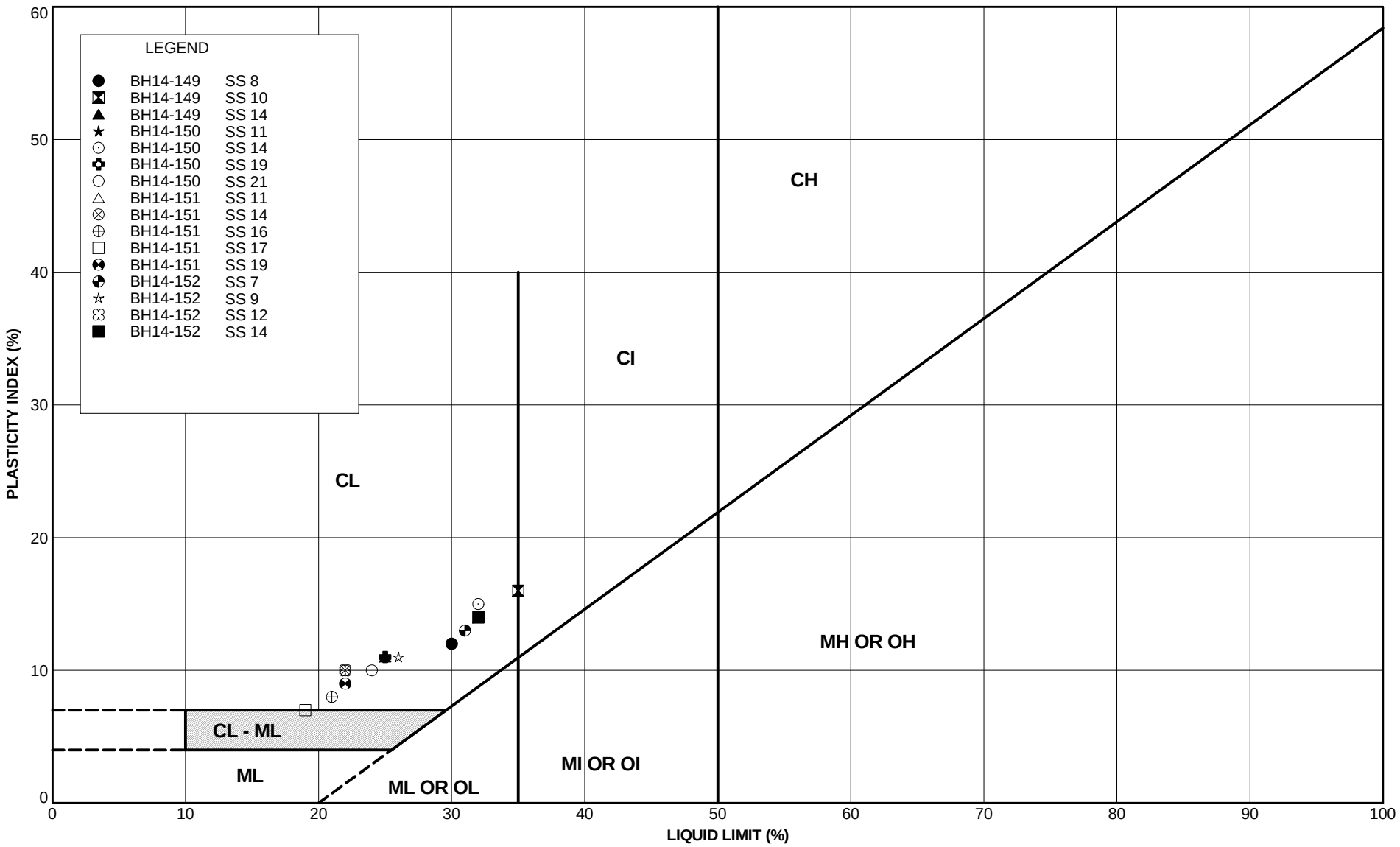
GRAIN SIZE DISTRIBUTION
CLAYEY SILT

Figure No: 2
Project No. 10000792
Date : February 15, 2015

Ministry of Transportation
Ontario

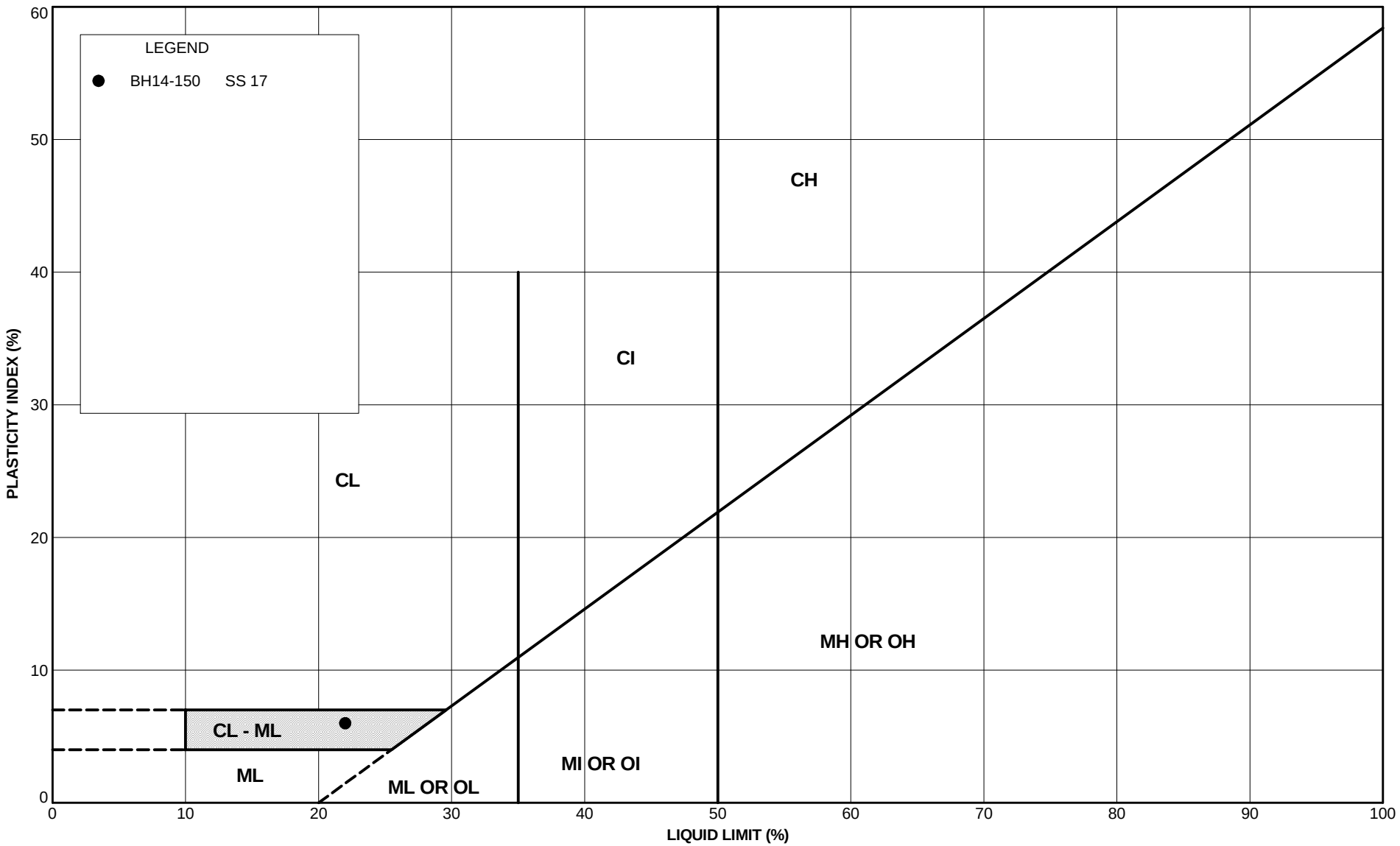


SPL

PLASTICITY CHART
SILTY CLAY

FIGURE NO.	3
JOB NO.	10000792
DATE	February 15, 2014

Ministry of Transportation
Ontario



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PLASTICITY CHART
CLAYEY SILT

FIGURE NO.	4
JOB NO.	10000792
DATE	February 15, 2014

APPENDIX C

Results of Environmental and Chemical Soil Tests

AGAT Laboratories

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CLIENT NAME: **SPL CONSULTANTS**
51 CONSTELLATION COURT
TORONTO, ON M9W1K4
(416) 798-0065

ATTENTION TO: **Dennis Tseng**

PROJECT: **10000792**

AGAT WORK ORDER: **15T941868**

SOIL ANALYSIS REVIEWED BY: **Anthony Dapaah, PhD (Chem), Inorganic Lab Manager**

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

DATE REPORTED: **Feb 12, 2015**

PAGES (INCLUDING COVER): **14**

VERSION*: **1**

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

*NOTES

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

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

Corrosivity Package

DATE RECEIVED: 2015-02-04

DATE REPORTED: 2015-02-12

				SAMPLE DESCRIPTION:	BH14-150 SS15		BH14-151 SS12
				SAMPLE TYPE:	Soil		Soil
				DATE SAMPLED:	1/28/2015		1/28/2015
Parameter	Unit	G / S	RDL	6293855	RDL		6293890
Sulfide	%		0.01	0.09	0.01		0.03
Chloride (2:1)	µg/g	NA	2	32	4		43
Sulphate (2:1)	µg/g		2	24	4		23
pH (2:1)	pH Units		NA	8.28	NA		8.18
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.249	0.005		0.188
Resistivity (2:1)	ohm.cm		1	4020	1		5320
Redox Potential (2:1)	mV		5	247	5		252

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6293855-6293890 * Sulphide analysis was 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

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Certificate of Analysis

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

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

DATE RECEIVED: 2015-02-04

DATE REPORTED: 2015-02-12

		SAMPLE DESCRIPTION:		BH14-150 SS15	BH14-151 SS12
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		1/28/2015	1/28/2015
Parameter	Unit	G / S	RDL	6293847	6293890
Antimony	µg/g	1.3	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	2	1
Barium	µg/g	220	2	131	63
Beryllium	µg/g	2.5	0.5	<0.5	<0.5
Boron	µg/g	36	5	9	6
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.42	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5
Chromium	µg/g	70	2	18	14
Cobalt	µg/g	21	0.5	7.1	4.9
Copper	µg/g	92	1	15	11
Lead	µg/g	120	1	7	5
Molybdenum	µg/g	2	0.5	<0.5	<0.5
Nickel	µg/g	82	1	13	9
Selenium	µg/g	1.5	0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.8	1.1
Vanadium	µg/g	86	1	24	19
Zinc	µg/g	290	5	40	28
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.105	0.188
Sodium Adsorption Ratio	NA	2.4	NA	1.38	0.445
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.97	7.90

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6293847-6293890 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

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Certificate of Analysis

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

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

DATE RECEIVED: 2015-02-04

DATE REPORTED: 2015-02-12

		SAMPLE DESCRIPTION:		BH14-150 SS16	BH14-151 SS13
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		1/28/2015	1/27/2015
Parameter	**Unit**	**G / S**	**RDL**	**6293852**	**6293891**
F1 (C6 to C10)	µg/g		5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA
Moisture Content	%		0.1	21.2	12.8
Surrogate	**Unit**	**Acceptable Limits**			
Terphenyl	%	60-140		110	130

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6293852-6293891 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified without the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

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AGAT WORK ORDER: 15T941868

PROJECT: 10000792

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

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

DATE RECEIVED: 2015-02-04

DATE REPORTED: 2015-02-12

		SAMPLE DESCRIPTION:		BH14-150 SS16	BH14-151 SS13
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		1/28/2015	1/27/2015
Parameter	Unit	G / S	RDL	6293852	6293891
Dichlorodifluoromethane	µg/g	0.05	0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.02	0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	0.25	0.05	<0.05	<0.05
Acetone	ug/g	0.5	0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05
Methylene Chloride	ug/g	0.05	0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	0.05	0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	0.05	0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	0.5	0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	0.05	0.02	<0.02	<0.02
Chloroform	ug/g	0.05	0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	0.05	0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.05	0.05	<0.05	<0.05
Benzene	ug/g	0.02	0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.05	0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.05	0.03	<0.03	<0.03
Bromodichloromethane	ug/g	0.05	0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	0.5	0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04
Toluene	ug/g	0.2	0.05	<0.05	<0.05
Dibromochloromethane	ug/g	0.05	0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	0.05	0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.05	0.04	<0.04	<0.04
Chlorobenzene	ug/g	0.05	0.05	<0.05	<0.05
Ethylbenzene	ug/g	0.05	0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05

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Certificate of Analysis

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

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

DATE RECEIVED: 2015-02-04

DATE REPORTED: 2015-02-12

		SAMPLE DESCRIPTION:		BH14-150 SS16	BH14-151 SS13
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		1/28/2015	1/27/2015
Parameter	**Unit**	**G / S**	**RDL**	**6293852**	**6293891**
Bromoform	ug/g	0.05	0.05	<0.05	<0.05
Styrene	ug/g	0.05	0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05
Xylene Mixture	ug/g	0.05	0.05	<0.05	<0.05
1,3-Dichloropropene	µg/g	0.05	0.04	<0.04	<0.04
n-Hexane	µg/g	0.05	0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8	% Recovery	50-140		90	89
4-Bromofluorobenzene	% Recovery	50-140		89	91

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

6293852-6293891 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

Soil Analysis

RPT Date: Feb 12, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	6293848		<0.8	<0.8	0.0%	< 0.8	101%	70%	130%	94%	80%	120%	99%	70%	130%
Arsenic	6293848		2	2	0.0%	< 1	103%	70%	130%	101%	80%	120%	100%	70%	130%
Barium	6293848		75	76	1.3%	< 2	101%	70%	130%	101%	80%	120%	110%	70%	130%
Beryllium	6293848		0.6	0.6	0.0%	< 0.5	101%	70%	130%	109%	80%	120%	112%	70%	130%
Boron	6293848		5	5	0.0%	< 5	74%	70%	130%	106%	80%	120%	112%	70%	130%
Boron (Hot Water Soluble)	6293962		<0.10	<0.10	0.0%	< 0.10	103%	60%	140%	98%	70%	130%	106%	60%	140%
Cadmium	6293848		<0.5	<0.5	0.0%	< 0.5	107%	70%	130%	102%	80%	120%	110%	70%	130%
Chromium	6293848		16	17	6.1%	< 2	83%	70%	130%	101%	80%	120%	101%	70%	130%
Cobalt	6293848		6.2	6.2	0.0%	< 0.5	88%	70%	130%	98%	80%	120%	91%	70%	130%
Copper	6293848		12	12	0.0%	< 1	91%	70%	130%	107%	80%	120%	99%	70%	130%
Lead	6293848		12	12	0.0%	< 1	114%	70%	130%	103%	80%	120%	107%	70%	130%
Molybdenum	6293848		<0.5	<0.5	0.0%	< 0.5	96%	70%	130%	95%	80%	120%	100%	70%	130%
Nickel	6293848		12	12	0.0%	< 1	93%	70%	130%	97%	80%	120%	93%	70%	130%
Selenium	6293848		<0.4	<0.4	0.0%	< 0.4	121%	70%	130%	100%	80%	120%	102%	70%	130%
Silver	6293848		<0.2	<0.2	0.0%	< 0.2	82%	70%	130%	108%	80%	120%	105%	70%	130%
Thallium	6293848		<0.4	<0.4	0.0%	< 0.4	100%	70%	130%	110%	80%	120%	115%	70%	130%
Uranium	6293848		0.6	0.5	18.2%	< 0.5	104%	70%	130%	102%	80%	120%	108%	70%	130%
Vanadium	6293848		23	24	4.3%	< 1	83%	70%	130%	92%	80%	120%	92%	70%	130%
Zinc	6293848		46	47	2.2%	< 5	100%	70%	130%	98%	80%	120%	100%	70%	130%
Chromium VI	6296254		<0.2	<0.2	0.0%	< 0.2	102%	70%	130%	99%	80%	120%	98%	70%	130%
Cyanide	6293603		<0.040	<0.040	0.0%	< 0.040	91%	70%	130%	96%	80%	120%	92%	70%	130%
Mercury	6293848		<0.10	<0.10	0.0%	< 0.10	111%	70%	130%	91%	80%	120%	99%	70%	130%
Electrical Conductivity	6293847	6293847	0.105	0.109	3.7%	< 0.005	99%	90%	110%	NA			NA		
Sodium Adsorption Ratio	6293847	6293847	1.38	1.10	22.6%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	6293847	6293847	7.97	8.04	0.9%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.

Corrosivity Package															
Sulfide	6293855		0.09	0.10	10.5%	< 0.01	94%	80%	120%	NA			NA		
Chloride (2:1)	6293855	6293855	32	25	24.6%	< 2	90%	80%	120%	98%	80%	120%	103%	70%	130%
Sulphate (2:1)	6293855	6293855	24	22	8.7%	< 2	93%	80%	120%	97%	80%	120%	100%	70%	130%
pH (2:1)	6293855	6293855	8.28	8.32	0.5%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	6293855	6293855	0.249	0.242	2.9%	< 0.005	97%	90%	110%	NA			NA		
Redox Potential (2:1)	6293855	6293855	247	252	2.0%	< 5	95%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

Certified By:

AGAT Laboratories

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

Soil Analysis (Continued)

RPT Date: Feb 12, 2015			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

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS
AGAT WORK ORDER: 15T941868
PROJECT: 10000792
ATTENTION TO: Dennis Tseng
SAMPLING SITE:
SAMPLED BY:D.T.

Trace Organics Analysis

RPT Date: Feb 12, 2015

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - VOCs (Soil)															
Dichlorodifluoromethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	66%	50%	140%	107%	50%	140%	116%	50%	140%
Vinyl Chloride	6297391		< 0.02	< 0.02	0.0%	< 0.02	90%	50%	140%	109%	50%	140%	84%	50%	140%
Bromomethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	103%	50%	140%	109%	50%	140%	113%	50%	140%
Trichlorofluoromethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	99%	50%	140%	106%	50%	140%	120%	50%	140%
Acetone	6297391		< 0.50	< 0.50	0.0%	< 0.50	125%	50%	140%	129%	50%	140%	125%	50%	140%
1,1-Dichloroethylene	6297391		< 0.05	< 0.05	0.0%	< 0.05	118%	50%	140%	120%	60%	130%	117%	50%	140%
Methylene Chloride	6297391		< 0.05	< 0.05	0.0%	< 0.05	112%	50%	140%	106%	60%	130%	124%	50%	140%
Trans- 1,2-Dichloroethylene	6297391		< 0.05	< 0.05	0.0%	< 0.05	117%	50%	140%	130%	60%	130%	121%	50%	140%
Methyl tert-butyl Ether	6297391		< 0.05	< 0.05	0.0%	< 0.05	64%	50%	140%	64%	60%	130%	128%	50%	140%
1,1-Dichloroethane	6297391		< 0.02	< 0.02	0.0%	< 0.02	120%	50%	140%	128%	60%	130%	115%	50%	140%
Methyl Ethyl Ketone	6297391		< 0.50	< 0.50	0.0%	< 0.50	78%	50%	140%	110%	50%	140%	107%	50%	140%
Cis- 1,2-Dichloroethylene	6297391		< 0.02	< 0.02	0.0%	< 0.02	71%	50%	140%	87%	60%	130%	75%	50%	140%
Chloroform	6297391		< 0.04	< 0.04	0.0%	< 0.04	91%	50%	140%	101%	60%	130%	88%	50%	140%
1,2-Dichloroethane	6297391		< 0.03	< 0.03	0.0%	< 0.03	108%	50%	140%	122%	60%	130%	102%	50%	140%
1,1,1-Trichloroethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	89%	50%	140%	107%	60%	130%	84%	50%	140%
Carbon Tetrachloride	6297391		< 0.05	< 0.05	0.0%	< 0.05	59%	50%	140%	67%	60%	130%	57%	50%	140%
Benzene	6297391		< 0.02	< 0.02	0.0%	< 0.02	91%	50%	140%	99%	60%	130%	88%	50%	140%
1,2-Dichloropropane	6297391		< 0.03	< 0.03	0.0%	< 0.03	78%	50%	140%	89%	60%	130%	72%	50%	140%
Trichloroethylene	6297391		< 0.03	< 0.03	0.0%	< 0.03	73%	50%	140%	73%	60%	130%	74%	50%	140%
Bromodichloromethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	67%	50%	140%	75%	60%	130%	62%	50%	140%
Methyl Isobutyl Ketone	6297391		< 0.50	< 0.50	0.0%	< 0.50	86%	50%	140%	88%	50%	140%	84%	50%	140%
1,1,2-Trichloroethane	6297391		< 0.04	< 0.04	0.0%	< 0.04	104%	50%	140%	111%	60%	130%	95%	50%	140%
Toluene	6297391		< 0.05	< 0.05	0.0%	< 0.05	106%	50%	140%	111%	60%	130%	104%	50%	140%
Dibromochloromethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	60%	50%	140%	64%	60%	130%	59%	50%	140%
Ethylene Dibromide	6297391		< 0.04	< 0.04	0.0%	< 0.04	67%	50%	140%	73%	60%	130%	73%	50%	140%
Tetrachloroethylene	6297391		< 0.05	< 0.05	0.0%	< 0.05	98%	50%	140%	97%	60%	130%	94%	50%	140%
1,1,1,2-Tetrachloroethane	6297391		< 0.04	< 0.04	0.0%	< 0.04	69%	50%	140%	62%	60%	130%	73%	50%	140%
Chlorobenzene	6297391		< 0.05	< 0.05	0.0%	< 0.05	103%	50%	140%	104%	60%	130%	100%	50%	140%
Ethylbenzene	6297391		< 0.05	< 0.05	0.0%	< 0.05	89%	50%	140%	92%	60%	130%	88%	50%	140%
m & p-Xylene	6297391		< 0.05	< 0.05	0.0%	< 0.05	85%	50%	140%	86%	60%	130%	86%	50%	140%
Bromoform	6297391		< 0.05	< 0.05	0.0%	< 0.05	60%	50%	140%	60%	60%	130%	52%	50%	140%
Styrene	6297391		< 0.05	< 0.05	0.0%	< 0.05	65%	50%	140%	89%	60%	130%	88%	50%	140%
1,1,2,2-Tetrachloroethane	6297391		< 0.05	< 0.05	0.0%	< 0.05	104%	50%	140%	104%	60%	130%	92%	50%	140%
o-Xylene	6297391		< 0.05	< 0.05	0.0%	< 0.05	83%	50%	140%	90%	60%	130%	85%	50%	140%
1,3-Dichlorobenzene	6297391		< 0.05	< 0.05	0.0%	< 0.05	77%	50%	140%	84%	60%	130%	85%	50%	140%
1,4-Dichlorobenzene	6297391		< 0.05	< 0.05	0.0%	< 0.05	94%	50%	140%	89%	60%	130%	91%	50%	140%
1,2-Dichlorobenzene	6297391		< 0.05	< 0.05	0.0%	< 0.05	85%	50%	140%	88%	60%	130%	82%	50%	140%
1,3-Dichloropropene	6297391		< 0.04	< 0.04	0.0%	< 0.04	58%	50%	140%	69%	60%	130%	63%	50%	140%
n-Hexane	6297391		< 0.05	< 0.05	0.0%	< 0.05	85%	50%	140%	113%	60%	130%	123%	50%	140%

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

Trace Organics Analysis (Continued)

RPT Date: Feb 12, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)															
F1 (C6 to C10)	6296684		< 5	< 5	0.0%	< 5	97%	60%	140%	90%	80%	120%	77%	60%	140%
F2 (C10 to C16)	6294228		< 10	< 10	0.0%	< 10	101%	60%	140%	95%	80%	120%	87%	60%	140%
F3 (C16 to C34)	6294228		< 50	< 50	0.0%	< 50	102%	60%	140%	96%	80%	120%	104%	60%	140%
F4 (C34 to C50)	6294228		< 50	< 50	0.0%	< 50	98%	60%	140%	96%	80%	120%	96%	60%	140%

Certified By:

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Method Summary

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

SAMPLED BY:D.T.

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

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Method Summary

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SAMPLING SITE:

SAMPLED BY:D.T.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P &T GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	GRAVIMETRIC ANALYSIS
Moisture Content	VOL-91-5009	CCME Tier 1 Method, SW846 5035,8015	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

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Method Summary

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T941868

PROJECT: 10000792

ATTENTION TO: Dennis Tseng

SAMPLING SITE:

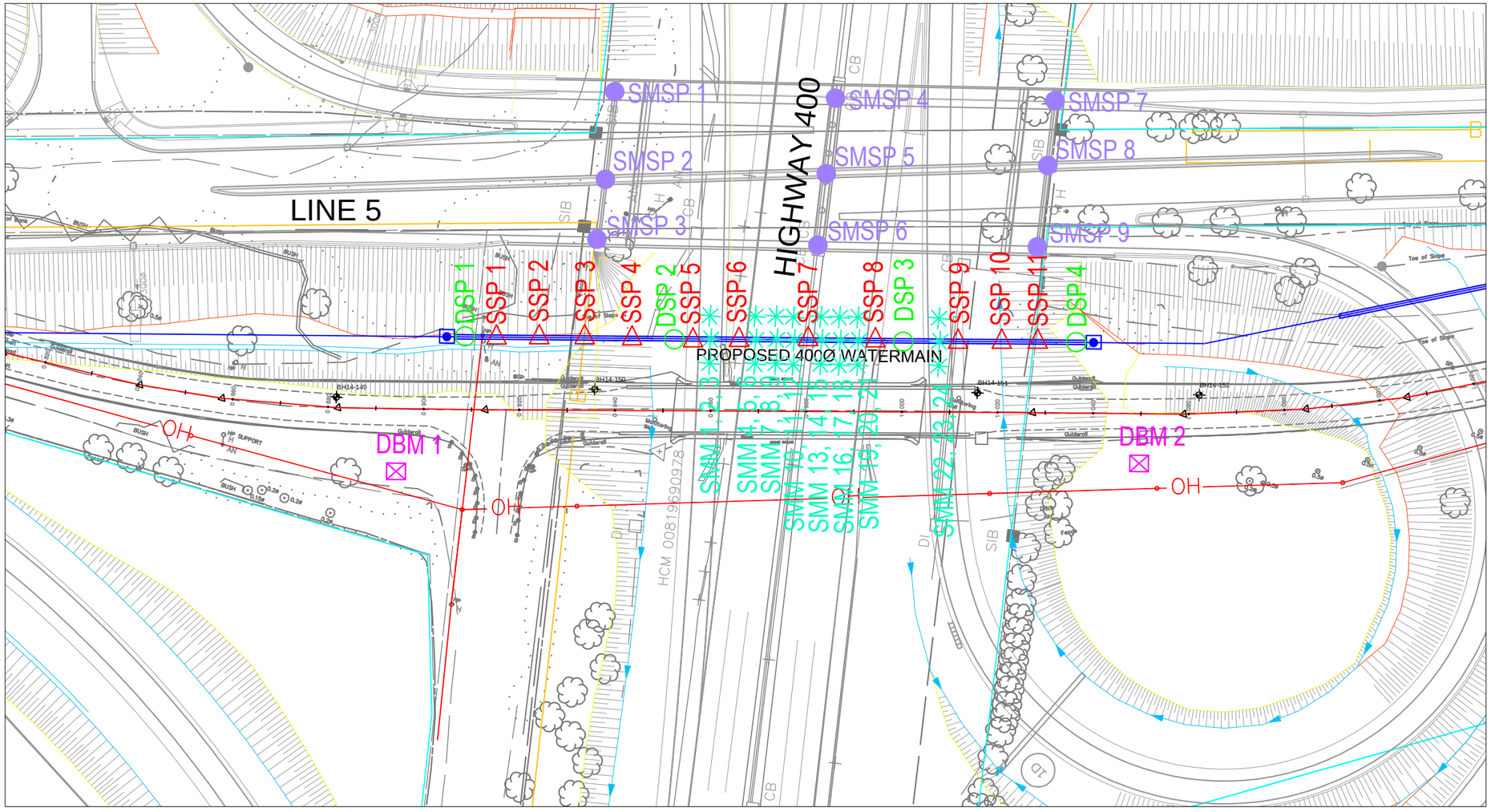
SAMPLED BY:D.T.

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Appendix D

Recommended Layout of Ground Monitoring Arrays (Drawing D1)
Installation Details of Ground Monitoring Arrays (Drawing D2)

METRIC
DIMENSIONS ARE IN METRES
UNLESS OTHERWISE SHOWN



HIGHWAY 400 AT LINE 5
Recommended Layout of
Ground Monitoring Arrays

SHEET

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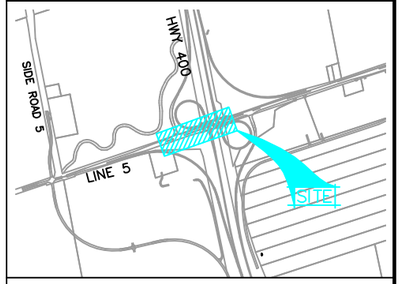

KEY PLAN
NOT TO SCALE

LEGEND

- DBM - Deep Benchmark
- SSP - Shallow Settlement Point
- DSP - Deep Settlement Point
- SMM - Surface Monitoring Marker
- SMSP - Surface Mounted Settlement Point

No	ELEVATION	NORTHING	EASTING

REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No

HWY No 400				DIST	Bradford
SUBM'D DT	CHECKED IL	DATE	Feb 25, 2015	SITE	
DRAWN ZMO	CHECKED IL	APPROVED	IL	DWG	D1

C:\Users\spl\Desktop\792\10000792-Hwy400@Line5-Monitoring Plan-Feb23-2015.dwg Printed: Feb 26, 2015

TYPICAL INSTALLATION DETAILS

HIGHWAY 400 AT LINE 5
Installation Details of
Ground Monitoring Arrays

SHEET

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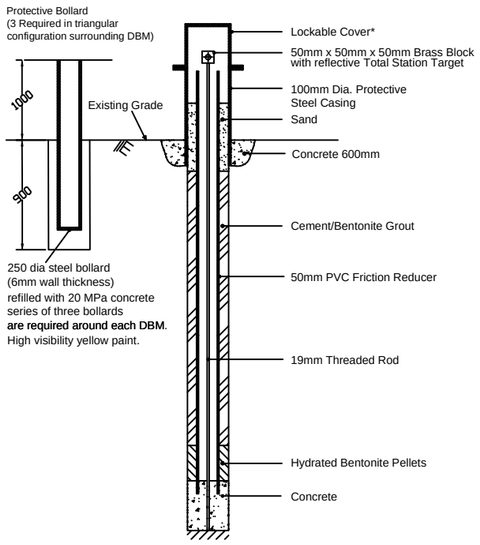
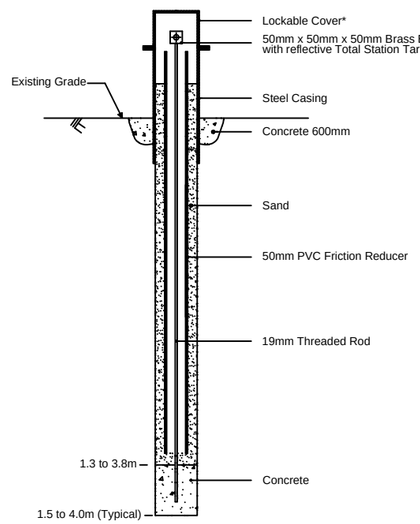
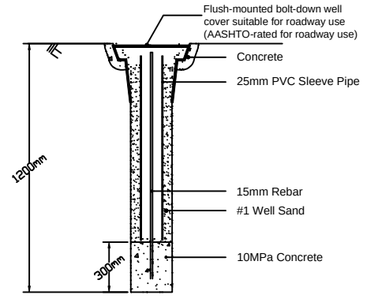
Geotechnical • Environmental • Materials • Hydrogeology



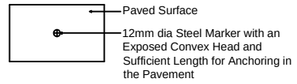
PROPOSED TYPICAL
DEEP SEATED BENCHMARK (DBM)
(DEPTH OF ANCHOR TO BE 5M BELOW SHAFT OR TUNNEL)



PROPOSED TYPICAL
DEEP SETTLEMENT POINT (DSP)
(DEPTH OF ANCHOR TO BE ≥1.5M ABOVE TUNNEL CROWN)
(IN UNPAVED AREA)



PROPOSED TYPICAL
SHALLOW SETTLEMENT POINT (SSP)
(IN UNPAVED AREA)



PROPOSED TYPICAL
SURFACE MONITORING MARKER (SMM)
(IN PAVED AREA)

NOTES: *USE OF ABOVE-GRADE PROTECTIVE CASING IS PERMISSIBLE ONLY OUTSIDE OF THE ROADWAY 'CLEAR ZONE'; ELSEWHERE USE FLUSH-MOUNTED COVERS AS SHOWN IN THE SSP DETAIL ON THIS SHEET.

TABLE 1
MINIMUM MONITORING FREQUENCY FOR DSP, SSP AND SMM

Stage	Frequency	Anticipated No. of Readings per Instrument (**)
Baseline Readings (*)	3 readings on 2 consecutive days	3
Just prior to start of tunnelling	Once	1
During Tunnelling	A minimum of three (3) sets of readings be taken daily for all instruments located within a distance of 20m of the advancing tunnel face, provided that movements are within anticipated limits. Monitoring of movements is also required during work stoppages, such as during non-operation periods (off-shifts) or weekends.	Variable
From completion of tunnelling to completion of main installation	A minimum of one(1) set of readings be taken daily for all instruments, provided that movements are within anticipated limits. Monitoring of movements is also required during work stoppages, such as during non-operation periods (off-shifts) or weekends.	Variable
After completion of main installation	After the end of installation, all instruments shall be read weekly for the first month.	4

(*) Baseline Readings: Instrument elevation readings taken prior to tunnelling to provide a baseline against which all subsequent readings are compared to assess settlements of the ground and embarkments.
(**) Number of readings may vary.

Note:
-The above outline is recommended for all installed monitoring devices, including the Settlement Points.
-Installation Schedule: At least two weeks prior to start of tunnelling, or shaft shoring during installation.
-ACCURACY REQUIRED- DSP/SSP/SMM/SMSP ±1.5mm
- DBM = 0.5mm

SUMMARY OF INSTRUMENTS

	Min. Numbers Required
DBM	**2**
DSP	**4**
SSP	**11**
SMM	**24**
SMSP	**9**

SETTLEMENT CRITERIA:

Definition	Deflection Movement	
Review Level	≥ 6mm for SSP, SMM & DSP ≥ 3mm for SMSP	- Immediately notify Town of Bradford West Gwillimbury, MTO, and the geotechnical engineer for further assessment; Proceed with caution.
Alert Level	≥ 12mm for SSP, SMM & DSP ≥ 7.5mm for SMSP	- Halt tunnelling and stabilize the face. Grout any overcut. Propose a course of action for review and approval by the Town of Bradford West Gwillimbury, MTO and Geotechnical Engineer. Carry out immediate remedial work to the settlement zone as approved by the Town of Bradford West Gwillimbury/ MTO.

NOTES:

Deep Seated Benchmark is to be founded on bedrock minimum of 15m below ground surface and located at least 40m away from the tunnelling alignment.

Locations of instrument shown are approximate. Actual locations to be determined by Contractor's consultant subject to utility locates and line of sight.

Final locations of SMMs to be selected in consultation with MTO.

REVISIONS		
DATE	BY	DESCRIPTION

GEOCRES No

HWY No 400				DIST	Bradford
SUBM'D DT	CHECKED IL	DATE	Feb 25, 2015	SITE	
DRAWN ZMO	CHECKED IL	APPROVED	IL	DWG	D2

\\SERVER\Geotech\10 GeoProjects\1-1000 Projects\10000792 - RFP-14-48 Line 5 and 6 Town of Bradford\Drawings\10000792-Hwy 400@Line5-Detail Monitoring Plan-April07-2015.dwg Printed: Apr 07, 2015

APPENDIX E

Statement of Limitations

LIMITATIONS OF REPORT

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to SPL Consultants Limited at the time of preparation. Unless otherwise agreed in writing by SPL Consultants Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.