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Final Report
Geotechnical Investigation
Proposed Residential Development
King Street West and Station Road
Caledon, ON

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1 INTRODUCTION

This report provides the results of the geotechnical investigation commissioned by King Station Facility Inc. (King Station) in support of the development of an undeveloped parcel of land located at the southeast corner of King Street West and Station Road in Caledon, Ontario.

The work was completed in accordance with directions received from King Station.

The purpose of the geotechnical investigation was to determine the subsurface conditions and provide the necessary geotechnical recommendations and parameters for the design and construction of the planned residential townhomes and retirement residence.

2 SITE DESCRIPTION

The subject property is legally described as Part of Lots 8, Concession 6 (Geographic Township of Albion, Regional Municipality of Peel), in the Town of Caledon, Ontario. The location of the subject property is shown on Drawing 1 in **Appendix B**. The property is currently occupied by two existing single family residences. The subject property occupies a total area of approximately 3 hectares (7 acres), as shown on Drawing No. 1 in **Appendix B**, which was developed based on an overall Site Plan provided to Stantec Consulting Ltd. (Stantec).

The site is bound by King Street West to the north, Station Road to the west, with existing residential developments surrounding the property.

The ground surface cover across the site generally consists of landscaped grass as the surface cover except the slope along the south property line which is mostly rough grass with weed cover.

A paved driveway enters from King Street West and extends westward to the existing dwelling. A second driveway is located off King Street West slightly to the east and the driveway extends south to access a dwelling on the upper slope located slightly east of the south-east corner of the site.

The property is a sloping site with a south-north gradient, with the grade dropping 17 m across the site.

The well- treed area in the northwest corner of the property has an overall slope of 2.3:1.0 (Horizontal: Vertical); the bank however is flatter on the south west ridge and south property line with a slope of 3.0:1.0 (Horizontal: Vertical) to 6.0:1.0 (Horizontal: Vertical). Based on the geometry outlined on the topographic plan the west side to the center of the property generally has a slope of approximately 4.0:1.0 (Horizontal: Vertical) to 6.0:1.0 (Horizontal: Vertical). The vegetation on the bank consists predominantly of landscaped grass, rough grass, shrubs and trees of varying maturity. There was no evidence of seepage in the bank.

3 BACKGROUND

3.1 Terraprobe Limited Geotechnical Slope Stability Investigation – January 24, 1997

The following geotechnical report relevant to the Site was provided to Stantec for consideration in the context of preparing our original proposal for this investigation. It is noted that the report was provided 'For Information Only', without benefit of reliance:

- Geotechnical Slope Stability Investigation Report
  Proposed Residential Condominiums
  King St.W and Station Rd, Bolton, Ontario
  Prepared For: Don Robb, Michael LaBrier, and Facilities Management Services Inc.
  Prepared by: Terraprobe Limited
  Report Date: January 24, 1997
  File No.: 96328

The investigation was conducted for a proposed development. The investigation consisted of advancing five (5) boreholes across the property.

The subsurface stratigraphy encountered in the boreholes consisted of surficial materials consisting of topsoil, which overly very stiff to hard clayey silt till overlying dense sandy silt till. Some of the boreholes encountered earth fill on the lower slope, near the existing dwelling consisting of sandy silt with some clay and gravel and extended to depths of 1.5 to 2.2 m below existing grade. The earth fill was in a loose to compact state. Groundwater was encountered in some of the boreholes at depths of 1.1 m to 7.0 m below existing ground surface upon completion of the drilling. Monitoring wells were installed in all five of the boreholes to permit long term groundwater level monitoring.

The report indicated the competent slightly cohesive till is considered to have a very low permeability and a low infiltration rate.

A detailed engineering analysis of slope stability was carried out using a computerized version of a rigorous method of analysis (Spencer-Wright). This method of analysis allows calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope.

The report indicated the side slopes are generally not steep, ranging from 3 to 1 (horiz. to vert.), to about 6:1. The localized well-treed north-west corner is slightly steeper at about 2.3 to 1. There are two existing dwellings located on the slope in the central parts of the site.

The report indicated for land development, MNR Policy Guidelines suggest a minimum Factor of Safety of 1.3 to 1.5 for slope stability, and MTRCA Policy Guidelines require a minimum Factor of Safety of 1.5 or more. Based on the analysis results (in all cases F.S. ≥ 1.68), the existing slopes are adequately stable against slides. Most of the site slope areas have a minimum F.S. of about 2.5 or more, while the well-treed north-west corner has a minimum F.S. of about 1.68 or more. The existing slope crest slightly south of the south property line is considered to be the long-term stable slope crest.

The report recommended conventional spread founded on the very stiff to hard clayey silt till and dense to very dense sandy silt till. Foundations designed to bear on the undisturbed native soils can be designed for a maximum allowable design foundation pressure of 300 kPa and 450 kPa, respectively. The report recommends that the minimum footing width for spread foundations be 0.5 m, and a minimum footing width of 0.8 m be used for individual footings or drilled caissons.

3.2 Terraprobe Inc. Geotechnical Slope Stability Review/Update – August 26, 2013

The following geotechnical report relevant to the Site was provided to Stantec for consideration in the context of preparing our original proposal for this investigation. It is noted that the report was provided ‘For Information Only’, without benefit of reliance:

- Geotechnical Slope Stability Review/Update
  Proposed Seniors Residence and Townhouse Complex
  King Street West and Station Road, Caledon, Ontario
  Prepared For: King Station Facility Inc.
  Prepared by: Terraprobe Inc.
  Report Date: August 26, 2013
  File No.: 11-13-3138

The review was conducted in the context of a previous slope stability investigation report (File No. 96328, dated January 24, 1997) prepared by Terraprobe for the purpose of assessing the long-term slope stability and erosion risk of the existing slope.

In addition, a number of subsurface investigations were conducted by Terraprobe for proposed residential development at the site. The investigations consisted of advancing five (5) boreholes to depths of 6.6 m to 12.6 m below grade in 1997 and six (6) boreholes to a depth of 5 m below grade in 2005. The reports stated that the subject site consisted of topsoil at ground surface, underlain by earth fill or weathered/disturbed soils, which was in turn underlain by native soil deposits predominately comprised of sandy silt till and clayey silt till. The boreholes encountered perched ground water in sand seams within the glacial till.

The updated version of the report concluded that the current slope conditions were considered to be stable long-term and conducive to the development concept for the areas where there would not be changes or modifications to the existing slope conditions. The report stated that the proposed development concept required several structural retaining walls which should be designed by a professional engineer once the development details were finalized.

4 PROPOSED DEVELOPMENT

It is understood that the subject site will be incorporated into a larger residential development. The proposed development will consist of a seven storey retirement residence to be located in the northwest corner of the property and a townhouse complex (9 residential blocks), and associated access roads and parking areas on the remainder of the site.

It is anticipated that the townhouses will be two to three storeys with basements. The approximate proposed finished floor elevations will vary from 245.6 m to 231.7 m.

The retirement residence will consist of a seven storey building with a two level underground parking structure covering the bulk of the area. The selection of appropriate design loads, framing systems have yet to be considered in the architectural and structural design.

The proposed finished floor will be Elevation 238.5 m for the retirement residence.

It is anticipated that strip and spread footings will be the likely foundation system appropriate for the site and framing system. It is further anticipated that the foundation system will extend to the depth required for frost protection.

As noted the drawing provided indicates that two levels of underground parking is being considered for the planned development. With reference to the vertical scale provided on a drawing, the approximate elevation of the lower level of the underground parking has been taken as 231.5 m.

The parking garage floor will be constructed on a concrete slab-on-grade bearing on clear crushed stone with a vapor barrier supported on engineered fill or native undisturbed soil.

A passenger drop off area and access road from Station Road for light passenger vehicles will be constructed at the periphery of the proposed building.

Retaining walls of various heights will be constructed around the periphery of the development. The scope of work for this investigation does not included recommendations and comments for slope stability and the proposed retaining walls.

At the time of the preparation of this report, details with respect to the structural design of the planned development are currently being developed.

The general scope of development is shown on Drawing 1, in **Appendix B**.

5 SCOPE OF WORK

The proposed scope of work for the geotechnical investigation included the following:

- Advance 7 boreholes across the Site. Advance 4 of the boreholes (located within the retirement residence building footprint) to a depth of 5 to 14 m below existing grade and advance 3 boreholes (located in the areas of the townhouse development) to a depth of 5 m below existing grade. In addition, the boreholes were to provide access to determine the depth/elevation of the static groundwater table on the property.
- Prepare a geotechnical report that included the following components:
  - Site Plan showing the borehole locations;
  - Borehole records;
  - Factual results of the investigation and conditions encountered;
  - Results of the geotechnical laboratory testing program; and,
  - Geotechnical comments addressing the following:
    - Discussion of unusual or problematic conditions identified or encountered during the investigation and their implication with respect to the planned scope of development;
    - Site preparation requirements;
    - General groundwater control requirements (temporary for construction and permanent) as warranted in consideration of the site conditions encountered;
    - Anticipated foundation type, foundation depths/elevations and bearing resistances and reactions for ULS and SLS with estimates of anticipated settlements;
    - Comments regarding floor slab design and construction, including modulus of sub-grade reaction for use in design of slab-on-grade as appropriate;
    - Specifications and compaction requirements for service trench and perimeter foundation wall backfills;
    - Recommendations for shoring system(s) including lateral earth pressure parameters for use in design and construction of the shoring system (The geotechnical report should not be construed as the design document for the shoring system. The shoring system would be designed by others, using the geotechnical parameters provided in this document);
    - Comments on excavation of existing soils;
    - Comments on retaining wall construction;
    - Seismic Site Classification based on the Ontario Building Code (OBC), for use in seismic design of a building;
    - Materials and compaction requirements for below interior slabs-on-grade;
    - Suitability of existing soil materials for reuse as backfill;
    - Frost susceptibility assessment of existing soils; and,
    - Typical asphalt pavement structure to meet the Town of Caledon Standards.

The locations of the boreholes are shown on Drawing No. 1 in **Appendix B**.

6 METHOD OF INVESTIGATION

6.1 Field Program

Prior to commencing the field investigation, the various public utility companies were consulted to identify where public utilities crossed the property boundaries. In addition, a private locator was contracted to clear the boreholes of any on-site services.

The fieldwork for the investigation was carried out on April 18, 19 and 22, 2013. A total of 7 boreholes (BH1 to BH7) were advanced for this investigation at the locations shown on Drawing No. 1 in **Appendix B**.

The boreholes were advanced using a track mounted drill rig equipped with 150 mm (outside diameter) solid-stem augers. Stantec personnel recorded the conditions encountered in the boreholes. Where overburden soils were present, samples were recovered at regular intervals using a 50 mm (outside diameter) split-tube sampler by conducting Standard Penetration Tests (SPTs) in accordance with the procedures outlined in ASTM specification D1586. All soil samples recovered from the boreholes were placed in moisture-proof bags and returned to our laboratory for detailed geotechnical classification and testing as required.

All boreholes were backfilled with a mixture of granular bentonite and auger spoils in accordance with the requirements of the Ontario Ministry of the Environment Regulation 903.

6.2 Survey

The borehole locations were surveyed in the field by a Stantec certified survey crew using the base co-ordinate system. The ground surface elevation at the borehole is referenced to a Geodetic Datum. The approximate elevations of the boreholes and their locations are provided in Table 6.1.

Table 6-1: Borehole locations and elevations

Borehole No.	UTM NAD 83 CSRS Coordinates (CGVD 1928:1978 Adjustment)		Ground Surface Elevation (m)
	Northing	Easting	
BH1	4858642.16	600822.50	232.84
BH2	4858673.12	600849.12	232.23
BH3	4858704.12	600903.14	232.77
BH4	4858658.36	600896.73	237.73
BH5	4858597.10	600858.53	241.68
BH6	4858624.71	600884.86	240.57
BH7	4858673.72	600973.11	243.85

The ground surface elevation at the borehole location is provided on the Borehole Records attached in **Appendix C**.

6.3 Laboratory Testing

All soil samples returned to the laboratory were subjected to detailed visual examination and classification.

Grain size distribution, Atterberg Limits and moisture content tests, were conducted on representative samples of the soils obtained from the investigation. The results of the laboratory tests are discussed in the text of this report and are provided on the Borehole Records in **Appendix C** and the figures included in **Appendix D**.

Unless requested in advance, all samples will be stored in our laboratory for a period of two months, from completion of the field work.

7 RESULTS OF INVESTIGATION

7.1 General Information

The subsurface conditions encountered in the boreholes are shown on the Borehole Records provided in **Appendix C**.

An explanation of the symbols and terms used on the Borehole Records is also provided in the appendix.

In general, the ground surface cover consists of exposed surface cover, earth fill or topsoil, overlying glacial deposits of clayey silt till, silty sand till and sandy silt till. A localized stratum of silty clay was found underlying the sandy silt till in one location.

Groundwater was not encountered in any of the boreholes at the time of drilling.

A general overview of the soil and groundwater conditions encountered in the boreholes is provided below.

7.2 Ground Surface Cover

The ground surface cover at the borehole locations typically consisted of exposed surface cover of topsoil.

Topsoil

The ground surface cover at the borehole locations typically consisted of grass and sparse vegetation with supporting topsoil. The topsoil was approximately 100 mm to 200 mm thick.

7.3 Earth Fill

A surficial layer of earth fill was encountered underlying the topsoil in boreholes BH1, BH2, BH3 and BH4 and was found extending to a depth of approximately 0.7 m to 2.3 m below existing grade. The earth fill consists mainly of sandy silt and clayey silt materials with gravel and some clay with occasional organic and topsoil inclusions.

N-values of 0, 3, 4, 5 and 9 were obtained from the SPTs advanced in the fill materials. The values show the fill materials were loosely placed with a nominal degree of compaction.

The fill materials were assessed as moist to wet based on visual and textural examination of the samples in the field. Laboratory test results indicated that the moisture content ranged from 20% to 25%, with an average of 24%.

Visual examination shows that the sandy silt fill has the same composition as the underlying sandy silt till and silty sand till, except the fill contains organics and topsoil inclusions, and the structure is amorphous.

7.4 Clayey Silt Till

A predominant stratum of clayey silt till was encountered in boreholes BH5, BH6 and BH7 beneath the topsoil veneer and underlying the earth fill in borehole BH4. The clayey silt till material typically has some sand to being sandy with a trace of gravel, with occasional sand and silt seams and layers within the clayey silt till mantle and occasional sandy silt till layers. Some of the seams and layers are wet. This deposit extended to beyond the investigated depth of 14.3 m in one of the boreholes. The clayey silt till contained a trace of rootlets in the upper zone in some of the boreholes.

Sample examinations detected fissures permeating the upper layers of the glacial till, occurring within a depth of 0.8 m to 1.2 m from the prevailing ground surface and becoming less prevalent with depth. This indicates the upper layers have been fractured by the weathering process.

Based on the N-values obtained from the SPTs, the consistency of the clayey silt till was very loose to dense, being generally compact to dense.

The clayey silt till was assessed as moist to wet based on visual and textural examination of the samples in the field. Laboratory test results indicated that the moisture content ranged from 8% to 23%, with an average of 15%.

Grain size analyses tests were completed on two representative samples of the clayey silt till. The results of the tests were as follows:

- Gravel 2% and 4%
- Sand 14% and 23%
- Silt 49% and 53%
- Clay 24% and 31%

The results of the grain size distribution tests are shown on the Borehole Record sheets included in **Appendix C** and are shown on Figure No. 1 in **Appendix D**.

Atterberg Limit Tests were carried out on the clayey silt till obtained from a portion of Sample No. 5 at an approximate depth of 3.4 m in borehole BH4; and from a portion of Sample No. 11 obtained at an approximate depth of 12.5 m in borehole BH6. The test results are as follows:

Atterberg Limit Tests

- Liquid Limit: 21% and 30%
- Plastic Limit: 10% and 13%
- Plasticity Index: 8% and 20%

The results of the tests are shown on the Borehole Records in **Appendix C** and also plotted on Figure No. 2 in **Appendix D**.

The results of the Atterberg Limits Tests indicate that the soil can be described as a clayey SILT (TILL) of low plasticity. For purposes of this report, and consistent with the methods described in the Canadian Foundation Engineering Manual (2006, 4th Edition) and ASTM specification D2487, the soil in this stratum is described as clayey silt till.

7.5 Sandy Silt Till

The soil stratum encountered in the investigation consisted of sandy silt till and was encountered in boreholes BH2, BH3 and BH5 underlying the earth fill and clayey silt till. The glacial till consists of sandy silt and contains seams and interstratified layers of sand and gravel with cobbles and boulders increasing with depth. The sandy silt till is brown to grey in colour.

Occasional fine sand lenses and partings were observed in some of the glacial till samples, some of which were wet with seepage.

The compactness of the sandy silt till soil based on the N-Values obtained from the SPTs, was assessed as loose to very dense, generally being compact to dense.

Based on visual and textural examination, the sandy silt till was assessed as moist. Laboratory test results indicated that the moisture content ranged from approximately 9% to 17%.

7.6 Silty Sand Till

A localized stratum of silty sand till was encountered underlying the earth fill in borehole BH1. The silty sand till typically contained some clay, and some gravel. With increasing depth, the presence of cobbles, boulders became more frequent. The silty sand till extended beyond the investigated depth of 5.2 m below the existing grade.

Sample examinations detected fissures permeating the upper layers of the glacial till, occurring within a depth of 0.8 m to 1.2 m from the prevailing ground surface and becoming less prevalent with depth. This indicates the upper layers have been fractured by the weathering process.

Based on the N-values obtained from the SPT's, the state of compactness of the silty sand till was assessed as dense to very dense, typically being very dense.

Based on visual and textural examination, the silty sand till was assessed as moist. The result of the natural moisture content test was 7%.

A grain size distribution test was completed on one representative sample of the silty sand till including Sample 5 obtained at a median depth of 3.4 m in borehole BH1. The results of the tests were as follows:

- 11% gravel.
- 45% sand.
- 34% silt.
- 10% clay.

The results of the grain size analysis tests are shown on Figure 1 included in **Appendix D**.

7.7 Silty Clay

A stratum of silty clay was encountered in borehole BH5 underlying the sandy silt till and extended beyond the investigated depth of 14.3 m below grade surface. The silty clay material contained a trace to some sand, with occasional sand and silt seams and layers within the silty clay mantle. Some of the seams and layers were wet.

Based on the N-values obtained from the SPTs, the consistency of the silty clay was very stiff.

The silty clay was assessed as wet based on visual and textural examination of the samples in the field. Laboratory test results indicated that the moisture content was 19%.

7.8 Infiltration and Hydraulic Conductivity Testing

It is understood King Station is considering a storm water management infiltration pit system to be located on site. As such, infiltration and hydraulic conductivity testing program was conducted based upon the Physical Constraints for Stormwater Management Practices Types (Excerpted & modified from Table 4.1 of MOE SWM Planning and Design Manual – March 2003). The MOE Guideline indicates the criteria (minimum infiltration rate ≥ 15 mm/hr) shall be calculated based upon a percolation test conducted on-site. The in situ hydraulic conductivity testing was conducted at a depth of 1.5 m below existing grade.

For reference, the results of the grain size distribution tests on the respective soil strata encountered in the boreholes can be compared with the grain size curves and soil types referenced in the Ontario Building Code (2006) to estimate the coefficient of permeability of the soils encountered in the investigation. Based on this comparison, the following value is provided:

- SM – Silty sand, sand-silt mixtures 10^{-3} to 10^{-5} cm/sec
- ML – Clayey silts with slight plasticity 10^{-5} to 10^{-6} cm/sec and less

As noted above, the in situ soils consist of an earth fill or topsoil, overlying glacial deposits of clayey silt till, silty sand till and sandy silt till. A localized stratum of silty clay was found underlying the sandy silt till in one location.

In situ hydraulic conductivity testing was conducted in one location in the vicinity of borehole BH2 within the sandy silt till material. The testing consisted of creating a fall in water level within the borehole, and recording the rate at which the water level returns to static conditions. The hydraulic data was analyzed to determine the horizontal conductivity of the overburden material and then be used to assess the percolation potential of the soil.

The results of the in situ hydraulic conductivity testing at the selected location, a percolation time (T) of 22 mins/cm was calculated based upon a percolation test. The estimate coefficient of permeability (K) is 10^{-5} cm/sec.

7.9 Groundwater

Free groundwater was not present in the open boreholes on completion of drilling.

Localized seepage from wet sand and silt seams and layers within the till strata can be expected.

It should be noted that the groundwater level is subject to seasonal fluctuations.

8 GEOTECHNICAL ENGINEERING ASSESSMENT

8.1 Summary and Evaluation of Existing Conditions

The stratigraphy encountered in the boreholes generally consists of a ground surface cover of topsoil and sparse vegetation. Fill materials consisting of sandy silt and clayey silt materials with gravel and some clay with occasional organic and topsoil inclusions, 0.7 m to 2.3 m thick were encountered underlying the topsoil. Strata of native very loose to dense, being generally compact to dense clayey silt till, loose to very dense, generally being compact to dense sandy silt till, dense to very dense, typically being very dense silty sand till and very stiff silty clay were encountered.

The following general development considerations and constraints are provided with respect to observations made during the investigation, the subsurface conditions encountered, and the intended scope of development:

- The overall soil and groundwater findings indicates the overall Site is suitable for development such as lightly to moderately loaded slab-on-grade buildings with municipal services, landscaping features and municipal local roads;
- The existing fill material is not suitable for the support of foundations. Therefore, it is suggested the fill material be removed and reused where suitable or replaced with engineered fill for normal footing and sewer and road construction with the foundation designed with a 150 kPa SLS;
- Based on the ground surface elevations recorded at the borehole locations and the proposed FFE, a cut and fill program will be required to develop the design grades on the site; and
- The program for grading and earthworks should be designed in advance, and carefully executed in consideration of the time of year of execution, prevailing weather conditions, storm-water management control, and associated issues and concerns, and the intended end-use of the property as described;
- The use of conventional spread and strip footing foundations founded on the native sandy silt till, silty sand till and clayey silt till is a practical foundation option for the planned scope of development. The strip footing is designed with a Factored ULS Resistance of 180 to 370 kPa and a SLS Reaction of 180 to 330 kPa including a strip width of 0.45 m to 0.6 m. The ULS value includes a resistance factor of 0.5 m, the SLS reaction has been calculated for 25 mm of settlement;
- If higher bearing capacities are required, deep foundations such as caissons or piles would be required to support the retirement residence building. Based on conditions encountered in the boreholes and local geology, the pile foundations will be required to extend in excess of 14 to 25 m below existing grade; however, to confirm the depth of piles further geotechnical investigation should be undertaken;
- The use of a conventional slab-on-grade floor slab is considered suitable for the planned scope of development for the retirement residence.

Additional geotechnical comments, discussion, and recommendations are provided in the following sections with respect to the design and construction of the planned development.

8.2 Site Preparation

8.2.1 Demolition and Decommissioning

The remnants of any existing foundations (i.e. the dwellings and swimming pool) encountered during excavation must be properly disposed of offsite.

Where the proposed buildings and underground basement/parking areas will not cover the footprint of the demolished structures, backfilling to grade will be required.

8.2.2 Stripping

Prior to grading and/or cut and fill earthworks operations, all topsoil and other non-suitable material will require removal. The thickness of topsoil encountered in the boreholes ranged from approximately 100 mm to 200 mm. It is considered likely that thicker zones may be present across the subject property.

8.3 Grading and Earthworks

Based on a comparison of the design FFE and the ground surface elevations recorded at the borehole location, it is anticipated that a comprehensive engineering cut and fill program will be required to facilitate the planned scope of development.

With respect to the required cut, it is anticipated that the cut materials will consist of fill materials and native clayey silt till and sandy silt till to silty sand till soil.

The compactness/consistency of the existing fill material is variable and is not suitable for the support of shallow strip and spread footings. The fill material within the building envelope plus 3.0 m horizontally beyond the periphery should be removed (sub-excavation) and replaced with compacted engineered fill. Geotechnical comments with respect to excavations are provided in Section 8.8.

Subsequent to completing the stripping and removal of fill materials, the exposed sub-grade surface will consist of a combination of till soils. The exposed sub-grade surface should be inspected to confirm the removal of any deleterious materials, organics, or loose/soft materials (including the loose native soils encountered in the area of borehole BH2) or wet zones. Where such materials are identified, they should be removed and the areas backfilled with engineered fill in accordance with the recommendations provided below.

The exposed surface must be proof-rolled and compacted using large, vibratory compaction equipment with a minimum static weight of ten tonnes. This will provide a uniform, compact surface that will minimize the potential for infiltration of precipitation and ground surface runoff, and promote drainage at the ground surface. The proof rolling program should consist of a minimum of five passes per unit area to provide a uniform surface for construction and to confirm that the surficial soils have been compacted to achieve the required density consistent with the placement of engineered fill as discussed below.

Excavation in the native till soils should be straight forward using large tracked excavating equipment. Presuming that portions of the till soils will be used as fill within the site, any cobbles (in excess of 150 mm on any dimension) and boulders should be removed prior to reuse. Further comments with respect to reuse of this soil are provided below.

It is not anticipated that imported fill materials will be required for general grading of the subject property. However, should materials be required for this purpose, it is recommended that materials with characteristics similar to the native till soils on site (as described in this report) be imported for this purpose. Additional details with respect to materials recommended for use during periods of poor weather conditions are discussed below. As a minimum, materials meeting the requirements of OPSS Granular B – Type I or Type II, or Select Sub-Grade Material (SSM) should be considered for use.

All fill materials imported to the site must meet all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

All materials placed as engineered fill should be placed in 200 mm thick loose lifts. Each lift should be uniformly compacted to achieve a minimum of 98% of the material's Standard Proctor Maximum Dry Density (SPMDD).

The program for grading and earthworks should be designed in advance, and carefully executed in consideration of the time of year of execution, prevailing weather conditions, construction storm-water management control, and associated issues and concerns, and the intended end-use of the subject property as described herein.

8.4 Site Materials Reuse

As stated above, the existing ground surface cover consists of topsoil and earth fill.

Generally, the clayey silt till and sandy silt till to silty sand till encountered during the investigation can be considered suitable for reuse as general engineered fill to develop design grades and elevations, or for use in backfilling service trenches. The results of the moisture content tests and visual inspection of the samples obtained from the investigation indicate that the till soil should be suitable for reuse at the existing moisture content. It is noted, however, that coarser zones may exist in the till and these zones may contain perched groundwater. The quantity of groundwater and associated seepage may be considerable when initially encountered, but these zones are typically limited in extent and over a short duration, the seepage typically reduces considerably or stops entirely. Based on the results of the grain size test completed on a representative sample of this soil, it is suggested that the till soil be considered to have a moderate to high frost susceptibility and should therefore not be used as perimeter foundations backfill, as granular base and sub-base materials, or for similar applications where development of frost could jeopardize the serviceability of the planned infrastructure.

8.5 Adverse Weather Construction

Additional precautions, effort, and measures may be required, when and where construction is undertaken during late fall, winter, and early spring construction when the temperature and climatic conditions have an adverse influence on the standard construction practices or during periods of inclement weather.

Given the overburden soils present on the site, issues associated with the time of year of construction may not be as prevalent as on other sites. However the native till soil, imported fills, and any fill materials that may be present on the site, may pose a concern, subject to the prevailing weather conditions. Provided that the perimeter of the site has a storm drainage swale installed and that the surface of the native till (or engineered fill where the till is reused in this application) is sloped, compacted, and protected from exposure to excess moisture, freeze-thaw cycles, and loading from construction traffic, there should be limited concerns developed in this respect. Where the till soils or engineered fill is exposed, it may be necessary to provide improved, ‘all-weather’ access. In this respect, a suitable construction road would include the use of a woven geosynthetic such as terra-track 24-15 (as manufactured by Terrafix) or equal, placed on the proof rolled and compacted surface of the sub-grade. The surface of the sub-grade must also be sloped to provide positive drainage. A 450 mm thick layer of the crushed bedrock processed to meet the Granular B – Type II specification should be placed on the geosynthetic to provide an excellent sub-base for construction traffic. The vehicles can travel on this surface, or if necessary, an additional layer of finer grain material (such as 20 mm minus crushed rock) can be placed to develop a smoother surface.

With respect to all earthworks activities undertaken during the late fall through to late spring, when less-than-ideal construction conditions may prevail, the following comments are provided:

1. All of the engineered fill should consist of granular materials, including either the crushed rock or imported Granular B or A materials. The use of non-granular fill materials may be considered, but may be problematic.
2. The intended area of fill should be clearly identified in the field prior to commencing the work.
3. Ramps or roads for access (see above for further consideration) must be constructed outside of the limits of intended fill.

4. Fill placement should be inspected by qualified field personnel on a full time basis under the supervision of a geotechnical engineer, with the authority to stop the placement of fill at any time when conditions are considered to be unfavourable.
5. Imported materials that contain ice, snow, or any frozen material should not be accepted for use.
6. Overnight frost penetration may occur, even in granular fill materials, where precipitation and ground surface runoff pools and accumulates, and freezing temperatures exist. Any frozen materials must be removed prior to placing subsequent lifts of engineered fill. Breaking the frost in-situ is not considered acceptable.
7. It may be necessary to stop the placement of engineered fill during periods of cold, where ambient temperatures are -5°C or less, exist.

It should be noted that the placement of engineered fill materials during cold weather conditions requires extra effort beyond that typical when better climatic conditions prevail. At any time where conditions are deemed unfavourable, the engineered fill operation must be suspended.

Additional considerations for heating of concrete, heating of forms and reinforcing steel, protection of concrete from freezing, and similar measures may also be required subject to climatic conditions at the time of construction.

Appropriate scheduling of the work may also require specific consideration and revision from the typical adopted. The scope of work intended may have to be reduced or adjusted, and/or only select construction activities be undertaken during specific climatic conditions. The areas of planned engineered fill may have to be reduced on a daily basis, the extent of excavations may have to be limited, with all excavating and associated backfilling completed without delay.

8.6 Foundations

8.6.1 Townhouse Blocks A to J

Conventional shallow spread and strip footing foundations can be founded in the native sandy silt till and clayey silt till soils and engineered fill. Geotechnical design parameters are provided below in the tables below.

Table 8-1: Conventional Spread and Strip Footings on Native Sandy Silt Till, Clayey Silt Till

Footing Size	Factored ULS Resistance (kPa)	SLS Reaction (kPa)
Spread Footings		
0.9 m x 0.9 m	250	250
1.2 m x 1.2 m	250	250
1.5 m x 1.5 m	260	200
2.1 m x 2.1 m	280	150
Strip Footings		
0.45 m wide	180	180
0.6 m wide	200	200

Table 8-2: Footing on Compacted Engineered Fill

Footing Size	Factored ULS Resistance (kPa)	SLS Reaction (kPa)
Strip Footings		
0.6 m wide	225	150
0.45 m wide	225	150

The ULS values provided above include a resistance factor of 0.5. The SLS reaction values have been calculated to provide a total settlement of 25 mm (or less) and differential settlement of 19 mm.

The calculated values provided above for the foundations are based on a minimum of 0.6 m of soil cover.

Where construction is undertaken during winter conditions, the footing sub-grade must be protected from freezing.

8.6.2 Retirement Residence

Conventional shallow spread and strip footing foundations can be founded in the native compact to very dense sandy silt to silty sand till and stiff to hard clayey silt till soils. Geotechnical design parameters are provided below in the table below.

Table 8-3: Conventional Spread and Strip Footings on Native Sandy Silt Till and Clayey Silt Till

Footing Size	Factored ULS Resistance (kPa)	SLS Reaction (kPa)
Spread Footings		
1.5 m x 1.5 m	530	300
2.1 m x 2.1 m	530	250
2.7 m x 2.7 m	550	200
Strip Footings		
0.45 m wide	360	270
0.6 m wide	370	330

The ULS values provided above include a resistance factor of 0.5. The SLS reaction values have been calculated to provide a total settlement of 25 mm (or less) and differential settlement of 19 mm.

The calculated values provided above for the foundations are based on a minimum of 1.2 m of soil cover.

Where construction is undertaken during winter conditions, the footing sub-grade must be protected from freezing.

8.6.3 Lateral Earth Pressure Parameters

Lateral earth pressure parameters for use in the design of the proposed retaining walls and perimeter foundation walls for the building are provided below in the table below. These values are un-factored.

The parameters provided do not consider surcharge loading such as may be applied by the existing building and related infrastructure, and presume that there is a permanent horizontal back slope at the rear of the walls.

It is recommended that OPSS Granular B be used as backfill adjacent the perimeter walls. Where it is not practical to place the Granular B material in the zone behind the wall extending beyond the toe an angle of 45° measured from the vertical, the values for the existing fill materials and the native silty sand till soils can be used in the design.

Table 8-4: Un-factored Lateral Earth Pressure Parameters

Parameters	Granular Fill (OPSS Granular B Type I)	Native Till	Engineered Fill Material
Bulk Unit Weight (kN/m^3)	21	22	20
Angle of Internal Friction (degrees)	32	30	28
Coefficient of Active Earth Pressure, k_a	0.31	0.3	0.36
Coefficient of Passive Earth Pressure, k_p	3.3	3.0	2.8
Coefficient of Earth Pressure at Rest, k_o	0.47	0.5	0.53

For retaining walls that are designed to allow rotation, the active earth pressure coefficients may be used for design. For rigidly tied structures, the at-rest pressure should be used for design.

The factor of safety against sliding of reinforced concrete foundations can be evaluated using the values shown in Table 8-4 below.

Table 8-5: Coefficient of Friction to Resist Sliding

Subsoil	Un-factored Coefficient of Friction between Concrete and Subsoil
Native Till	0.42
Engineered Fill	0.38

8.6.4 Earthquake Design Considerations

The Ontario Building Code (O. Reg. 350/06) specifies that structures should be designed to withstand forces due to earthquake.

For the purpose of earthquake design the relevant geotechnical information required based on the conditions at this site is the “Site Class”.

Given the discussions provided above associated with the sub-excavation and replacement of the existing heterogeneous fill materials, we recommend that Site Class C be applied to this site, in accordance with Table 4.1.8.4.A of the Ontario Building Code (2006).

8.7 Floor Slab

A conventional slab-on-grade can be used for the planned building, provided that the subgrade is prepared in accordance with the recommendations provided herein.

It is recommended that a moisture break be installed prior to construction of the floor slab. The moisture break should consist of a 200 mm thick layer of OPSS Granular A compacted to a minimum of 100% of the materials SPMDD.

A modulus of subgrade reaction, k_s, of 30 MN/m^3 can be used for design of the floor slab at this site, provided that the construction is in accordance with the recommendations provided herein.

A perimeter drainage system will be required whereas under-floor drains will not be required for the planned building.

The floors slabs should not be tied to any load-bearing walls or columns.

8.8 Excavations and Backfill

8.8.1 Excavations

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA).

All fill materials encountered in this investigation should be classified as Type 3 soils. The maximum excavation side slope for a Type 3 soil is 1:1 (Horizontal: Vertical) in accordance with the OHSA regulation.

The compact to very dense clayey silt till, sandy silt till and silty sand till can be classified as a Type 2 soil. The maximum excavation side slope for a Type 2 soil is 1:1 (Horizontal: Vertical) in accordance with the OHSA regulation, with a maximum vertical cut of 1.2 m at the base of the excavation, in accordance with the regulation.

The side slopes of the excavations in soils should be protected from exposure to precipitation and associated ground surface runoff, to prevent further softening and loss of strength of these fill materials and soils that could lead to additional sloughing and caving.

If space is restricted such that the side slopes cannot be safely cut back in accordance with the OHSA Regulation, or sloughing and cave-in are encountered in the excavation, the slopes should be flattened to achieve a stable configuration or temporary shoring provided.

Free groundwater was not encountered in the boreholes upon completion of the drilling. Groundwater seepage from the clayey silt till, sandy silt till and silty sand till soils should be handled by pumping from sumps using conventional submersible pumps provided the excavations remain open for a short period of time, less than 48 hours.

If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened to a stable configuration.

8.8.2 Backfill

Pipe bedding materials specifications for underground utilities should be in accordance with the manufacturer's and/or the designer's recommendations. Granular bedding materials should be adequate for service installations for the subject property.

It is suggested that the bedding material be placed around the service pipes with a minimum of 300 mm cover on all sides of the pipe. The granular bedding should be compacted to a minimum of 95% SPMDD.

Backfill for service trenches may consist of approved portions of the native till soils, subject to the constraints and limitations stated above with respect to reuse of these soils, or the crushed bedrock, processed to achieve a grain size consistent with either OPSS Granular A or OPSS Granular B Type II, as the project requirements, and manufacturer's and Regional Authorities dictate. The use of imported Granular B Type I may also be considered for use as necessary to augment the available on-site materials.

All trench backfill placed within the building envelope should be placed in 200 mm thick loose lifts and compacted to a minimum of 98% SPMDD for the full thickness of the backfill.

All trench backfill placed outside of the building envelope should be placed in 200 mm thick loose lifts and compacted to a minimum of 95% SPMDD up to 0.5 m below the subgrade level and 98% above this level.

In landscape areas, the backfill may be placed in 300 mm thick lifts and compacted to a minimum of 95% SPMDD to the finished grade.

Water, sewer, and storm lines installed outside of heated areas should be provided with a minimum of 1.2 m of soil cover for adequate frost protection.

Backfill adjacent to the building perimeter foundation walls should consist of free-draining, non-frost susceptible granular materials, such as OPSS Granular 'B'. Where potential for adverse frost conditions exist, such as at doorways, appropriate consideration for the implementation of supplementary drainage is warranted. Additional comments in this respect are provided in subsequent sections of this report.

8.9 Pavement Structure Design

Provided that the exposed sub-grade surface is prepared in accordance with the recommendations provided in the previous sections of this report, and all required earthworks are conducted as recommended herein, the asphalt pavement structures provided below can be considered for use at this site.

Table 8-6: Recommended Asphalt Pavement Structure Design

Material	Thickness (mm)	Compaction Requirements
HL3 (top course asphaltic concrete)	40 mm	97 % BRD
HL8 (base course asphaltic concrete)	65 mm	97 % BRD
OPSS Granular ‘A’ Base	150 mm	100 % SPMDD
OPSS Granular ‘B’ Sub-base	300 mm	100 % SPMDD

The design shown above should provide a pavement service life in the order of 15 years, although additional operation and maintenance effort beyond that considered typical, may be required during the life cycle of the pavements.

The base and sub-base materials should be compacted to a minimum of 100% SPMDD. The asphaltic concrete should be compacted to a minimum of 97% Bulk Relative Density (BRD).

9 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of King Station Limited Partnership, who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec should any these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report;
- Basis of the report;
- Standard of care;
- Interpretation of site conditions;
- Varying or unexpected site conditions; and,
- Planning, design or construction.

Respectfully Submitted,

STANTEC CONSULTING LTD.

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APPENDIX A

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.

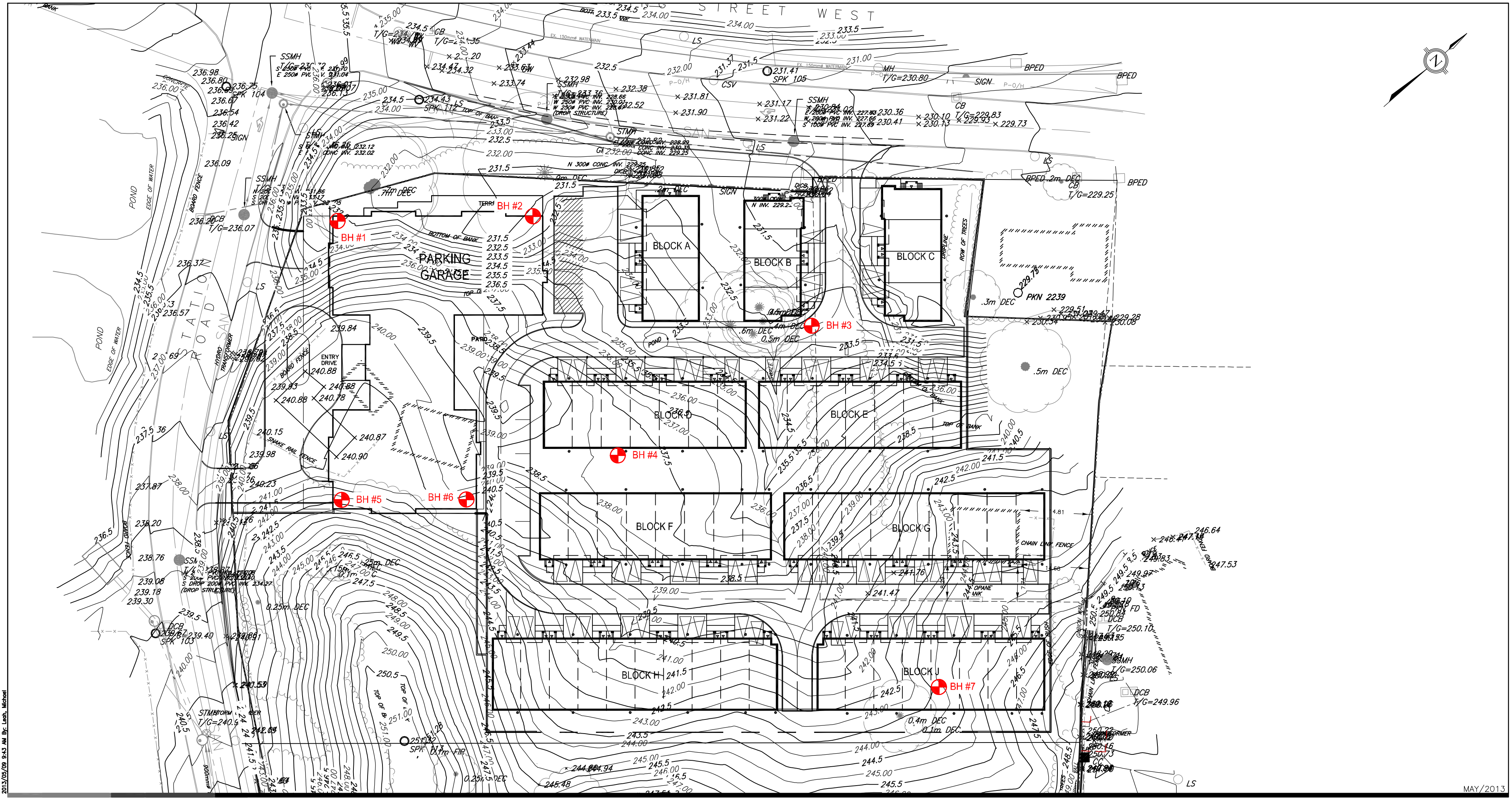
VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd must be notified immediately to assess if the varying or unexpected conditions are substantial 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

Drawings

C:\Users\mlesh\Desktop\Borehole Location Plans (1606)\160622088\160622088_BoreholeLocationPlan.dwg
2013/05/09 9:43 AM By: Lesh, Michael



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LEGEND

● BOREHOLE LOCATION

SCALE: 1:750

Client/Project
KING STATION FACILITY INC.
TOWN OF CALEDON, ONTARIO
160622088

Figure No.
1.0

Title
BOREHOLE LOCATION PLAN

APPENDIX C

Symbols and Terms Used on the Borehole and Test Pits Record Sheets, Borehole Records

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:

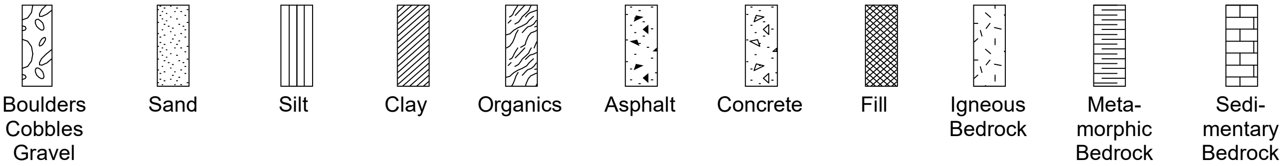
Strength Classification	Unconfined Compressive Strength (MPa)
Extremely Weak	< 1
Very Weak	1 – 5
Weak	5 – 25
Medium Strong	25 – 50
Strong	50 – 100
Very Strong	100 – 250
Extremely Strong	> 250

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.



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

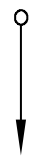
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration 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

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BOREHOLE RECORD

BH1

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

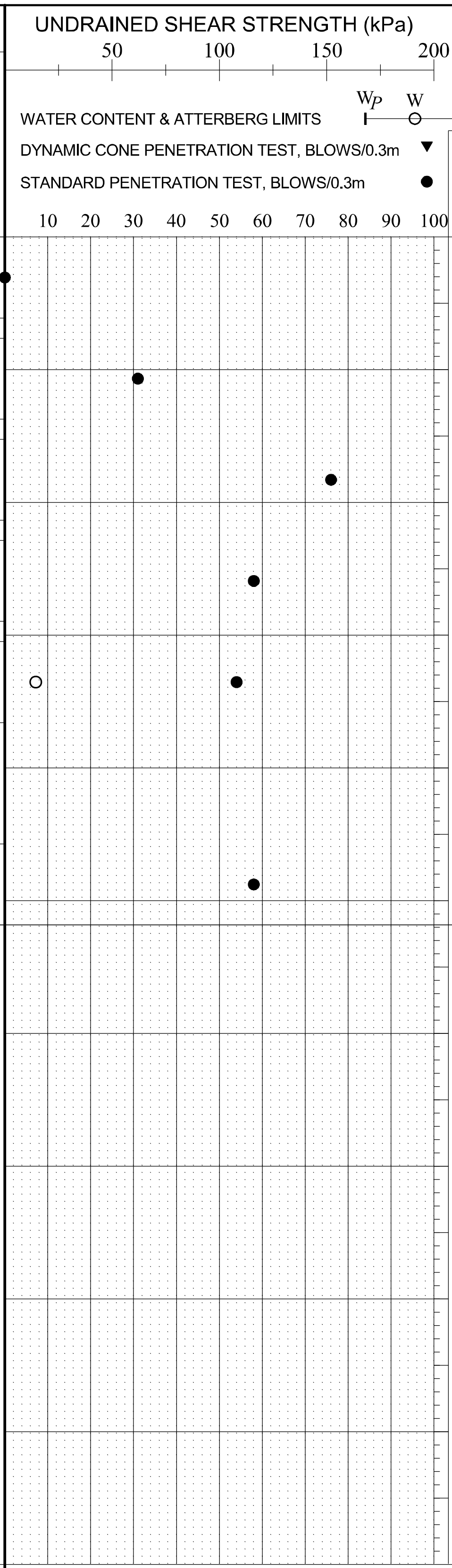
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	232.8	
	232.6	150 mm Topsoil
	232.2	FILL: brown, sandy silt, some clay
5	227.6	Dense to very dense, grey, silty SAND (SM), some gravel, some clay, TILL - moist - occasional cobbles and boulders increasing with depth
		END OF BOREHOLE at approximately 5.2 m below existing grade. Borehole open and dry upon completion of drilling.

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	GR	SA	SI	CL
1	SS	1	150/610	0				
3–4	SS	2	410/610	31				
6	SS	3	360/610	76				
8–9	SS	4	510/610	58				
11	SS	5	560/610	54	11	45	34	10
16	SS	6	510/610	58				



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH2

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

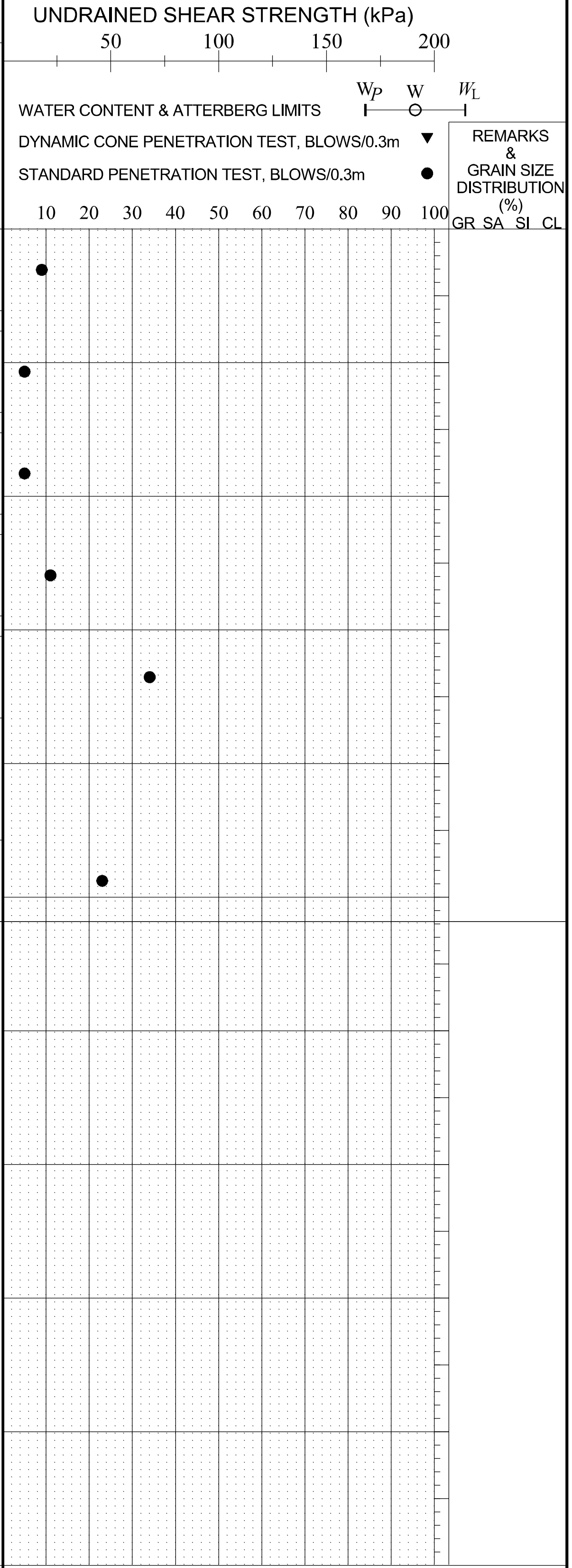
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	**232.2**	100 mm Topsoil		
		FILL: brown, sandy silt, some clay, with topsoil inclusions and asphalt inclusions	F	
	230.7	Loose to dense, brown, sandy SILT (ML), trace to some clay, trace gravel,TILL - grey at 2.7 m - moist - occasional cobbles		
	227.0	END OF BOREHOLE at approximately 5.2 m below existing grade. Borehole open and dry upon completion of drilling.		

DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	250/610	9
3-4	SS	2	300/610	5
6	SS	3	150/610	5
8-9	SS	4	360/610	11
11	SS	5	510/610	34
16	SS	6	510/610	23



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

BOREHOLE RECORD

BH3

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

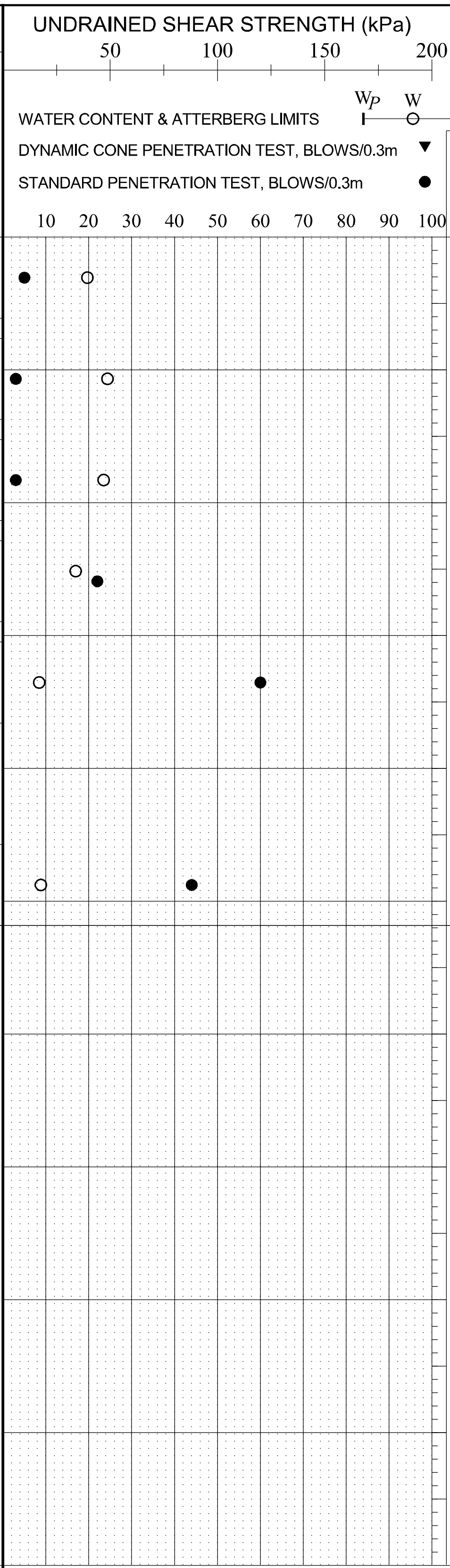
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	232.7	100 mm Topsoil		
		FILL: dark brown to brown, sandy silt, trace to some clay, gravel, topsoil - with occasional topsoil inclusions	F	
	230.4	Compact to very dense, brown, sandy SILT (ML), trace to some clay, trace gravel,TILL - grey at 3.0 m - moist to wet - occasional cobbles		
	227.5	END OF BOREHOLE at approximately 5.2 m below existing grade. Borehole open and dry upon completion of drilling.		

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	200/610	5
3.5	SS	2	200/610	3
6	SS	3	150/610	3
8.5	SS	4	250/610	22
11	SS	5	360/610	60
16	SS	6	510/610	44



REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

☐ Field Vane Test, kPa

▣ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

BH4

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

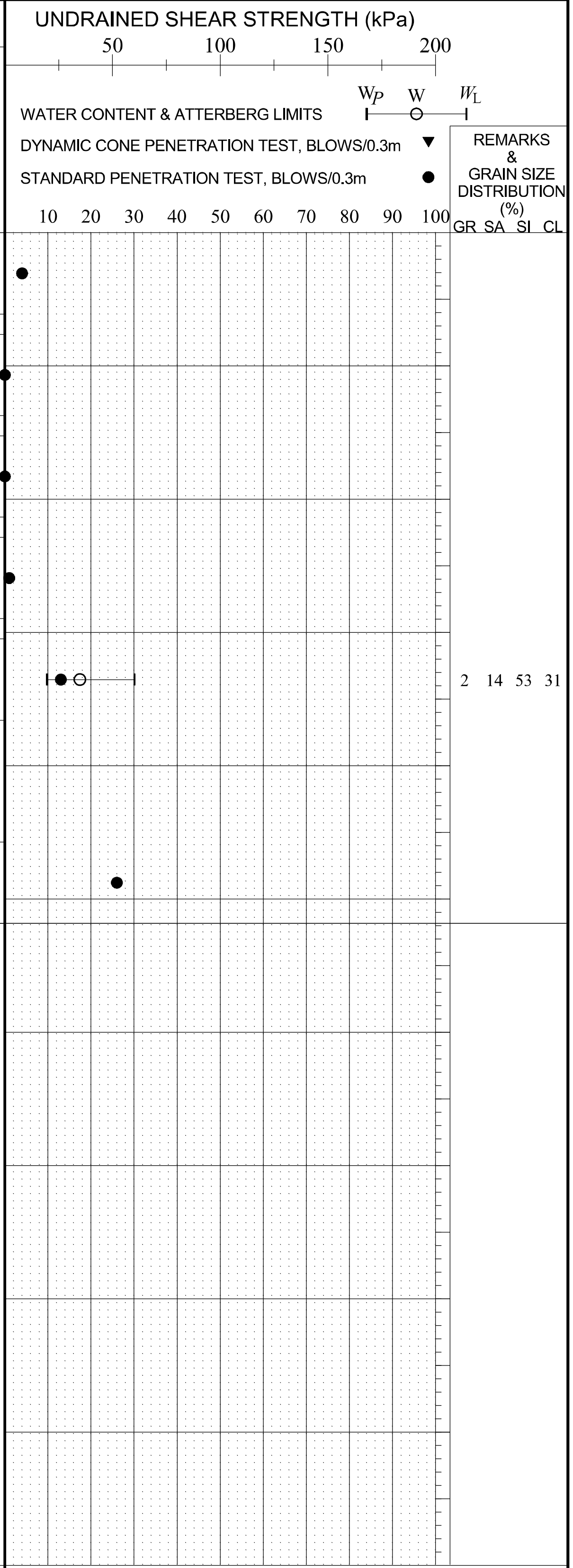
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	**237.7**	
	237.5	150 mm Topsoil
		FILL: dark brown to brown, sandy silt and silty clay, trace to some gravel and topsoil - moist to wet
	235.4	Very loose to compact, brown, clayey SILT (ML), some sand, trace gravel,TILL - moist to wet - occasional cobbles
	232.5	END OF BOREHOLE at approximately 5.2 m below existing grade. Borehole open and dry upon completion of drilling.

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	1	250/610	4	
3	SS	2	100/610	0	
6	SS	3	100/610	0	
8	SS	4	150/610	1	
11	SS	5	150/610	13	2 14 53 31
16	SS	6	460/610	26	



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH5

SHEET 1 of 2

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

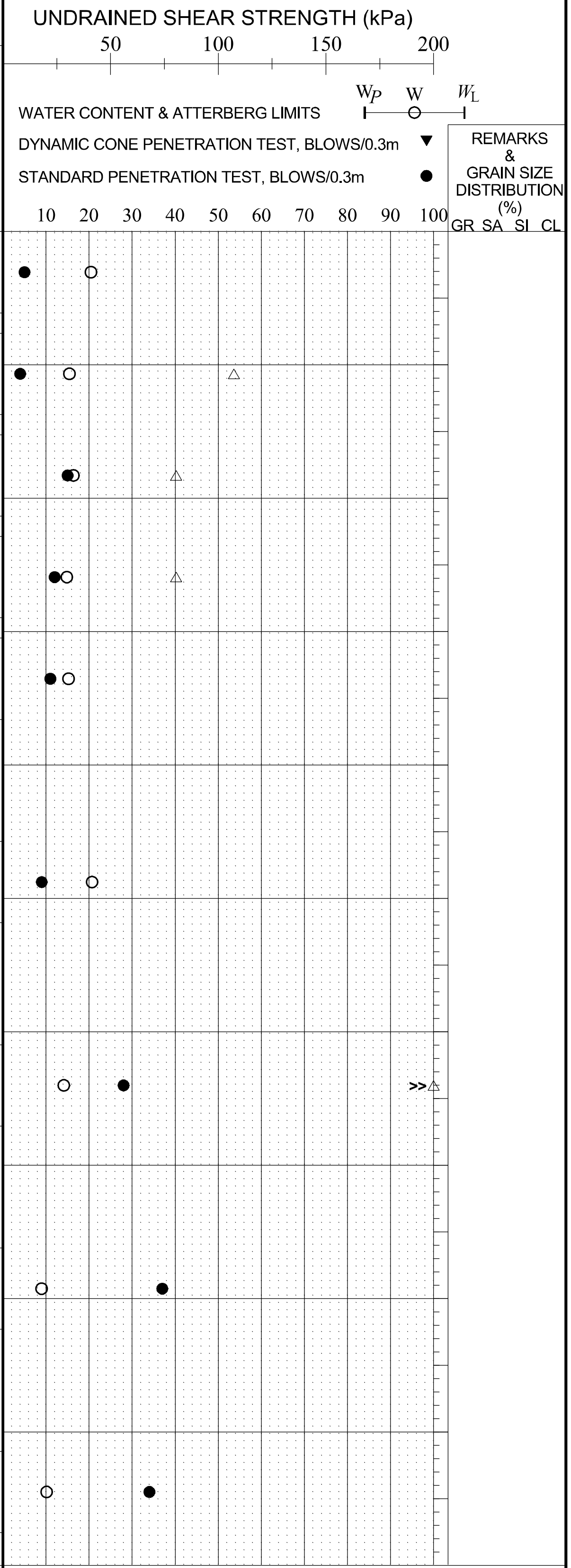
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	**241.6**			
	241.4	200 mm Topsoil		
		Firm to very stiff, brown to grey, clayey SILT (ML), sandy, trace gravel, TILL - moist to wet - occasional cobbles		
7	234.6	Dense, grey, sandy SILT (ML), trace to some clay, trace gravel,TILL - moist - occasional cobbles		
10				

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	200/610	5
3.5	SS	2	300/610	4
6	SS	3	460/610	15
8.5	SS	4	410/610	12
11	SS	5	460/610	11
16	SS	6	410/610	9
21	SS	7	510/610	28
26	SS	8	560/610	37
31	SS	9	510/610	34



□ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH5

SHEET 2 of 2

CLIENT King Station Limited Partnership

LOCATION 232-240 King Street, Bolton, ON

DATES: BORING

WATER LEVEL

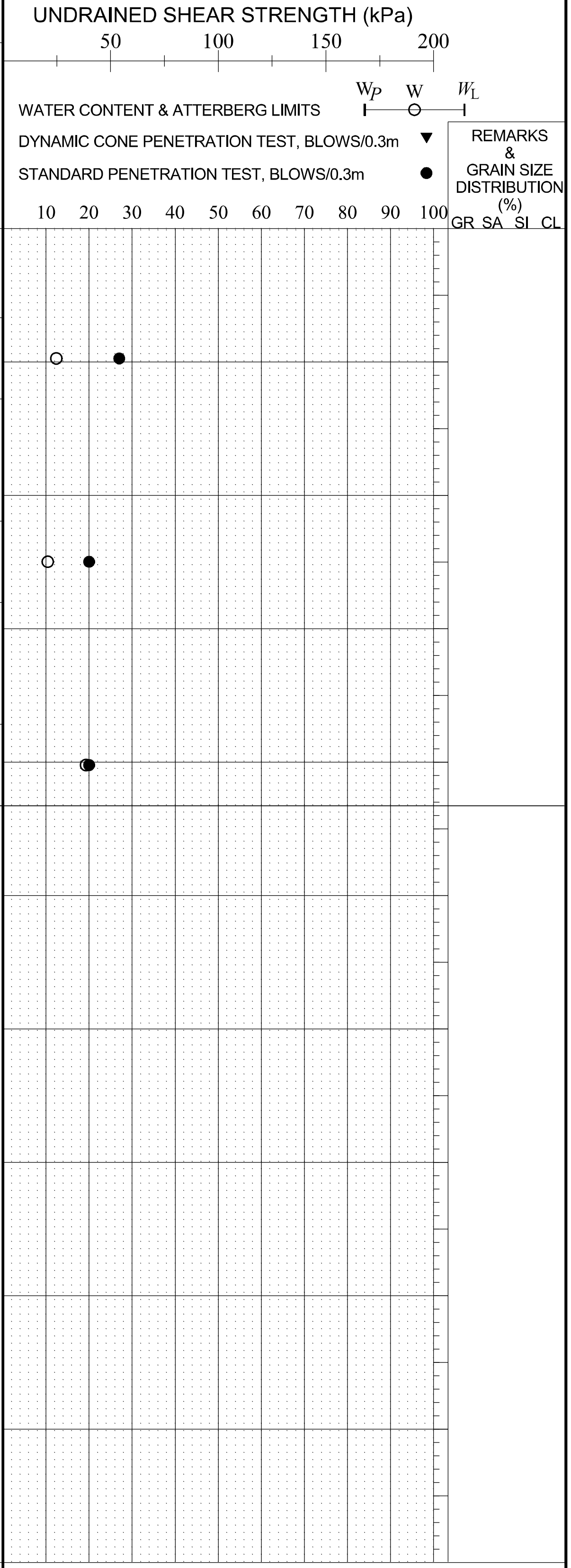
PROJECT No. 160622088

DATUM

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
10	**231.6**	Compact, grey, sandy SILT (ML), trace to some clay, trace gravel,TILL - moist - occasional cobbles		
13	228.3	Very stiff, grey, silty CLAY (CL), with sand - wet		
14	227.3	END OF BOREHOLE at approximately 14.3 m below existing grade. Borehole open and dry upon completion of drilling.		

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
36	SS	10	560/610	27
41	SS	11	510/610	20
46	SS	12	460/610	20



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

BOREHOLE RECORD

BH6

SHEET 1 of 2

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

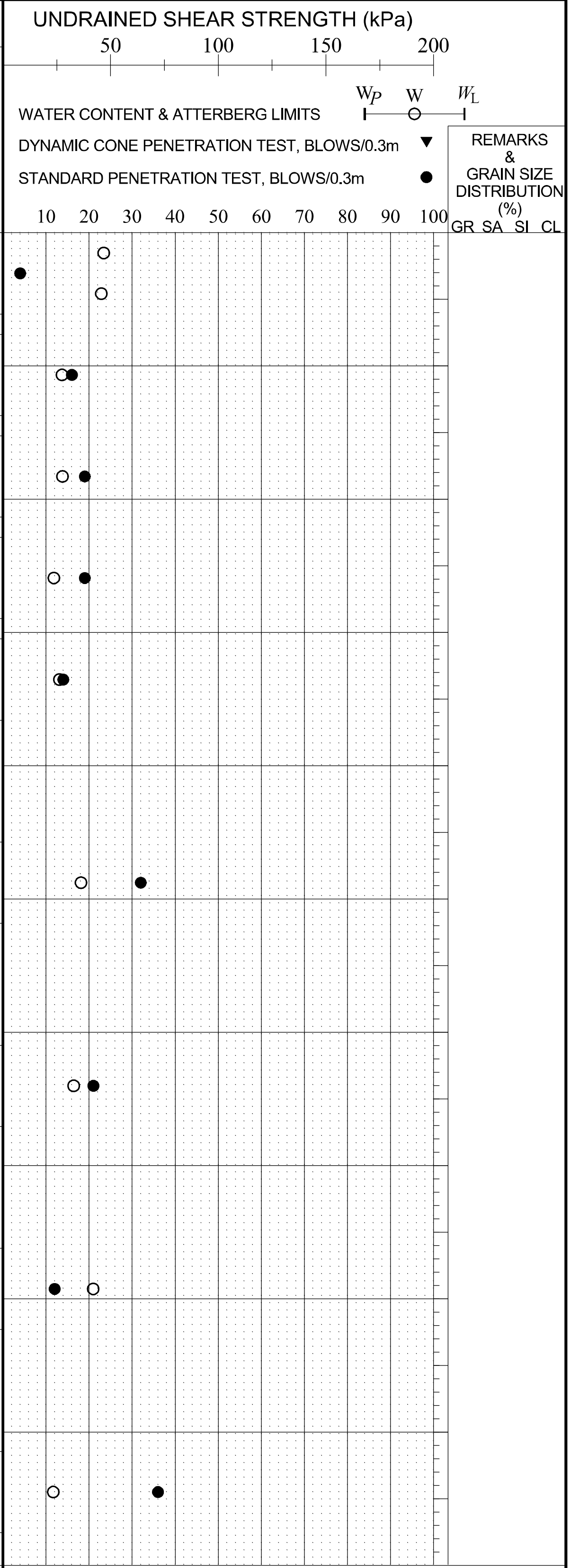
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	240.5	100 mm Topsoil		
		Loose to dense, brown, clayey SILT (ML), sandy, trace gravel, TILL - moist to wet - grey at 3.0 m - occasional cobbles		
10				

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	300/610	4
3–4	SS	2	360/610	16
6	SS	3	460/610	19
8–9	SS	4	510/610	19
11	SS	5	510/610	14
16	SS	6	510/610	32
21	SS	7	510/610	21
26	SS	8	510/610	12
31	SS	9	460/610	36



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH6

SHEET 2 of 2

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

DATES: BORING

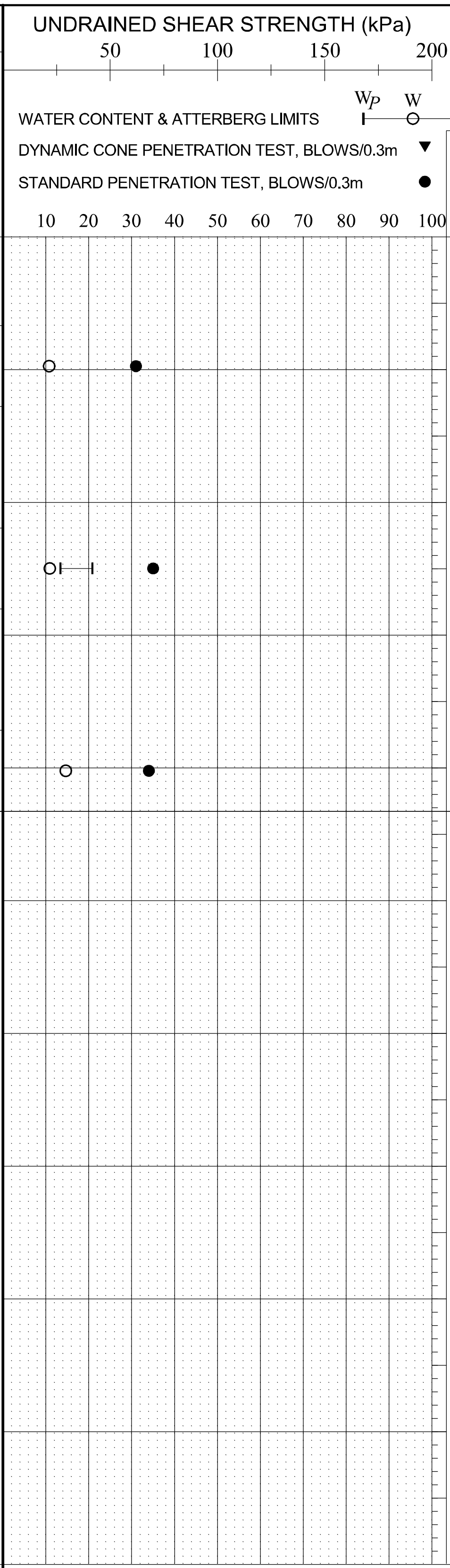
WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	GR	SA	SI	CL
10	**230.5**	Dense, grey, clayey SILT (ML), sandy, trace gravel, TILL - moist to wet - occasional cobbles			33								
11					36	SS	10	460/610	31				
12					41	SS	11	510/610	35	4	23	49	24
14					46	SS	12	410/610	34				
	226.2	END OF BOREHOLE at approximately 14.3 m below existing grade. Borehole open and dry upon completion of drilling.			47								

DEPTH (m): 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

DEPTH (ft): 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65



REMARKS & GRAIN SIZE DISTRIBUTION (%)

☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

BH7

CLIENT King Station Limited Partnership

PROJECT No. 160622088

LOCATION 232-240 King Street, Bolton, ON

DATUM

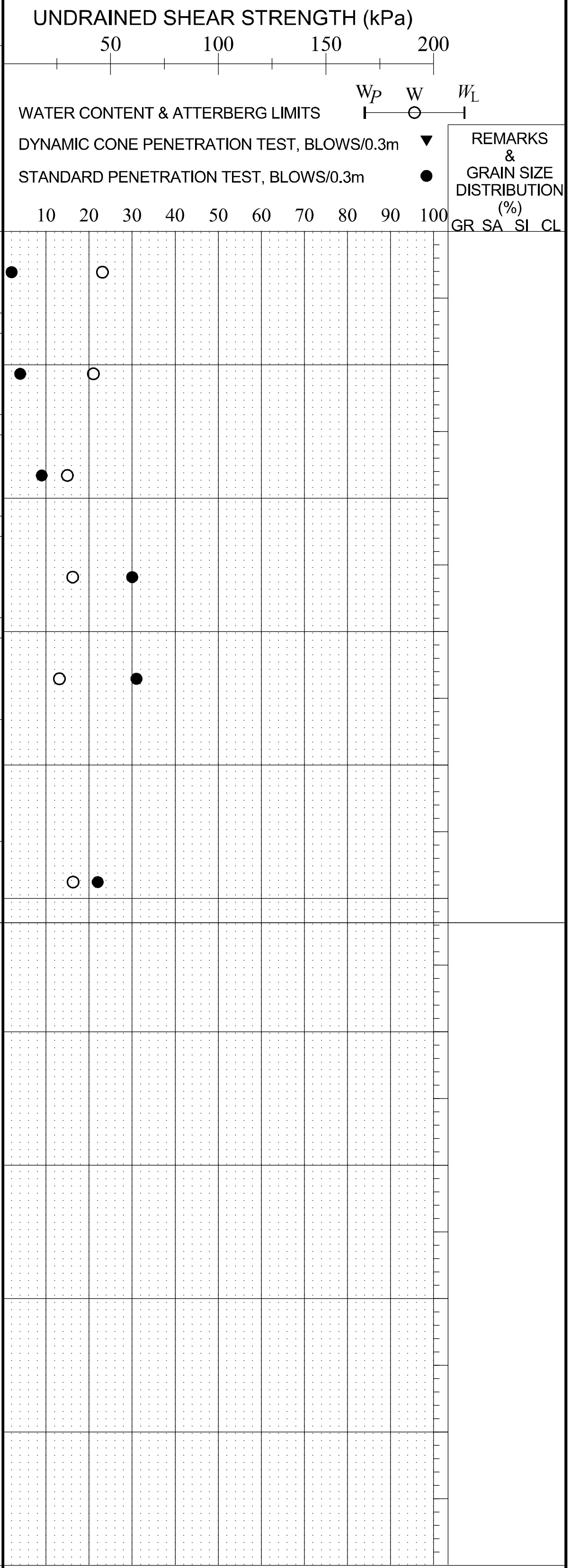
DATES: BORING

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	**243.8**			
	243.6	200 mm Topsoil		
		Very loose to dense, brown, clayey SILT (ML), sandy, trace gravel, TILL - moist to wet - grey at 4.0 m - occasional cobbles		
5	238.6	END OF BOREHOLE at approximately 5.2 m below existing grade. Borehole open and dry upon completion of drilling.		

	SAMPLES			
DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	200/610	2
3-4	SS	2	51/610	4
6	SS	3	410/610	9
8-9	SS	4	510/610	30
11	SS	5	510/610	31
16	SS	6	560/610	22



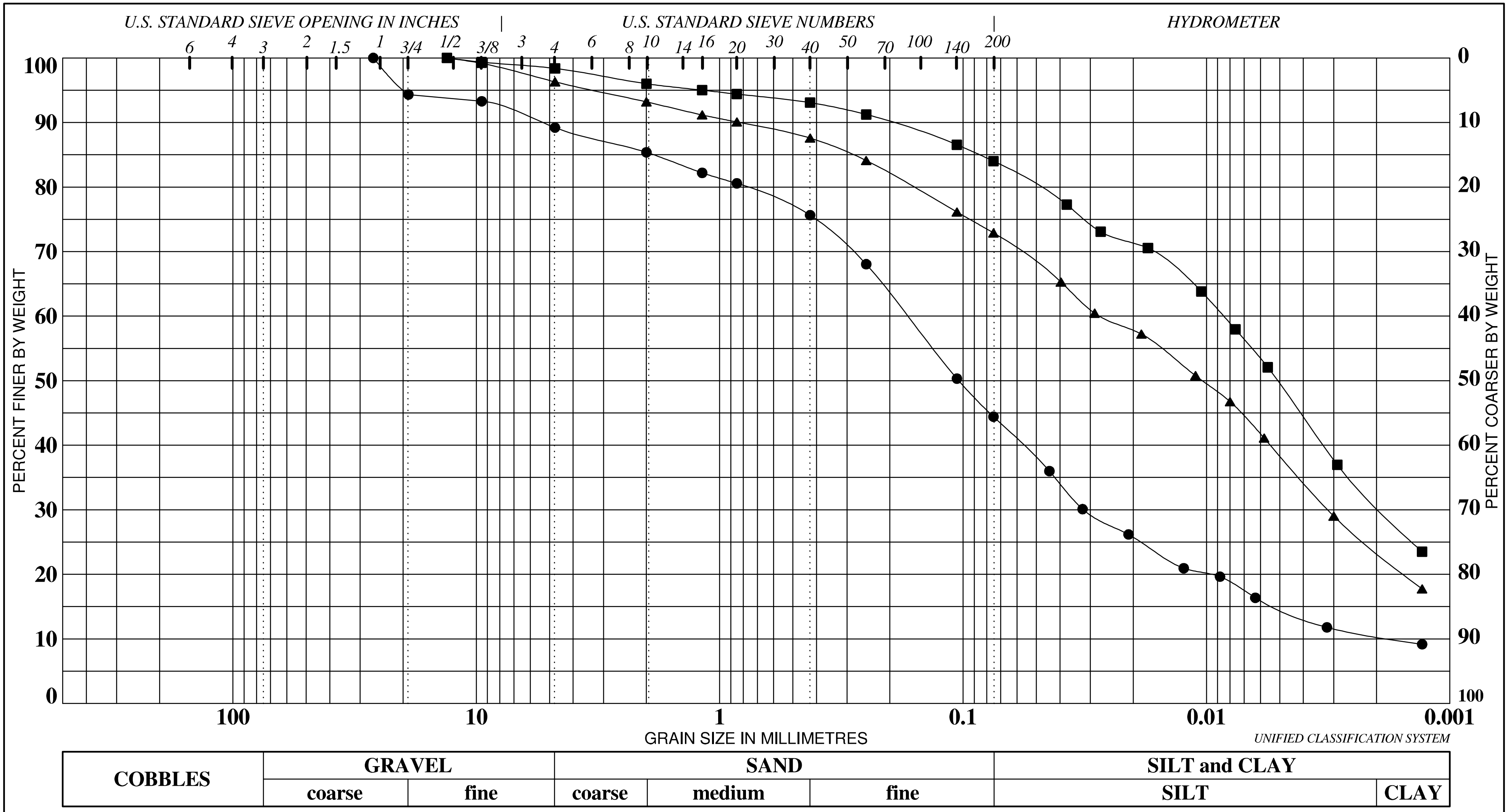
☐ Field Vane Test, kPa

▣ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

APPENDIX D

Geotechnical Laboratory Test Results



Specimen		Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH1	3.4	silty SAND (SM), some gravel, some clay TILL	7				11	45	34	10
■	BH4	3.4	clayey SILT (ML), some sand, trace gravel, TILL	17	30	10	20	2	14	53	31
▲	BH6	12.5	clayey SILT (ML), sandy, trace gravel, TILL	11	21	13	7	4	23	49	24

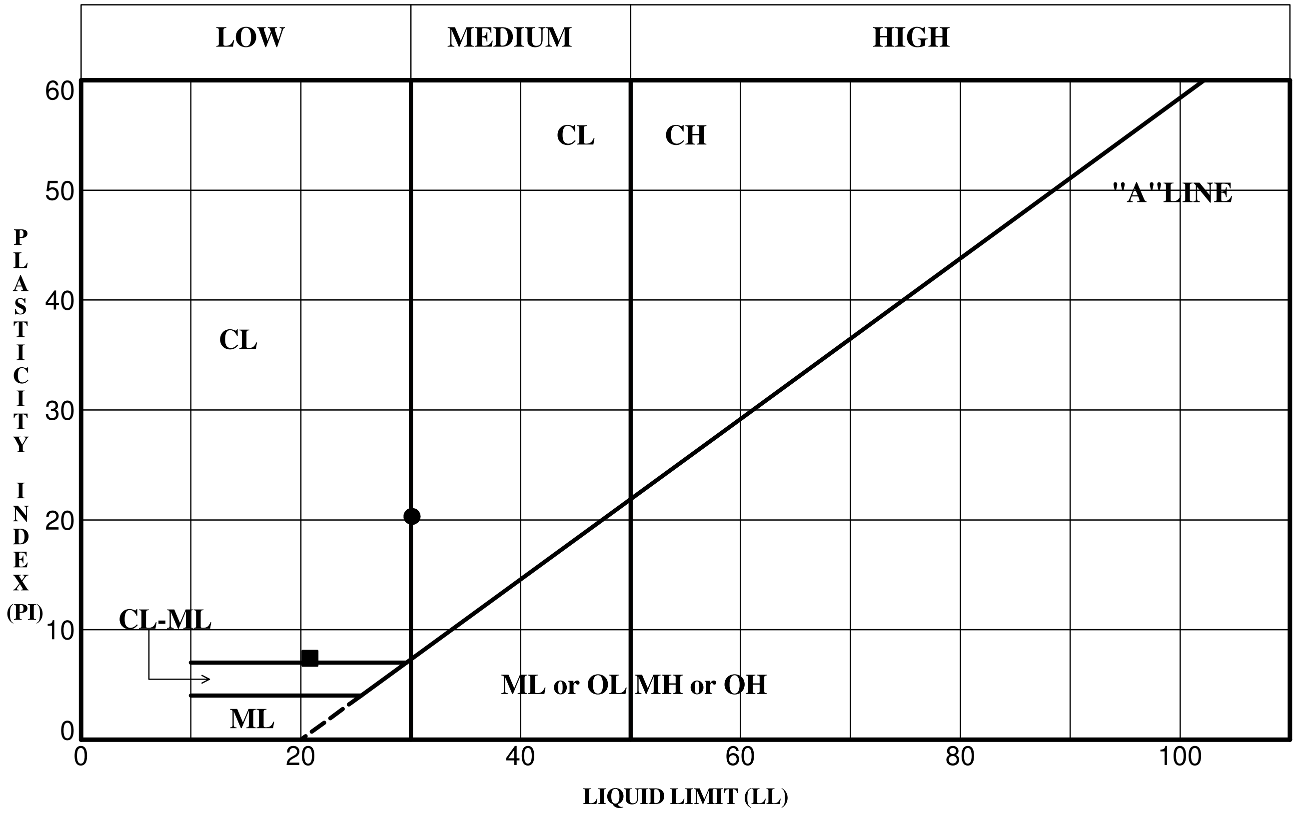
Stantec

Project: King Street West - Bolton
Location: 232-240 King Street, Bolton, ON
Project No.: 160622088

GRADATION CURVE (ASTM D422)

Figure: 1
Remarks:

PLASTICITY CHART



	Specimen	Depth (m)	LL	PL	PI	Fines	W%	Classification
●	BH4	3.4	30	10	20	84	17	clayey SILT(ML), some sand, trace gravel, TILL
■	BH6	12.5	21	13	8	73	11	clayey SILT(ML), sandy, trace gravel, TILL

STANTEC MM-ATTERBERG 160622088.GPJ MM.GDT 13/5/15

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Project: King Street West - Bolton

Location:232-240 King Street, Bolton, ON

Project No.: 160622088

ATTERBERG LIMITS (ASTM D4318)

Figure: 2

Remarks: