McINTOSH PERRY

MEMORANDUM

To: Circle K – Central Canada Division
From: McIntosh Perry Consulting Engineers
Date: April 19, 2021
Re: SPA Submission and Existing Geotechnical Report, 1545 Woodroffe Ave. Ottawa, ON

Introduction

This memorandum is prepared to provide comments on the “Geotechnical Investigation Report, Proposed New Facilities to Existing Gas and Service Station, 1445 Woodroffe Avenue, Ottawa, Ontario”, prepared by Alston Associates Inc. and submitted January 21, 2015 (the Report). This is being conducted in the context of assisting with the application for Site Plan Approval (SPA) to redevelop this property. As part of the SPA process, the City of Ottawa requires a Geotechnical Study and the Alston report is being submitted along with this Memorandum.

The Report has been reviewed and evaluated against the City of Ottawa Guideline for Geotechnical Investigation and Reporting for Development Applications (the Guideline). The Guideline indicates minimum requirements of geotechnical investigation and reporting. However, the geotechnical engineer on record, in this case, Alston, is ultimately responsible for the completeness and accuracy of its report. The City of Ottawa, nor the author of this review, are liable for the accuracy of the Report contents. The purpose of the review is to compare the Report to the minimum requirements in the Guideline.

Compliance Review

The Guideline indicates that each submitted report should address the geotechnical design requirements for the subsurface conditions at the site to support the planned structures, roadways, utilities, or other infrastructure. The geotechnical report can also establish limitations on the site grading, which may be critical to the design of services, roadways, and structures. The Guideline indicates since geotechnical engineering involves analysis and design using natural materials, there are many uncertainties. It is therefore a common practice to provide geotechnical inspection and testing during construction so that the conditions at the site can be confirmed with regard to the findings of the original investigation.

As per the Guideline, the proposed project falls under “Commercial Retail Development”. The following is a brief review to confirm the Report includes all that critical information requested by the Guideline and applicable to the proposed project. Based on our previous experience with the City of Ottawa review process, each geotechnical report is reviewed to ensure the following information is provided.

General Report Requirements

- **Professional Engineer Stamp:** provided
- **Suitability of the site for the proposed development:** the report, in general, emphasizes the site is suitable for development.
- **Cause of adverse effects or aggravated hazard due to the proposed development:** <u>this is not discussed in the report</u>
- **Codes and standards are listed in the report:** references are provided throughout the report either in the text or appendices. However, it is prudent to catalog all laboratory testing references and design references in a concise listing to ensure it passes the City of Ottawa review process.
- **The extent of the investigation shall meet the Guideline:** the extent of investigation meets the Guideline requirements
- **The minimum requirement for borehole spacing requirement for "Individual Buildings" is 30 to 50 m:** borehole spacing meets requirements
- **The minimum requirement for depth of investigation is 2 to 3 times of the footing width for shallow foundation systems, or 6 to 7 m for low-rise buildings or once the glacial till is encountered:** provided
- **Sampling interval:** meets the Guideline recommendations

Factual Geotechnical Report

- **A description of the site location, current land use:** provided on page 1
- **Description of site terrain and topography:** no topography, borehole logs include ground elevation, a site plan with borehole locations are provided in Appendix B. Again, borehole surface elevations are given in a table included in section 4.4 on page 4. This should satisfy the Guideline requirements.
- **Adjacent land uses should also be discussed, if relevant to the proposed works, or if there is a potential for impacts (e.g., potential settlements, or if shoring or underpinning are required):** Adjacent land uses are briefly labeled on the site plan included in Appendix B. <u>Excavation or dewatering effects on adjacent properties are not discussed.</u>
- **If significant excavations will be required (e.g., for basement levels), these should also be described:** expectations for excavation condition are discussed in section 5.3.
- **A discussion of existing geotechnical information for the site or geologic mapping:** <u>no discussion on existing information, no surficial geology or physiography reference, no well record reference.</u>

- **A description of the subsurface investigation procedure (e.g., borehole drilling, sampling and in situ testing, laboratory testing, and groundwater level measurement):** surface and subsurface conditions are described in section 4 of the report. In section 4.5.1 the substratum is defined as "Silty Clay", however, the grain size analysis indicates 13% sand, 57% silt, and 30% clay. It is unknown what soil description method is used in this report. The undrained shear strength is picked based on DMT results vs. vane shear test results which seems to be a resorbable approach. This review does not comment on the accuracy of the results. The description of the sand layer seems to match the field investigation results.
- **A summary of the subsurface conditions on the site and the results of the in situ and laboratory testing:** provided
- **A scaled plan showing the site and the locations of the boreholes:** provided
- **Drawings or tables showing the findings of the investigation (i.e., borehole and test pit logs, with elevations):** several tables and graphs are provided, such as borehole summary, groundwater summary table, borehole logs, in-situ test results, and laboratory test results.
- **Drawings or tables showing the factual results of the laboratory testing:** included in the Appendices
- **Groundwater level:** given in section 4.6

Design recommendation components

- **Limit of excavation, slope stability:** not applicable to this site, however, the Report does not mention irrelevance of slope stability check.
- **Excavation dewatering:** expected groundwater flow and dewatering needs are discussed in section 5.3.
- **Foundation Design recommendations, geotechnical resistance:** footing sizes, geotechnical resistance at ULS and SLS, and expected settlements are provided. The foundation level is not clear and can be subject to interpretations. Recommendations are given for slab-on-grade design and construction.
- **Soil chemical condition, corrosion potential, cement type:** sulphate and pH are tested, and cement type recommended in section 5.7. Corrosivity potential is not discussed.
- **Seismic site classification, liquefaction potential:** seismic site class is recommended in section 5.6. Liquefaction potential is not discussed.
- **Impact of excavation on adjacent structures:** no discussion on the adverse effects of construction on adjacent properties.
- **Earthwork and quality control for construction:** provided

- **Site grading and grade raise limitations:** some assumptions on potential grade raise are mentioned in the report, however, there are no clear comments on the limits of grade raise and the adverse effects of grade raise on the existing or proposed structures.
- **Recommendations for installation of utilities:** missing, no recommendation on utility pipe bedding and backfill.
- **Frost protection:** Recommendations are given in section 5.1
- **Pavement design:** given in section 5.4 of the report
- **Slope stability:** not applicable to this site, no mentions in the report.

It is noted that the Phase I and II environmental site assessment (ESA) reports deal with groundwater and geology issues.

Closure

This memorandum provides a non-technical review for the sole purpose of a development application to the City of Ottawa. The author has tried to refrain from making engineering comments, opinions, or judgments. This review does not relieve the authors of the Geotechnical Report from their liability. The accuracy of the recommendations is solely on the Report authors. This review is prepared based on our experience with the City of Ottawa approval process. Each geotechnical report is compared with the Guideline. The underlined items are those which may be listed in the City comments and may require further information and correction and resubmission process. Some of the underlined items might be even included, or implied, in the report.

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alston associates inc.
consulting engineers

geotechnics
construction materials testing

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED NEW FACILITIES TO EXISTING GAS AND SERVICE STATION

1545 WOODROFFE AVENUE,

OTTAWA, ONTARIO

Report Ref. No. 14-140
January 21, 2015

Prepared For:
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APPENDICES

1 INTRODUCTION

Alston Associates Inc. (**AAI**) has been retained by Parsons Canada Ltd. (Parsons) to carry out a geotechnical investigation for reconstruction of an existing gasoline service facility located at 1545 Woodroffe Avenue in the City of Ottawa, Ontario. Authorization to proceed with this study was given by Laila Chalati of Parsons.

We understand that it is proposed to demolish the existing restaurant, car wash and C-store buildings and pump island at the site, and re-construct the C-store, car wash and pump island at new locations as shown on Parsons's drawing No. A, titled "*Site Plan with Proposed Structures*" dated December 3, 2014 (attached in Appendix B). A garage enclosure will also be installed adjacent to the new C-store. It is assumed that the existing underground gas storage tank nest is to remain in place.

It was requested by Parsons that eight (8) boreholes be advanced at the site to evaluate the geotechnical conditions at the locations of the proposed structures. Parsons advanced several additional boreholes at the property for environmental investigation purposes; their findings is not included in this report.

The purpose of this study was to determine the subsurface data developed at the locations of the proposed structures, and based on those data, characterize the underlying soil and groundwater conditions, determine the relevant geotechnical properties of encountered soils and provide recommendations on the geotechnical aspects for the design of the foundations and the implementation of the project as outlined above.

This report presents the results of the investigation performed in accordance with the general terms of reference outlined above and is intended for the guidance of the client and the design engineers only. It is assumed that the design will be in accordance with the applicable building codes and standards.

2 FIELDWORK

A representative from Parsons arranged locates of buried services and effected the drilling program.

The geotechnical fieldwork was carried out from December 10 to 13, 2014 under the supervision of an experienced field technician from **AAI**. The locations of the boreholes were determined by Parsons. Six (6) boreholes, numbered 303 through 308, were advanced to evaluate the geotechnical conditions at the locations of the proposed structures. Two (2) boreholes, located at the proposed C-Store and car wash, were deleted from the geotechnical investigation program as directed by Parsons.

The boreholes were advanced to depths ranging from 6.5 to 14 m below ground surface (mbgs). Monitoring wells were installed in Boreholes 303, 305, 306 and 308 by Parsons. The ground surface elevations at the locations of these four boreholes were provided to **AAI** by Parsons. The ground surface elevations at the locations of Boreholes 304 and 307 were assumed to be similar to the elevations of the closest boreholes; Boreholes 309 and 306 respectively, established by Parsons.

The locations of the boreholes, and the existing and proposed structures are shown on two Plans prepared by Parsons enclosed in Appendix B.

All boreholes were first excavated to a depth of at least 2.4 mbgs using hydro-vac; an excavation requirement by Imperial Oil Limited. The boreholes were then advanced using hollow stem augers.

Standard Penetration Tests (SPT) were carried out in the course of advancing the boreholes to take representative soil samples and to measure penetration index (N-values) to characterize the condition of the various soil materials. The number of blows of the striking hammer required to drive the split spoon sampler to 300 mm depth was recorded and these are presented on the borehole log sheets as penetration index values.

Dynamic cone penetration tests (DCPT) were performed below the sampling depths in Boreholes 303, 304, 305 and 306, as well as by advancing another borehole (numbered 308B) adjacent to 308. The purpose of performing the DCPT was to measure the penetration resistance of the soils at lower horizons below the borehole sampling depths. The DCPT was performed from 8.2 to 13.9 m in Borehole 303, 6.7 to 14 m in 304, 8.2 to 12.5 m in 305, 6.7 to 10.4 m in 306, and 2.8 to 14 m in 308B.

Field vane shear tests were carried out in the native clay soils; in Borehole 304 as well as by advancing another borehole (numbered 305B) adjacent to 305. The vane tests provided an in situ measurement on the undrained shear strength of the clay soil unit.

Results of the SPT, DCPT and vane shear tests are shown on the borehole logs enclosed in Appendix C.

Three (3) thin walled Shelby tubes were driven into the clay soil in Borehole 305B; at 3.8, 4.5 and 5.3 mbgs.

The subsurface soil information from Boreholes 305, 306 and 308 is complemented by the results of three soundings carried out adjacent to these boreholes. A Marchetti Flat Dilatometer (DMT) is used to measure the in situ properties of the various soil strata. The DMT consists of a thin blade shaped probe that incorporates a pressure cell. The probe is advanced into the ground at 200 mm depth increments; the pressure cell is activated at each increment to measure the enclosing soil pressure and the additional pressure required to cause deformation in the enclosing soils. From these two direct operator independent measurements are interpreted to give values of geotechnical parameters such as angle of internal friction or undrained shear strength, unit weight, coefficient of at rest earth pressure and deformation modulus, as well as providing an interpretation of the engineering behaviour of the soil materials under test.

DMT305 was positioned at a distance of 4 m east of Borehole 305, advanced from 2.8 to 9.4 mbgs; DMT306 was positioned 2 m north of 306, advanced from 2.8 to 8 mbgs; DMT308 was positioned 4 m east of 308, advanced from 3 to 7 mbgs. The DMT soundings and results are enclosed in Appendix D.

Groundwater level observations were made in the open boreholes upon completion of advancement. The groundwater levels in the monitoring wells were measured by Parsons on December 15, 2014.

3 LABORATORY TESTS

The soil samples recovered from the split spoon sampler were properly sealed, labelled and brought to our laboratory. They were visually classified and water content tests were conducted on all soil samples retained from Boreholes 305 and 308. The results of the classification and water contents are presented on the borehole logs attached in Appendix C of this report.

Grain-size analyses were carried out on two (2) soil samples; Atterberg Limits tests on one (1) clay soil sample. One undisturbed clay soil sample was subjected to one-dimensional consolidation test. The results of the laboratory tests are presented in Appendix E as Figures E-1 through E-4.

In addition, two (2) soil samples were submitted to AGAT Laboratories for chemical analysis for pH and soluble sulphate. The results of these tests are enclosed in Appendix F; discussed in Section 5.6 of this report.

4 SUBSURFACE CONDITIONS

Details of the subsurface conditions contacted in the geotechnical boreholes are given on the individual borehole logs enclosed in Appendix C. A brief description of the soil units and groundwater conditions are given in the following subsections.

It should be noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design, and therefore, should not be construed as exact planes of geological change.

4.1 Site Description

The site is located on the northeast corner of the intersection of Woodroffe Avenue and Medhurst Drive in the City of Ottawa, and has the municipal address of 1545 Woodroffe Avenue. It is bounded by residential developments to the north and east.

The site currently operates as a gas and service station for cars and light trucks. A restaurant (Tim Hortons) is located in the northeast part of the property; a car wash facility in the southeast part. Other on site structures include a C-store and a pump island covered by canopy; positioned in the southwest part of the site. An underground gas storage tank nests is located close to the southwest frontage of the property.

The site cover is generally asphaltic concrete, except the northwest section and the south frontage are landscaped and covered by grass. Several trees outline the north and east property boundaries.

The ground surface topography of the site is relatively level.

4.2 Topsoil

Topsoil is present in Boreholes 303, 305 and 308. The thickness of topsoil at the borehole locations approximates 300 mm. It should be noted that the thickness of topsoil will vary between the boreholes.

4.3 Asphaltic Concrete Pavement

At the location of Boreholes 304, 306 and 307, the thickness of the asphaltic concrete layer ranges from 60 to 90 mm. The granular fill soil supporting the asphaltic concrete is about 360 mm thick; measured at the location of Borehole 304.

4.4 Fill Materials

The boreholes revealed that fill materials are present below the topsoil in Boreholes 303, 305 and 308 as well as below the asphaltic concrete pavement in the remaining boreholes.

The fill materials generally consist of sandy silty clay with trace of gravel, and with inclusions of large crushed rock with sizes ranging up to 200 mm (classified as cobbles); locally greater than 200 mm (classified as boulders).

The following table summarizes the approximate thicknesses and base elevations of the fill materials at the location of the boreholes.

Borehole	Ground Elevation (m)	Approximate Depth of Fill Materials (mbgs)	Bottom Elevation of Fill Materials (m)
303	100.12	3.1	97.02
304	99.58	2.5	97.08
305	100.16	2.8	97.36
306	99.92	2.7	97.22
307	99.92	2.4	97.52
308	100.05	2.8	97.25

The water content of the fill samples ranged from approximately 10 to 61% by weight. It is probable that the high water contents in the fill samples are due to soil wetting from the borehole excavation using hydro vacuum method.

4.5 Native Soils

4.5.1 Silty Clay

The fill materials rest on a deposit of silty clay with trace to some sand. The clay soil is wet, grey in colour and occasionally includes silt seams.

The thickness of the silty clay varies within the site area, ranging from approximately 2 m in Borehole 304 to 4 m in 305. Based on the borehole findings, the thickness of the clay soil increases from the west to the east.

Standard Penetration Resistance in the clay unit provided N-values ranging from 0 to 4, indicating soft to firm consistency.

Vane shear tests were carried out in the clay unit in Boreholes 304 and 305B. The undrained shear strength (Su) of the tested clay soils were measured to be in the range of 89 KPa to 123 KPa.

Interpretation of the DMT data indicates that the silty clay has Su in the range of 15 to 33 kPa; generally between 20 to 25 kPa. The high Su values as derived from the field vane shear tests are considered unrepresentative of the condition of the clay soil encountered.

Sieve and hydrometer analyses, as well Atterberg Limits test, were carried out on one (1) representative silty clay sample obtained from Borehole 305 at 3.8 m depth (Sample 5). The test revealed that the clay unit consists of 13% sand, 57% silt and 30% clay. Atterberg Limits test revealed that the Liquid Limit of the soil is 24%, the Plasticity Index is 8.4. Using the plasticity diagram as shown on Figure 3.1 of the CFEM 4th Edition, the silty clay is classified as "*inorganic clays of low plasticity*". The test results are enclosed in Appendix E as Figures E-1 and E-2.

One-dimensional consolidation test carried out on the clay soil from Borehole 305B revealed that the tested sample has an initial void ratio of 1.459; the Compression Index (Cc) is estimated to be 0.13; the pre-consolidation pressure (Pc') is about 100 kPa. The Pc' value provides an indication regarding the maximum effective stress to which the clay soil unit has been consolidated by previous loading. The test result is presented on the Consolidation Test Report as Figure E-3.

The water content of the samples of the silty clay ranged from approximately 22 to 49% by weight.

Based on the grain size distribution test result, the Coefficient of Permeability (k) of the silty clay is estimated to be less than 1 x 10^{-7} cm/sec.

4.5.2 Sand

Beneath the silty clay soil, the boreholes contacted a deposit of sand with trace silt and trace gravel. Based on our field observations, the sand deposit is water bearing.

SPT carried out in the sand unit measured N-values ranging from 0 to 23; very loose to compact soil condition.

Sieve analysis was carried out on one (1) representative sand sample obtained from Borehole 307 at 6.1 m depth (Sample 8). The test revealed that the soil consists of 4% gravel, 92% sand and 4% silt and clay. The laboratory test result is enclosed in Appendix E as Figure E-4.

Based on the grain size distribution test results, the Coefficient of Permeability (k) of the sand soil is estimated to be 6.1 x 10^{-2} cm/sec; corresponding to medium relative permeability.

It is inferred that the sand stratum extends below the sampling depths of the boreholes. DCPT that were performed in Boreholes 303, 304, 305, 306 and 308B revealed that the penetration index values of the soil increases with depth; generally greater than 15 blows (per 300 mm penetration) below an approximate depth of 9 m in Boreholes 303, 305 and 308B and below 7 m in Boreholes 304 and 306. Higher penetration index values in excess of 50 were measured in the boreholes at greater depths; between 11 and 12 mbgs.

Based on the DCPT results, the indications are that the upper zone of the sand soil has a loose compactness condition; becoming compact and changing to very dense condition with increasing depths. The dynamic cone was driven to refusal below approximately 12.5 mbgs in Borehole 305, and 14 mbgs in Boreholes 303 and 304.

Interpretation of the soil deformation parameters by DMT shows that the sand soil is characterized by a friction angle (phi) which ranges from 28 to 42°; loose to dense compactness condition in this regard.

4.5.3 Bedrock

DCPT soundings were advanced to refusal at depths ranging from 12.5 to 14 mbgs at BH303, BH304, and BH305. On this basis, and on the basis of borehole findings at vicinal sites, bedrock is anticipated to be situated at an approximate depth of 14 mbgs.

4.6 Groundwater

Groundwater measurements were made in the monitoring wells installed in Boreholes 303, 305, 306 and 308; by Parsons on December 15, 2014. The groundwater monitoring results as provided by Parsons are shown in the following table.

Borehole	Ground Elevation (m)	Depth of Groundwater (m)	Groundwater Elevation (m)
304	99.58	4.96	94.62
305	100.27	4.09	96.18
306	99.92	5.32	94.60
308	100.05	4.08	95.97

Using the groundwater level monitoring results, the indications are that the groundwater flow at the site is in an approximately northeast to southwest direction.

It should be noted that groundwater levels are subject to seasonal fluctuations. A higher groundwater table condition will likely develop in the spring and following significant rainfall events.

5 DISCUSSION AND RECOMMENDATIONS

The following discussions and recommendations are based on the factual data obtained from the boreholes advanced at the site by **AAI** and are intended for use by the client and design engineers only.

Contractors bidding on this project or conducting work associated with this project should make their own interpretation of the factual data and/or carry out their own investigations.

The investigation has revealed that below the surficial topsoil layer or asphaltic concrete pavement, the subsurface soil comprises of fill materials extending to about 2.5 to 3 mbgs, underlain by native soil consisting of soft to firm silty clay, followed by loose becoming compact to very dense sand deposit. On the basis of our fieldwork, laboratory tests and other pertinent information supplied by the client, the following comments and recommendations are made.

It should be understood that the comments are to be considered preliminary, and should be reviewed by **AAI** before the detailed design are finalized.

5.1 Foundation Design

In order to provide adequate protection to the foundation soil from freezing temperatures, the exterior foundations should be positioned at a minimum depth of 1.8 m below the exterior grade; for the City of Ottawa area. In this regard, foundations for the proposed car wash, C-Store and canopy structures should be installed at/below the required frost depth.

Assuming that there will be very minor changes in site grades, the foundations for the proposed structures will be positioned within the lower section of the fill materials; providing a crust of about 0.7 to 1.2 m above the silty clay stratum.

It will be possible to utilize conventional spread and wall footings to support the new structures, provided that the foundation design is based on a low value of applied soil bearing pressure.

Using a presumed bearing pressure of 50 kPa and based on the data determined from DMT, it is estimated that the foundations will experience some settlements predominantly derived from the silty clay stratum. The predicted settlements at the location of the proposed structures are tabulated below. The analyses are based on an assumed footing dimension of 2 m by 2 m for the proposed C-Store, 2.5 m by 2.5 m for the proposed canopy, and a width of 1.2 m for the wall footings. It is also assumed that the foundation for the proposed car wash will utilize wall footing only.

Proposed Structure	Predicted Settlement (mm)		
	Pad Footing (2 m x 2 m)	Pad Footing (2.5 m x 2.5 m)	Wall Footing (1.2 m width)
C-Store	10	Not analysed	13
Canopy	Not analysed	25	Not analysed
Car Wash	Not analysed	Not analysed	25

On the basis of settlement analyses, it is recommended that the footing foundations be designed for bearing resistance at Serviceability Limit States (SLS) of 50 kPa, and a factored geotechnical resistance bearing resistance at Ultimate Limit States (ULS) of 75 kPa, for vertical and centric loads.

Considerations may be given to insulating the proposed footings. The advantage of using artificial thermal insulation is that the minimum frost protection (1.8 m in depth) will not be required, thereby reducing the excavation depth accordingly. In the event this option is favored, it is possible that a slightly higher soil bearing resistance values may be used. **AAI** would be pleased to provide additional recommendations regarding this option, if so required.

During construction, it will be necessary to proof-roll the subgrade soil at the footing foundation level(s). Any soft fill areas should be sub-excavated and replaced with engineered fill placed in lifts not exceeding 200 mm in thickness and compacted to at least 98% of the material's Standard Proctor Maximum Dry density (SPMDD). As the fill materials contain large size cobbles and boulders, care will be required to minimize over-excavation of the fill soils. In this regard, it is recommended that a mud slab (lean concrete) be placed to fill the depressions below the foundation base, as well as to provide a smooth bearing surface.

The pump island will be constructed with canopy. Uplift resistance should be considered for the design of the canopy structure which is subject to wind uplift forces. The uplift resistance should be provided using the dead weight of the foundation as well the soil weight above the footing of the canopy structures. For design purposes, the unit weight of concrete may be taken as 24 kN/m^3 and the backfill placed above the footings is 18 kN/m^3. If increased uplift capacities are required, this may be achieved by increasing the weight (size) of the foundation, or alternatively, with the use of anchors such as helical piles. Provisions should be made in the excavation and/or helical pile installation contract for the removal of the cobbles and boulders.

In the event the recommended soil bearing capacity is not sufficient to support the proposed structures, then it will be necessary to utilize deep foundations systems such as helical piles or driven piles to support the proposed structures. Based on the DCPT results, it is anticipated that the helical piles will have to be advanced to about 10 mbgs; driven piles to about 14 mbgs. For preliminary purposes, it may be assumed that factored load capacities of about 250 KN and 1000 kN may be obtained from helical pile and driven pile foundation systems. **AAI** will provide further recommendations should a deep foundation system is preferred.

Due to variations in the consistency of the founding soils and/or softening caused by excavation disturbance and/or seasonal frost effects, all footing subgrade must be evaluated by the Geotechnical Engineer prior to placing foundation concrete to ensure that the soil exposed at the excavation base is consistent with the design geotechnical bearing resistance.

5.2 Concrete Slab-on-Grade

The subgrade at the floor slab for the proposed C-Store and car wash should consist of compacted fill soil which is adequate to support a slab-on-grade construction. Subgrade preparation should include the removal of any weak, loose or soft soils. After removal of all unsuitable materials, the subgrade should then be proof-rolled with heavy rubber tired equipment. The proof-rolling operation should be witnessed by the Geotechnical Engineer. Any soft or wet subgrade areas which deflect significantly should be sub-excavated and replaced with suitable approved earth fill material compacted to at least 98% of SPMDD.

Where new fill is required, excavated fill materials from the site or similar clean imported fill material may be used, free from topsoil, organic or deleterious matter provided the material is placed in large areas where it can be compacted with heavy compactors. Oversize particles (cobbles, boulders) larger than 150 mm should be discarded from the fill material. The fill material should not be frozen and should not be too wet for efficient compaction (water content at optimum or 2 percent greater than optimum). The fill placement should not be performed during winter months when freezing temperatures occur persistently or intermittently. All fill placed below the slab on grade areas of the buildings must be placed in lifts of 200 mm thickness or less.

It is recommended that a combined moisture barrier and a levelling course, having a minimum thickness of 150 mm and comprised of free draining material such as Granular "A" be provided as a base for the slab-on-grade. The base material should be compacted to 98% of its SPMMD. Alternatively, 19 mm clear stone (OPSS 1004) may be used and compacted by vibration to a dense state, with filter fabric separating the clear stone and the subgrade soils.

Provided the subgrade, under-floor fill and granular base are prepared in accordance with the above recommendations, the Modulus of Subgrade Reaction (Ks) for floor slab design will be 20,000 kPa/m.

The soils at the site are susceptible to frost effects which would have the potential to deform hard landscaping adjacent to the building. At locations where the new structures are expected to have flush entrances, care must be taken in detailing the exterior slabs / sidewalks, providing insulation / drainage / non-frost susceptible backfill to maintain the flush threshold during freezing weather conditions.

5.3 Excavations and Groundwater Control

Based on the field results, temporary excavations for the new structures are not expected to pose any unusual difficulty. Excavation of the soils at this site can be carried out with heavy hydraulic excavators.

All excavations must be carried out in accordance with Occupational Health and Safety Act (OHSA). With respect to OHSA, the fill materials are expected to conform to Type 3 soil classification. The very soft to soft silty clay deposit is classified as Type 4 soil.

Temporary excavations for slopes in Type 3 soil should not exceed 1.0 horizontal to 1.0 vertical or flatter. Locally, where very loose and/or soft soils are encountered at shallow depths or within zones of persistent seepage, it may be necessary to flatten the side slopes as necessary to achieve stable conditions.

Side slopes of excavations in Type 4 soil should not be any steeper than 1 vertical to 3 horizontal.

For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number designation. Excavation side-slopes should not be unduly left exposed to inclement weather.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation side-walls must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

Based on the presumed excavation depths for the foundations, groundwater problem is not anticipated at the site. Any groundwater that may seep into the excavations is expected to be very minimal and it will be possible to maintain the excavations functionally free of water by means of light duty submersible pumps.

The fill soils are susceptible to disturbance when wet, so construction scheduling should consider the amount of excavation left to the elements during foundation preparation. Rainwater entering the foundation excavation must be pumped away (not allowed to pond). The foundation subgrade soils should be protected from freezing conditions, inundation and construction traffic at all times.

It is recommended that the footings placed on the exposed subgrade soils should be poured on the same day as they are excavated, after removal of all unsuitable materials and approval of the bearing surface by the Geotechnical Engineer. If construction proceeds during freezing weather conditions, adequate temporary frost protection shall be provided for the bearing soils and concrete foundations.

5.4 Pavement Design

It is anticipated that the existing asphaltic concrete surfacing which covers the site, will be removed and replaced during the construction works. It is assumed the pavement will support cars and light trucks with occasional heavy tractor trailer truck (fuel delivery vehicle) traffic and pavement thickness designs provided consider this loading condition.

Preparation for construction of the new pavement should be as described above for the slab-on-glade.

The following alternative pavement thickness designs are provided to support cars and light trucks, and occasional fuel delivery vehicles.

Pavement Component	Component Thickness (mm)	
	Conventional Design	Alternative Design
Asphaltic Concrete Surface Course (HI3)	40	40
Asphaltic Concrete Base Course (HI8)	60	60
Granular Base Course (OPSS Granular A)	150	425
Granular Sub-Base Course (OPSS Granular B - Type I)	400	N/A

The subgrade must be compacted to at least 98% of SPMDD. The granular materials should be placed in lifts not exceeding 200 mm thick and be compacted to a minimum of 100% SPMDD.

Asphaltic concrete materials should be rolled and compacted as per OPSS 310. The granular and asphaltic concrete pavement materials and their placement should conform to OPSS 310, 501, 1010 and 150, and the pertinent Municipality specifications.

Asphaltic concrete materials should be compacted to 97% of their Marshall density. Granular materials should be compacted to 100% SPMDD.

The pavement thickness designs provided above presume that construction will take place under favourable conditions. In the event that construction takes place during the spring thaw, the late fall, or following heavy rainfall events, a thicker granular sub-base layer may be required to compensate for reduced subgrade strength, particularly in areas of shallow clayey soils.

The long-term performance of the proposed pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible when fill is placed and that the subgrade is not disturbed and weakened after it is exposed. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be crowned and sloped to provide effective drainage. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Sub-drains may be provided to facilitate effective and assured drainage of the pavement structures as required to intercept excess subsurface moisture and minimize subgrade softening. The invert of sub-drains should be maintained at least 0.3 m below subgrade level.

Additional comments on the construction of pavement areas are as follows:

As part of the subgrade preparation, proposed pavement areas should be stripped of unsuitable earth fill and other obvious objectionable material. Fill required to raise the grades to design elevations should be free of organic material and at a moisture content which will permit compaction to the specified densities. The subgrade should be properly shaped, crowned, and then proof-rolled. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD.

The most severe loading conditions on pavement areas and the subgrade may occur at construction time during wet and un-drained conditions. Consequently, special provisions such as restricted lanes, half-loads during paving etc., may be required, especially if construction is carried out during unfavourable weather conditions.

5.5 Lateral Earth Pressures

Parameters used in the determination of earth pressure acting on temporary shoring walls are defined below.

Soil Parameters

Parameter	Definition	Units
Φ'	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

The appropriate un-factored values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Soil Parameter Values

Soil	Parameter				
	Φ'	γ	K_a	K_p	K_o
Compact Granular Fill [(1)] - Granular 'B' (OPSS 1010)	32°	22	0.31	3.23	0.47
Fill Materials	28°	17	0.36	2.78	0.53
Silty Clay	25°	16	0.41	2.44	0.60

Notes:

1. Compacted to a minimum of 95% Standard Proctor Maximum Dry Density.
2. Passive and sliding resistance within the zone subject to frost action (i.e. within 1.2 m below finished grade) should be disregarded in the lateral resistance computations.
3. In the case of a structure below the groundwater table, the use of submerged soil weight should be considered along with the appropriate hydrostatic pressures.
4. Temporary and/or permanent surcharges at the ground surface should be considered in accordance with the applicable soil mechanics methods.

The design earth pressures in compacted backfill should be augmented with the dynamic effects of the compaction efforts, which typically are taken as a uniform 12 kPa pressure over the entire depth below grade where the calculated earth pressure based on the above earth pressure factors is less than 12 kPa. However, this dynamic effect should be ignored when calculating the passive resistance for thrust blocks, or other instances where the general stability of the structure relies on the passive resistance.

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following formula:

$$\mathbf{P = K(\gamma h + q)}$$

where **P** = lateral pressure in kPa acting at a depth h (m) below ground surface

K = applicable lateral earth pressure coefficient

γ = bulk unit weight of backfill (kN/m^3)

q = the complete surcharge loading (kPa)

This equation assumes that positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (R) depends on the normal load on the soil contact (N) and the frictional resistance of the soil (tan Φ') expressed as: $R = N \tan \Phi'$. This is an ultimate resistance value and does not contain a factor of safety.

5.6 Earthquake Design Parameters

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.18.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of the Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (Vs) measurements have been taken. In the absence of such measurements, the classification is estimated on the basis of empirical analysis of undrained shear strength or penetration resistance. The applicable penetration resistance is that which has been corrected to a rod energy efficiency of 60% of the theoretical maximum or the (N_{60}) value.

Based on the borehole information and soundings from DCPT, the subsurface stratigraphy as revealed in the boreholes generally comprises fill materials underlain by soft to very soft silty clay, followed by very loose becoming compact sand, turning into dense to very dense soils. Based on the above, the site designation for seismic analysis is Class E according to Table 4.1.8.4.A from the quoted code.

The site specific 5% damped spectral acceleration coefficients, and the peak ground acceleration factors are provided in the 2012 Ontario Building Code - Supplementary Standard SB-1 (September 14, 2012), Table 1.2, location Ottawa, Ontario.

5.7 Chemical Characterization of Subsurface Soil

Two (2) soil samples, obtained from Borehole 306 at 2.3 m depth (Sample 3) and 3.8 m depth (Sample 5), were submitted to AGAT Laboratories for pH index test, and determination of water-soluble sulphate content and its potential of attacking the subsurface concrete.

The soil sample at 2.3 m depth is fill materials; at 3.8 m depth is native silty clay.

The test results revealed that the pH index of the fill soil sample is 7.57 and the clay soil sample is 7.52. The pH of the two tested samples reveals a slight alkalinity.

The water-soluble sulphate content of the fill soil sample is 0.0067% and the native soil sample is 0.0361%. The concentration of water-soluble sulphate content of the tested samples is below the CSA Standard of 0.1% water-soluble sulphate (Table 12 of CSA A23.1, Requirements for Concrete Subjected to Sulphate Attack). Special concrete mixes against sulphate attack is therefore not required for the sub-surface concrete of the proposed addition.

The Certificate of Chemical Analysis provided by the analytical chemical testing laboratory is contained in Appendix F of this report.

6 LIMITATIONS OF REPORT

The Limitations of Report, as quoted in Appendix 'A', are an integral part of this report.

Yours respectively

alston associates inc.

Michael Lam, B.Eng. (Civil)
Senior Geotechnical Inspector

LICENSED PROFESSIONAL ENGINEER
V. NERSESIAN
33778705
MARCH 2, 15
PROVINCE OF ONTARIO

Vic Nersesian, P. Eng.
Vice President, Geotechnical Services

APPENDIX A

LIMITATIONS OF REPORT

Limitations of Report

The conclusions and recommendations in this report are based on information determined at the inspection locations. Soil 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 soil investigation.

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 details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

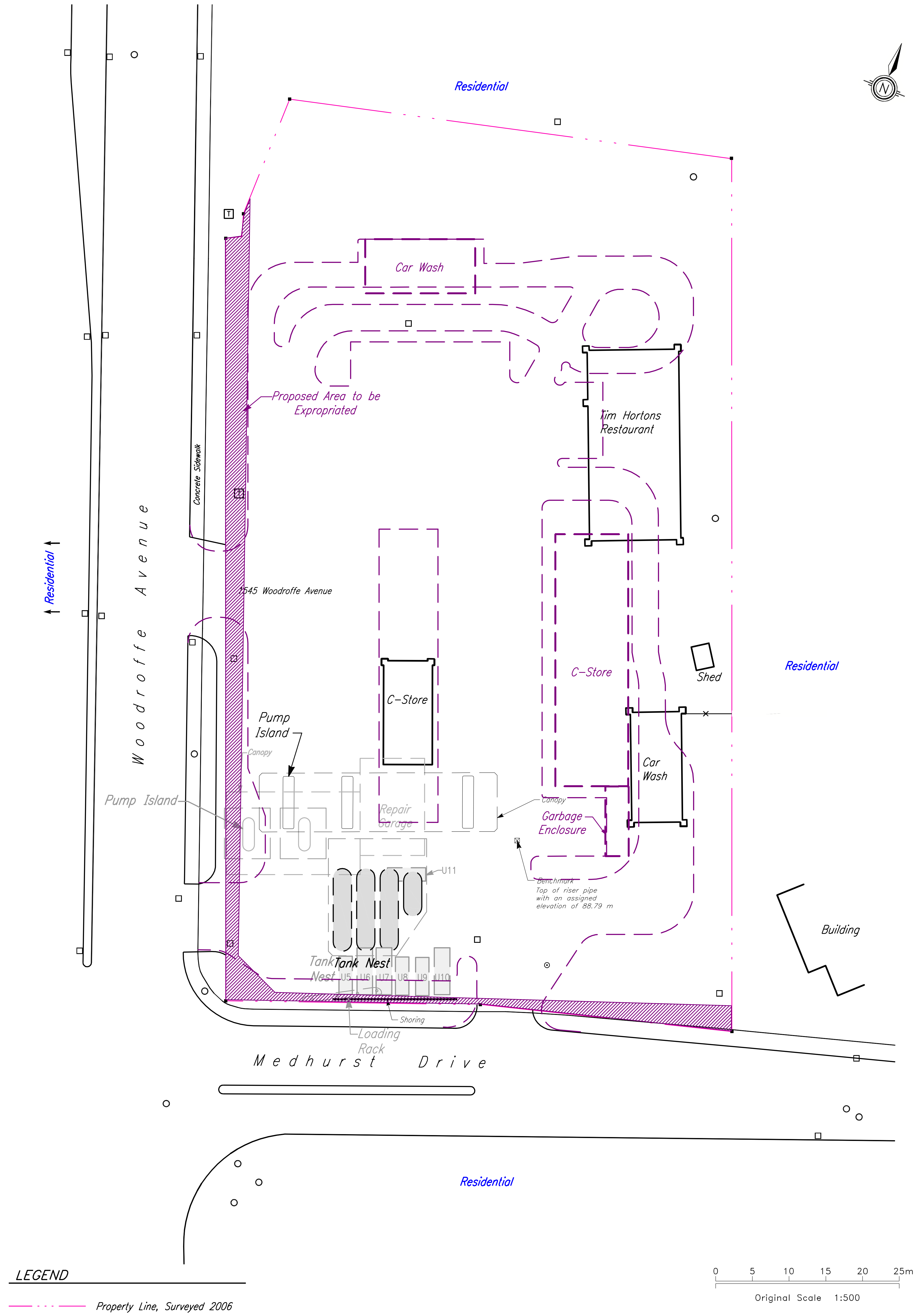
This report was prepared for Parsons Canada Ltd. by Alston Associates Inc. The material in it reflects Alston Associates Inc. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions which the Third Party may make based on it, are the sole responsibility of such Third Parties.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis. We recommend also that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the test holes. In cases where these recommendations are not followed, the company’s responsibility is limited to accurately interpreting the conditions encountered at the test holes, only.

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of inspection locations may not be sufficient to determine all the factors that may affect construction methods and costs. 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.

APPENDIX B

BOREHOLE LOCATION PLAN AND EXISTING AND PROPOSED STRUCTURES



LEGEND

— · · · —	Property Line, Surveyed 2006
▪	Property Boundary Pin
×—×	Fence
🅃	Transformer (Pad Mounted)
○	Manhole
□	Catch Basin
2010/12/31	Date Format: yyyy/mm/dd

NOTE: All features are approximate.

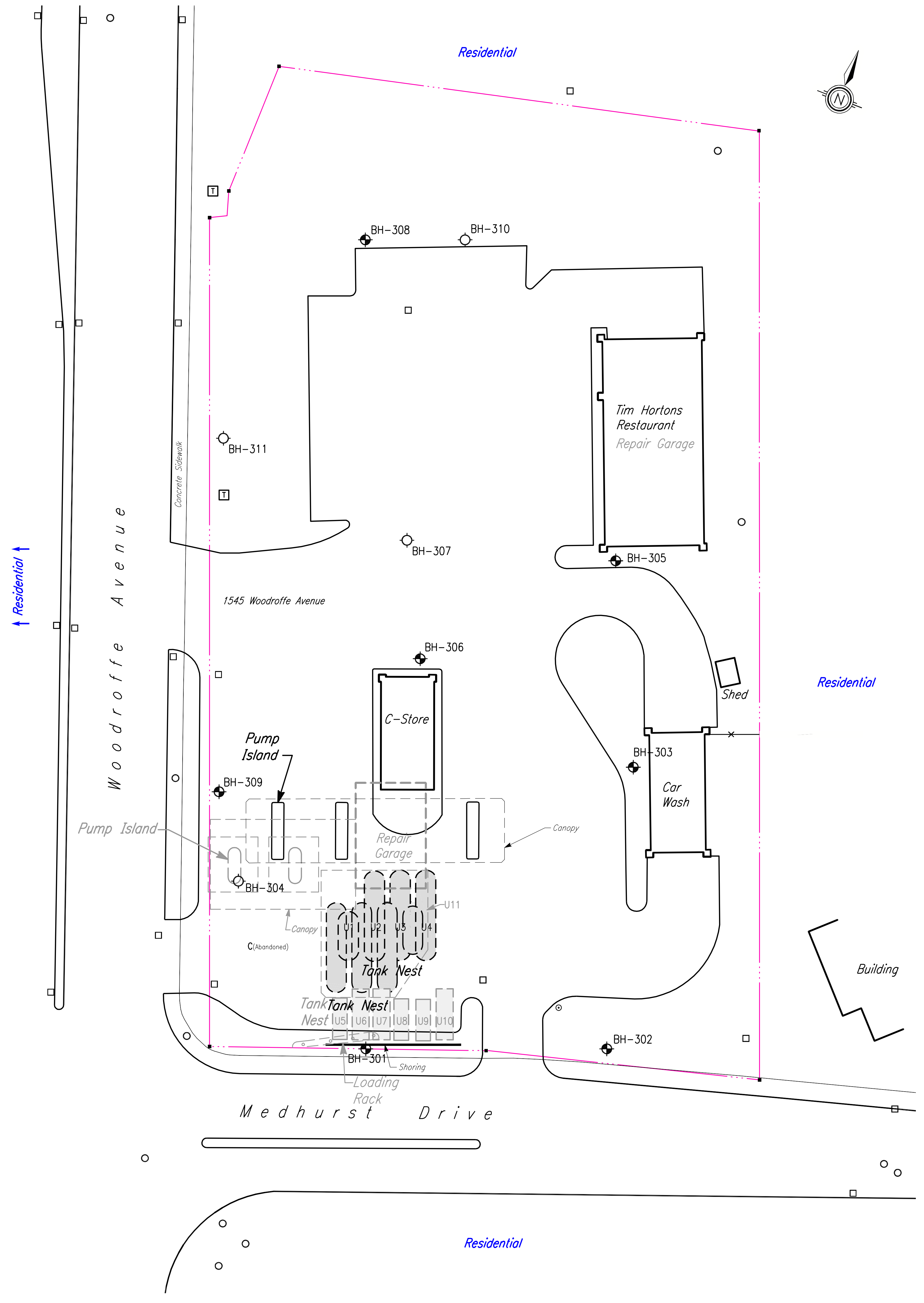
REFERENCE: Clark Wilkinson Alton survey dated 2006/07/21.
Imperial Oil Drawing 2009

Site Plan with Proposed Structures

1545 Woodroffe Avenue
Nepean, Ontario

Drawn: BAI	Page Size: 11 x 17 in	Ref. No.: 10-8518.3
Reviewed: HNL	File No.: 8518S156	Date: 2015/01/21
PARSONS		Drawing No.: A

Ref.: S-34-P



Utilities

□ *Catch Basin*

○ *Manhole*

⊙ *Utility Pole*

NOTE: All features are approximate.

REFERENCE: Clark Wilkinson Alton survey dated 2006/07/21.

0 5 10 15 20 25m

Scale 1:500

LEGEND

— — — — —	*Former Feature*
—— · · · ——	*Property Line, Surveyed 2006*
■	*Property Boundary Pin*
—×——×—	*Fence*
T	*Transformer (Pad Mounted)*
⌖	*Borehole* *BH-304, BH-307, BH-310 and BH-311 by Parsons, 2014*
⊕	*Monitoring Well* *BH-301 to BH-303, BH-305, BH-306, BH-308 and BH-309 by Parsons 2014*
2010/12/31	*Date Format: yyyy/mm/dd*

Tank Chart

Tank	Type	Capacity	Product	Status
U1	Double Wall Fibreglass UST	22 700 L	Diesel	Active
U2	Double Wall Fibreglass UST	46 000 L	Gasoline	Active
U3	Double Wall Fibreglass UST	46 000 L	Gasoline	Active
U4	Double Wall Fibreglass UST	46 000 L	Gasoline	Active
U5	UST	13 600 L	Gasoline	Removed
U6	UST	22 700 L	Gasoline	Removed
U7	UST	22 700 L	Gasoline	Removed
U8	UST	13 600 L	Diesel	Removed
U9	UST	13 600 L	Gasoline	Removed
U10	UST	22 700 L	Gasoline	Removed
U11	UST	2 273 L	Furnace Oil	Removed

Site Plan

1545 Woodroffe Avenue
Nepean, Ontario

Drawn: BAI	Page Size: 11 x 17 in	Ref. No.: 10-8518.3
Reviewed: HNL	File No.: 8518S150	Date: 2015/01/16
PARSONS		Drawing No.: 1

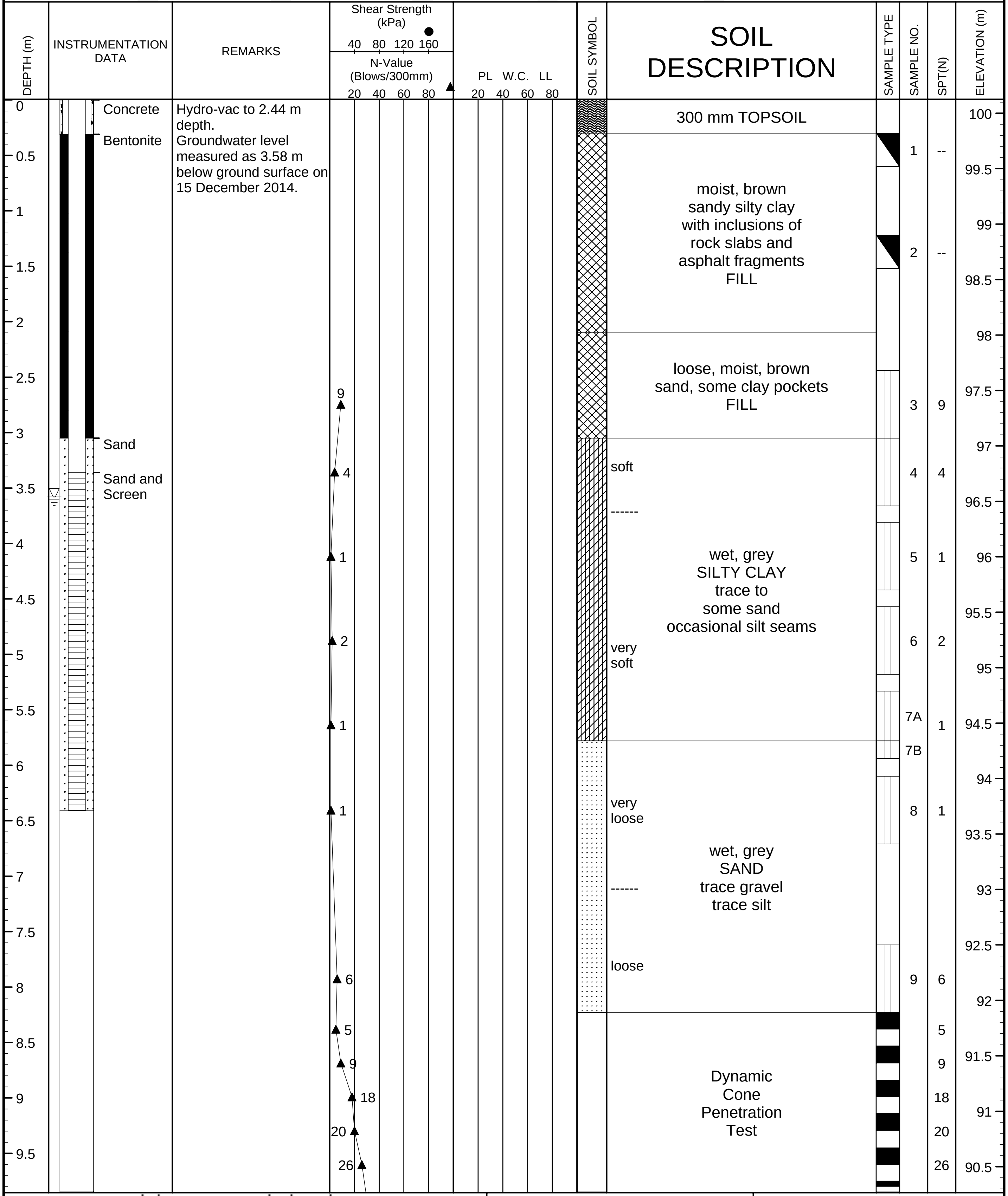
Ref.: S-34-P

APPENDIX C

BOREHOLE LOG SHEETS

CLIENT: Parsons	METHOD: Augering and Split Spoon Sampling		**BH No.: 303**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN	ELEV. (m) 100.12	
LOCATION: Ottawa, ON	NORTHING:	EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE: ▮ AUGER ◩ DRIVEN ⧗ CORING ▬ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



REMARKS: Hydro-vac to 2.44 m depth. Groundwater level measured as 3.58 m below ground surface on 15 December 2014.

SOIL DESCRIPTION:

300 mm TOPSOIL

moist, brown
sandy silty clay
with inclusions of
rock slabs and
asphalt fragments
FILL

loose, moist, brown
sand, some clay pockets
FILL

soft
------
very soft

wet, grey
SILTY CLAY
trace to
some sand
occasional silt seams

very loose
------
loose

wet, grey
SAND
trace gravel
trace silt

Dynamic
Cone
Penetration
Test

SAMPLE NO.	SPT(N)
1	--
2	--
3	9
4	4
5	1
6	2
7A	1
7B	
8	1
9	6
	5
	9
	18
	20
	26

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LOGGED BY: KC	DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN	Page 1 of 2

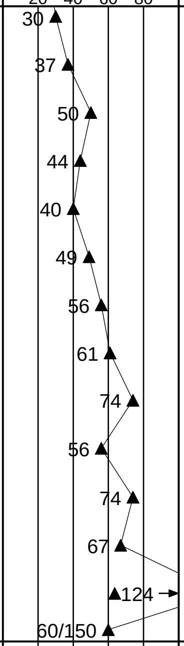
CLIENT: Parsons
METHOD: Augering and Split Spoon Sampling
PROJECT: IOL, 1545 Woodroffe Avenue
PROJECT ENGINEER: VN
ELEV. (m) 100.12

BH No.: 303

LOCATION: Ottawa, ON
NORTHING:
EASTING:
PROJECT NO.: 14-140

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▮ SHELBY ⌶ SPLIT SPOON

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 N-Value (Blows/300mm) ▲ 20 40 60 80	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
10			30			Dynamic Cone Penetration Test	▀		30	90
			37				▀		37	
10.5			50				▀		50	89.5
			44				▀		44	
11			40				▀		40	89
			49				▀		49	
11.5			56				▀		56	88.5
12			61				▀		61	88
			74				▀		74	
12.5			56				▀		56	87.5
13			74				▀		74	87
			67				▀		67	
13.5			124 →				▀		124	86.5
			60/150				▀		60/150	
						END OF BOREHOLE				



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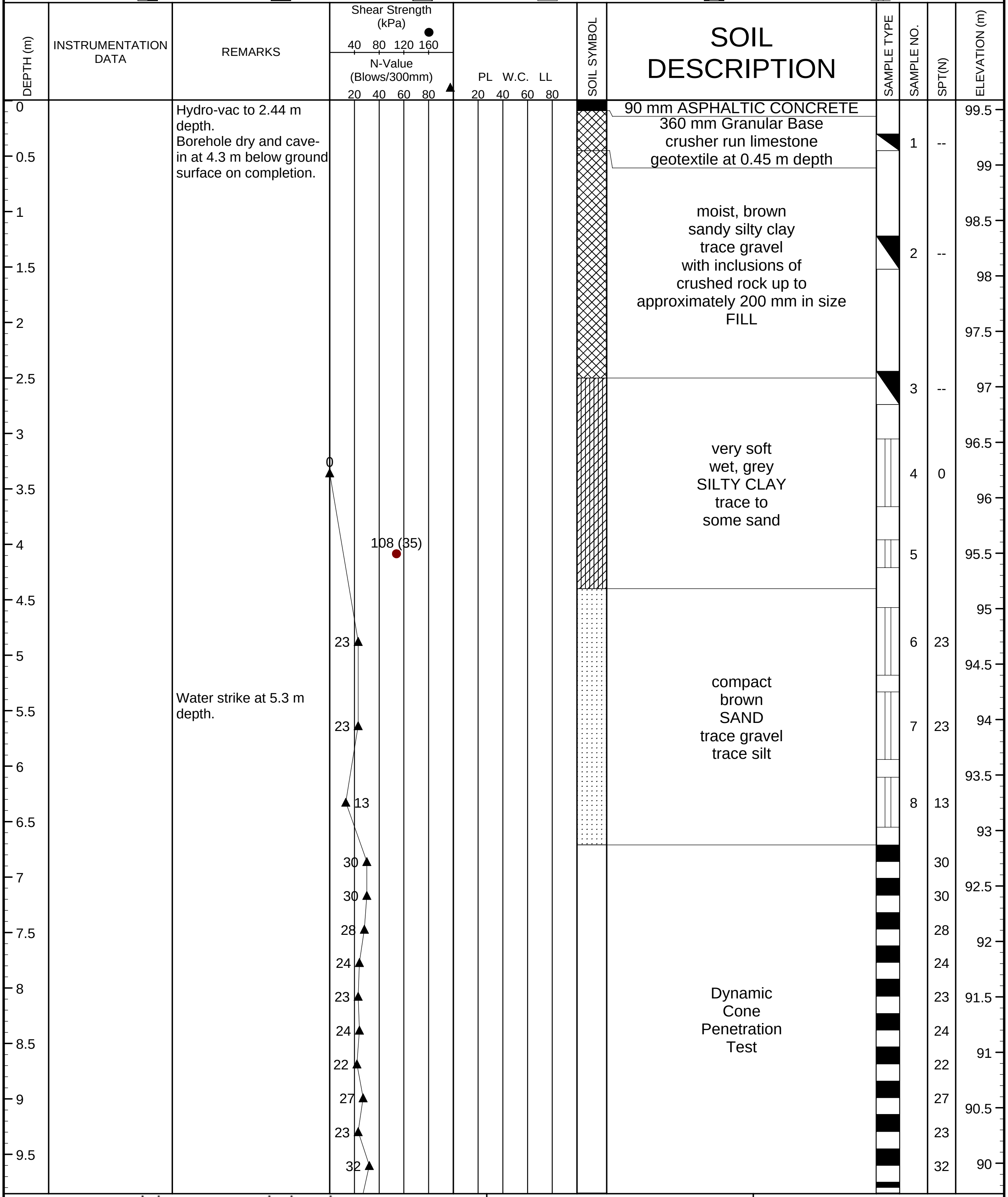
DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN

CLIENT: Parsons
METHOD: Augering and Split Spoon Sampling

BH No.: 304

PROJECT: IOL, 1545 Woodroffe Avenue
PROJECT ENGINEER: VN
ELEV. (m) 99.58
LOCATION: Ottawa, ON
NORTHING:
EASTING:
PROJECT NO.: 14-140

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



REMARKS:

Hydro-vac to 2.44 m depth.
Borehole dry and cave-in at 4.3 m below ground surface on completion.

Water strike at 5.3 m depth.

SOIL DESCRIPTION

90 mm ASPHALTIC CONCRETE

360 mm Granular Base
crusher run limestone
geotextile at 0.45 m depth

moist, brown
sandy silty clay
trace gravel
with inclusions of
crushed rock up to
approximately 200 mm in size
FILL

very soft
wet, grey
SILTY CLAY
trace to
some sand

compact
brown
SAND
trace gravel
trace silt

Dynamic
Cone
Penetration
Test

SAMPLE NO.	SPT(N)
1	--
2	--
3	--
4	0
5	
6	23
7	23
8	13
	30
	30
	28
	24
	23
	24
	22
	27
	23
	32

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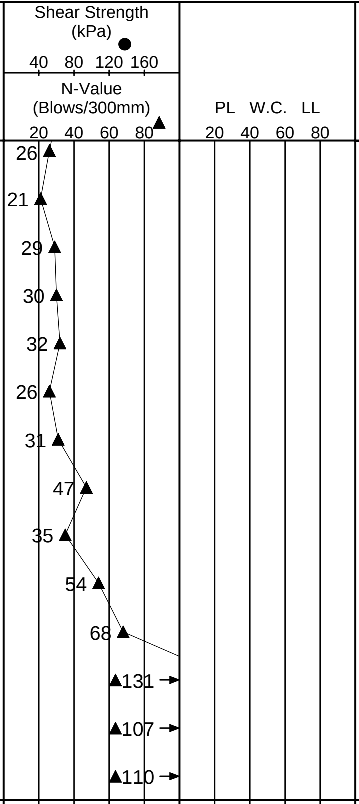
DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN

CLIENT: Parsons	METHOD: Augering and Split Spoon Sampling		**BH No.: 304**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN	ELEV. (m) 99.58	
LOCATION: Ottawa, ON	NORTHING:	EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE ◧ AUGER ◪ DRIVEN ⧗ CORING ⬒ DYNAMIC CONE ▮ SHELBY Ⅰ SPLIT SPOON



DEPTH (m)	INSTRUMENTATION DATA	REMARKS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)
10				Dynamic Cone Penetration Test	⬒		26
					⬒		21
10.5					⬒		29
					⬒		30
11					⬒		32
					⬒		26
11.5					⬒		31
12					⬒		47
					⬒		35
12.5					⬒		54
13					⬒		68
					⬒		131
13.5					⬒		107
					⬒		110
14				END OF BOREHOLE			

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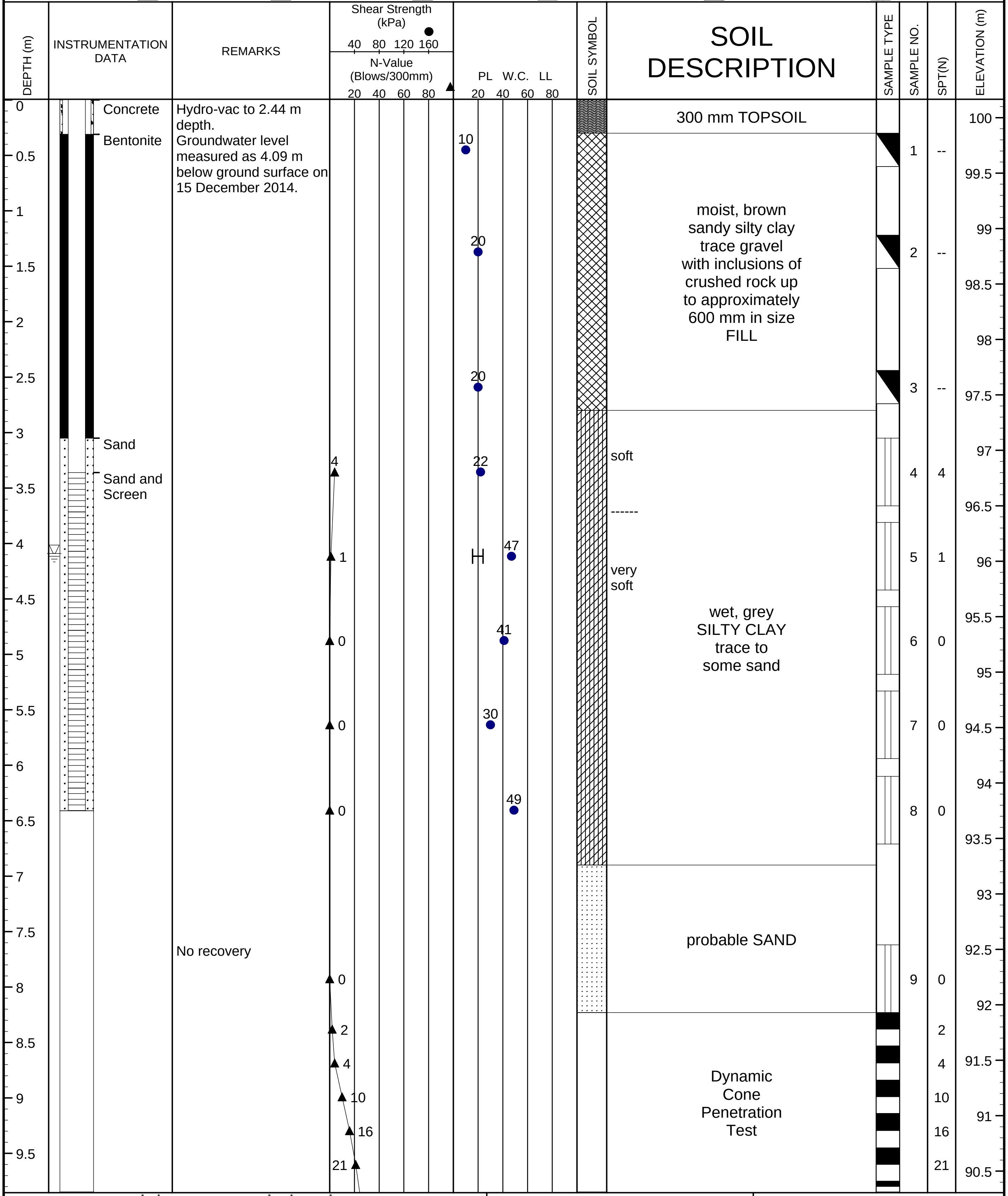
DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN

CLIENT: Parsons	METHOD: Augering and Split Spoon Sampling		**BH No.: 305**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN	ELEV. (m) 100.16	
LOCATION: Ottawa, ON	NORTHING:	EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



REMARKS:

Hydro-vac to 2.44 m depth.
Groundwater level measured as 4.09 m below ground surface on 15 December 2014.

No recovery

SOIL DESCRIPTION:

300 mm TOPSOIL

moist, brown
sandy silty clay
trace gravel
with inclusions of
crushed rock up
to approximately
600 mm in size
FILL

soil
------
very soft

wet, grey
SILTY CLAY
trace to
some sand

probable SAND

Dynamic
Cone
Penetration
Test

SAMPLE NO.	SPT(N)	W.C.
1	--	10
2	--	20
3	--	20
4	4	22
5	1	47
6	0	41
7	0	30
8	0	49
9	0	
	2	
	4	
	10	
	16	
	21	

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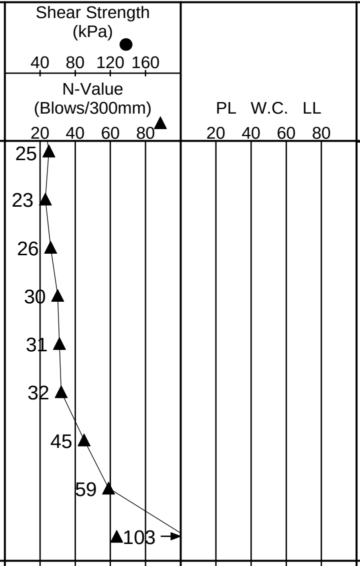
	REVIEWED BY: VN	Page 1 of 2

CLIENT: Parsons
METHOD: Augering and Split Spoon Sampling
PROJECT: IOL, 1545 Woodroffe Avenue
PROJECT ENGINEER: VN
ELEV. (m) 100.16

BH No.: 305

LOCATION: Ottawa, ON
NORTHING:
EASTING:
PROJECT NO.: 14-140

SAMPLE TYPE ▯ AUGER ◪ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▮ SHELBY ⌶ SPLIT SPOON



DEPTH (m)	INSTRUMENTATION DATA	REMARKS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
10				Dynamic Cone Penetration Test	▀		25	
					▀		23	90
10.5					▀		26	89.5
					▀		30	
11					▀		31	89
11.5					▀		32	
					▀		45	88.5
12					▀		59	88
					▀		103	
				END OF BOREHOLE				

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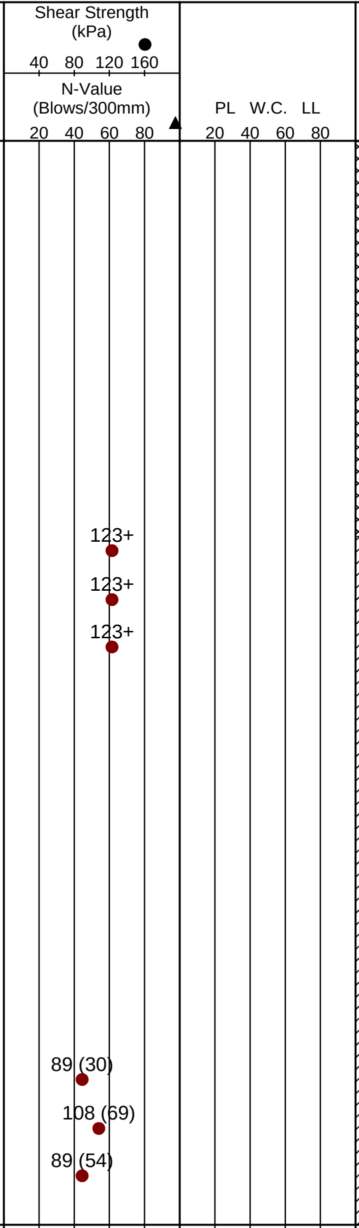
DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN

CLIENT: Parsons	METHOD: Augering and Thin Wall Tube Sampling	**BH No.: 305B**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN / ELEV. (m) 100.16	
LOCATION: Ottawa, ON	NORTHING: / EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE ◨ AUGER ◩ DRIVEN ⧗ CORING ⬒ DYNAMIC CONE ▮ SHELBY ⌶ SPLIT SPOON



DEPTH (m)	INSTRUMENTATION DATA	REMARKS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0 – 2.5		Hydro-vac to 2.44 m depth.	▩	moist, brown sandy silty clay trace gravel with inclusions of crushed rock FILL				100 – 97.5
2.5 – 6.85			▥	wet, grey SILTY CLAY trace to some sand				97.5 – 93.5
3.8 – 4.25		No recovery			▮	1		96
4.55 – 5.0		No recovery			▮	2		95.5
5.3 – 5.75					▮	3		94.5

END OF BOREHOLE
Refusal to advancement of vane.

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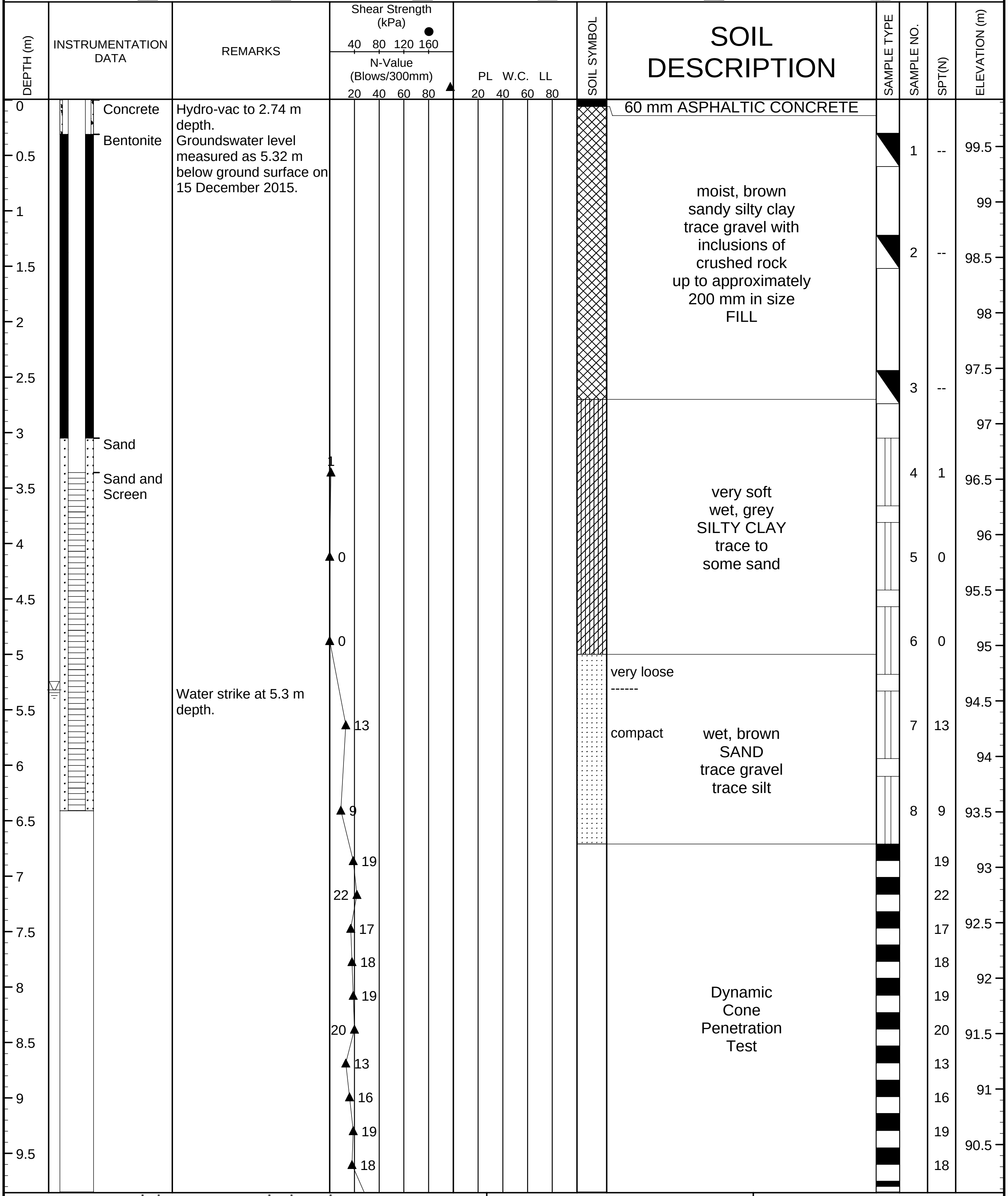
LOGGED BY: KC	DRILLING DATE: 10 Dec. 2014
REVIEWED BY: VN	Page 1 of 1

CLIENT: Parsons	METHOD: Augering and Split Spoon Sampling		**BH No.: 306**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN	ELEV. (m) 99.92	
LOCATION: Ottawa, ON	NORTHING:	EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE ▮ AUGER ◪ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



REMARKS:

Hydro-vac to 2.74 m depth.
Groundswater level measured as 5.32 m below ground surface on 15 December 2015.

Water strike at 5.3 m depth.

SOIL DESCRIPTION:

60 mm ASPHALTIC CONCRETE

moist, brown
sandy silty clay
trace gravel with
inclusions of
crushed rock
up to approximately
200 mm in size
FILL

very soft
wet, grey
SILTY CLAY
trace to
some sand

very loose
------
compact
wet, brown
SAND
trace gravel
trace silt

Dynamic
Cone
Penetration
Test

SAMPLE TYPE	SAMPLE NO.	SPT(N)
DRIVEN	1	--
DRIVEN	2	--
DRIVEN	3	--
SPLIT SPOON	4	1
SPLIT SPOON	5	0
SPLIT SPOON	6	0
SPLIT SPOON	7	13
SPLIT SPOON	8	9
DYNAMIC CONE		19
DYNAMIC CONE		22
DYNAMIC CONE		17
DYNAMIC CONE		18
DYNAMIC CONE		19
DYNAMIC CONE		20
DYNAMIC CONE		13
DYNAMIC CONE		16
DYNAMIC CONE		19
DYNAMIC CONE		18

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	REVIEWED BY: VN	Page 1 of 2

CLIENT: Parsons
METHOD: Augering and Split Spoon Sampling

BH No.: 306

PROJECT: IOL, 1545 Woodroffe Avenue
PROJECT ENGINEER: VN
ELEV. (m) 99.92
LOCATION: Ottawa, ON
NORTHING:
EASTING:
PROJECT NO.: 14-140

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 N-Value (Blows/300mm) ▲ 20 40 60 80	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
10			30 ▲ 35 ▲			Dynamic Cone Penetration Test	▀ ▀		30 35	90
						END OF BOREHOLE				

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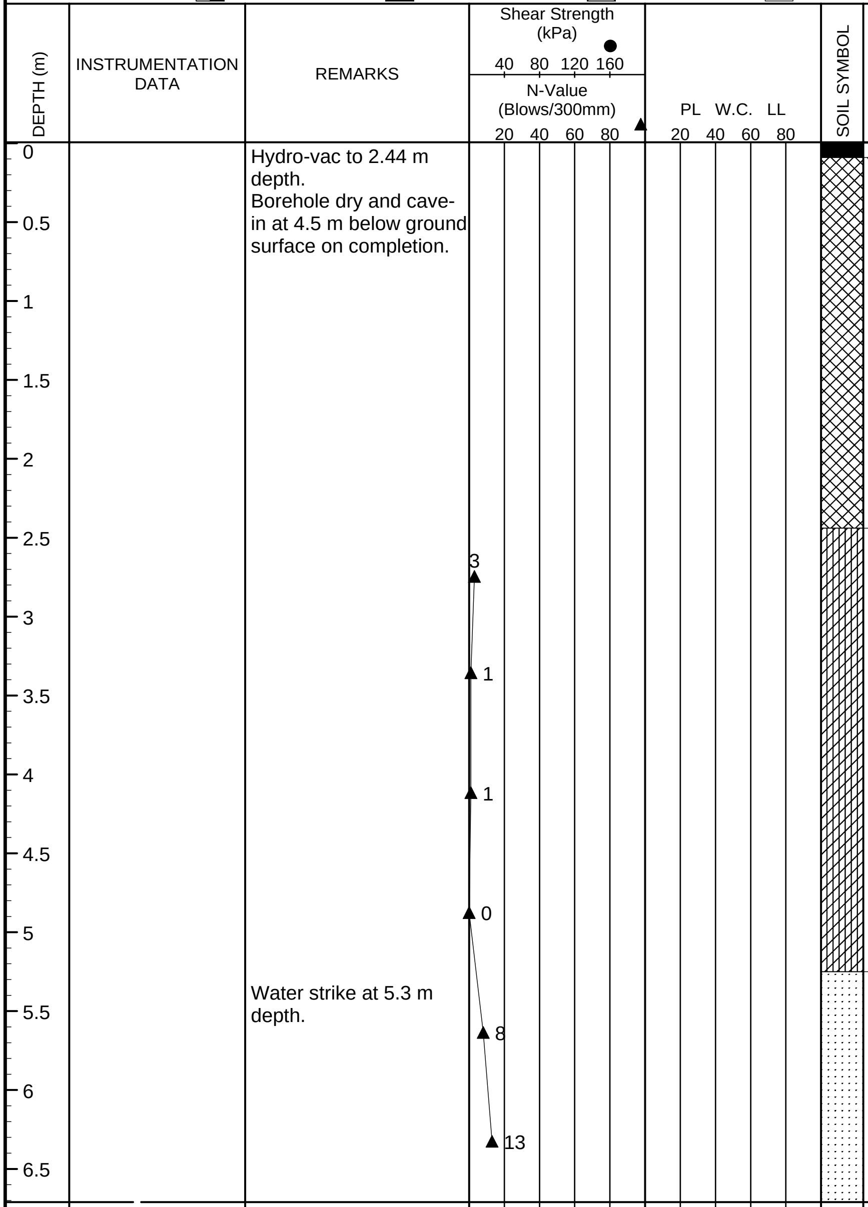
consulting engineers

LOGGED BY: KC
DRILLING DATE: 11 Dec. 2014
REVIEWED BY: VN

CLIENT: Parsons	METHOD: Augering and Split Spoon Sampling	**BH No.: 307**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN ELEV. (m) 99.92	
LOCATION: Ottawa, ON	NORTHING: EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE ◨ AUGER ◪ DRIVEN ⧗ CORING ⬒ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

INSTRUMENTATION DATA	REMARKS
	Hydro-vac to 2.44 m depth. Borehole dry and cave-in at 4.5 m below ground surface on completion.
	Water strike at 5.3 m depth.



SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
90 mm ASPHALTIC CONCRETE				
moist, brown sandy silty clay trace gravel with inclusions of crushed rock up to approximately 200 mm in size FILL	◪	1		99.5
				99
	◪	2		98.5
				98
				97.5
soil: soft ------	⌶	3	3	97
wet, grey SILTY CLAY trace to some sand occasional silt seams	⌶	4	1	96.5
very soft	⌶	5	1	96
				95.5
	⌶	6	0	95
wet, brown SAND trace gravel trace silt loose ------	⌶	7	8	94.5
				94
compact	⌶	8	13	93.5

END OF BOREHOLE

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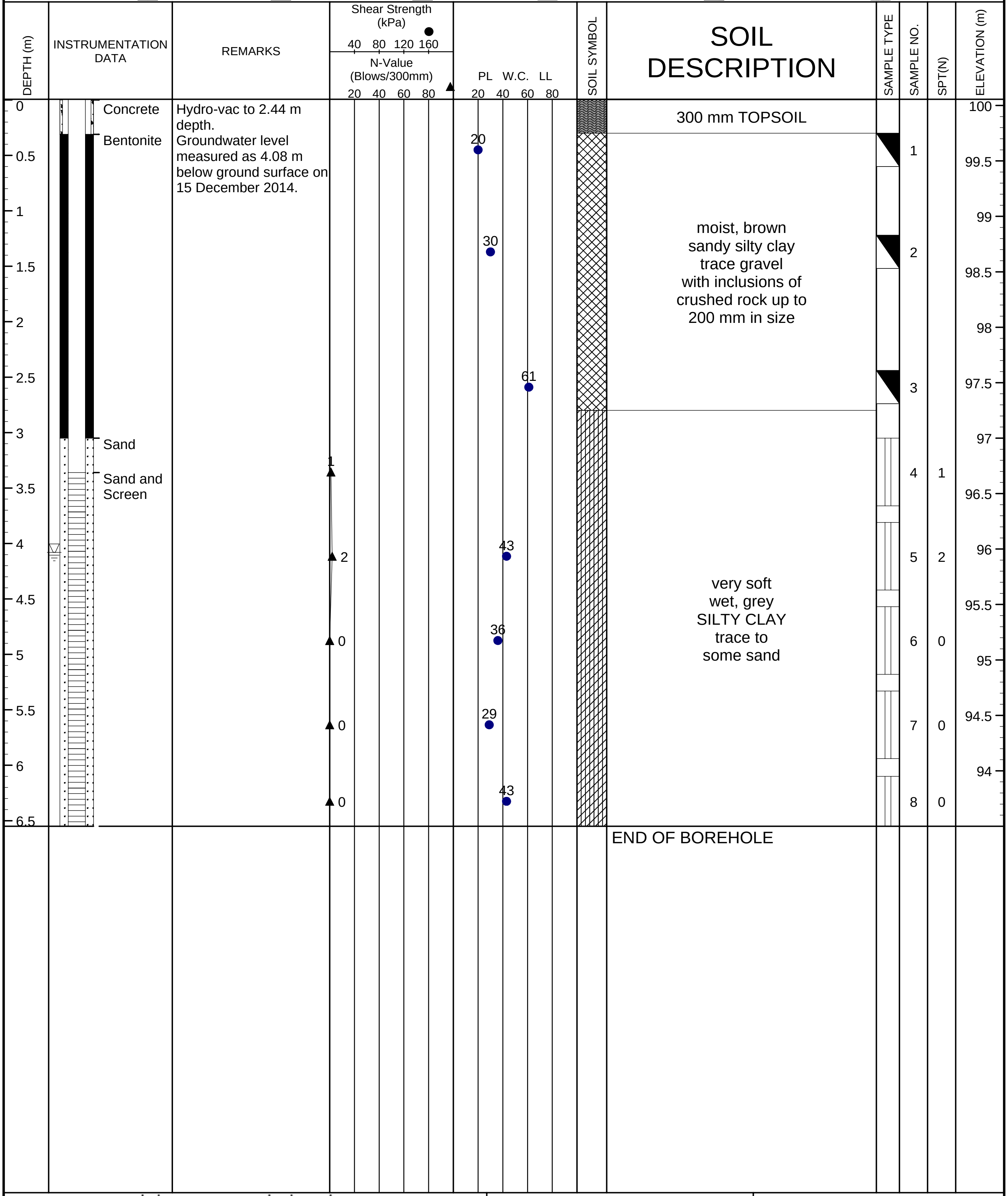
LOGGED BY: KC	DRILLING DATE: 11 Dec. 2014
REVIEWED BY: VN	Page 1 of 1

CLIENT: Parsons
PROJECT: IOL, 1545 Woodroffe Avenue
LOCATION: Ottawa, ON
METHOD: Augering and Split Spoon Sampling
PROJECT ENGINEER: VN
ELEV. (m) 100.05
NORTHING:
EASTING:

BH No.: 308

PROJECT NO.: 14-140

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧓ CORING ⬒ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



Hydro-vac to 2.44 m depth.
Groundwater level measured as 4.08 m below ground surface on 15 December 2014.

SOIL DESCRIPTION

300 mm TOPSOIL

moist, brown
sandy silty clay
trace gravel
with inclusions of
crushed rock up to
200 mm in size

very soft
wet, grey
SILTY CLAY
trace to
some sand

END OF BOREHOLE

SAMPLE NO.	SPT(N)	W.C.
1		20
2		30
3		61
4	1	
5	2	43
6	0	36
7	0	29
8	0	43

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LOGGED BY: KC
REVIEWED BY: VN
DRILLING DATE: 13 Dec. 2014
Page 1 of 1

CLIENT: Parsons

METHOD: Dynamic COne Penetration Test

PROJECT: IOL, 1545 Woodroffe Avenue

PROJECT ENGINEER: VN

ELEV. (m) 100.05

BH No.: 308B

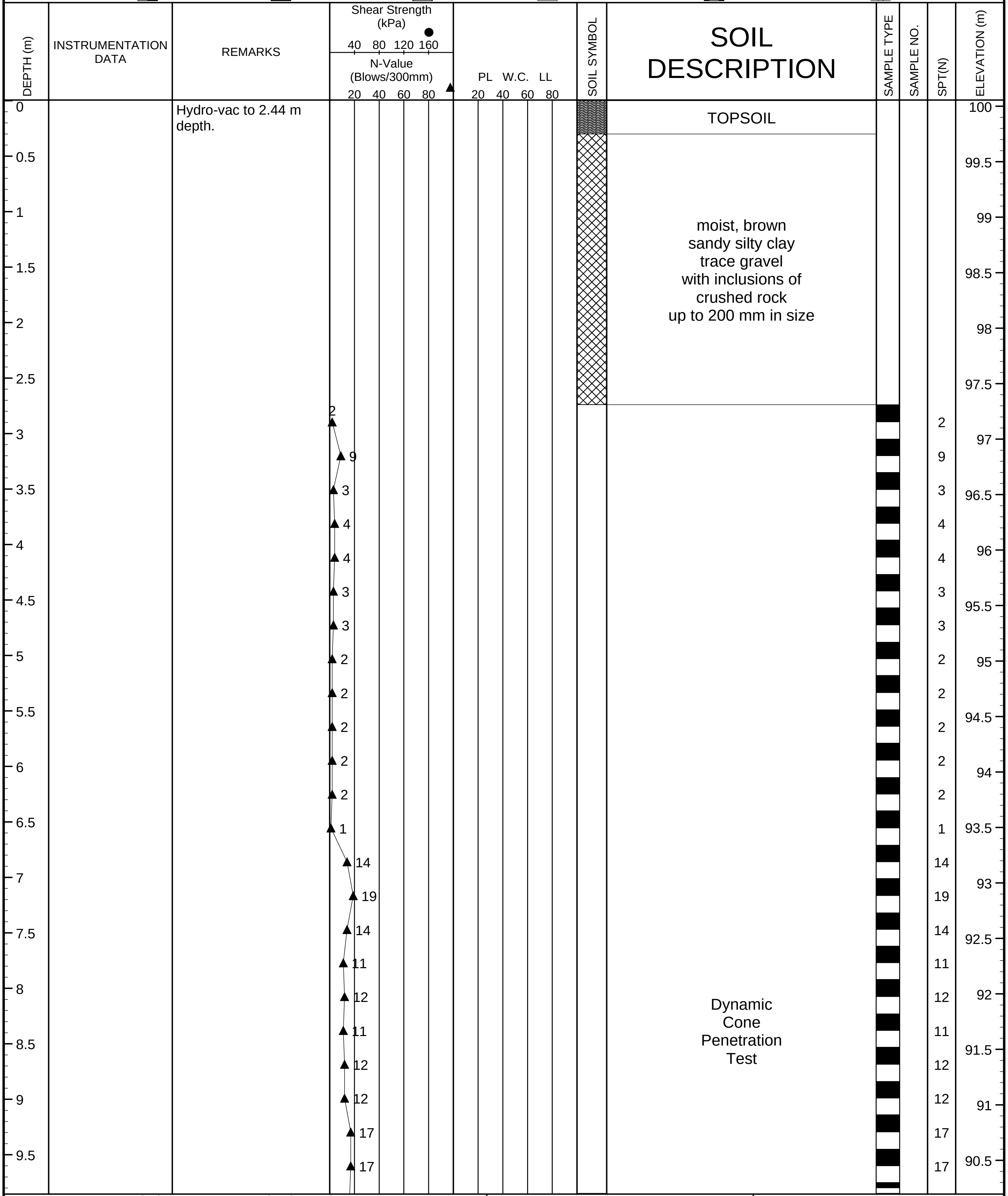
LOCATION: Ottawa, ON

NORTHING:

EASTING:

PROJECT NO.: 14-140

SAMPLE TYPE ◧ AUGER ◩ DRIVEN ⧓ CORING ⬒ DYNAMIC CONE ◫ SHELBY ⌶ SPLIT SPOON



Hydro-vac to 2.44 m depth.

SOIL DESCRIPTION

TOPSOIL

moist, brown
sandy silty clay
trace gravel
with inclusions of
crushed rock
up to 200 mm in size

Dynamic
Cone
Penetration
Test

SPT(N)
2
9
3
4
4
3
3
2
2
2
2
2
1
14
19
14
11
12
11
12
12
17
17

alston associates inc.
consulting engineers

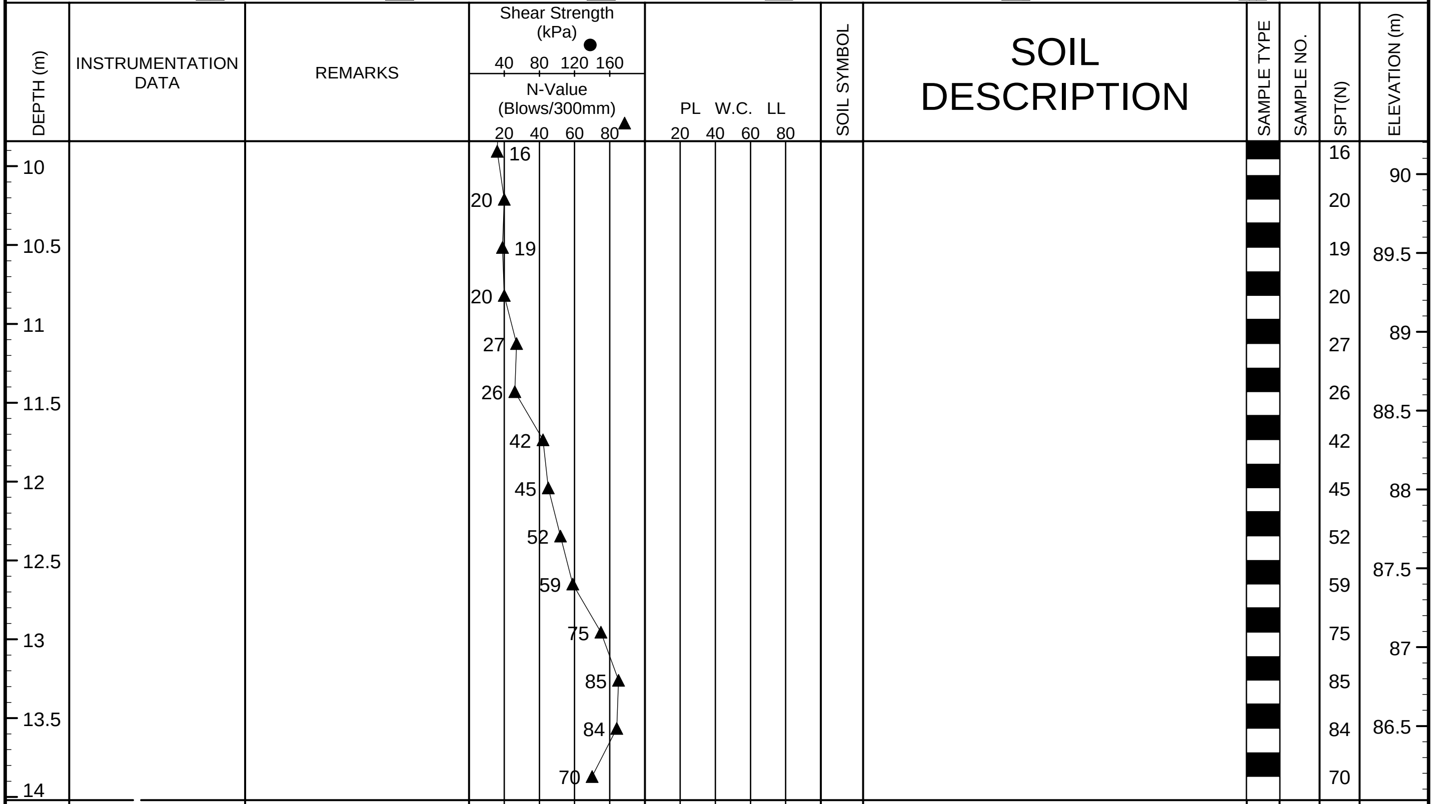
LOGGED BY: KC

DRILLING DATE: 12 Dec. 2014

REVIEWED BY: VN

CLIENT: Parsons	METHOD: Dynamic COne Penetration Test		**BH No.: 308B**
PROJECT: IOL, 1545 Woodroffe Avenue	PROJECT ENGINEER: VN	ELEV. (m) 100.05	
LOCATION: Ottawa, ON	NORTHING:	EASTING:	PROJECT NO.: 14-140

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



SPT(N)
16
20
19
20
27
26
42
45
52
59
75
85
84
70

END OF BOREHOLE

alston associates inc. consulting engineers	LOGGED BY: KC	DRILLING DATE: 12 Dec. 2014
	REVIEWED BY: VN	Page 2 of 2

APPENDIX D

DILATOMETER SOUNDINGS AND RESULTS

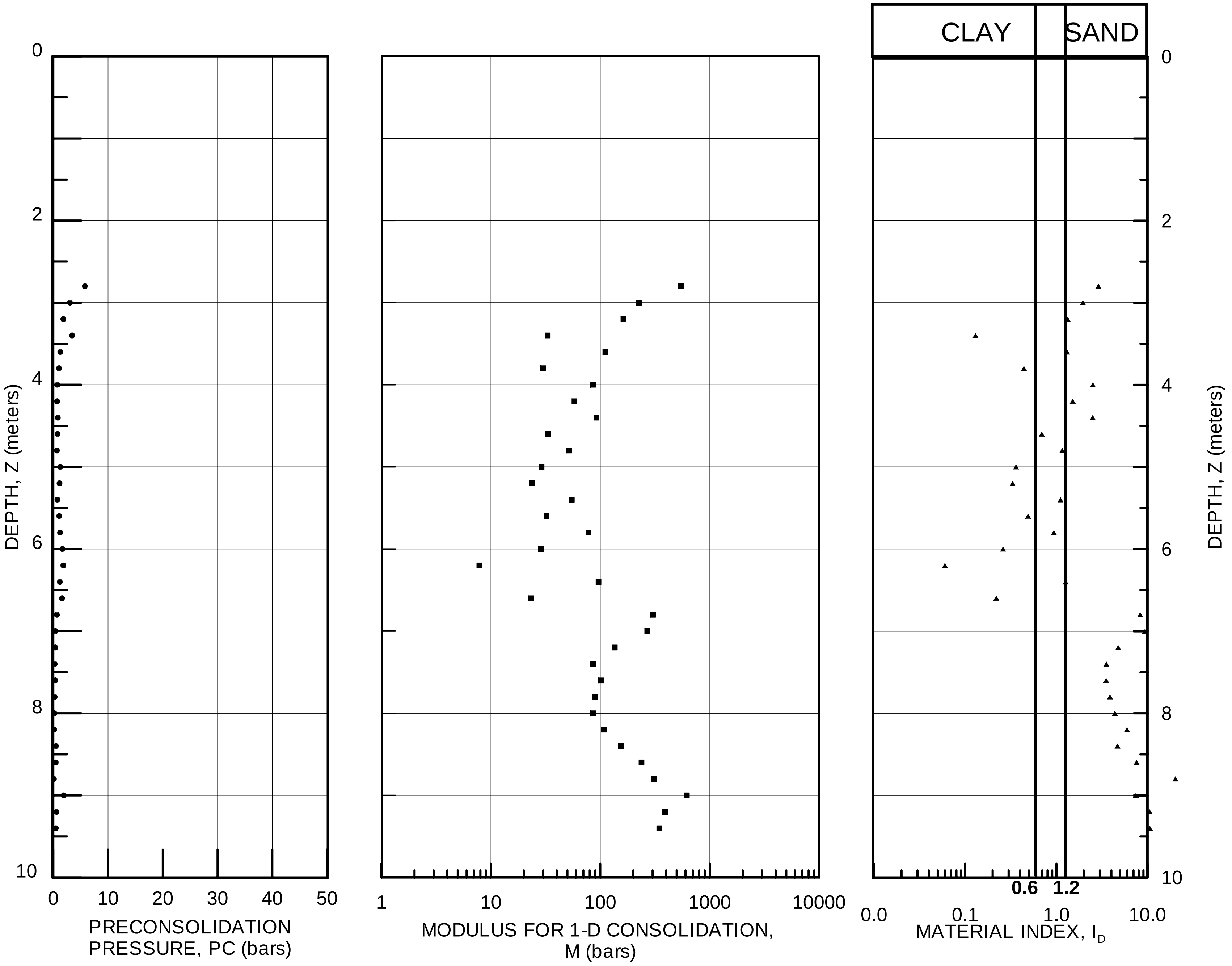
Ground Surface Elev.: _____ m
Northing: _______, Easting: ______

PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

DILATOMETER RESULTS

ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-12

SOUNDING
DMT 305



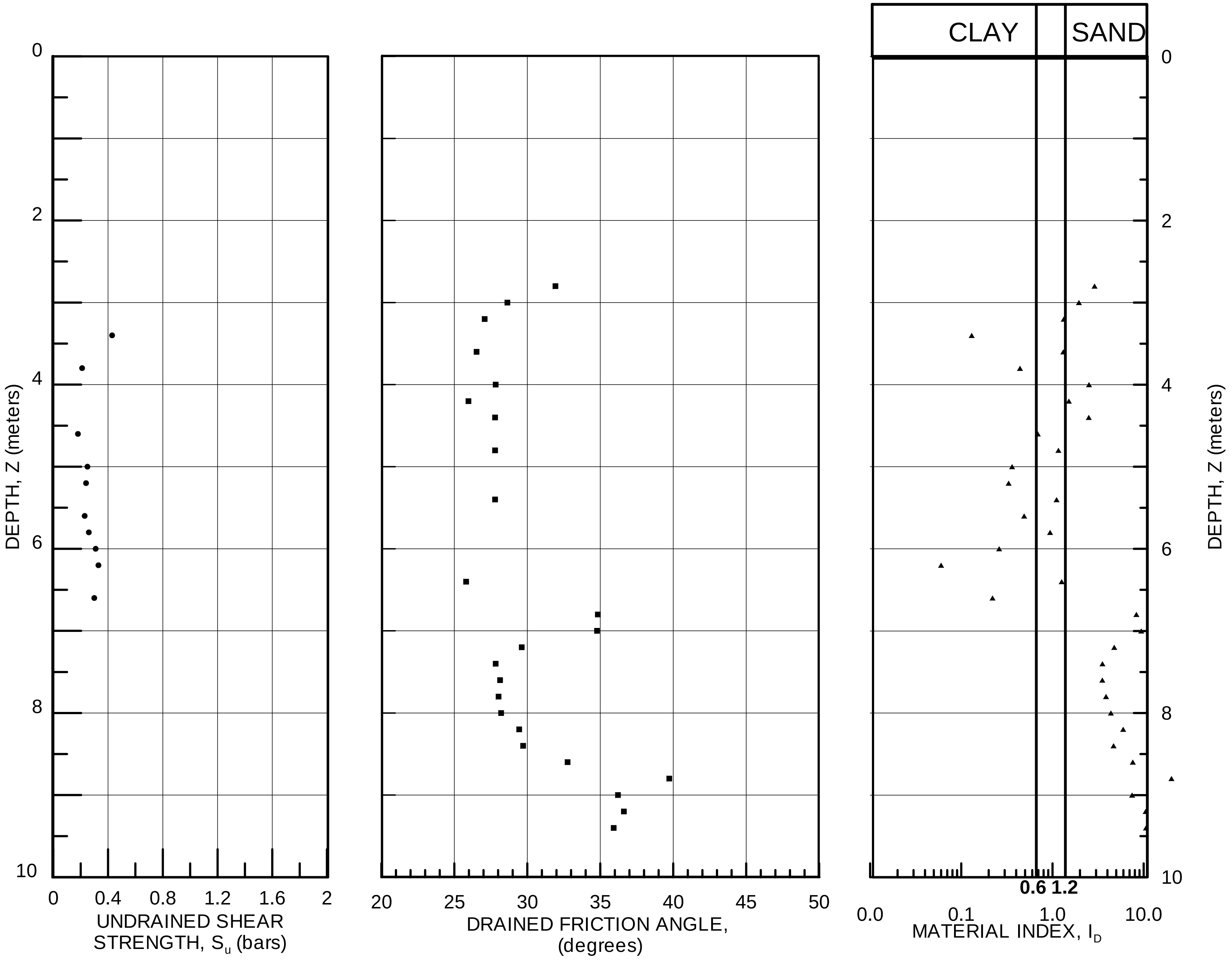
Ground Surface Elev.:_____ m
Northing: _______, Easting: _______

DILATOMETER RESULTS

PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-12

SOUNDING
DMT 305

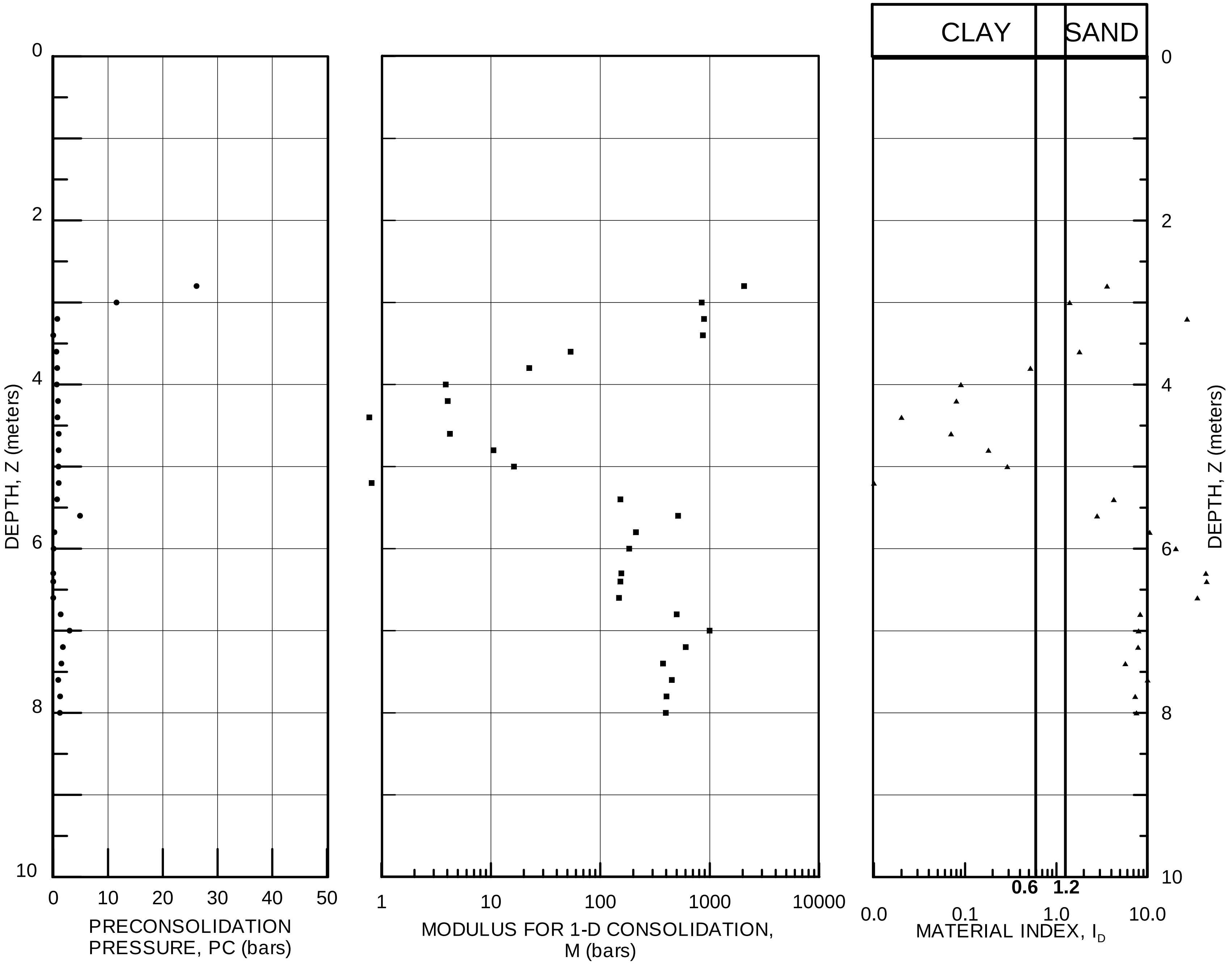


Z (M)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	ED (BAR)	ID	KD	GAMMA (T/M3)	SV' (BAR)	PC (BAR)	OCR	KO	PHI (PHI)	M (BAR)	Su (BAR) f(SV', Kd)	SOIL TYPE
2.8	3.20	12.00	0.00	2.90	11.28	0.00	0.000	291	2.89	4.93	1.9	0.59	5.8	9.81	0.92	32	547	---	SILTY SAND
3.0	2.30	7.20	0.00	2.20	6.48	0.00	0.000	148	1.95	3.52	1.8	0.62	3.1	4.90	0.84	29	226	---	SILTY SAND
3.2	2.40	6.20	0.00	2.35	5.48	0.00	0.000	108	1.33	3.58	1.7	0.66	1.8	2.79	0.88	27	162	---	SANDY SILT
3.4	3.80	5.10	0.00	3.88	4.38	0.00	0.000	17	0.13	5.62	1.7	0.69	3.5	5.01	1.26	---	33	0.43	CLAY
3.6	2.00	5.30	0.00	1.98	4.58	0.00	0.000	90	1.31	2.73	1.7	0.72	1.3	1.78	0.79	27	111	---	SANDY SILT
3.8	1.80	3.40	0.00	1.86	2.68	0.00	0.000	28	0.44	2.47	1.6	0.76	1.1	1.39	0.66	---	30	0.21	SILTY CLAY
4.0	1.20	4.80	0.00	1.16	4.08	0.00	0.000	101	2.51	1.47	1.8	0.79	0.8	0.97	0.61	28	86	---	SILTY SAND
4.2	1.30	4.00	0.00	1.31	3.28	0.00	0.000	68	1.51	1.59	1.6	0.82	0.7	0.84	0.67	26	58	---	SANDY SILT
4.4	1.30	5.10	0.00	1.25	4.38	0.00	0.000	108	2.50	1.46	1.8	0.86	0.8	0.96	0.61	28	92	---	SILTY SAND
4.6	1.60	3.50	0.00	1.65	2.78	0.00	0.000	39	0.69	1.85	1.6	0.89	0.8	0.89	0.51	---	33	0.18	CLAYEY SILT
4.8	1.50	4.00	0.00	1.52	3.28	0.00	0.000	61	1.16	1.65	1.7	0.92	0.7	0.74	0.44	28	52	---	SILT
5.0	2.20	3.80	1.20	2.26	3.08	1.30	0.000	28	0.36	2.37	1.6	0.95	1.2	1.31	0.64	---	29	0.25	SILTY CLAY
5.2	2.10	3.60	0.70	2.17	2.88	0.80	0.020	25	0.33	2.22	1.6	0.97	1.1	1.18	0.60	---	24	0.24	CLAY
5.4	1.70	4.30	0.10	1.71	3.58	0.20	0.039	65	1.11	1.71	1.7	0.98	0.8	0.78	0.46	28	55	---	SILT
5.6	2.10	3.90	0.60	2.15	3.18	0.70	0.059	36	0.49	2.11	1.6	0.99	1.1	1.09	0.58	---	32	0.23	SILTY CLAY
5.8	2.40	5.30	0.60	2.40	4.58	0.70	0.079	76	0.94	2.31	1.7	1.00	1.3	1.25	0.63	---	78	0.26	SILT
6.0	2.80	4.30	1.50	2.87	3.58	1.60	0.098	25	0.26	2.72	1.6	1.02	1.7	1.62	0.72	---	29	0.31	CLAY
6.2	3.00	4.00	1.90	3.09	3.28	2.00	0.118	6	0.06	2.90	1.5	1.03	1.8	1.78	0.76	---	8	0.33	MUD
6.4	2.40	5.90	2.00	2.37	5.18	2.10	0.137	97	1.26	2.14	1.7	1.04	1.2	1.16	0.74	26	96	---	SANDY SILT
6.6	2.80	4.20	1.80	2.87	3.48	1.90	0.157	21	0.22	2.58	1.6	1.05	1.6	1.49	0.69	---	23	0.30	CLAY
6.8	1.80	12.40	0.00	1.41	11.68	0.00	0.177	356	8.31	1.16	1.8	1.07	0.7	0.62	0.37	35	303	---	SAND
7.0	1.50	11.00	0.00	1.17	10.28	0.00	0.196	316	9.39	0.90	1.8	1.08	0.4	0.38	0.34	35	269	---	SAND
7.2	1.30	6.50	0.00	1.18	5.78	0.00	0.216	159	4.76	0.88	1.8	1.10	0.4	0.36	0.50	30	135	---	SAND
7.4	1.10	4.70	0.00	1.06	3.98	0.00	0.236	101	3.53	0.74	1.7	1.11	0.3	0.26	0.52	28	86	---	SAND
7.6	1.30	5.40	0.00	1.24	4.68	0.00	0.255	119	3.51	0.87	1.8	1.13	0.4	0.36	0.53	28	101	---	SAND
7.8	1.10	4.80	0.00	1.06	4.08	0.00	0.275	105	3.86	0.68	1.7	1.14	0.3	0.23	0.51	28	89	---	SAND
8.0	1.00	4.60	0.00	0.96	3.88	0.00	0.294	101	4.37	0.58	1.7	1.16	0.2	0.16	0.50	28	86	---	SAND
8.2	1.00	5.30	0.00	0.93	4.58	0.00	0.314	127	5.96	0.52	1.7	1.17	0.2	0.14	0.46	29	108	---	SAND
8.4	1.60	7.40	0.00	1.45	6.68	0.00	0.334	181	4.67	0.94	1.8	1.19	0.5	0.42	0.50	30	154	---	SAND
8.6	1.70	10.20	0.00	1.42	9.48	0.00	0.353	280	7.58	0.89	1.8	1.20	0.4	0.37	0.41	33	238	---	SAND
8.8	1.30	12.20	0.00	0.90	11.48	0.00	0.373	367	20.21	0.43	1.8	1.22	0.1	0.09	0.03	40	312	---	SAND
9.0	3.40	20.50	0.00	2.69	19.78	0.00	0.393	593	7.45	1.86	1.9	1.23	1.9	1.52	0.40	36	616	---	SAND
9.2	2.20	15.60	0.00	1.67	14.88	0.00	0.412	458	10.49	1.01	1.9	1.25	0.6	0.47	0.28	37	389	---	SAND
9.4	2.00	14.00	0.00	1.54	13.28	0.00	0.432	407	10.58	0.88	1.8	1.27	0.5	0.36	0.29	36	346	---	SAND

Ground Surface Elev.: _____ m
Northing: _______, Easting: ______

PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

DILATOMETER RESULTS



ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-11

SOUNDING
DMT 306

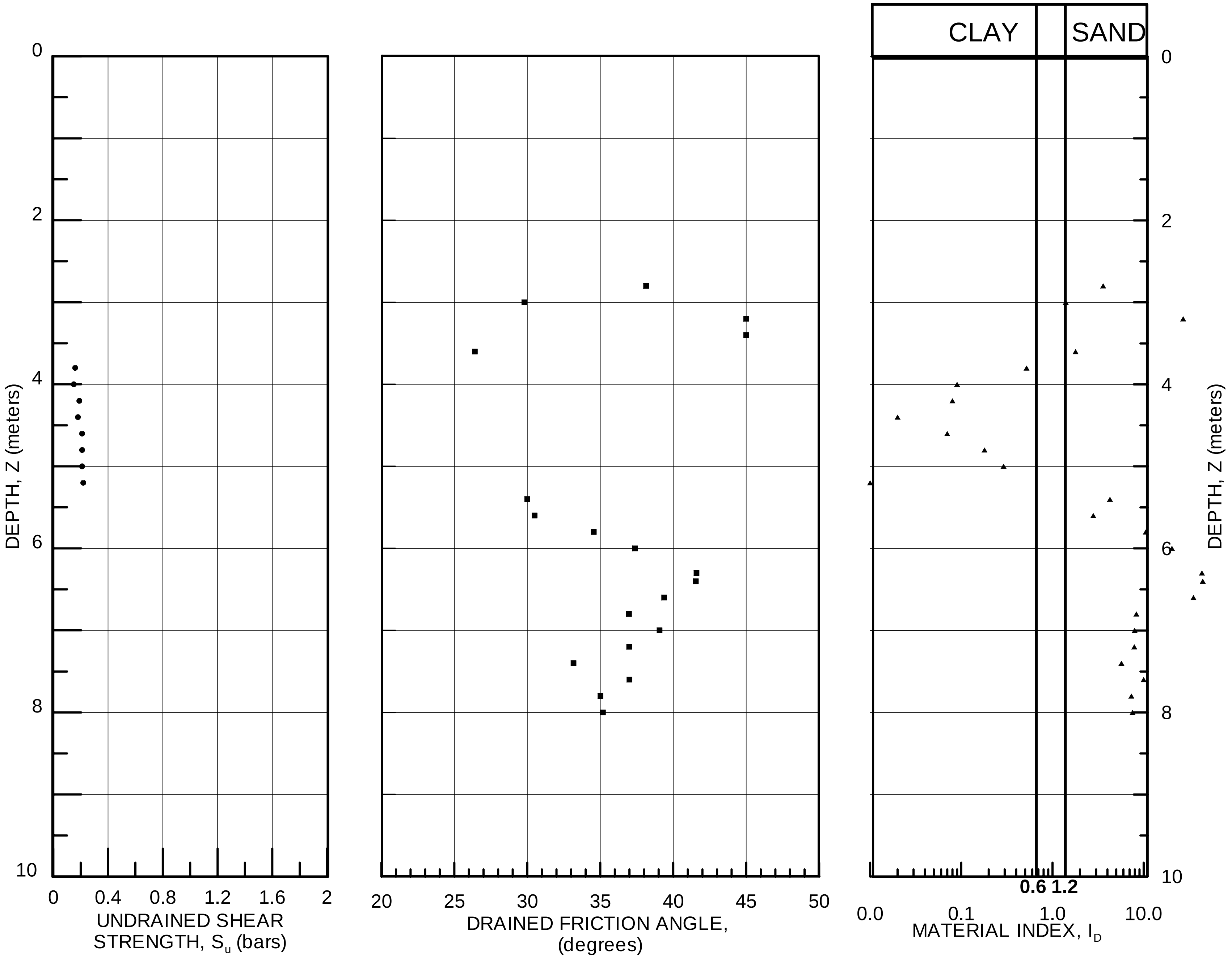
Ground Surface Elev.:_____ m
Northing: _______, Easting: _______

DILATOMETER RESULTS

PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-11

SOUNDING
DMT 306

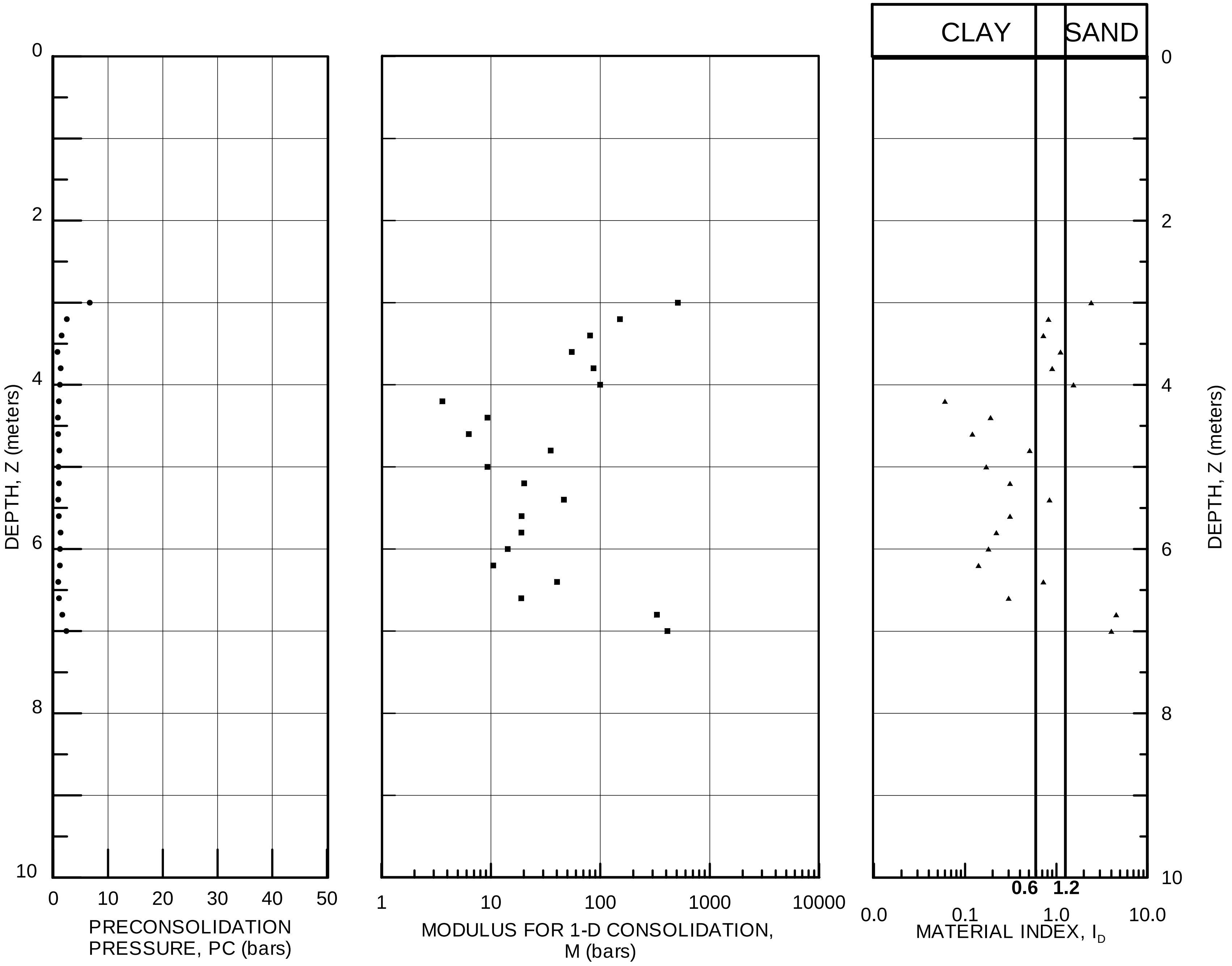


Z (M)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	ED (BAR)	ID	KD	GAMMA (T/M3)	SV' (BAR)	PC (BAR)	OCR	KO	PHI (PHI)	M (BAR)	Su (BAR) f(SV', Kd)	SOIL TYPE
2.8	7.40	30.00	0.00	6.40	29.43	0.00	0.000	799	3.59	10.89	2.0	0.59	26.2	44.52	1.39	38	2062	---	SAND
3.0	7.10	16.80	0.00	6.75	16.23	0.00	0.000	329	1.40	10.78	2.0	0.63	11.6	18.45	1.68	30	845	---	SANDY SILT
3.2	2.30	30.00	0.00	1.05	29.43	0.00	0.000	985	27.06	1.58	1.9	664.00	0.7	1.16	1.09	45	884	---	SAND
3.4	1.40	30.00	0.00	0.10	29.43	0.00	0.000	1017	282.61	0.15	1.7	0.97	0.0	0.01	1.26	45	865	---	SAND
3.6	1.00	3.40	0.20	1.01	2.83	0.30	0.000	63	1.79	1.39	1.6	0.73	0.6	0.78	0.64	26	53	---	SANDY SILT
3.8	1.40	2.80	0.00	1.46	2.23	0.00	0.000	26	0.52	1.93	1.6	0.76	0.7	0.94	0.53	---	22	0.16	SILTY CLAY
4.0	1.30	2.10	0.50	1.39	1.53	0.60	0.000	5	0.09	1.77	1.5	0.79	0.7	0.82	0.48	---	4	0.15	MUD
4.2	1.60	2.40	0.50	1.69	1.83	0.60	0.000	5	0.08	2.07	1.5	0.82	0.9	1.05	0.56	---	4	0.19	MUD
4.4	1.50	2.20	0.60	1.60	1.63	0.70	0.000	1	0.02	1.89	1.5	0.85	0.8	0.91	0.51	---	1	0.18	MUD
4.6	1.80	2.60	0.70	1.89	2.03	0.80	0.000	5	0.07	2.16	1.5	0.88	1.0	1.13	0.59	---	4	0.21	MUD
4.8	1.80	2.80	0.70	1.88	2.23	0.80	0.000	12	0.18	2.08	1.5	0.91	1.0	1.06	0.57	---	11	0.21	MUD
5.0	1.80	3.00	0.10	1.87	2.43	0.20	0.000	19	0.29	2.00	1.6	0.94	0.9	1.00	0.54	---	16	0.21	CLAY
5.2	1.90	2.60	0.80	2.00	2.03	0.90	0.020	1	0.01	2.09	1.5	0.95	1.0	1.07	0.57	---	1	0.22	MUD
5.4	1.40	7.00	0.00	1.25	6.43	0.00	0.039	179	4.26	1.26	1.8	0.96	0.7	0.72	0.53	30	153	---	SAND
5.6	3.80	13.50	0.00	3.45	12.93	0.00	0.059	329	2.80	3.45	1.9	0.98	4.9	4.97	0.78	30	514	---	SILTY SAND
5.8	1.00	8.50	0.00	0.76	7.93	0.00	0.079	249	10.53	0.68	1.8	1.00	0.2	0.22	0.32	35	211	---	SAND
6.0	0.60	7.20	0.00	0.40	6.63	0.00	0.098	216	20.36	0.30	1.7	1.01	0.1	0.05	0.16	37	183	---	SAND
6.3	0.40	6.10	0.00	0.25	5.53	0.00	0.128	183	43.54	0.12	1.7	1.03	0.0	0.80	0.19	42	156	---	SAND
6.4	0.40	6.00	0.00	0.25	5.43	0.00	0.137	179	44.44	0.11	1.7	1.04	0.0	0.70	0.19	42	153	---	SAND
6.6	0.20	5.90	0.00	0.30	5.33	0.00	0.157	174	35.14	0.14	1.7	1.05	0.0	0.01	0.02	39	148	---	SAND
6.8	2.60	17.60	0.00	1.98	17.03	0.00	0.177	522	8.32	1.69	1.9	1.07	1.4	1.27	0.35	37	499	---	SAND
7.0	3.90	25.50	0.00	2.95	24.93	0.00	0.196	762	7.97	2.53	2.0	1.09	3.0	2.74	0.33	39	996	---	SAND
7.2	3.00	19.40	0.00	2.31	18.83	0.00	0.216	573	7.87	1.89	1.9	1.11	1.8	1.58	0.37	37	605	---	SAND
7.4	2.60	13.80	0.00	2.17	13.23	0.00	0.236	383	5.70	1.72	1.9	1.13	1.5	1.32	0.50	33	373	---	SAND
7.6	2.40	17.60	0.00	1.77	17.03	0.00	0.255	529	10.00	1.33	1.9	1.14	0.9	0.80	0.26	37	450	---	SAND
7.8	2.60	15.80	0.00	2.07	15.23	0.00	0.275	456	7.31	1.55	1.9	1.16	1.3	1.08	0.41	35	402	---	SAND
8.0	2.60	16.00	0.00	2.06	15.43	0.00	0.294	464	7.55	1.50	1.9	1.18	1.2	1.01	0.40	35	396	---	SAND

Ground Surface Elev.: _____ m
Northing: _______, Easting: ______

PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

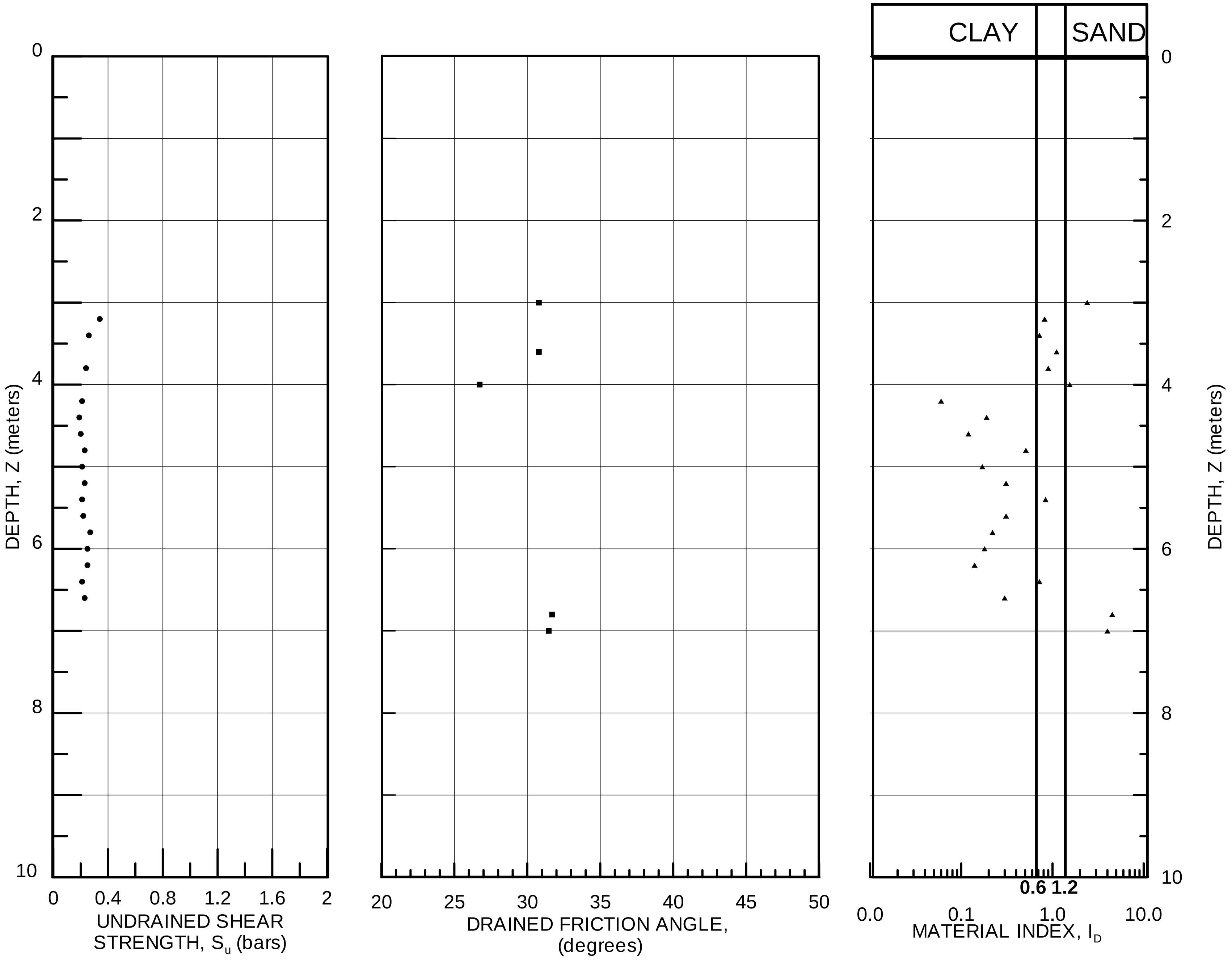
DILATOMETER RESULTS



ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-12

SOUNDING
DMT 308

Ground Surface Elev.:_____ m
Northing: _______, Easting: _______



PROJECT: 1545 Woodroffe Avenue
LOCATION: Ottawa, ON

DILATOMETER RESULTS

ALSTON ASSOCIATES INC.
FIELD TECH.: KC
SOUNDING DATE: 2014-12-12

SOUNDING
DMT 308

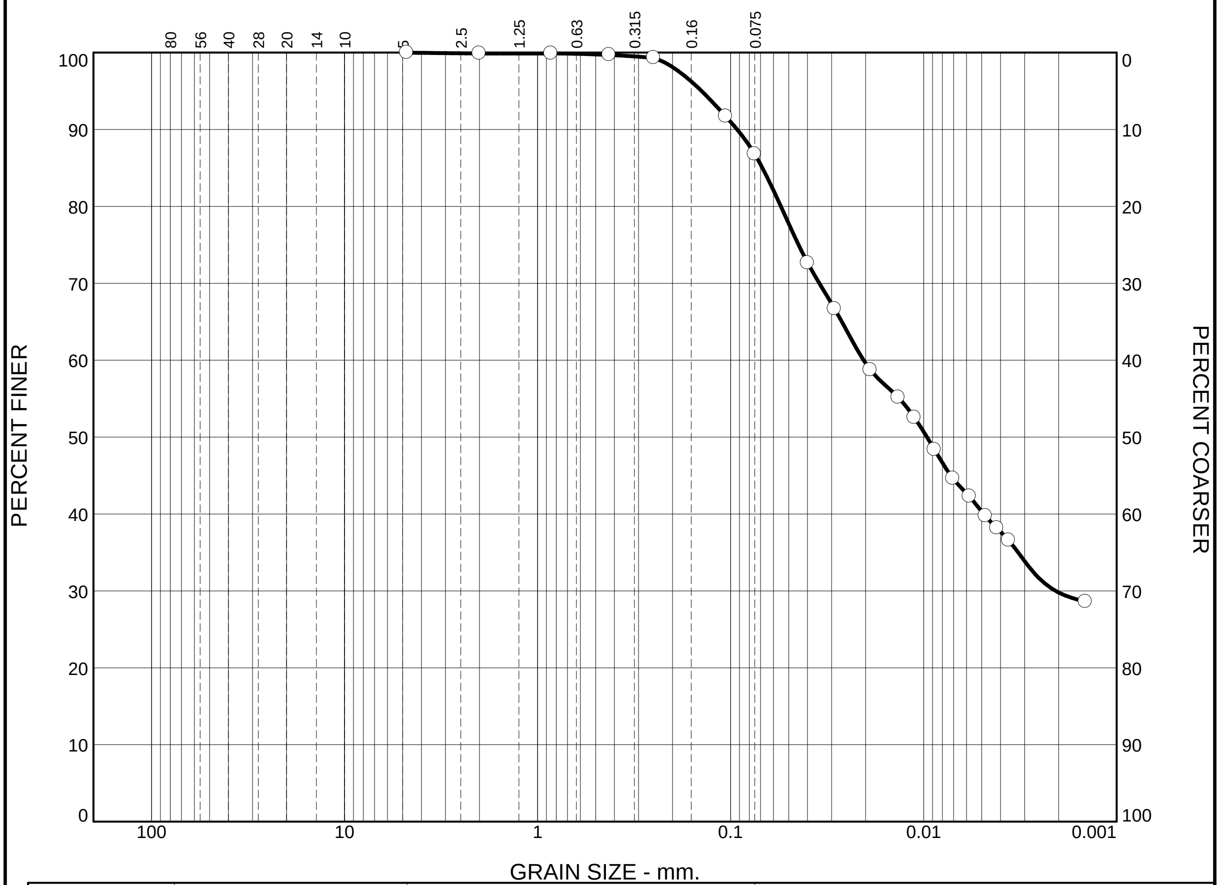
DMT 308

Z (M)	A (BAR)	B (BAR)	C (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	ED (BAR)	ID	KD	GAMMA (T/M3)	SV' (BAR)	PC (BAR)	OCR	KO	PHI (PHI)	M (BAR)	Su (BAR) f(SV', Kd)	SOIL TYPE
3.0	3.50	11.80	0.00	3.23	11.00	0.00	0.000	270	2.41	5.13	1.9	0.63	6.7	10.56	0.97	31	511	---	SILTY SAND
3.2	3.10	6.40	0.00	3.08	5.60	0.00	0.000	87	0.82	4.64	1.7	0.66	2.5	3.72	1.10	---	151	0.34	CLAYEY SILT
3.4	2.30	4.80	0.00	2.32	4.00	0.00	0.000	58	0.72	3.33	1.7	0.70	1.5	2.22	0.86	---	81	0.26	CLAYEY SILT
3.6	1.50	4.00	0.20	1.52	3.20	0.30	0.000	58	1.11	2.08	1.7	0.73	0.8	1.07	0.57	31	55	---	SILT
3.8	2.20	5.00	0.00	2.21	4.20	0.00	0.000	69	0.90	2.89	1.7	0.76	1.4	1.77	0.76	---	87	0.24	SILT
4.0	1.80	5.30	0.00	1.77	4.50	0.00	0.000	95	1.54	2.22	1.7	0.80	1.2	1.51	0.73	27	100	---	SANDY SILT
4.2	1.80	2.80	0.70	1.90	2.00	0.80	0.000	4	0.06	2.29	1.5	0.83	1.0	1.24	0.62	---	4	0.21	MUD
4.4	1.60	2.80	0.60	1.69	2.00	0.70	0.000	11	0.19	1.97	1.5	0.86	0.8	0.98	0.54	---	9	0.19	MUD
4.6	1.70	2.80	0.80	1.79	2.00	0.90	0.000	7	0.12	2.02	1.5	0.89	0.9	1.02	0.55	---	6	0.20	MUD
4.8	2.00	3.90	0.40	2.05	3.10	0.50	0.000	36	0.51	2.24	1.6	0.92	1.1	1.19	0.61	---	35	0.23	SILTY CLAY
5.0	1.80	3.00	0.70	1.89	2.20	0.80	0.000	11	0.17	1.99	1.5	0.95	0.9	0.99	0.54	---	9	0.21	MUD
5.2	2.00	3.50	0.60	2.07	2.70	0.70	0.020	22	0.31	2.14	1.6	0.96	1.1	1.11	0.58	---	20	0.23	CLAY
5.4	1.90	4.30	0.50	1.93	3.50	0.60	0.039	55	0.84	1.94	1.7	0.97	0.9	0.95	0.53	---	46	0.21	CLAYEY SILT
5.6	2.00	3.50	0.70	2.07	2.70	0.80	0.059	22	0.31	2.05	1.6	0.98	1.0	1.04	0.56	---	19	0.22	CLAY
5.8	2.40	3.80	0.90	2.48	3.00	1.00	0.079	18	0.22	2.41	1.6	1.00	1.3	1.34	0.65	---	19	0.27	CLAY
6.0	2.30	3.60	1.10	2.38	2.80	1.20	0.098	15	0.18	2.27	1.6	1.01	1.2	1.22	0.61	---	14	0.25	CLAY
6.2	2.30	3.50	1.50	2.39	2.70	1.60	0.118	11	0.14	2.23	1.5	1.02	1.2	1.19	0.61	---	11	0.25	MUD
6.4	2.00	4.20	0.40	2.04	3.40	0.50	0.137	47	0.72	1.84	1.7	1.03	0.9	0.88	0.50	---	40	0.21	CLAYEY SILT
6.6	2.20	3.70	1.10	2.27	2.90	1.20	0.157	22	0.30	2.03	1.6	1.04	1.1	1.02	0.55	---	19	0.23	CLAY
6.8	2.50	12.00	0.00	2.17	11.20	0.00	0.177	313	4.53	1.88	1.9	1.06	1.7	1.56	0.56	32	329	---	SAND
7.0	3.00	13.20	0.00	2.64	12.40	0.00	0.196	339	4.00	2.26	1.9	1.08	2.4	2.22	0.61	31	410	---	SAND

APPENDIX E

LABORATORY TEST RESULTS

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	0	0	0	13	57	30

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0684	0.0205	0.0096	0.0021				

Material Description	USCS	AASHTO
○ SILTY CLAY, some sand		

Project No. 14-140 **Client:** Parsons

Project: IOL, 1545 Woodroffe Avenue

○ **Sample Number:** BH 305, Sample 5

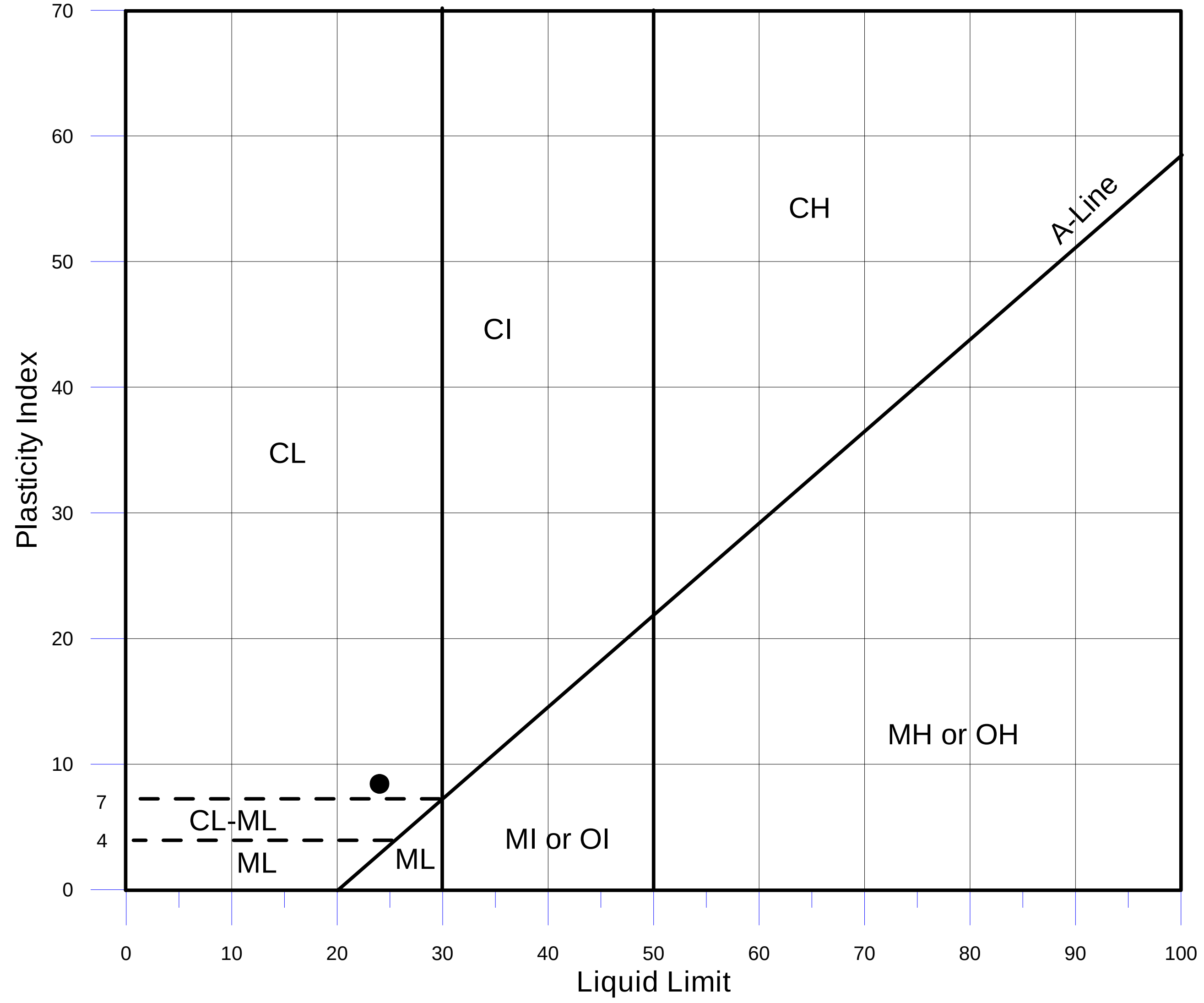
Remarks:

alston associates inc.
consulting engineers

Figure E-1

Tested By: GL/TS **Checked By:** JB

PLASTICITY CHART



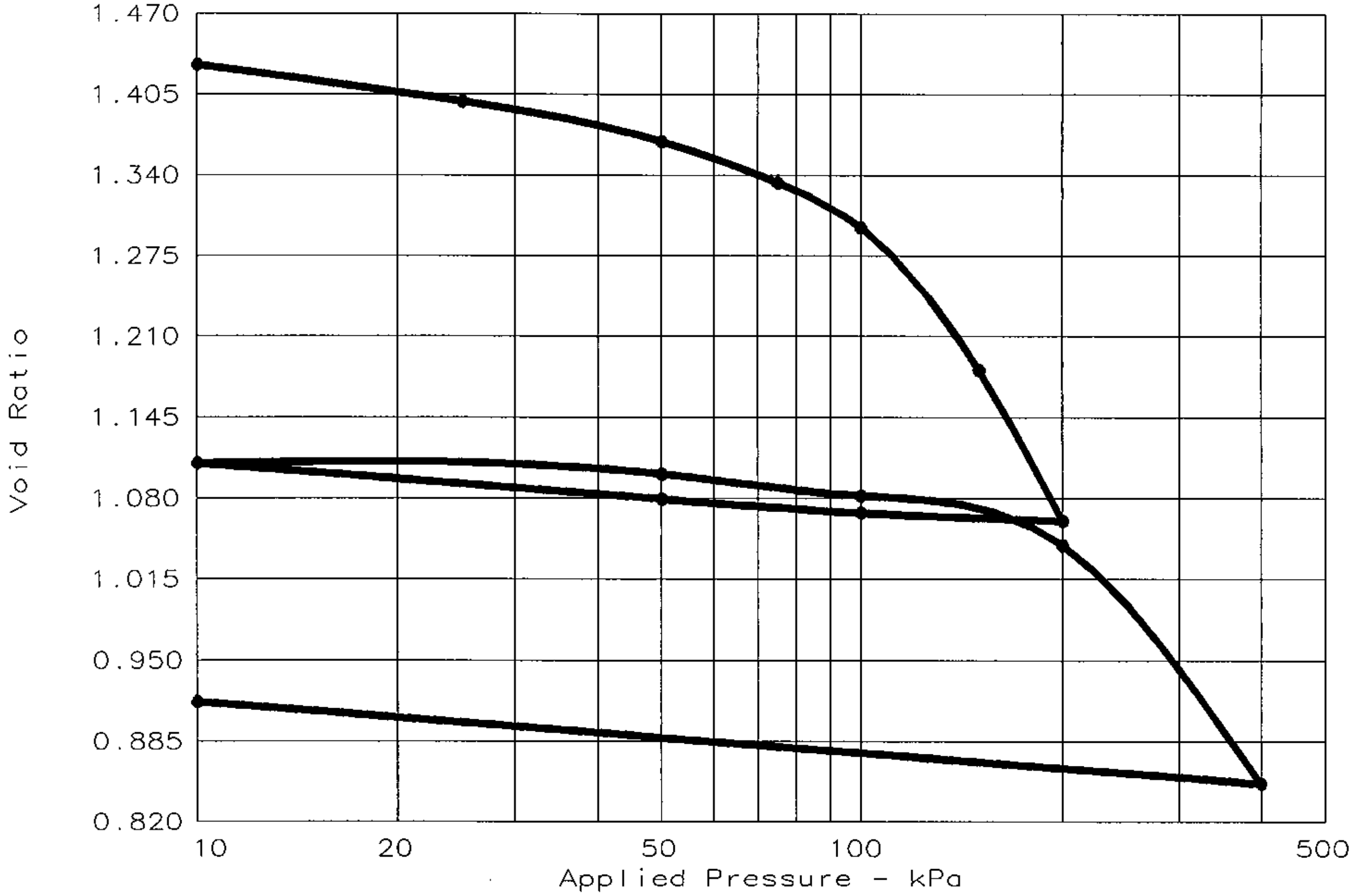
Client: Parsons
Project: 1545 Woodroffe Avenue, Ottawa, Ontario
Ref. No.: 14-140

Sample	Symbol
Borehole 305, Sample 5	●

Remarks:

alston associates inc.

CONSOLIDATION TEST REPORT



Coefficients of Consolidation (sq. cm./min.)								
No.	Load	Cv	No.	Load	Cv	No.	Load	Cv
1	10.00	0.178	13	200.00	0.101			
2	25.00	0.171						
3	50.00	0.130						
4	75.00	0.049						
5	100.00	0.464						
7	200.00	0.178						
11	50.00	0.267						
12	100.00	0.115						

Natural Saturation	Natural Moisture	Dry Dens. (kG/cu. m.)	LL	PI	Sp.Gr.	Initial void ratio
95.4 %	51.6 %	1098.0			2.700	1.4590

TEST RESULTS

MATERIAL DESCRIPTION

grey silty clay

Project No.: 14-140
Project: 1545 Woodroffe Avenue, Ottawa, ON
Location: Borehole 305B, Sample 3
Sample depth 5.3 - 5.8 m
Date: 18 Dec. 2014

Remarks:

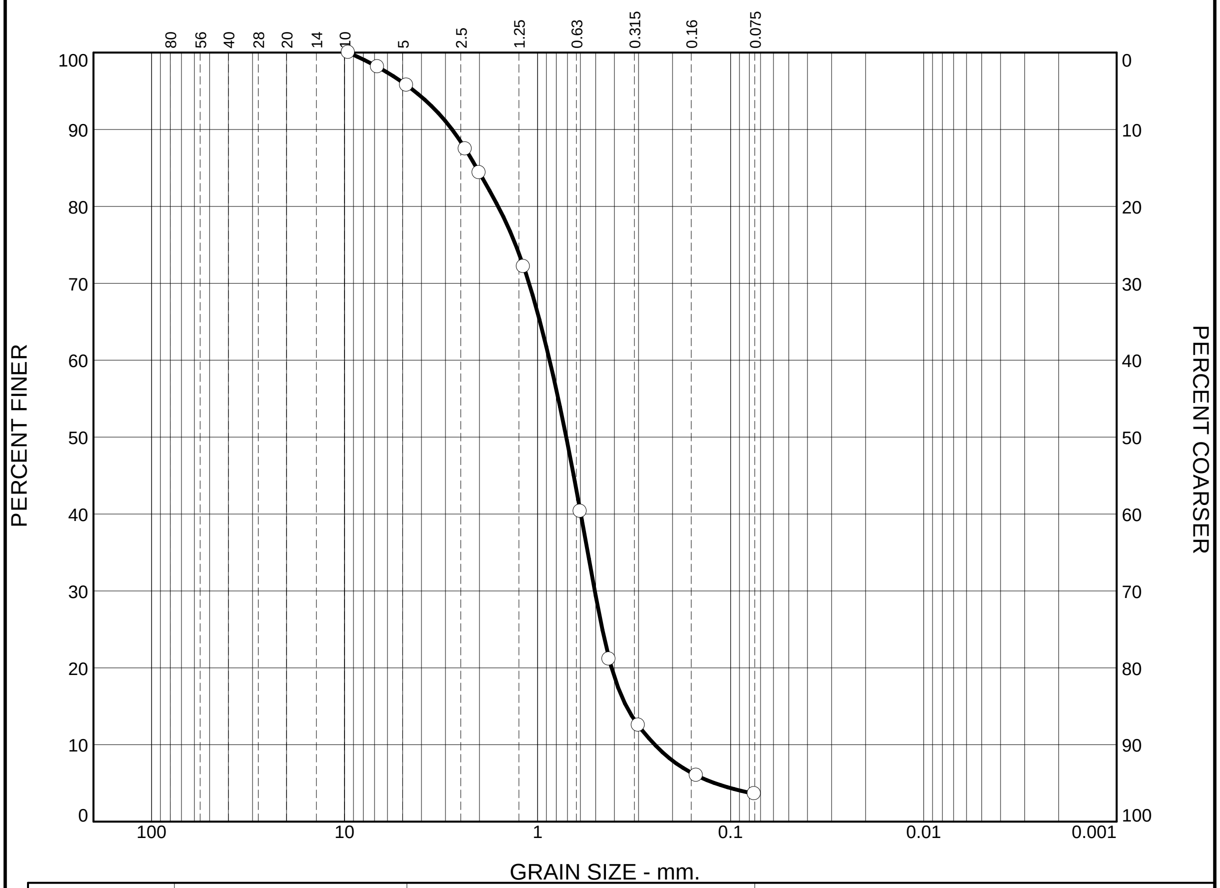
Prepared for:
Parsons

CONSOLIDATION TEST REPORT

alston associates inc.

Fig. No. E-3

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	4	12	63	17	4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.0695	0.8671	0.7109	0.5057	0.3472	0.2471	1.19	3.51

Material Description	USCS	AASHTO
○ SAND, trace gravel, trace silt	SP	

Project No. 14-140 **Client:** Parsons

Project: IOL, 1545 Woodroffe Avenue

○ **Sample Number:** BH 307, Sample 8

alston associates inc.
consulting engineers

Remarks:

Figure E-4

Tested By: GL **Checked By:** JB

APPENDIX F

CERTIFICATE OF CHEMICAL ANALYSES

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

CLIENT NAME: ALSTON ASSOCIATES
90 SCARSDALE RD
TORONTO, ON M3B2R7
(905) 474-5265

ATTENTION TO: VIC NERSESIAN

PROJECT: 14-140

AGAT WORK ORDER: 14T929001

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

DATE REPORTED: Dec 19, 2014

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

NOTES

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

Certificate of Analysis

AGAT WORK ORDER: 14T929001
PROJECT: 14-140

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

CLIENT NAME: ALSTON ASSOCIATES

ATTENTION TO: VIC NERSESIAN

SAMPLING SITE:

SAMPLED BY:Michael Lam

pH & Sulphate (Soil)

DATE RECEIVED: 2014-12-16

DATE REPORTED: 2014-12-19

			SAMPLE DESCRIPTION:	306 / S5		306 / S3
			SAMPLE TYPE:	Soil		Soil
			DATE SAMPLED:	12/11/2014		12/11/2014
Parameter	Unit	G / S	RDL	6190161	RDL	6190166
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.52	NA	7.57
Sulphate (2:1)	µg/g		8	361	2	67

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

6190161 pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.
Elevated RDL indicates the degree of sample dilution prior to the analysis to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instrument.

6190166 pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By:

Quality Assurance

CLIENT NAME: ALSTON ASSOCIATES
PROJECT: 14-140
SAMPLING SITE:

AGAT WORK ORDER: 14T929001
ATTENTION TO: VIC NERSESIAN
SAMPLED BY:Michael Lam

Soil Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
pH & Sulphate (Soil)															
pH, 2:1 CaCl2 Extraction	6143827		8.15	8.22	0.9%	NA	100%	80%	120%	NA			NA		
Sulphate (2:1)	6184687		147	147	0.0%	< 2	97%	70%	130%	100%	70%	130%	99%	70%	130%

Comments: NA signifies Not Applicable.

Certified By:

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
6190161	306 / S5	Soil	11-DEC-2014	16-DEC-2014

pH & Sulphate (Soil)

Parameter	Date Prepared	Date Analyzed	Initials
pH, 2:1 CaCl2 Extraction	18-DEC-2014	18-DEC-2014	BG
Sulphate (2:1)	19-DEC-2014	19-DEC-2014	MM

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
6190166	306 / S3	Soil	11-DEC-2014	16-DEC-2014

pH & Sulphate (Soil)

Parameter	Date Prepared	Date Analyzed	Initials
pH, 2:1 CaCl2 Extraction	18-DEC-2014	18-DEC-2014	BG
Sulphate (2:1)	19-DEC-2014	19-DEC-2014	MM

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

Method Summary

CLIENT NAME: ALSTON ASSOCIATES

PROJECT: 14-140

SAMPLING SITE:

AGAT WORK ORDER: 14T929001

ATTENTION TO: VIC NERSESIAN

SAMPLED BY:Michael Lam

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH