Geotechnical Design Report

Proposed Building Addition at 8560 Campeau Drive, Ottawa, ON

Prepared for:
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c/o United Brotherhood of Carpenters and Joiners of America
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Project No. 121626324

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by the Carpenters' Local 93 Training Centre Association to provide geotechnical engineering services for the design of a building addition to the existing building at 8560 Campeau Drive in Ottawa, Ontario (the Site). The Site location is shown on Drawing No. 1, and the footprint of the existing building and proposed addition are shown on Drawing No. 2 in Appendix B. The new building addition will consist of a single storey structure with an approximate building footprint of 1,243 m^2.

Limitations associated with this report and its contents are provided in the statement of conditions included in Appendix A.

2.0 BACKGROUND DOCUMENTS

Stantec previously issued a geotechnical investigation report titled "Detailed Geotechnical Investigation Report, Proposed Development Campeau Drive & Palladium Drive, Block 22, Ottawa, ON" dated December 2014. The 2014 report was prepared for the design and construction of the existing building at the Site.

A copy of the structural set of as-built drawings for the existing building were provided. The drawings indicated the building is supported on shallow strip and spread footings founded approximately 1.5 m below ground level. The foundation sizes range from 750 mm wide strip footings to 3000 mm by 3000 mm spread footings. The foundations were placed on a 75 mm to 100 mm thick mud slab over native clay subgrade.

3.0 SCOPE OF WORK

The scope of work is to prepare a geotechnical report for the proposed building addition which includes the following:

- A summary of the available geotechnical information from previous investigations
- Borehole logs and rock core logs
- Laboratory test results
- A borehole location plan
- Geotechnical resistances (ULS and SLS) for shallow foundations
- Excavation and backfill requirements
- Frost protection recommendations
- Site preparation recommendations
- Groundwater level estimates or measurements
- Seismic site classification according to the 2012 Ontario Building Code (OBC)
- Pavement recommendations for the proposed access road and parking areas

4.0 RESULTS OF 2014 GEOTECHNICAL INVESTIGATION

The following sections provide a summary of the subsurface conditions and laboratory test results encountered during the 2014 Geotechnical Investigation.

In general, the subsurface soil profile at the borehole locations consisted of topsoil underlain by fat to lean clay overlying, till over, limestone bedrock. Detailed descriptions of the subsurface soil conditions are presented on the Boreholes Records provided in Appendix C. Laboratory test results are shown on the Borehole Records as well as in Appendix D.

The borehole records depict conditions at a particular location and at the particular times indicated. The boreholes were advanced prior to the construction of the existing building, the construction of the building, associated underground services and pavement surfaces have altered the subsurface conditions.

An explanation of the symbols and terms used on the Borehole Records also provided in Appendix C.

4.1 SUBSURFACE SOIL CONDITIONS

The following sections summarize the soil and groundwater conditions.

4.1.1 Topsoil

The topsoil was encountered in all boreholes and ranged from approximately 150 to 600 mm in thickness.

This layer was removed during the construction of the existing building and pavement surfaces.

4.1.2 Fat to lean Clay (CH to CL)

A deposit of clay was encountered in all the boreholes. In boreholes BH14-6, BH14-7, BH14-8 and BH14-9 the clay layer extended to the elevations between 94.5 and 95.3 m. In borehole BH14-3 the results of the Dynamic Cone penetration Test inferred a termination elevation of 93.7 m for the clay layer. A layer of sand was observed in boreholes BH14-1, BH14-2, BH14-3 and BH14-6.

The consistency of the clay material ranged from firm to very stiff as indicated by the measured in-situ shear strengths of 30 kPa to greater than 100 kPa.

The moisture content of the clay ranged from 21% to 57%.

Grain size analysis and Atterberg limit tests were carried out on select samples of the clay. The grain size distribution of the clay indicated a soil composition of 0 to 1% gravel, 1 to 7% sand, 42 to 51% silt and 47 to 55% clay. The plastic and liquid limits of the clay ranged between 18 and 23, and 37 and 66, respectively. The grain size distribution curves and the plasticity chart are shown in Figures 1 and 3, Appendix D.

This material was classified as a fat to lean clay (CH to CL) in accordance with the Unified Soil Classification System (USCS).

4.1.3 Silt (ML)

A 0.8 m thick silt layer was encountered beneath the clay layer in borehole BH14-9. The compactness of silt layer was very loose as indicated by the 'N' value from the standard penetration test (SPT). The moisture content of layer was 56%. One Atterberg Limit test performed on this material yielded non-plastic result.

4.1.4 Till (SC-SM, SM, ML)

A till deposit was encountered beneath the clay layer in boreholes BH14-6, BH14-8 and BH14-9. The till layer was encountered at elevations between 93.8 m and 95.3 m and extended to elevations between 91.0 and 92.6 m.

The compactness of the till material ranged from very loose to dense as indicated by the 'N' values from the standard penetration test (SPT). The moisture content of the till was 9 to 27%.

The results from the grain size analysis of this layer are shown in Figure 2, Appendix D and indicate a soil composition of 19% gravel, 47% sand, 26% silt size and 8% clay size.

This material in borehole BH14-6 was classified as a silty clayey sand with gravel (SC-SM) in accordance with the USCS.

The till material encountered in boreholes BH14-8 and BH14-9 can be classified as clayey silt (ML) and silty sand (SM) respectively.

4.1.5 Bedrock

Grey limestone bedrock was confirmed by coring in boreholes BH14-7 and BH14-9. The depth to bedrock was approximately 7.6 and 10.5 m (elevation 94.4 and 91.0 m) below ground surface in boreholes BH14-7 and BH14-9 respectively. The limestone had a flat joint orientation with very close to medium spacing.

The total core recovery (TCR) was 51 to100%. Rock Quality Designation (RQD) varied from 46 to 100% which shows poor to excellent bedrock quality. The unconfined compressive strength of four rock sample ranged between 82 and 116 MPa. The rock can be classified as strong to very strong rock. Photos of the rock core and the field bedrock core logs are shown in Appendix C.

4.2 GROUNDWATER

Groundwater was observed at the time of drilling in the open boreholes. The inferred and measured groundwater levels are shown in Table 4.1.

Table 4.1: Inferred and Measured Groundwater Levels

Borehole No.	Depth (m)	Elevation (m)
BH14-1	2.7 (Inferred)	99.9
BH14-2	3.0 (Inferred)	99.3
BH14-3	2.3 (Inferred)	100.1
BH14-4	3.4 (Inferred)	98.6
BH14-5	3.7 (Inferred)	98.2
BH14-6	2.3 (Inferred)	99.7
BH14-8	Below 3.7	N/A

The inferred groundwater levels could be influenced from the drilling. Fluctuations due to seasonal variations or precipitation events should be anticipated.

5.0 DISCUSSIONS AND RECOMMENDATIONS

5.1 GENERAL

It is understood that the existing building is supported by shallow spread and strip footings founded on the native clay. To reduce differential settlement between the existing building and proposed building addition, the addition should also be designed and constructed with shallow spread and strip footings at the same depths of the existing building foundations.

The conditions observed at the borehole locations is considered acceptable for shallow foundations for lightly loaded structures.

Existing fill material beneath the footprint of the proposed addition will need to be removed and replaced with compacted Structural Fill. Addition guidance for site preparation is provided in Section 5.2

5.2 SITE PREPARATION

5.2.1 Grading

A grade raise is not proposed at the location of the building addition.

5.2.2 Building Shallow Foundations

All existing pavement, fill, and organic material should be excavated and removed from beneath the building foundations. Bearing soils will require inspection by geotechnical personnel to verify design bearing pressures. Building foundations should be placed directly on the undisturbed native soil or on Structural Fill placed on native soils.

Structural Fill should be used to raise the grade where required. Structural Fill should consist of OPSS Granular B Type II or OPSS Granular A. It should be placed in lifts no thicker than 300 mm and compacted to at least 100% Standard Proctor maximum dry density (SPMDD).

It is recommended that a 75 mm to 100 mm thick layer of lean concrete (mud slab) be placed on the foundation subgrade to protect it from disturbance during construction.

5.2.3 Floor Slab

All pavement structures, fill and organic material and other deleterious materials should be entirely removed from beneath the slab. Prepared subgrades should be inspected by geotechnical personnel prior to placement of fill or concrete. A layer of free draining granular material such as OPSS Granular A at least 200 mm in thickness should be placed immediately beneath the floor slab for leveling, drainage and support purposes. This material should be compacted to at least 100% Standard Proctor maximum dry density.

5.2.4 Re-Use of Site Generated Material

The overburden soils observed on site consist primarily of clay. The existing site materials will not be reusable as grading fills or subgrade fill. It is noted that compaction is highly dependent on the moisture content of the material, thus the amount of re-useable material will be dependent on the natural moisture content, weather conditions and the construction techniques at the time of excavation and placement.

5.3 FOUNDATIONS

5.3.1 Shallow Foundations

We have calculated the resistances at Ultimate Limits States (ULS) and Serviceability Limits States (SLS) for spread (square) and strip footings. The values are provided below in Table 5.1.

Table 5.1: Geotechnical Resistance for Shallow Footings

Founding Element	Footing Width (m)	Factored Geotechnical Resistance at ULS (kPa)	Geotechnical Resistance at SLS (kPa)
Spread footing on clay crust (1)	1.0 to 3.0	200	100
Strip footing on clay crust (1)	0.5 to 2.0	160	100
Spread footing on firm clay (2)	1.0 to 3.0	130	100
Strip footing on firm clay (2)	0.5 to 2.0	110	100

Notes:

(1) The underside of footings is placed at the geodetic elevation 99.0 m or higher.
(2) The underside of footings is placed below geodetic elevation 99.0 m.

The factored geotechnical bearing resistance at ULS incorporates a resistance factor of 0.5. The geotechnical reactions at SLS were developed consistent with a total settlement of 25 mm and includes the effects of a 1 m grade raise; the increase to the soil stress in the clay deposit is not expected to exceed 80% of the preconsolidation pressure of the clay.

The unfactored horizontal resistance of spread footings may be calculated using the following unfactored coefficients of friction:

0.55 between OPSS Granular A and cast-in-place concrete
0.30 between clay and cast-in-place concrete

A resistance factor against sliding of 0.8 should be applied to obtain the resistance at ULS.

5.3.2 Frost Penetration Depth

All perimeter and interior footings within 1 m distance from the exterior walls require a minimum frost protection equivalent to a soil cover of 1.5 m for protection against frost action.

Footings in unheated areas or exterior footings should have a minimum frost protection equivalent to a soil cover of at least 1.8 m.

5.4 FLOOR SLAB

The recommendations provided herein are based on the assumption that the average net slab loads will not exceed 12 kPa. Should a greater average load be proposed, the recommendations must be reviewed.

The floor slab constructed as recommended above may be designed using a soil modulus of subgrade reaction, k, of 20 MPa/m. Non-structural slab-on-grade units should float independently of all load-bearing walls and columns.

Where construction is undertaken during winter months, floor slab subgrades should be protected from freezing. Alternatively, the floor slab subgrade must be completely thawed then proof rolled prior to placing concrete.

The native soils at this site are susceptible to frost heave. If wide building openings to the exterior are proposed such as loading bays, a 100 m thick layer of insulation should be installed beneath the floor slab to prevent frost heave. The compressive strength of the insulations should be selected based on the floors slab load with consideration for insulation creep settlement. Alternatively, the floor slab should be placed on a 1.2 m thick pad of compacted Structural Fill.

5.5 TEMPORARY EXCAVATIONS & GROUNDWATER CONTROL

The overburden soils should be classified as Type 3 soil as defined by the Occupational Health and Safety Act and Regulations for Construction Projects. Within Type 3 soils, open cut excavations must be sloped no steeper than one horizontal to one vertical (1H:1V) from the bottom of the trench.

Excavations should not extend below the underside of existing foundations.

Groundwater and/or surface run-off may be encountered during excavation and construction. It is expected that groundwater may be controlled by sump and pumping methods. The clay deposit encountered in the borehole is a low permeability material. It is anticipated that construction activities and groundwater dewatering can be carried out at less than 50,000 L/day.

The proposed building addition and site modifications are not expected to have long term impacts to the local groundwater level. The proposed construction is not anticipated to cause soil settlement related to groundwater lowering.

The quality of groundwater that may be removed during the construction activities should be assessed at that time to determine if it may be disposed of directly to the local sanitary/storm sewer without treatment, under a permit that would be required from the City of Ottawa Sewer Use Program. Construction contractor has the responsibility to obtain a permit under the City of Ottawa Sewer Program and testing/discharge of water to sanitary or storm sewer. Discharge of pumped groundwater to the environment is not considered.

It is recommended that a 75 mm to 100 mm thick layer of lean concrete be placed on the subgrade of temporary excavations to protect the subgrade from disturbance.

5.6 ASPHALT PAVEMENTS AND CONCRETE SIDEWALKS

The proposed development includes asphalt parking areas and access roads. It is anticipated that the parking area will be used by cars and the access roads will be used infrequently by small delivery trucks (2 to 3 ale trucks). The recommended pavement structures are illustrated in Table 5.2.

Table 5.2: Recommended Asphalt Pavement Structure Design

Material	Standard Duty Parking Areas	Heavy Duty Fire and Truck Routes	Compaction Requirements
SP 12.5 (surface course asphalt)	50 mm	40 mm	92 % MTRD
SP 19 (base course asphalt)	--	50 mm	92 % MTRD
OPSS Granular A Base	150 mm	150 mm	100 % SPMDD
OPSS Granular B Type II Sub-base	500 mm	500 mm	100 % SPMDD

In preparation for construction of new pavements, the finished sub-grade surface should be proof-rolled and compacted to identify the presence of soft, wet, or deflecting areas; such areas should be removed and replaced with approved engineered fill.

The finished sub-grade surface must be compacted to achieve a minimum of 95% of the materials SPMDD immediately prior to placement of the granular materials.

5.6.1 General Pavement Comments

The finished sub-grade surface should be graded to promote positive drainage away from the pavements. It is recommended that the sub-grade surface be sloped towards catch basin structures at a minimum cross-fall of 2% across the parking lots and reduced to 1% along the perimeter curb line. Sub-drain stubs with a minimum length of 3 m extending from the catch basin and manhole locations are recommended at low points in the sub-grade to prevent ponding of water and promote positive drainage.

In transition zones between different pavement structures, such as between the heavy duty and standard duty pavements, the installation of supplementary drainage is suggested to minimize the potential for future distress. The supplementary drainage can consist of the installation of sub-drains, placed a minimum of 100 mm below the finished surface of the sub-grade. The sub-drain can consist of a perforated flexible pipe, with geotextile sock, backfilled with clear stone on all sides, and extended to the closest manhole to provide a positive outfall.

5.6.2 Concrete Sidewalks

The design and construction of the sidewalks slabs should include a granular base layer consisting of a minimum of 200 mm of compacted OPSS Granular A. The design should also include positive drainage away from the edge of the building and beyond the limits of the concrete. Frost heave of sidewalks could be reduced by constructing frost tapers and extending the granular base to 1.2 m below ground surface.

5.7 SEISMIC CONSIDERATIONS

The site soils are not considered to be susceptible to soil liquefaction.

Geophysics GPR International Inc. was retained to perform a Multi-Channel Analysis of Surface waves (MASW) testing to determine the shear wave velocity variation of soil and bedrock in the top 30 m of the overburden. The MASW surveys were carried out on August 14, 2014. The detailed report of the MASW test and the corresponding results are shown in Appendix E.

The results of MASW report show that the average (harmonic mean) shear wave velocity in top 30 m of soil and bedrock is 476 m/sec and therefore the recommended site classification for seismic site response for this site is Site Class C in accordance with Table 4.1.8.4. A of the 2012 Ontario Building Code.

5.8 CEMENT TYPE AND CORROSION POTENTIAL

Two samples of the native soil were submitted to Paracel Laboratories in Ottawa, Ontario for analysis of pH, water soluble sulphate and chloride concentrations, and resistivity. The analysis results are summarized in Table 5.3.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the subsurface environment. The results are provided to aid in the selection of coatings and corrosion protection systems for items such as steel pipe in contact with the soil and groundwater at the site.

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. The soluble sulphate concentrations for the two samples indicate that a low degree of sulphate attack is expected for concrete in contact with soil and water. General Use (GU) Portland cement is therefore considered suitable for use at this site.

Table 5.3: Results of Chemical Analysis

Borehole No.	Sample No.	Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-m)
BH14-2	SS-2	1.52-2.13	7.64	<5	15	40.8
BH14-5	SS-3	2.28-2.89	7.75	<5	8	44.3

5.9 TREE PLANTING RESTRICTIONS

The soil at the site is considered "Sensitive Marine Clay" which is sensitive to settlement from the water demand from trees. The selection and planting of trees should follow the City of Ottawa guidelines for tree planting in "Sensitive Marine Clay".

5.10 PIPE BEDDING AND BACKFILL

Service line construction should be in accordance with City of Ottawa specifications.

Bedding for new watermains and storm sewers should be in accordance with City of Ottawa typical details. It is recommended that a minimum of 150 mm of OPSS Granular A material be placed below the pipe invert as bedding material. At locations where soft/loose subgrades are encountered, consideration should be given to increasing the thickness of the bedding material to 300 mm to 400 mm. Granular pipe backfill, placed above the invert should also consist of OPSS Granular A material. These materials should be compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

Impervious clay seals should be installed in pipe trenches as per the City of Ottawa Standard Detail Drawing S8. Seals should be installed at a 50 m spacing along the utility trenches.

Trench backfill placed within the upper 1.5 m should be compatible in nature to the soils exposed in the trench walls, or alternatively 3H:1V frost tapers should be constructed within the upper 1.5 m zone. These materials should be compacted to a minimum of 95% SPMDD. Below 1.5 m, the trench backfill should consist of compactable site generated materials or imported OPSS Select Subgrade Material. These materials should be compacted to a minimum of 95% SPMDD.

It should be noted that reuse of the site generated material will be highly dependent on the materials' moisture content at time of placement. Backfill should be compacted in lifts not exceeding 300 mm.

Existing services that cross above the proposed pipes will need to be supported. The Contractor should be responsible for designing and providing these supports in accordance with pipe or utility manufacturer's specifications. Special attention should be given for pressurized systems, in regard to unconfined or exposed lengths of pipe. Temporary excavation support may need to be modified at these service crossings.

6.0 CLOSURE

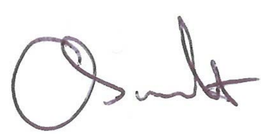
The conclusions in the Report are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from the Client and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided to applicable authorities having jurisdiction and others for whom the Client is responsible, Stantec does not warrant the services to any third party. The report may not be relied upon by any other party without the express written consent of Stantec, which may be withheld at Stantec's discretion.

Yours very truly,

STANTEC CONSULTING LTD.



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Senior Associate – Senior Geotechnical Engineer

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APPENDIX A

A.1 STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

APPENDIX B

B.1 DRAWING NO. 1 – KEY PLAN

B.2 DRAWING NO. 2 – BOREHOLE LOCATION PLAN

200 0 200 m 400 m

1 : 20 000

APRIL 2014
Project No. 122411024

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NOTES

BASEPLAN FROM MAPART 2006.

Client/Project

CARPENTERS LOCAL 93 TRAINING CENTRE ASSOCIATION

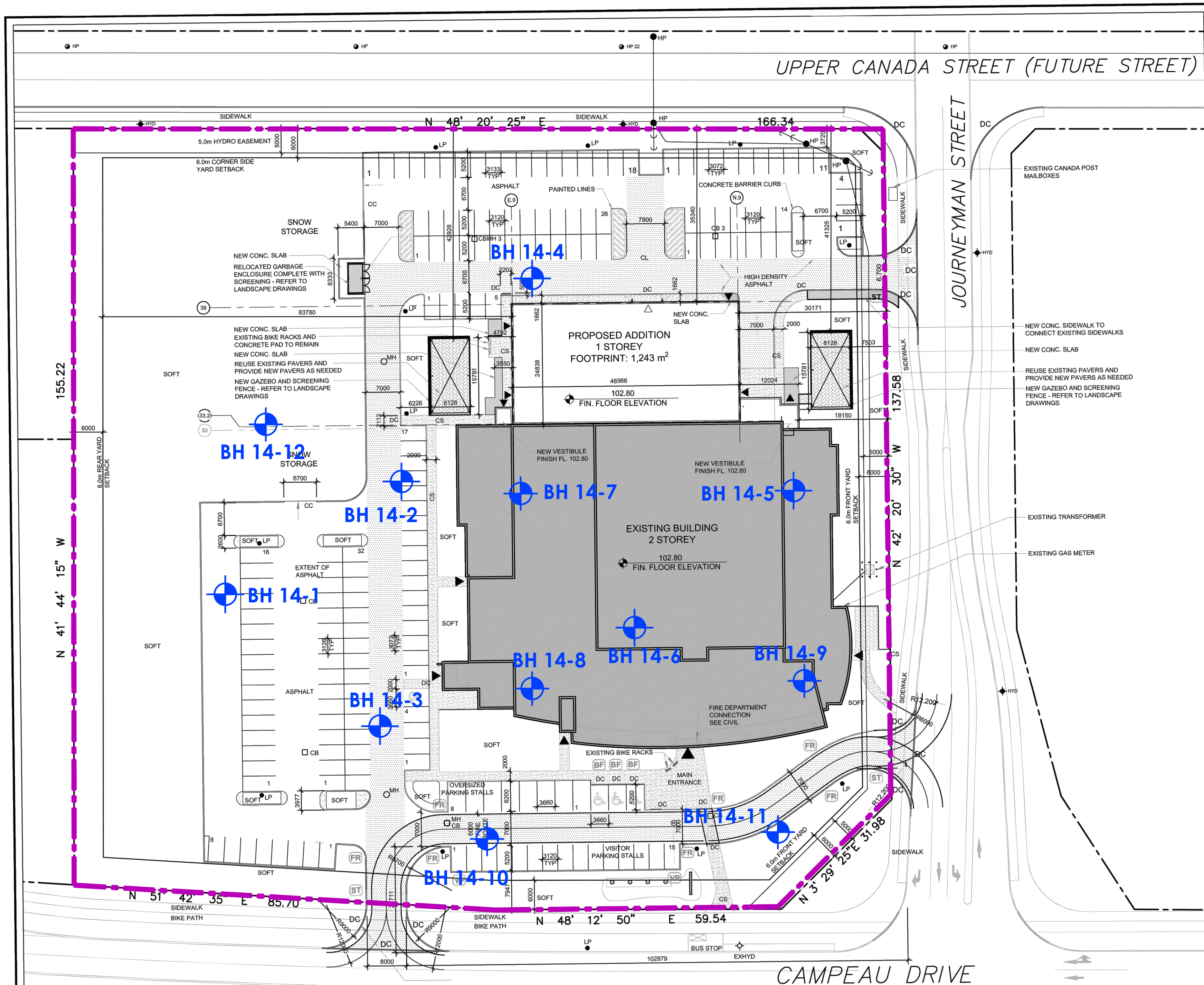
DETAILED GEOTECHNICAL INVESTIGATION, BLK. 22
CAMPEAU & PALLADIUM DRIVES, OTTAWA, ON.

Drawing No.

1

Title

KEY PLAN



1 A001 OVERALL SITE PLAN
SCALE 1:400

PROJECT INFORMATION

TOPOGRAPHICAL PLAN INFORMATION:

SURVEY PROPERTY BOUNDARIES TAKEN FROM TOPOGRAPHICAL PLAN OF PART OF LOT 4 CONCESSION 1, CITY OF OTTAWA, PREPARED BY STANTEC GEOMATICS LTD. DATED APRIL 22, 2014.

SITE ZONING AS PER OTTAWA ZONING BY-LAW 2008-250 SITE DESIGNATION
IP13 - BUSINESS PARK INDUSTRIAL ZONE
AREA "C" OF SCHEDULE 1, CITY OF OTTAWA

BUILDING CLASSIFICATION

THE BUILDING IS CLASSIFIED AND DESIGNED TO CONFORM TO THE ONTARIO BUILDING CODE 2012 (CURRENT EDITION) PART 3

OCCUPANCY

GROUP A, DIVISION 2, SPRINKLERED (3.2.2.24)

BUILDING STATISTICS

EXISTING BUILDING FOOTPRINT = 4,721m²/ 50,817ft²
NEW BUILDING ADDITION FOOTPRINT = 1,243m²/ 13,380ft²
TOTAL BUILDING FOOTPRINT = 5,964m²/ 64,196ft²

EXISTING GROSS FLOOR AREA = 5,562m²/ 59,869ft²
ADDITION GROSS FLOOR AREA = 1,243m²/ 13,380ft²
TOTAL GROSS FLOOR AREA = 6,805m²/ 73,249ft²

NUMBER OF STOREYS = 2

THE BUILDING IS SPRINKLERED

NUMBER OF ACCESS ROUTES REQUIRED = 1
NUMBER OF ACCESS ROUTES PROVIDED = 1

CONSTRUCTION TYPE = NON-COMBUSTIBLE CONSTRUCTION

FLOOR ASSEMBLES ARE FIRE SEPARATIONS - FIRE-RESISTANCE RATINGS 1 HR MIN.

EXISTING PARKING REQUIREMENTS

REQUIRED: 139 + 3 B/F SPACES

PROVIDED: 178 + 4 B/F SPACES

NEW PARKING REQUIREMENTS

REQUIRED: 139 + 3 B/F SPACES

PROVIDED: 178 + 4 B/F SPACES

ZONING INFORMATION

NOTE: ALL ZONING DEFINITIONS AND REQUIREMENTS AS PER CITY OF OTTAWA ZONING BY-LAW 2008-250

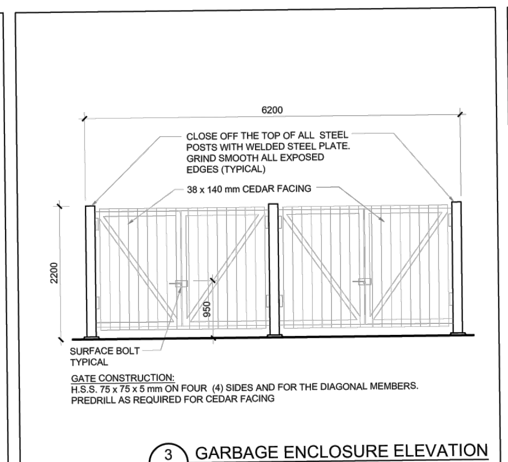
ZONING MECHANISM	REQUIRED	PROVIDED
DEFINITION	IP-13 BUSINESS PARK INDUSTRIAL ZONE	
MIN. LOT AREA	750 m²	26,310.11 m² (6.50 Acres)
MIN.LOT WIDTH	NO Minimum	166.34 m
MAX. LOT COVERAGE (%)	55	23
MIN. FRONT YARD SETBACK	6 m	18.15 m
MIN. CORNER SIDE YARD SETBACK	6 m	35.34 m (UPPER CANADA ST.)
MIN. INTERIOR SIDE YARD SETBACK	4 m	
MIN. REAR YARD SETBACK	6 m	83.78 m
MAX. FLOOR SPACE INDEX	2	0.26
MAX. BUILDING HEIGHT	22.0 m	11.50 m
MIN. WIDTH OF LANDSCAPE AREA	3 m	3.72 m
PARKING LANDSCAPE BUFFER	FOR A PARKING LOT CONTAINING 100 OR MORE SPACES: ABUTTING A STREET = 3 m NOT ABUTTING A STREET = 3 m	ABUTTING A STREET = 4.8m / 6.45m NOT ABUTTING A STREET = 3.72m
STANDARD PARKING SPACE	2.6m WIDTH x 5.2m LENGTH	2.6m WIDTH x 5.2m LENGTH
ACCESSIBLE PARKING SPACE	3.4m WIDTH x 5.2m LENGTH	3.66m WIDTH x 5.2m LENGTH
PARKING REQUIREMENTS	TRAINING CENTRE: 78 PARKING (3225 X 2.4 / 100m2 = 78 PLACE OF ASSEMBLY: 39 PARKING (384 X 10 / 100m2 = 39 OFFICE: 23 PARKING (962 X 2.4 / 100m2 = 23 TOTAL REQ,D = 139 PARKING SPACES	239 PARKING SPACES
HANDICAP ACCESSIBLE	AS PER OTTAWA TRAFFIC & PARKING BY-LAW 2017-301, PART "C", ITEM 122 (1), FOR A PARKING AREA WITH A CAPACITY OF 200-299 SPACES, 3 HANDICAP ACCESSIBLE SPACE IS REQ'D	4 ACCESSIBLE PARKING SPACE
LOADING SPACES	1 per 2,000 m² - 4,999 m² of G.F.A.	4,535 m² G.F.A. = 2 SPACE
BICYCLE PARKING RATE	OFFICE: 1 per 250 m² of G.F.A. (962m2/250) = 4 BICYCLE SPACES ALL OTHER SPACES: 1 per 1500m2 of G.F.A. (3225 + 384) / 1500m2 = 3 BICYCLE SPACES	16 BICYCLE SPACES

SIGNAGE LEGEND:

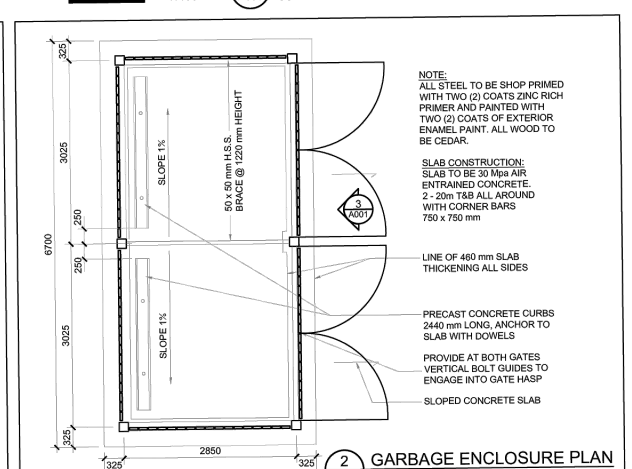
- NO TRESPASSING
- FR FIRE ROUTE
- BF HANDICAP PARKING
- VP VISITOR PARKING
- TP TEMPORARY PARKING
- ST STOP SIGN
- ONE WAY

LEGEND:

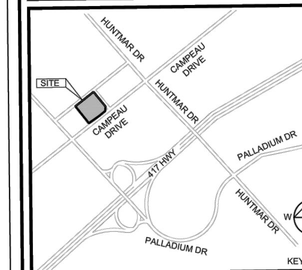
- EXHYD EXISTING FIRE HYDRANT
- HYD FIRE HYDRANT
- FP FLAG POLE
- HP HYDRO POLE
- LP LIGHT POLE - SEE ELECTRICAL
- CB CATCH BASIN - SEE CIVIL
- MH MANHOLE - SEE CIVIL
- BUILDING ENTRANCE/EXIT
- OVERHEAD DRIVE-IN DOOR
- HP HYDRO POLE
- DC DEPRESSED CURB
- CC CURB CUT
- NEW CURB
- PROPERTY LINE
- YARD SET BACK
- NEW CHAIN LINK FENCE
- 6m WIDE FIRE ROUTE AND HIGH DENSITY ASPHALT REFER TO CIVIL
- SOFT: SOFT LANDSCAPE AREA FOR SPECIFIC FEATURES REFER TO LANDSCAPE DRAWINGS
- CS CONCRETE SIDEWALK
- PAVERS



3 A001 GARBAGE ENCLOSURE ELEVATION
SCALE 1:50



2 A001 GARBAGE ENCLOSURE PLAN
SCALE 1:50



no.	revision	date
01	ISSUED FOR SITE PLAN CONTROL	2025-01-15

N45 ARCHITECTURE INC.
71 Bank Street, 7th Floor - Ottawa, Ontario, K1P 5N2
tel. 613.224.0095 fax 613.224.9811

CARPENTER'S UNION
LOCAL 93 - RENOVATION

8560 CAMPEAU DRIVE
OTTAWA, ONTARIO K2T 0N7

seal

drawing title

scale	drawn by
date	checked by
project number	drawing number

CONTRACTOR TO VERIFY ALL DIMENSIONS AND NOTIFY THE ARCHITECT OF ANY DISCREPANCIES BEFORE WORK COMMENCES.

revision

DO NOT SCALE DRAWINGS

CITY FILE NO.: D07-XX-XX-XXXX

PLAN NO.: XXXXXX

Drawing No. 2

APPENDIX C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

C.2 BOREHOLE RECORDS

C.3 FIELD BEDROCK CORE LOGS

C.4 ROCKCORE PHOTOGRAPHS

C.5 VIBRATING WIRE PIEZOMETER CALIBRATION SHEET

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
Very Soft	<0.25	<12.5
Soft	0.25 - 0.5	12.5 - 25
Firm	0.5 - 1.0	25 - 50
Stiff	1.0 - 2.0	50 – 100
Very Stiff	2.0 - 4.0	100 - 200
Hard	>4.0	>200

ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor*
25-50	*Poor*
50-75	*Fair*
75-90	*Good*
90-100	*Excellent*

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

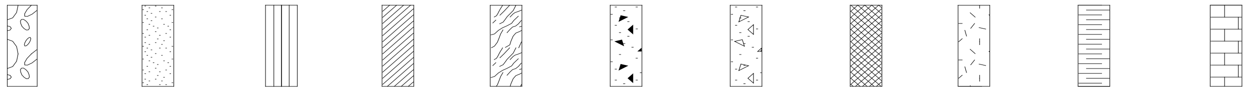
Strength Classification	Unconfined Compressive Strength (MPa)
Extremely Weak	< 1
Very Weak	1 – 5
Weak	5 – 25
Medium Strong	25 – 50
Strong	50 – 100
Very Strong	100 – 250
Extremely Strong	> 250

Terminology describing rock weathering:

Term	Description
Fresh	No visible signs of rock weathering. Slight discolouration along major discontinuities
Slightly Weathered	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
Moderately Weathered	Less than half the rock is decomposed and/or disintegrated into soil.
Highly Weathered	More than half the rock is decomposed and/or disintegrated into soil.
Completely Weathered	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

▼ measured in standpipe, piezometer, or well

▽ inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

BOREHOLE RECORD

N: 5 017 807 E: 348 642

BH 14-1

CLIENT: Carpenters Local 93 Training Center Association

BOREHOLE No.: BH 14-1

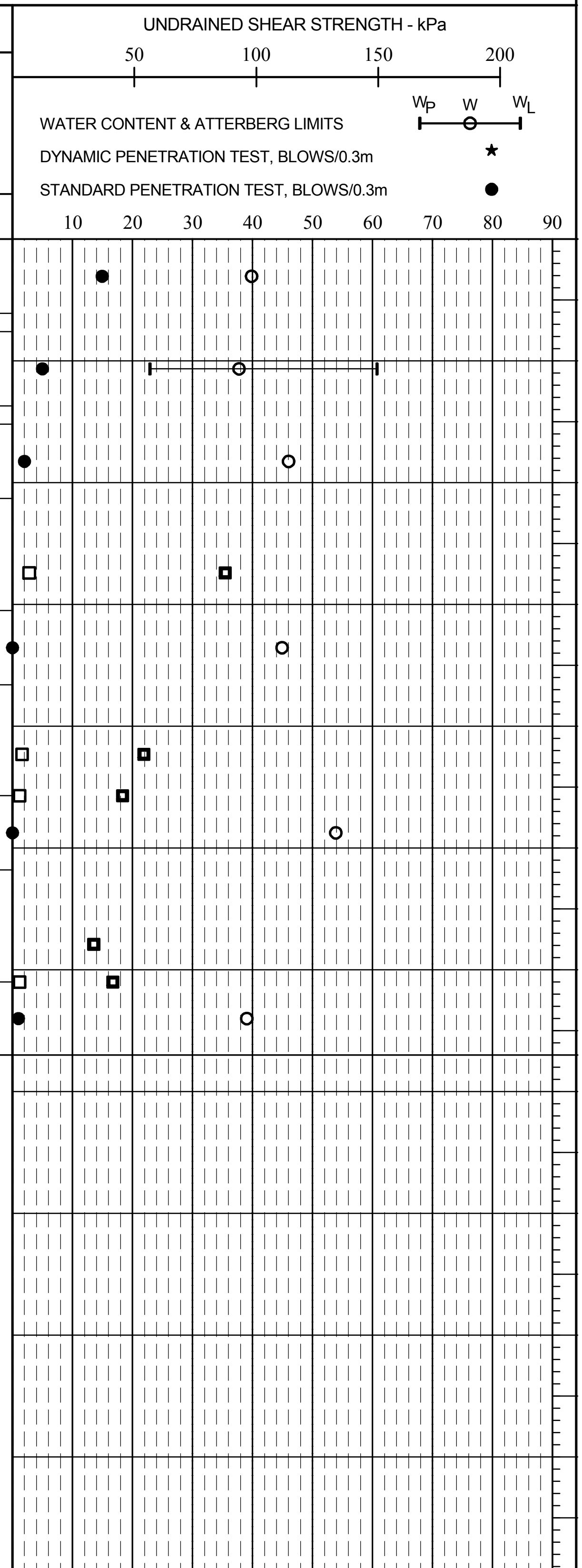
LOCATION: Campeau Drive, Ottawa, ON

PROJECT No.: 122411024

DATES: BORING March 31, 2014 WATER LEVEL

DATUM: Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	**102.61**							
	102.3	300 mm TOPSOIL (dark brown silty clay with rootlets)			SS	1	500	15
1		Firm greyish brown fat CLAY (CH)			SS	2	610	5
	101.1	- frozen						
2		Stiff grey fat CLAY (CH)			SS	3	610	2
	99.9			∇				
3		Firm to stiff grey lean to fat CLAY (CL-CH)			SS	4	610	0
4								
5					SS	5	610	0
6		- sand observed below 6.1 m			SS	6	610	1
	95.9	End of Borehole						
7								
8								
9								
10								
11								



∇ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd ________

Date ________

Stantec

BOREHOLE RECORD

N: 5 017 805 E: 348 712

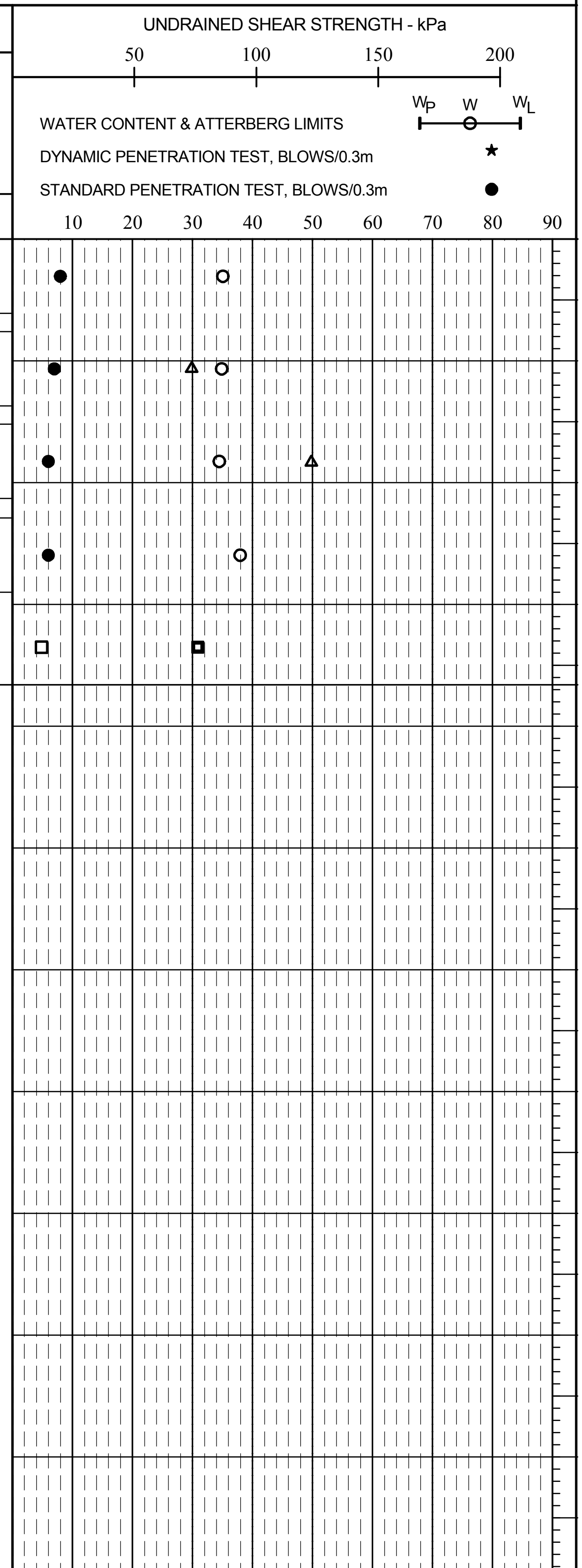
BH 14-10

CLIENT: Carpenters Local 93 Training Center Association
BOREHOLE No.: BH 14-10

LOCATION: Campeau Drive, Ottawa, ON
PROJECT No.: 122411024

DATES: BORING: August 22, 2014 WATER LEVEL:
DATUM: Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	102.15							
	102.0	180 mm TOPSOIL with rootlets and wood			SS	1	430	8
		Firm to very stiff brown to grey lean to fat CLAY (CL-CH)						
1					SS	2	400	7
2					SS	3	600	6
					SS	4	600	6
3	98.5							
		End of Borehole Su > 102 kPa						



Inferred Groundwater Level
Groundwater Level Measured in Standpipe

Field Vane Test, kPa
Remoulded Vane Test, kPa
Pocket Penetrometer Test, kPa

App'd ________
Date ________

Stantec

BOREHOLE RECORD

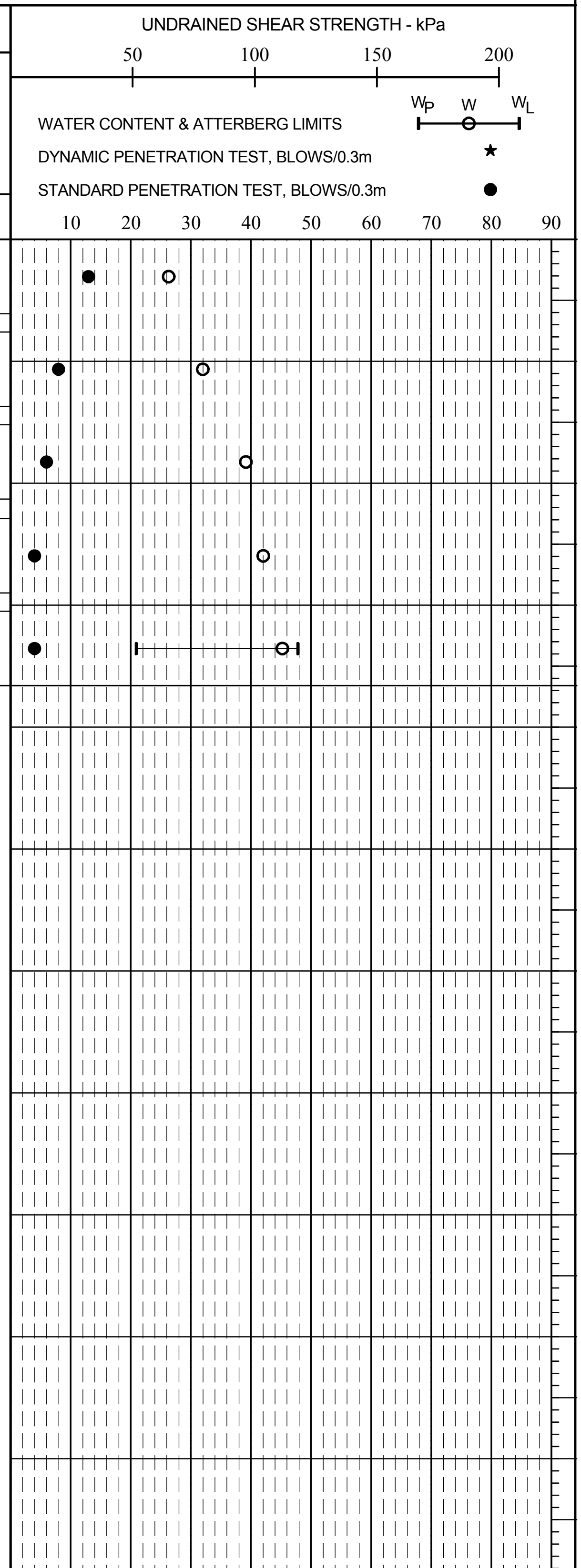
N: 5 017 846 E: 348 756

BH 14-11

CLIENT Carpenters Local 93 Training Center Association
LOCATION Campeau Drive, Ottawa, ON
DATES: BORING August 22, 2014 WATER LEVEL

BOREHOLE No. BH 14-11
PROJECT No. 122411024
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	101.81							
	101.7	150 mm TOPSOIL with rootlets and wood			SS	1	250	13
1		Firm to very stiff brown to grey lean to fat CLAY (CL-CH)			SS	2	450	8
2					SS	3	600	6
3					SS	4	600	4
	98.2				SS	5	600	4
4		End of Borehole						
5								
6								
7								
8								
9								
10								
11								



Inferred Groundwater Level
Groundwater Level Measured in Standpipe

Field Vane Test, kPa
Remoulded Vane Test, kPa
Pocket Penetrometer Test, kPa

App'd ________
Date ________

Stantec

BOREHOLE RECORD

N: 5 017 838 E: 348 622

BH 14-12

CLIENT Carpenters Local 93 Training Center Association
LOCATION Campeau Drive, Ottawa, ON
DATES: BORING August 22, 2014 WATER LEVEL

BOREHOLE No. BH 14-12
PROJECT No. 122411024
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	**102.43**							
	102.3	150 mm TOPSOIL with rootlets and wood			SS	1	190	10
1		Firm to very stiff brown to grey lean to fat CLAY (CL-CH)			SS	2	430	10
2					SS	3	560	10
					SS	4		4
3	98.8							
4		End of Borehole Su > 102 kPa						

UNDRAINED SHEAR STRENGTH - kPa (50, 100, 150, 200)

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

Scale: 10 20 30 40 50 60 70 80 90

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11

▽ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd
Date

STAN-GEO 122411024 - PALLADIUM & CAMPEAU DR BLOCK 22.GPJ SMART.GDT 9/29/14

Stantec BOREHOLE RECORD

N: 5 017 848 E: 348 653

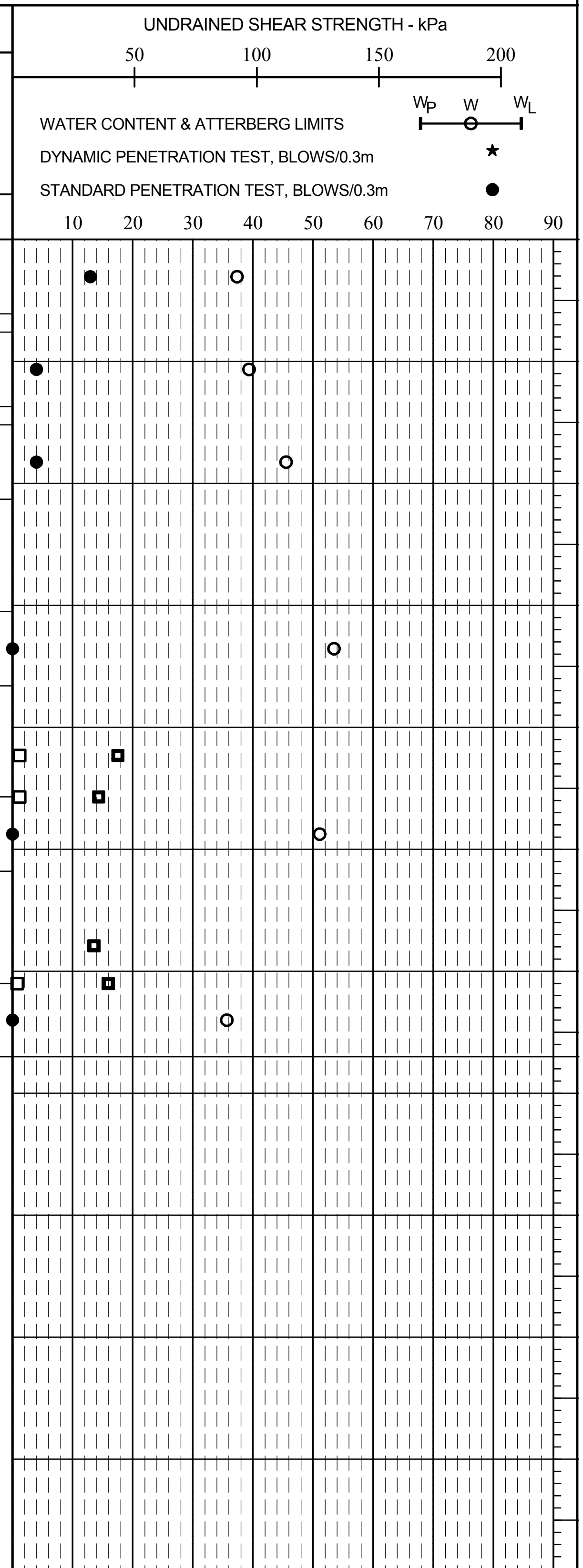
BH 14-2

CLIENT: Carpenters Local 93 Training Center Association
LOCATION: Campeau Drive, Ottawa, ON
DATES: BORING March 31, 2014 WATER LEVEL

BOREHOLE No. BH 14-2
PROJECT No. 122411024
DATUM Geodetic

Ground surface elevation: 102.27

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	WATER LEVEL	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0 – 0.3	102.0	300 mm TOPSOIL (dark brown silty clay with rootlets), frozen		SS	1	500	13
0.3 – 1.5	100.8	Brown to brownish-grey fat CLAY (CH) - frozen		SS	2	610	4
1.5 – 3.0	99.3	Firm to very stiff grey fat CLAY (CH) s_u > 106 kPa @ 2.7 m s_u > 106 kPa @ 3.0 m		SS	3	610	4
3.0 – 6.7	95.6	Firm grey lean to fat CLAY (CL-CH) - sand observed below 6.1 m	∇ (at 3.0 m)	SS	4	610	0
				SS	5	610	0
				SS	6	610	0
6.7		End of Borehole					



∇ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

▣ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd ______
Date ______

Stantec

BOREHOLE RECORD

N: 5 017 808 E: 348 684

BH 14-3

CLIENT: Carpenters Local 93 Training Center Association

BOREHOLE No.: BH 14-3

LOCATION: Campeau Drive, Ottawa, ON

PROJECT No.: 122411024

DATES: BORING April 1, 2014 WATER LEVEL

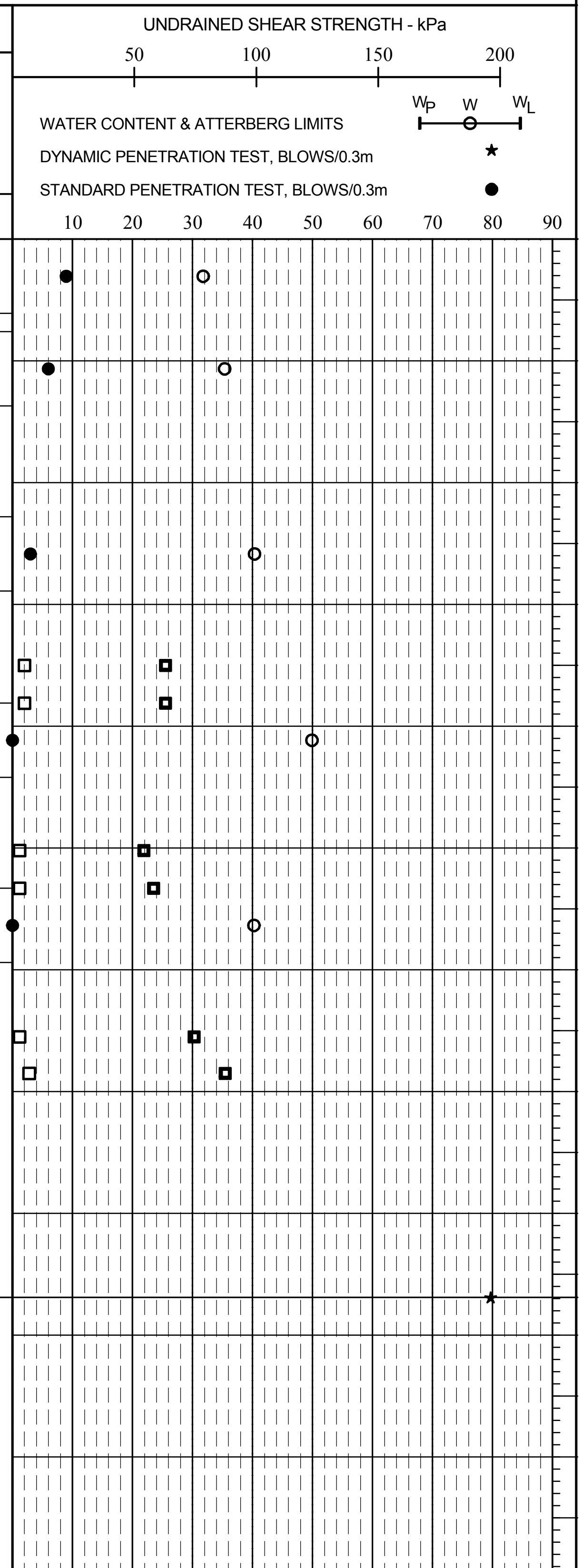
DATUM: Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION
0	102.41	
0.2	102.2	200 mm TOPSOIL (dark brown silty clay with rootlets)
		Firm brown to greyish brown fat CLAY (CH)
1.5	100.9	Firm to very stiff grey fat CLAY (CH) s_u > 106 kPa @ 2.0 m s_u > 106 kPa @ 2.3 m
2.9	99.5	Stiff grey lean to fat CLAY (CL-CH) - sand observed below 5.3 m
6.9	95.5	Inferred CLAY
8.7	93.7	End of Borehole Refusal of Dynamic Penetration Test

Water level: Inferred groundwater level at approx. 2.2 m depth.

SAMPLES

TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
SS	1	230	9
SS	2	405	6
SS	3	610	3
SS	4	610	0
SS	5	610	0



Inferred Groundwater Level

Groundwater Level Measured in Standpipe

Field Vane Test, kPa

Remoulded Vane Test, kPa

Pocket Penetrometer Test, kPa

App'd ________

Date ________

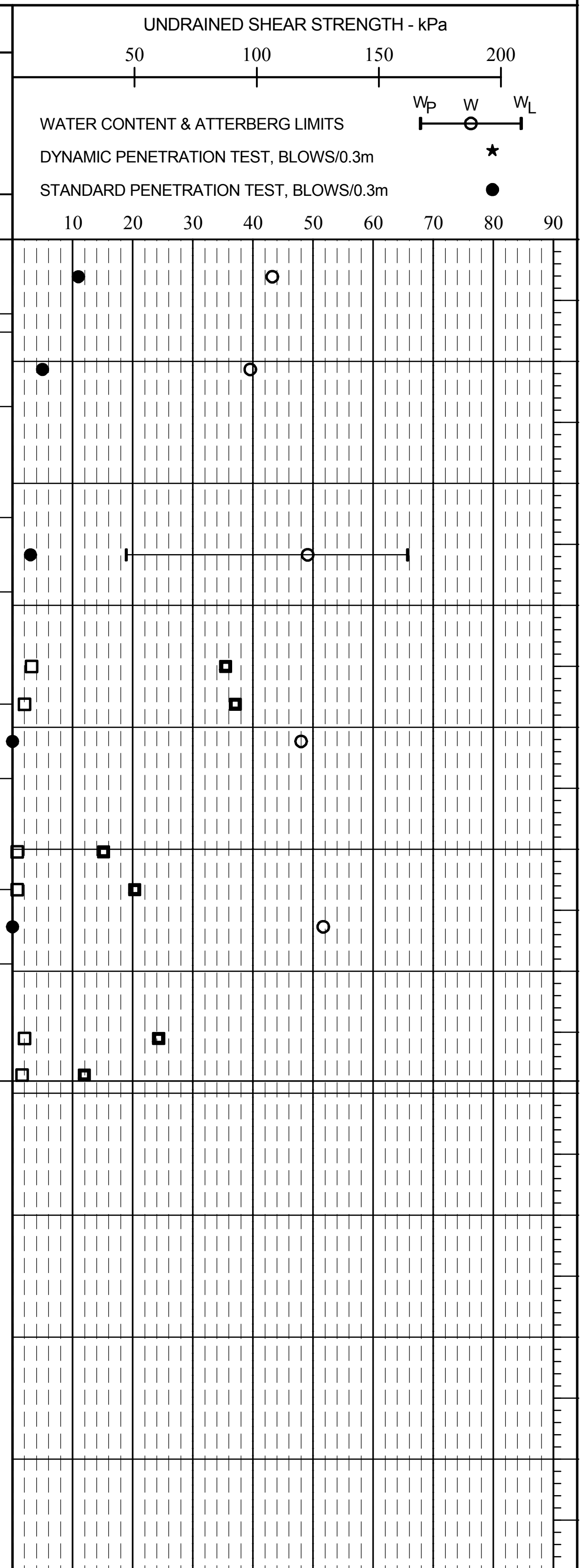
BOREHOLE RECORD

N: 5 017 897 E: 348 646

BH 14-4

CLIENT: Carpenters Local 93 Training Center Association
LOCATION: Campeau Drive, Ottawa, ON
DATES: BORING March 31, 2014 WATER LEVEL
BOREHOLE No. BH 14-4
PROJECT No. 122411024
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	WATER LEVEL	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	102.04						
	101.8	200 mm TOPSOIL (dark brown silty clay with rootlets)		SS	1	460	11
		Brown to greyish brown fat CLAY (CH)					
1				SS	2	460	5
	100.5	Very stiff grey fat CLAY (CH) s_u > 106 kPa @ 2.0 m s_u > 106 kPa @ 2.3 m					
2				SS	3	610	3
	99.1	Firm to stiff grey lean to fat CLAY (CL-CH)					
3			∇				
4				SS	4	610	0
5				SS	5	405	0
6							
	95.1	End of Borehole					
7							
8							
9							
10							
11							



∇ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd
Date

Stantec

BOREHOLE RECORD

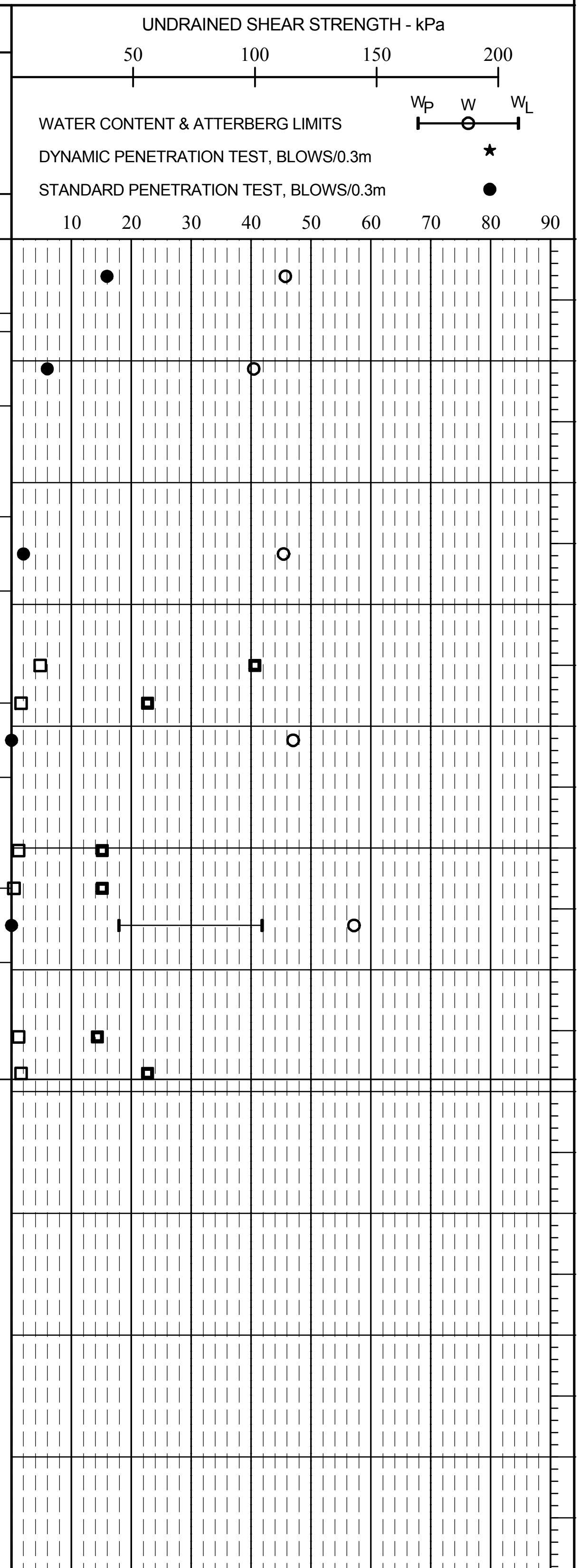
N: 5 017 900 E: 348 715

BH 14-5

CLIENT Carpenters Local 93 Training Center Association
LOCATION Campeau Drive, Ottawa, ON
DATES: BORING March 31, 2014 WATER LEVEL

BOREHOLE No. BH 14-5
PROJECT No. 122411024
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	101.89							
0 – 0.6	101.3	600 mm TOPSOIL (dark brown silty clay), frozen			SS	1	460	16
0.6 – 3.8	98.1	Firm to very stiff grey fat CLAY (CH)			SS	2	610	6
		s_u > 106 kPa @ 2.0 m						
		s_u > 106 kPa @ 2.3 m			SS	3	610	2
				∇ (3.6 m)				
3.8 – 6.9	95.0	Firm to stiff grey lean to fat CLAY (CL-CH)			SS	4	610	0
					SS	5	610	0
6.9		End of Borehole						



∇ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd
Date

Stantec

BOREHOLE RECORD

N: 5 017 858 E: 348 709

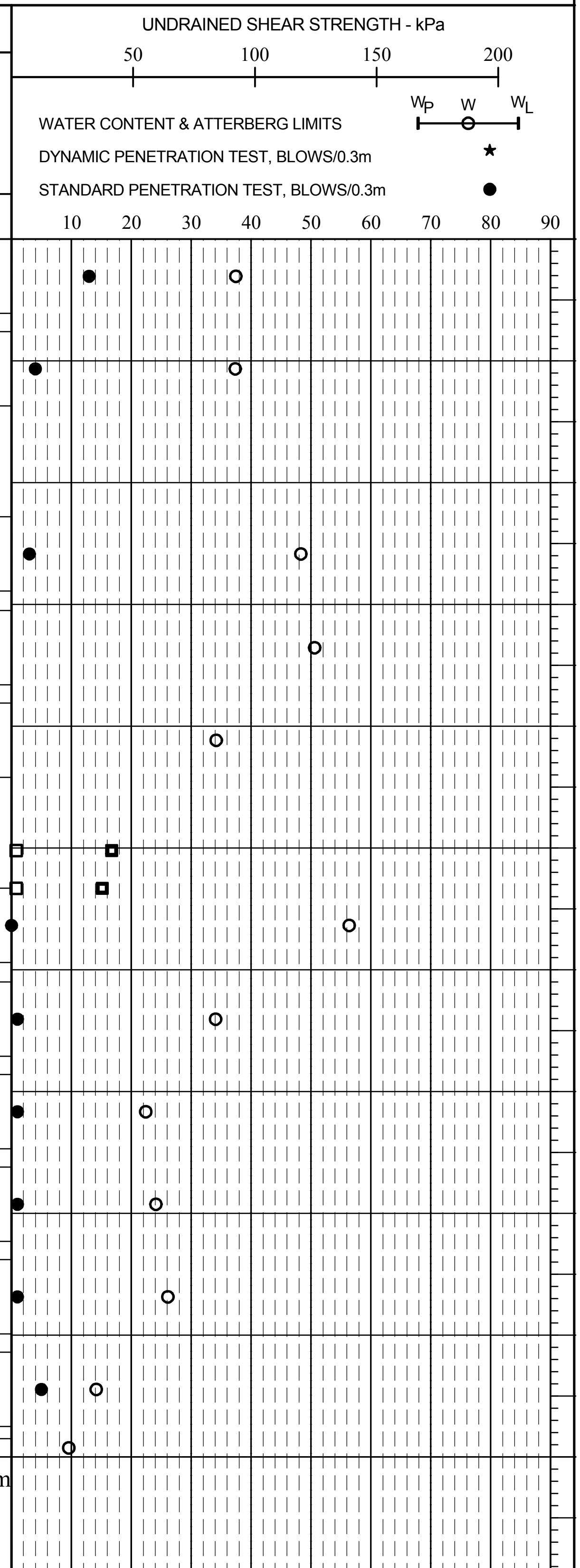
BH 14-6

CLIENT Carpenters Local 93 Training Center Association — BOREHOLE No. BH 14-6

LOCATION Campeau Drive, Ottawa, ON — PROJECT No. 122411024

DATES: BORING April 1, 2014 WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	101.97					
	101.7	300 mm TOPSOIL (dark brown silty clay), frozen	SS	1	380	13
		Firm brownish-grey to grey fat CLAY (CH) - top 300 mm frozen	SS	2	460	4
	100.5	Firm to very stiff grey lean to fat CLAY (CL-CH) s_u > 106 kPa @ 2.0 m s_u > 106 kPa @ 2.3 m	SS	3	610	3
			SS	4	460	-
			ST	5	610	-
			SS	6	610	0
		300 mm thick layer of sand observed @ 6.1 m	SS	7	610	1
	95.3	Very loose to loose grey silty clayey sand with gravel (SC-SM): TILL	SS	8	300	1
			SS	9	460	1
			SS	10	150	1
			SS	11	610	5
			SS	12	150	50/ 150mm
10	92.0	End of Borehole Auger Refusal on Inferred Bedrock				



Inferred Groundwater Level
Groundwater Level Measured in Standpipe

Field Vane Test, kPa
Remoulded Vane Test, kPa
Pocket Penetrometer Test, kPa

App'd ______
Date ______

Stantec

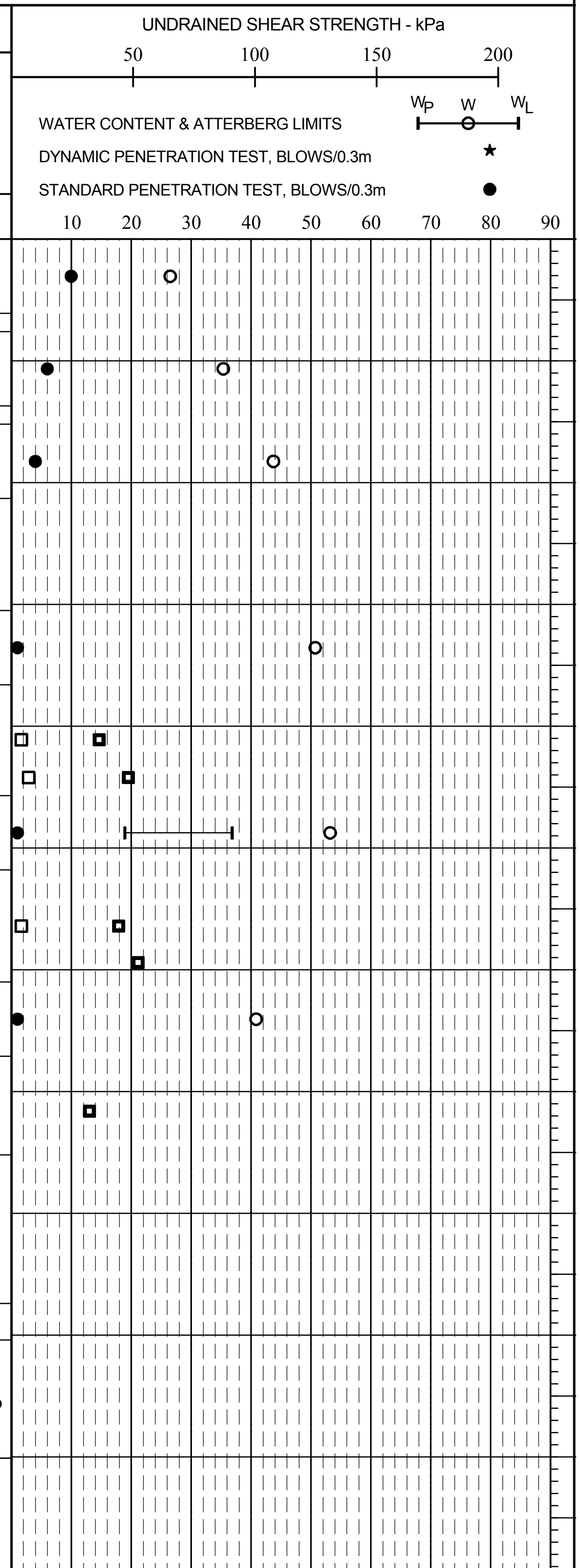
BOREHOLE RECORD

N: 5 017 863 E: 348 670

BH 14-7

CLIENT Carpenters Local 93 Training Center Association
BOREHOLE No. BH 14-7
LOCATION Campeau Drive, Ottawa, ON
PROJECT No. 122411024
DATES: BORING August 21, 2014 WATER LEVEL
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	102.04							
	101.8	200 mm TOPSOIL			SS	1	250	10
		Firm greyish brown to grey lean to fat CLAY (CL-CH)			SS	2	500	6
	100.2	Firm to very stiff grey lean to fat CLAY (CL-CH) s_u > 102 kPa @ 2.6 m s_u > 102 kPa @ 2.9 m			SS	3	500	4
					SS	4	600	1
					SS	5	600	1
					SS	6	600	1
	94.4	Grey Limestone BEDROCK -Poor to excellent quality -Very strong bedrock Refer to field bedrock core log for full description			NQ	7	51%	46%
					NQ	8	100%	100%
					NQ	9	100%	98%



Inferred Groundwater Level
Groundwater Level Measured in Standpipe

Field Vane Test, kPa
Remoulded Vane Test, kPa
Pocket Penetrometer Test, kPa

App'd
Date

STAN-GEO 122411024 - PALLADIUM & CAMPEAU DR BLOCK 22.GPJ SMART.GDT 9/29/14

BOREHOLE RECORD

N: 5 017 863 E: 348 670

BH 14-7

CLIENT Carpenters Local 93 Training Center Association
LOCATION Campeau Drive, Ottawa, ON
DATES: BORING August 21, 2014 WATER LEVEL

BOREHOLE No. BH 14-7
PROJECT No. 122411024
DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD	UNDRAINED SHEAR STRENGTH - kPa
11									
	90.5	End of Borehole							
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									

UNDRAINED SHEAR STRENGTH - kPa: 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P W W_L)
DYNAMIC PENETRATION TEST, BLOWS/0.3m ★
STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

∇ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

▣ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd ________
Date ________

Stantec

BOREHOLE RECORD

N: 5 017 835 E: 348 698

BH 14-8

CLIENT: Carpenters Local 93 Training Center Association

LOCATION: Campeau Drive, Ottawa, ON

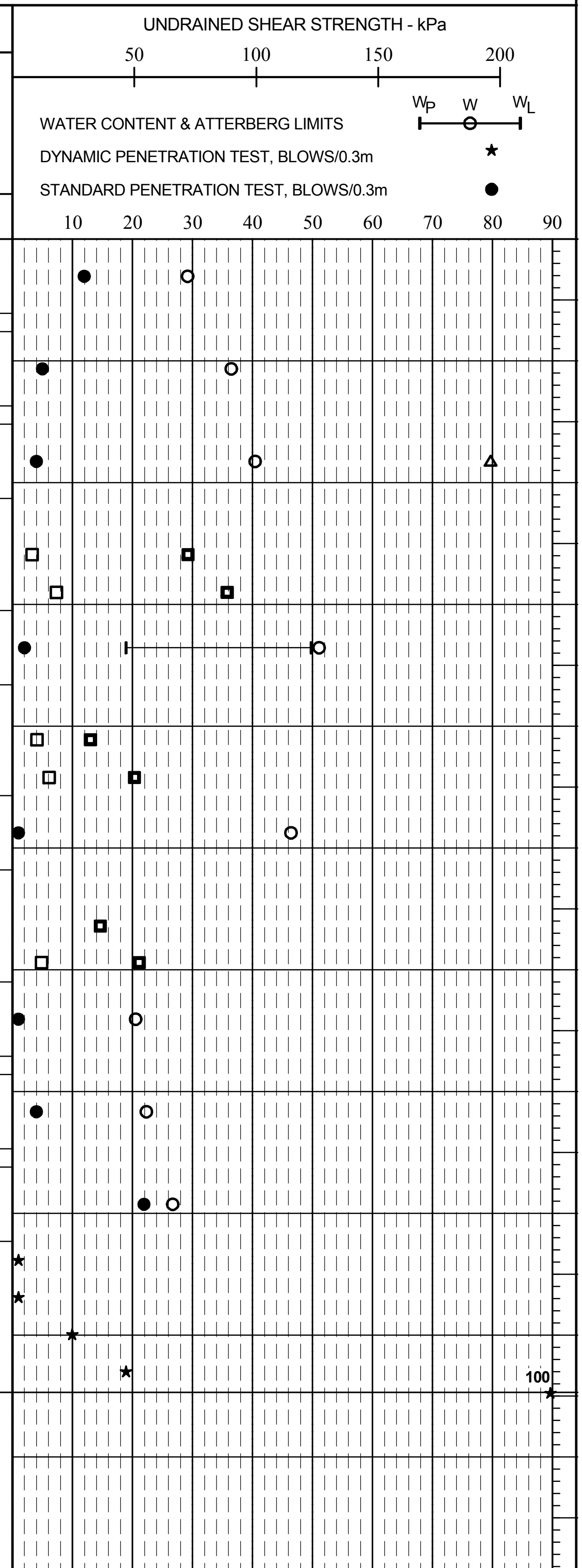
DATES: BORING August 25, 2014 WATER LEVEL

BOREHOLE No. BH 14-8

PROJECT No. 122411024

DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	102.08							
	101.9	200 mm TOPSOIL						
		Very stiff grey lean to fat CLAY (CL-CH)			SS	1	200	12
1					SS	2	405	5
					SS	3	600	4
2	100.0	Firm to stiff grey lean to fat CLAY (CL-CH)						
3					SS	4	600	2
5					SS	5	600	1
6					SS	6	600	1
7					SS	7	250	4
	94.5	Very loose to stiff clayey SILT (ML) TILL			SS	8	100	22
8		Dynamic Cone Penetration Test from 8.2 m to the End of Borehole						
	92.6	End of Borehole						
10		DCPT Refusal on Inferred Bedrock						
11		Vibrating Wire Piezometer						



Inferred Groundwater Level

Groundwater Level Measured in Standpipe

Field Vane Test, kPa

Remoulded Vane Test, kPa

Pocket Penetrometer Test, kPa

App'd

Date

Stantec

BOREHOLE RECORD

N: 5 017 835 E: 348 698

BH 14-8

CLIENT Carpenters Local 93 Training Center Association

LOCATION Campeau Drive, Ottawa, ON

DATES: BORING August 25, 2014 WATER LEVEL

BOREHOLE No. BH 14-8

PROJECT No. 122411024

DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm)	SAMPLES: N-VALUE OR RQD
11		Installed to 3.7 m						
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								

UNDRAINED SHEAR STRENGTH - kPa: 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

∇ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd ________

Date ________

Stantec

BOREHOLE RECORD

N: 5 017 873 E: 348 739

BH 14-9

CLIENT: Carpenters Local 93 Training Center Association

LOCATION: Campeau Drive, Ottawa, ON

DATES: BORING: August 22, 2014 WATER LEVEL:

BOREHOLE No.: BH 14-9

PROJECT No.: 122411024

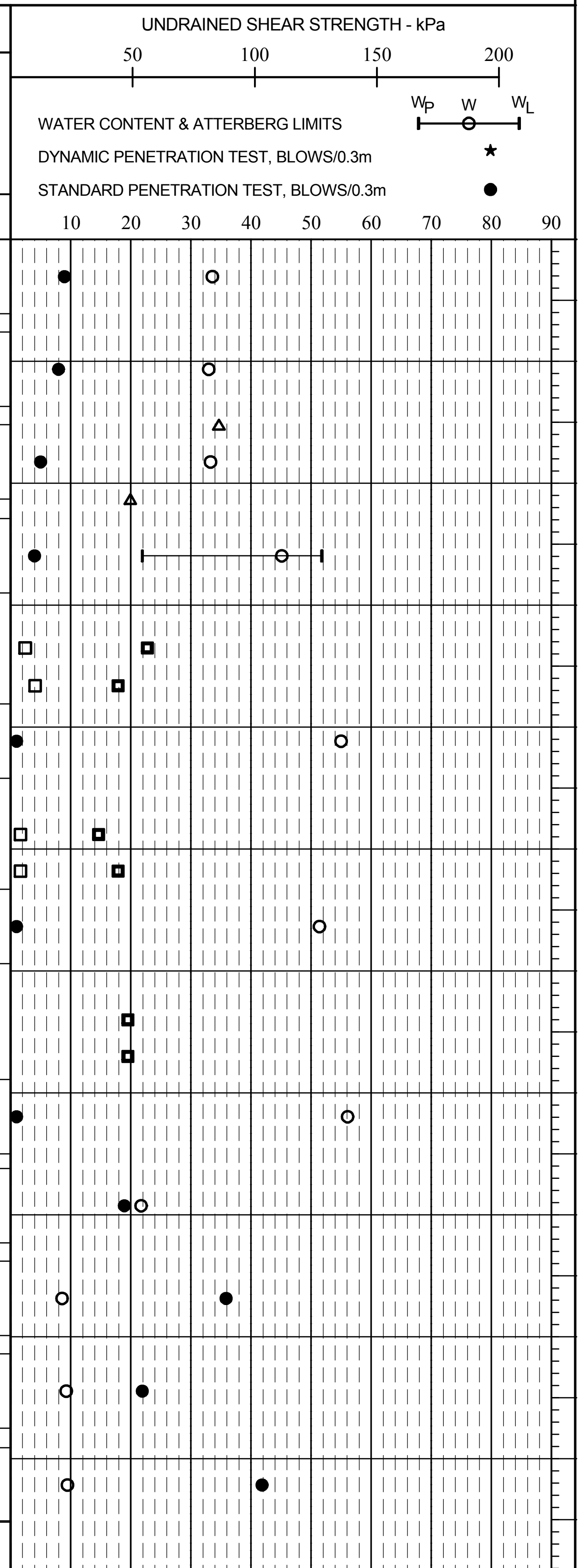
DATUM: Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT
0	**101.49**		
0.15	101.3	150 mm TOPSOIL	Topsoil
		Stiff to very stiff greyish brown to grey lean to fat CLAY (CL-CH)	Clay
2.1	99.4	Firm to stiff grey lean to fat CLAY (CL-CH)	Clay
6.9	94.6	Very loose grey SILT (ML) -non plastic @ 7.2 m	Silt
7.7	93.8	Compact to dense grey silty SAND (SM) TILL	Till
10.5	91.0	Grey Limestone BEDROCK	Bedrock

Water level: ∇ (inferred) at approx. 5.3 m

SAMPLES

TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
SS	1	480	9
SS	2	600	8
SS	3	600	5
SS	4	600	4
SS	5	600	1
SS	6	600	1
SS	7	430	1
SS	8	250	19
SS	9	450	36
SS	10	250	22
SS	11	450	42



∇ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd ______

Date ______

Stantec

BOREHOLE RECORD

N: 5 017 873 E: 348 739

BH 14-9

CLIENT Carpenters Local 93 Training Center Association | BOREHOLE No. BH 14-9

LOCATION Campeau Drive, Ottawa, ON | PROJECT No. 122411024

DATES: BORING August 22, 2014 WATER LEVEL | DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
11		-Fair to excellent quality -Strong to very strong bedrock Refer to field bedrock core log for full description			NQ	12	100%	96%
12					NQ	13	98%	70%
13	88.4	End of Borehole						
14								
15								
16								
17								
18								
19								
20								
21								
22								

UNDRAINED SHEAR STRENGTH - kPa: 50, 100, 150, 200

WATER CONTENT & ATTERBERG LIMITS (W_P, W, W_L)

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

∇ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd ______

Date ______

Field Bedrock Core Log

Stantec

Client:	Carpenters Local 93	**Project No.:**	122411024
Project:	Block 22, Campeau and Palladium Drive	**Date:**	September 12, 2014
Contractor:	Downing	**Borehole No.:**	BH 14-7
		Logger:	Kasgin Khaheshi

DEPTH FROM (m)	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO (m)	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	OCCASIONAL FEATURES	DRILLING OBSERVATIONS
7.5	NQ7	51%	46%	8.7	Grey Limestone BEDROCK (Casing dropped from 8.7 to 9.04 m)				B	F	C	SU				
9.04	NQ8	100%	100%	10	Grey Limestone BEDROCK				B	F	VC-M	SU				
10	NQ9	100%	98%	11.5	Grey Limestone BEDROCK				B	F	C-M	SU				

STRENGTH (MPa)
EH = Extremely Strong = > 250
VS = Very Strong = 100-250
S = Strong = 50-100
MS = Medium Strong = 25-50
W = Weak = 5 - 25
VW = Very Weak = 1-5
EW = Extremely Weak = < 1

WEATHERING
U = Unweathered = No Signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-like

DISCONTINUITY TYPE
B = Bedding Joint
J = Cross Joint
F = Fault
S = Shear Plane

SPACING
VW = Very Wide = >3m
W = Wide = 1-3 m
M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ORIENTATION
F = Flat = 0-20^0
D = Dipping = 20-50^0
V = n-Vertical = >50^0

ROUGHNESS
RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
LU = Slickensided Undulating
LP = Slickensided Planar

FILLING
T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay

Field Bedrock Core Log

Stantec

Client:	Carpenters Local 93	**Project No.:**	122411024
Project:	Block 22, Campeau and Palladium Drive	**Date:**	September 12, 2014
Contractor:	Downing	**Borehole No.:**	BH 14-9
		Logger:	Kasgin Khaheshi

DEPTH FROM (m)	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO (m)	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
10.5	NQ12	100%	96%	11.6	Grey Limestone BEDROCK				B	F	C	SU				
11.6	NQ13	98%	70%	13.1	Grey Limestone BEDROCK				B	F	VC-M	SU				

STRENGTH (MPa)
EH = Extremely Strong = > 250
VS = Very Strong = 100-250
S = Strong = 50-100
MS = Medium Strong = 25-50
W = Weak = 5 - 25
VW = Very Weak = 1-5
EW = Extremely Weak = < 1

WEATHERING
U = Unweathered = No Signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-like

DISCONTINUITY TYPE
B = Bedding Joint
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SPACING
VW = Very Wide = >3m
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M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ORIENTATION
F = Flat = 0-20^0
D = Dipping = 20-50^0
V = n-Vertical = >50^0

ROUGHNESS
RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
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LP = Slickensided Planar

FILLING
T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay

V:\01224\active\1224110XX\122411024\Detailed Investigation Report\Report\field_core_logs_122411024 BH 14-9.xlsx

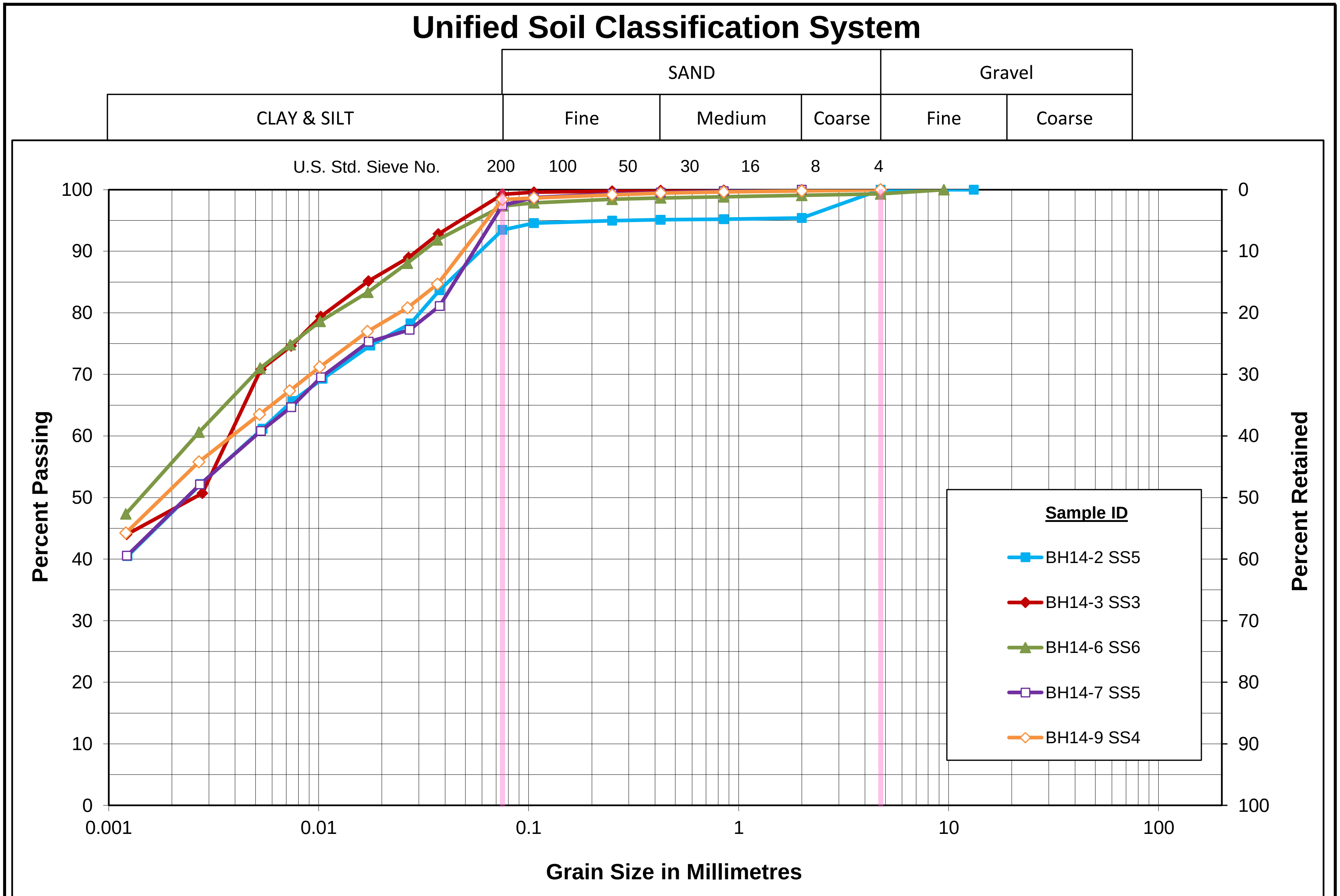
Stantec	Project No.: 122411024 Project Name: Proposed Development Campeau Drive & Palladium Drive, Block 22, Ottawa, ON	Rockcore Photographs

Rock Core Photo No.: 1	Borehole:BH14-7	Depth: 7.5 – 11.5 m

Rock Core Photo No.: 2	Borehole: BH14-9	Depth: 10.5 – 13.1 m

APPENDIX D

D.1 LABORATORY TEST RESULTS

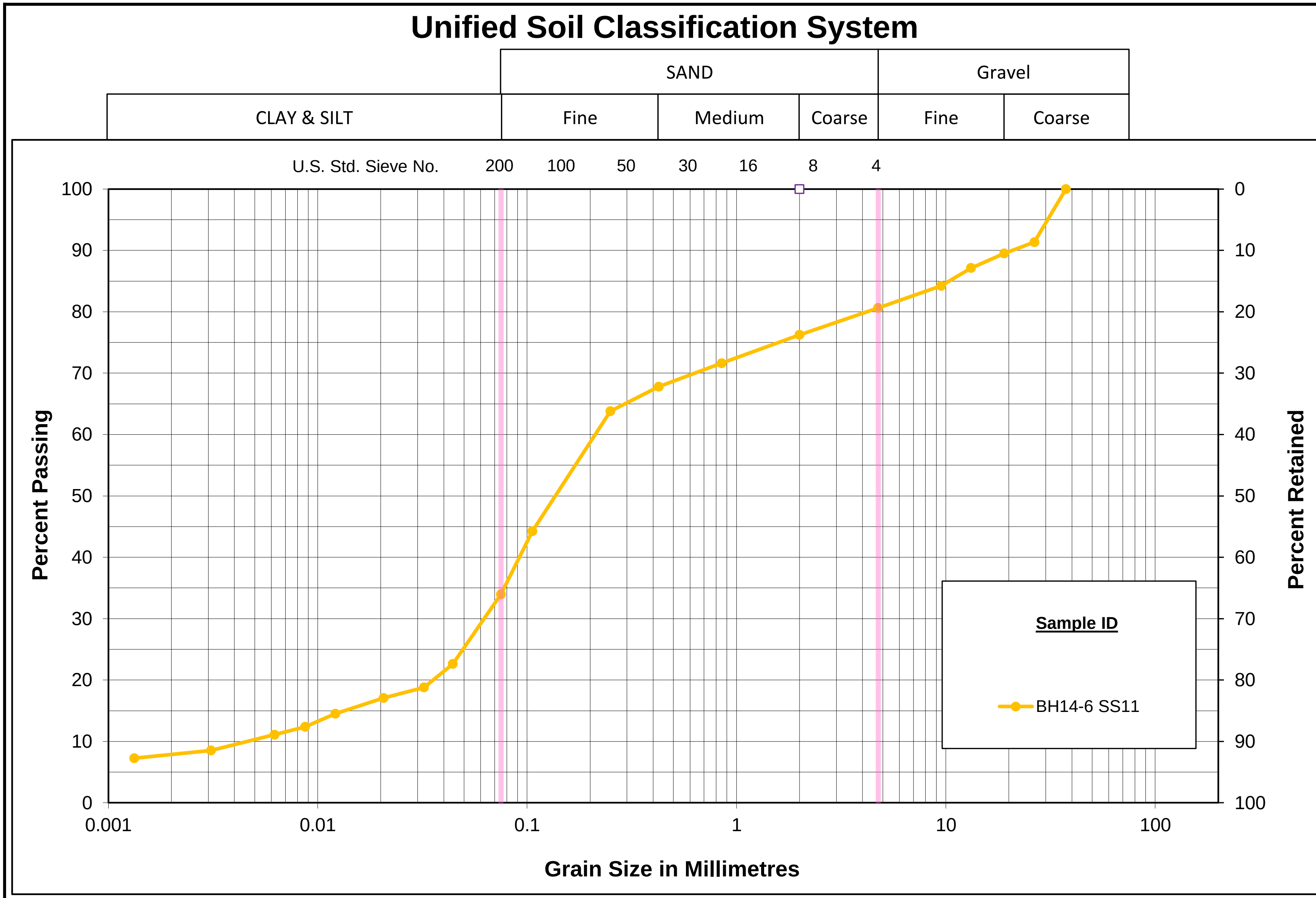


Stantec

GRAIN SIZE DISTRIBUTION
Lean to Fat CLAY

Figure No. 1

Project No. 122411024

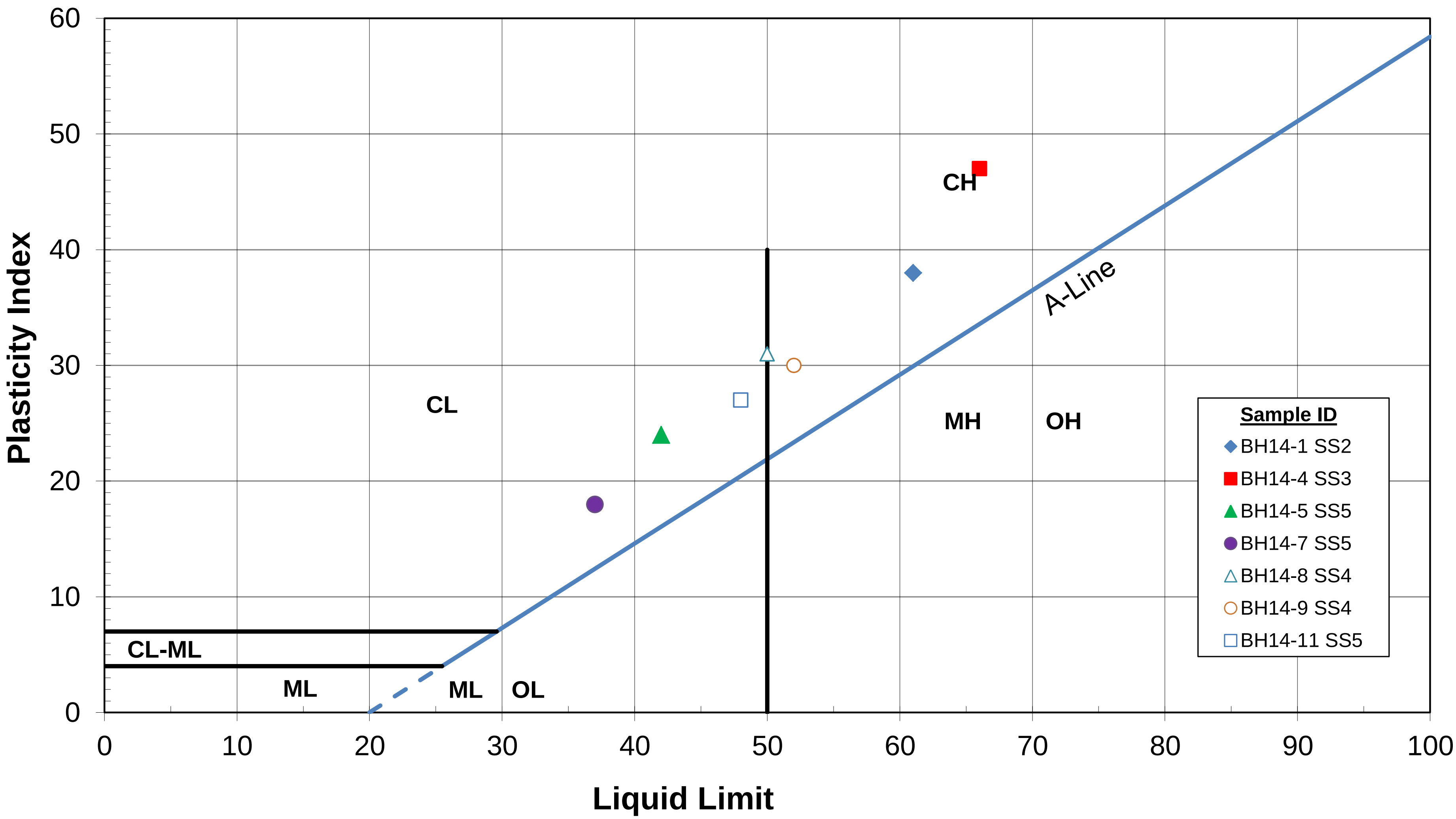


Stantec

GRAIN SIZE DISTRIBUTION
TILL

Figure No. 2

Project No. 122411024



Stantec

PLASTICITY CHART

Figure No. 3

Project No. 122411024

APPENDIX E

E.1 MASW TESTING REPORT

GEOPHYSICS GPR INTERNATIONAL INC.

100 – 2545 Delorimier Street
Longueuil (Québec)
Canada J4K 3P7

Tel. : (450) 679-2400
Fax : (514) 521-4128
info@gprmtl.com
www.geophysicsgpr.com

August 28th, 2014 Transmitted by email: Kasgin.KhaheshiBanab@stantec.com

Our Ref.: M-14896

Mr. Kasgin Khaheshi Banab, Ph.D., P.Eng.
Geotechnical Engineer
Stantec inc.
2781, Landcaster Rd, Suite 200
Ottawa (ON) K1B 1A7

Subject: **Shear-wave Velocity Sounding, Palladium Drive, Kanata, Ottawa**

Dear Sir,

Geophysics GPR International Inc. has been requested by Stantec inc. to carry out seismic shear wave surveys on a vacant field located west of the intersection of Palladium Drive and Huntmar Drive, in Kanata, Ottawa. The geophysical investigations used the Multi-channel Analysis of Surface Waves (MASW) and the Extended SPatial AutoCorrelation (ESPAC) methods. From the subsequent results, the V_{S30} value was calculated to identify the Site Class.

The surveys were carried out on August 14th, by Mr. Charles Trottier, M.A.Sc., phys. and Mr. Nicolas Beaulieu, Jr. Eng. Figure 1 shows the regional location of the site, and Figure 2 illustrates the location of the seismic spread. Both figures are presented in the appendix.

The following paragraphs briefly describe the survey design, the principles of the test methods, and the results in graphic and table format.

Method Principle

The *Multi-channel Analysis of Surface Waves* (MASW) and the *Extended SPatial AutoCorrelation* (ESPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface waves (“ground roll”). The MASW is considered an “active” method, as the seismic signal is induced at known location and time in the geophones spread axis. Conversely, the ESPAC is considered a “passive” method, using the low frequency “noises” produced far away. The dispersion properties are measured as a change in phase velocity with frequency. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding). Figure 3 outlines the basic operating procedure for the MASW method.

Figure 4 illustrates an example of one of the MASW/ESPAC records, the corresponding spectrogram analysis and resulting 1D V_S model. The ESPAC method allows deeper Vs soundings, but generally with a lower resolution for the surface portion. Its dispersion curve can then be merged with the higher frequency one from the MASW to calculate a more complete inversion.

More detailed descriptions of the methods are presented in *Shear wave velocity measurement guidelines for Canadian seismic site characterization in soil and rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, public file 7079, 2012. For the MASW method, one can also refer to *Multi-channel Analysis of Surface Waves*, Park, C.B., Miller, R.D. and Xia, J. Geophysics, Vol. 64, No. 3 (May-June 1999); p. 800–808. For the ESPAC method, one could refer to the paper *Shear Velocity Profiles Obtained from Microtremor Array Data with an Example from Direct Fitting of SPAC Curves*, Asten, M.W., 2007, Proceedings of the 20th SAGEEP Conference, Denver, Environmental and Engineering Geophysical Society, and for more details: *The Microtremor Survey Method*, Okada, H., S.E.G., Geophysical Monograph Series No. 12.

Interpretation Steps

The main processing sequence involved data inspection, editing (when required), picking the fundamental mode and the first higher ones, and 1D inversion of the MASW and ESPAC shot records using the SeisImagerSW™ software. The data inversions were realized with a non-linear least square method and a genetic algorithm. In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, localized surface seismic velocities variations, and/or dipping of overburden layers or rock. In general the precision of the calculated seismic shear wave velocities (V_S) is of the order of 15% or better.

Basic seismic refraction processing were also realized for rock depth evaluation, as well as for its seismic shear wave velocity. These results were used to guide the initial geophysical model, prior to the mathematical inversions, for optimised and more accurate V_S results.

Survey Design

The main seismic spread was located on a vacant field, north-west of Palladium Drive (cf. Figure 2). Its geophone spacing was 3 meters, which means that the total length of a 24 geophones spread was 69 meters. It was used for the MASW as well as for the seismic refraction surveys. A second shorter seismic spread, with geophone spacing of 1 meter, was dedicated to the near surface details.

The seismic records counted 4096 data, sampled at 1000 µs for the MASW, and 50 µs for the seismic refraction method. They were triggered by electrical close-contact.

Unlike the refraction method, which allows to produce a data point beneath each geophone, the shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length. The seismic records were realized with a seismograph Terraloc MK6 (from ABEM Instrument), and the geophones were 4.5 Hz. A 20 pounds sledgehammer was used as the primary energy source with impacts being recorded off both ends of the seismic spread.

RESULTS

The rock depth was calculated between 8 and 10 meters deep by seismic refraction (critical distances), and its shear wave velocity would be approximately 2445 m/s.

The V_{S30} value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (e.g. 30 metres) by the sum of the time spent in each velocity layer from the surface up to 30 metres. This value reflects an equivalent homogeneous single layer response. The calculated V_{S30} value is 475.6 m/s (cf. Table 1), corresponding to the Site Class “C”. Nevertheless, very low seismic velocities (V_S) were calculated from the surface and 5 meters deep.

CONCLUSION

Seismic surveys were realized with the MASW/ESPAC methods, to calculate the V_{S30} value for the Site Class determination. The vacant field is located west of the intersection of Palladium Drive and Huntmar Drive, in Kanata, Ottawa. The V_{S30} calculation is presented in Table 1.

The calculated V_{S30} value is 476 m/s. Based on this value (determined through the MASW/ESPAC methods), Table 4.1.8.4.A of the NBC, and the Building Code, O. Reg. 332/12, the investigated actual site presents a Class “C” ($360 < V_{S30} \leq 760$ m/s).

Between the surface and 5 meters deep, low seismic velocities were calculated. Geotechnical evaluation of the corresponding materials should be realized (without being limited to) for the clay sensitivity and the potential of liquefaction.

It must be noted that other geotechnical information gleaned onsite; including the presence of liquefiable soils, soft clays, high moisture content etc. can supersede the site classification provided in this report based on the V_{S30} value.

The V_S values calculated are representative of the in situ materials, and were not corrected for the total and effective stress.

This report has been written by Jean-Luc Arsenault, M.A.Sc., P.Eng.

Jean-Luc Arsenault, M.A.Sc., P.Eng.
Project Manager

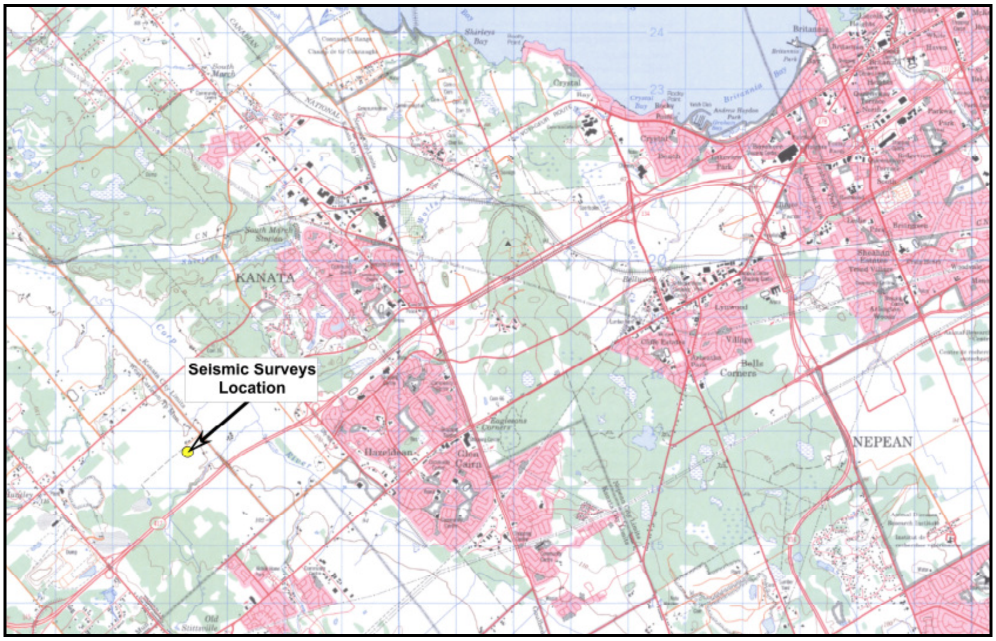


Figure 1: Regional location of the Site
(extracted from topographic map 31 G/5)

Figure 2: Location of the seismic spread
(source : *Google Earth*™)

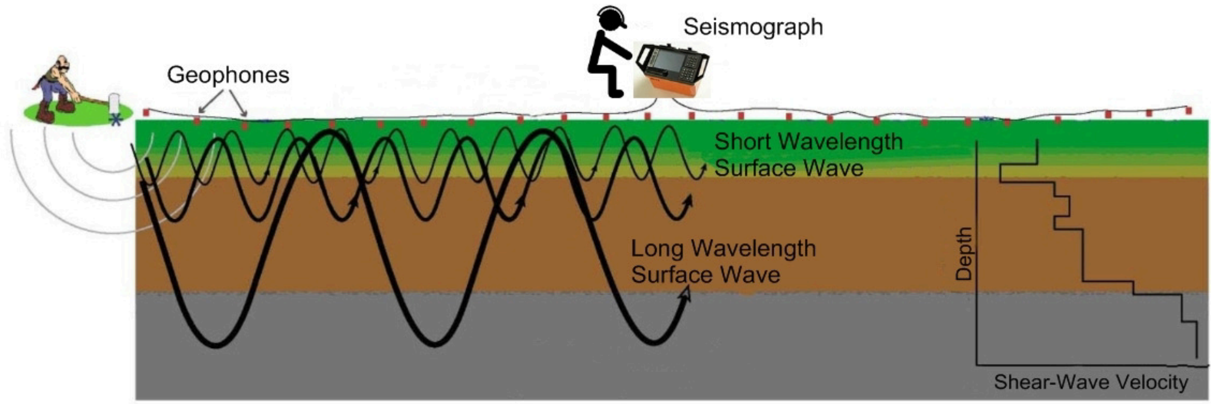


Figure 3: MASW Operating Principle

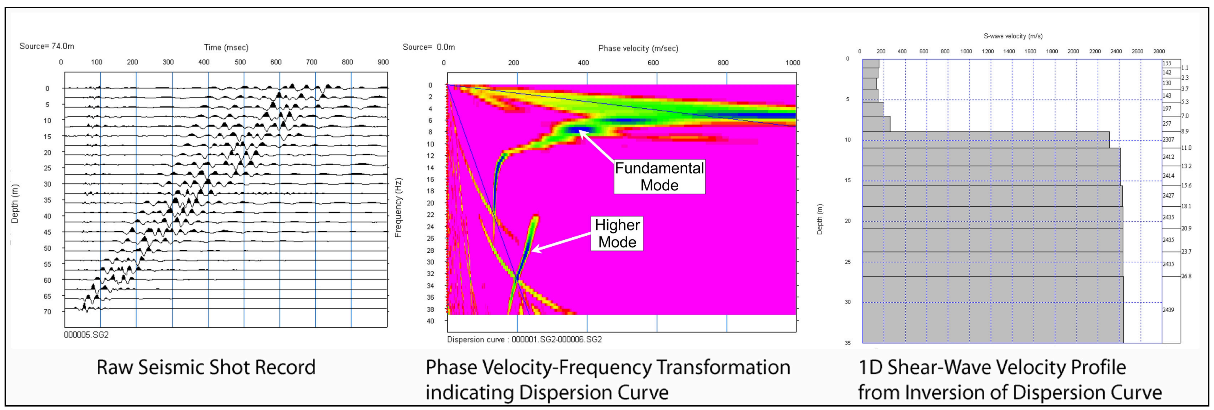


Figure 4: Example of a MASW/ESPAC shot record, phase velocity/frequency curve and resulting 1D shear wave velocity model

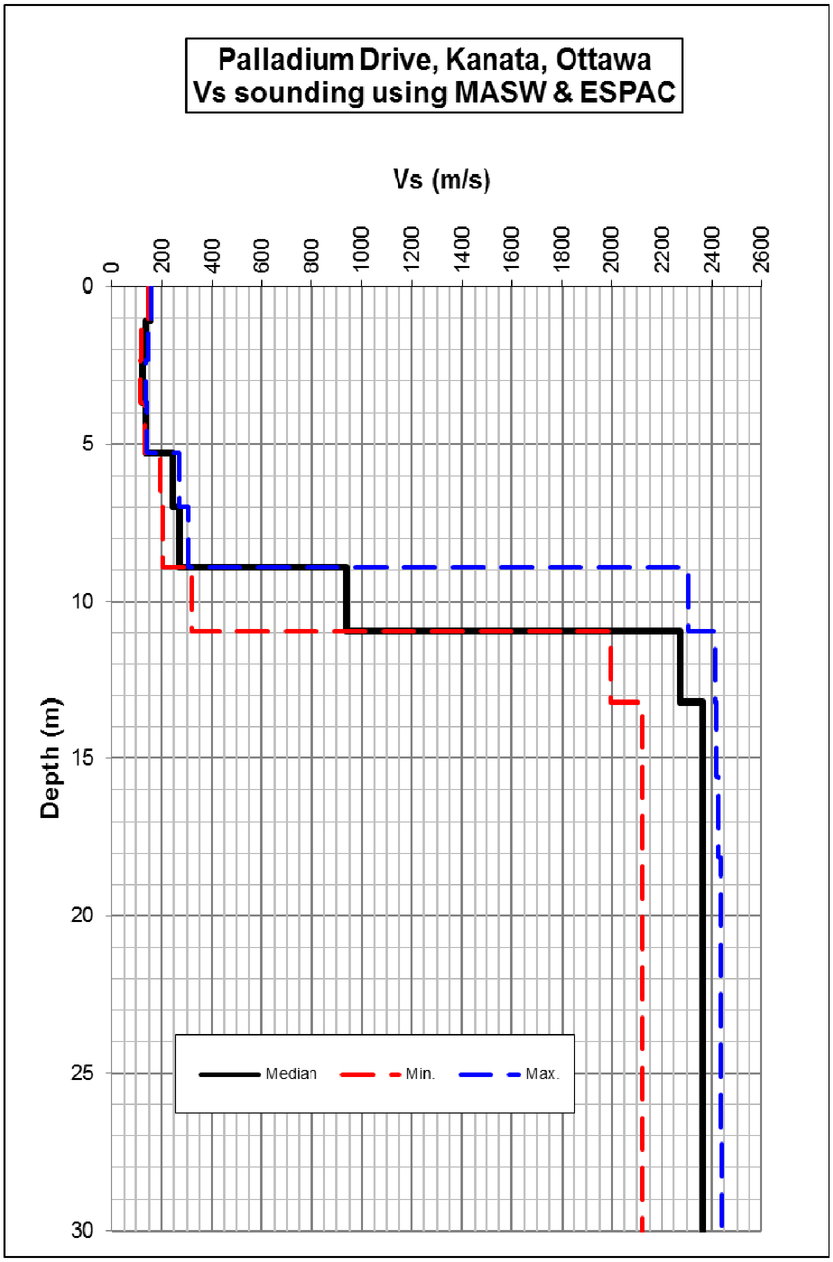


Figure 5: MASW Shear-wave Velocity Sounding

TABLE 1

V_{S30} Calculation for the Site Class

Depth (m)	Vs Min. (m/s)	Vs Median (m/s)	Vs Max. (m/s)	Thickness (m)	Cumulated Thickness (m)	Delay for med. Vs (s)	Cumulated Delay (s)	Average Vs for given Depth (m/s)
0.00	**145.1**	**154.2**	**159.4**					
1.07	**118.7**	**136.5**	**145.3**	1.07	1.07	0.006946	0.006946	154.2
2.31	**116.9**	**123.2**	**137.6**	1.24	2.31	0.009058	0.016004	144.2
3.71	**133.6**	**139.6**	**143.7**	1.40	3.71	0.011374	0.027378	135.4
5.27	196.5	241.9	272.3	1.57	5.27	0.011221	0.038599	136.6
7.01	204.4	269.2	306.5	1.73	7.01	0.007156	0.045754	153.1
8.90	317.4	937.7	2307.7	1.90	8.90	0.007043	0.052797	168.6
10.96	1995.9	2273.7	2412.6	2.06	10.96	0.002197	0.054994	199.3
13.19	2119.1	2365.9	2414.9	2.23	13.19	0.000979	0.055973	235.6
15.58	2119.1	2365.9	2427.7	2.39	15.58	0.001010	0.056983	273.3
18.13	2119.1	2365.9	2435.9	2.56	18.13	0.001080	0.058063	312.3
20.85	2119.1	2365.9	2435.9	2.72	20.85	0.001150	0.059213	352.1
23.74	2119.1	2365.9	2435.9	2.89	23.74	0.001219	0.060432	392.8
26.79	2119.1	2365.9	2439.4	3.05	26.79	0.001289	0.061721	434.0
30.00	2119.1	2365.9	2442.9	3.21	30.00	0.001359	0.063080	475.6

V_{S30} (m/s) =	**475.6**
Site Class :	**C ***

*: conditional to a geotechnical assessment of the soils between the surface and (at least) 5 meters deep.