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Geotechnical Investigation
Proposed Mixed-use Development

392, 398, 400, 402, 406 and 412 Wilson Street East
Hamilton (Ancaster), Ontario
L9G 2C3

Prepared for:

Wilson St. Ancaster Inc.
1 James Street South, 8th Floor
Hamilton, Ontario
L8P 4R5

Landtek File: 17477
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EXECUTIVE SUMMARY

SCOPE OF SERVICES

Proposed Development	Wilson St. Ancaster Inc. is intending to develop the site located at 392, 398, 400, 402, 406 and 412 Wilson Street East in Hamilton (Ancaster), Ontario as a mixed residential and commercial property. The development is anticipated to comprise of five to seven storeys with one level of underground parking. The development will also include at-grade asphalt paved parking, access roads, site servicing and landscaping
Report Deliverables	The purposes of the Geotechnical Investigation were to confirm the subsurface conditions at the site and to provide design and construction recommendations with regards to building foundations, floor slabs, pavement structures, and subsurface drainage and utilities.

SITE DETAILS AND SETTING

UTM 17T Coordinates	583248, 4786714	**Site Area (approx.)**	1.76 acres (7200 m^2)
Site Description	The project site is situated to the north of Academy Street and to the east of Wilson Street East, and is bound to the north and east by existing residential premises. The site boundary is irregular in shape. The site area is predominately covered by granular and asphalt paved areas, and existing commercial buildings with associated landscaped areas.		
Geology	Topsoil, asphalt pavement and granular material were encountered at the ground surface. Underlying the surface material is fill material comprising primarily of sand, silt, clay and concrete. The fill material extends to depth of between 1.5 m and 4.5 m below existing ground level. Underlying the fill is native sandy silt to sand deposits. Limestone/dolostone bedrock was encountered at a depth of about 11.1 m below existing ground level during this investigation.		

ENGINEERING CONSIDERATIONS

Foundations	It is considered by Landtek that bearing conditions to support the proposed structure on concrete footings can be provided by the native soils.
Settlements	The general limiting of the total settlement of 25 mm and the differential settlement to 19 mm by the recommended geotechnical reaction at the SLS is considered appropriate for the native soils at the site.
Earthquake Considerations	The subject property is considered to be a ‘D’ Site Class
Floor Slabs	The subgrade conditions can adequately support the concrete floor slab on grade, provided that areas of softened native soils are excavated to uncover, more competent soils underlying the soft sections.

CONSTRUCTION CONSIDERATIONS

Excavations	The subsurface soils to be encountered during excavation at the site are expected, in general, to behave as Type "3" and Type “4” materials according to the OHSA classification in Part III.
Dewatering	It is expected that any groundwater seepage during excavation work should be able to be controlled by pumping from sumps at the base of the excavation. If construction dewatering extracts groundwater exceeding 50,000 litres per day and less than 400,000 litres per day, the requirement is to register online with the MOECC Environmental Activity and Sector Registry (EASR). For amounts greater than 400,000 litres per day a Category 3 Permit To Take Water will be required.
Material Reuse	The native soils encountered on site are considered from a geotechnical perspective as suitable for re-use as engineered backfill.
Pavements	The subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck to traverse the exposed subgrade, prior to the placement of pavement granular fill.

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1.0 INTRODUCTION

Landtek Limited (herein "*Landtek*") is pleased to submit the geotechnical investigation report for the proposed mixed-use development located at civic addresses 392, 398, 400, 402, 406 and 412 Wilson Street in Hamilton (Ancaster), Ontario. The geotechnical investigation was undertaken in conjunction with a Phase 2 Environmental Site Assessment being completed by Landtek for the site. Authorization to proceed with the work was received from Mr. Giovanni Fiscaletti on behalf of Wilson St. Ancaster Inc. in January 2018.

Preliminary layout drawings provided to Landtek by Wilson St. Ancaster Inc. indicate that the proposed development is to comprise of five to seven storeys consisting of a mix of residential and commercial units. The development will also include at-grade asphalt paved parking, an access road, full site servicing and landscaping. It is understood that the structure will include a maximum of one level of underground parking.

The primary objectives of this investigation were:

- To confirm the subsurface soil and groundwater conditions for foundation design and construction;
- Provide design and construction recommendations with regards to building foundations, floor slabs, pavement structures, and subsurface drainage and utilities; and,
- Assess the characteristics of the soils to be excavated and their suitability for reuse on site as fill material.

This report has been prepared for the client, their nominated engineers, designers, and project managers. Further dissemination of this report is not permitted without Landtek's prior written approval. Further details of the limitations of this report are presented in Appendix A.

2.0 METHODOLOGY

Fieldwork undertaken at the site by Landtek included clearance of underground services, borehole layout, borehole drilling and soil sampling, and field supervision. A total of 12 boreholes (boreholes BH2, BH3, BH/MW4, BH5, BH/MW6, BH7, BH/MW8, BH/MW9S, BH/MW9D, BH/MW10, BH/MW11 and BH/MW12) were drilled at the site between January 29 and June 19, 2018; Eight (8) of the boreholes were installed as groundwater monitoring wells namely BH/MW4, BH/MW6, BH/MW8, BH/MW9S, BH/MW9D, BH/MW10, BH/MW11 and BH/MW12. BH1 was not drilled due to access restrictions. All boreholes were logged using those standard symbols and terms defined in Appendix B. The borehole location plan, Drawing 1, and the borehole logs are provided in Appendix C.

All boreholes were drilled using a CME-75 track-mounted drilling rig equipped with continuous flight, hollow stem augers, and were advanced to depths of between 3.5 m (borehole BH2) and 12.6 m (borehole BH/MW4) below existing ground level.

Standard Penetration Tests (SPT's) and split spoon samples were taken during drilling at selected depths. Full time supervision of drilling and soil sampling operations was carried out by a representative of Landtek. The soil samples were then transported to Landtek`s in-house, Canadian Council of Independent Laboratories (CCIL) certified laboratory and visually examined to determine their textural classification. Four selected composite soil samples were submitted to ALS Environmental for Soil Corrosivity testing to determine whether protection is required for buried concrete or metal structures from potentially corrosive soil environments. Moisture contents were carried out on all samples.

Elevations at the borehole locations were established by Landtek relative to site measurements using the top of Bell manhole cover located at the intersection of Wilson Street East and Academy Street as the temporary benchmark (herein *“TBM*”). An assumed elevation of 100.0 m was used for the TBM.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location

The site is located at civic addresses 392, 398, 400, 402, 406 and 412 Wilson Street in Hamilton (Ancaster), Ontario, and is centered at approximate grid reference 583248, 4786714 (UTM 17T coordinates). The Geodetic elevation of the ground surface in the area of the site ranges between 227.76 m and 229.88m.

The site location is shown in Figure 1 below.

***Figure 1**: Site location and surrounding area*

The project site is situated to the north of Academy Street and to the east of Wilson Street East, and is bound to the north and east by existing residential premises. The site covers an area of approximately 7200 m^2 (1.79 acres) and the site boundary is irregular in shape. The site area is predominately covered by granular and asphalt paved areas, and existing commercial buildings with associated landscaped areas.

3.2 Subsurface Conditions

Based on published geological information[1,2] and previous geotechnical[3] experience for the area, the predominant native overburden soils consist of glaciolacustrine sand with minor silt and clay deposits. The bedrock in the area is identified as blue-grey dolostone, identified as the Gasport Member of the Lockport Formation.
The borehole information is generally consistent with the geological data, and the predominant soils comprise of sand deposits with minor silt and clay. Dolostone/Limestone bedrock was

encountered during this investigation at a depth of approximately 11 m below existing ground level. The detailed borehole logs are presented in Appendix C, with the ground conditions encountered summarized in the following Table 1. Ground conditions encountered by the boreholes are discussed further in the sections following.

Table 1: Summary of Borehole Conditions Encountered

BH ID	Ground Elevation	Surface Material			Superficial Soils Depth and (Description)		Bedrock Contact Depth
		Asphalt	Granular	Topsoil	Fill	Native Soil[2]	
BH2	98.9 m	-	-	150 mm	0.15 m – 1.5 m (sand)	1.5 m – 3.0 m (sand)	-
BH3	99.7 m	-	-	150 mm	0.15 m – 2.5 m (sand)	2.5 m – 4.4 m (sand)	-
BH/MW4	100.0 m	-	100 mm	-	0.1 m – 4.5 m (sand)	4.5 m – 5.6 m (sand) 5.6 m – 6.4 m (silty clay) 6.4 m – 11.1 m (sand)	11.1 m[1]
BH5	98.1 m	-	-	150 mm	0.15 m – 1.7 m (silty sand)	1.7 m – 6.6 m (sand)	-
BH/MW6	99.3 m	100 mm	100 mm	-	0.2 m – 1.8 m (clayey silt)	1.8 m – 2.4 m (silt) 2.4 m – 6.6 m (silty sand)	-
BH7	99.4 m	100 mm	100 mm	-	0.2 m – 2.3 m (clay and silt)	2.3 m – 6.6 m (sand)	-
BH/MW8	100.1 m	-	100 mm	-	0.1 m – 4.5 m (clayey silt)	4.5 m – 5.6 m (sandy silt) 5.6 m – 7.3 m (silty sand)	-
BH/MW9	100.1 m	-	100 mm	-	0.1 m – 3.7 m (silty sand & clayey silt)	3.7 m – 4.9 m (silt) 4.9 m – 11.4 m (sand)	-
BH/MW10	100.1 m	-	150 mm	-	0.15 m – 1.5 m (sandy silt) 1.5 m – 2.0 m (concrete) 2.0 m – 4.5 m (sandy silt)	4.5 m – 6.6 m (sand)	-
BH/MW11	99.5 m	-	150 mm	-	0.15 m – 3.0 m (concrete) 3.0 m – 4.5 m (sandy silt)	4.5 m – 6.6 m (sand)	-
BH/MW12	100.5 m	100 mm	100 mm	-	0.2 m – 0.7 m (silt)	0.7 m – 1.5 m (clayey silt) 1.5 m – 4.0 m (sand, silt and sandy silt) 4.0 m – 7.0 m (Boulder)	

Notes:
1. Coring was conducted to prove 1.5 m of bedrock.
2. Terminus of borehole depths indicated.

Asphalt

Boreholes BH/MW6, BH7 and BH/MW12 were drilled through the existing asphalt surfaced parking lot and access route. The asphalt thickness is approximately 100 mm. Pavement granular material was encountered underlying the asphalt, and consisted of approximately 100 mm of sand and gravel.

Granular

Pavement granular material was encountered at the surface of boreholes BH/MW4 and BH/MW8 to BH/MW11, and consists of approximately 100 mm to 150 mm of sand and gravel.

Organic Soil

Topsoil was encountered at the ground surface in boreholes BH2, BH3 and BH5 and is approximately 150 mm thick.

Fill

Fill comprising predominantly of sand, silt, clay and concrete was encountered underlying the surface material in all the boreholes, and extends to a depth of between 0.7 m (borehole BH/MW12) and 4.5 m (boreholes BH/MW4, BH/MW8, BH/MW10 and BH/MW11) below existing ground level. The fill is primarily brown with various proportions of limestone/dolostone fragments, gravel and traces of rootlets, brick fragments, wood, coal, glass, and asphalt.

SPT 'N' values ranging from 0 to 18 were reported, indicating the fill material to be of a very loose to compact condition. Moisture contents in the fill range between 7 % and 25 %.

Silty Sand / Sandy Silt / Sand

Native silty sand, sand and sandy silt deposits were encountered in all the boreholes at depths of between 1.5 m (borehole BH2) and 4.9 m (borehole BH/MW9), and extend to a depth of about 11.1 m (borehole BH/MW4) below existing ground level. The sandy silt to sand deposits are generally brown and contain some silty clay interbeds and traces of boulders, shale and limestone fragments.

SPT 'N' values ranging from 0 to 50 blows for 130 mm of spoon penetration were reported, indicating the sandy silt to sand deposits to be of a very loose to very dense, but generally compact condition. The higher SPT 'N' values within the sandy silt to sand deposits may be attributed to the presence of limestone/dolostone fragments. Moisture contents in the silty sand to sand deposits range between 8 % and 24 %.

Silt

Silt deposits were encountered underlying the fill material at depths of between 1.8 m (BH/MW6) and 3.7 m (BH/MW9) and extend at depths of between 2.4 m and 4.9 m below existing ground level respectively. The silt deposits are brown in colour, and contain varying proportions of sand and traces of clay.

SPT 'N' values ranging from 2 to 5 were reported, indicating the silt deposits to be of a loose condition. Moisture contents in the silt range between 23 % and 31 %.

Clayey Silt to Silty Clay

Seams of clayey silt and silty clay were encountered in boreholes BH/MW4 and BH/MW12 at depths of between 5.6 m and 6.4 m and between 0.7 m and 1.5 m respectively. The clayey silt to silty clay seams are brown in colour and are of a firm to stiff consistency.

Boulders

Boulders or possible boulders were encountered in boreholes BH2, BH3, BH5, BH8 and BH/MW12 at depths of between 3.5 m and 7.3 m below existing ground level.

Bedrock

The borehole information indicates that bedrock contact, based on rock coring in borehole BH/MW4 is at a depth of approximately 11.1 m (approximate Geodetic elevation 218.4 m).The bedrock comprises a sedimentary dolostone/limestone of the Gasport Member of the Lockport Formation. The dolostone/limestone is grey, very finely crystalline, and slightly porous. Field identification of the intact rock core specimen classifies the bedrock as “medium strong” to “strong”. The Rock Quality Designation (RQD) value of the bedrock was 83 % indicating that the bedrock is of “good” quality.

Groundwater

Groundwater conditions were observed during drilling and then measured from the installed monitoring wells on February 21 and June 22, 2018. Water level readings in the monitoring wells were recorded and are summarized in Table 2 below.

It should be noted that these groundwater levels are not considered to reflect the long term stabilized water table. Groundwater conditions are expected to vary according to the time of the year and seasonal precipitation levels. During wet weather, an increase in water seepage is to be expected in the shallow fill deposits.

Table 2: Summary of Water Level Measurements

Borehole ID	Date Drilled	Water Strike	Measured Water Level	
		(mbgl*)	Depth (mbgl*)	Date
BH2	January 29, 2018	Dry	-	February 21, 2018
BH3	January 29, 2018	Dry	-	February 21, 2018
BH/MW4	February 2, 2018	6.4	10.6	February 21, 2018
BH5	January 29, 2018	4.5	-	February 21, 2018
BH/MW6	January 29, 2018	5.5	6.0	February 21, 2018
BH7	January 29, 2018	5.8	-	February 21, 2018
BH/MW8	January 31, 2018	6.0	5.3	February 21, 2018
BH/MW9S	January 31, 2018	6.7	5.8	February 21, 2018
BH/MW9D	February 5, 2018	6.7	6.1	February 21, 2018
BH/MW10	January 31, 2018	5.5	5.8	February 21, 2018
BH/MW11	January 31, 2018	5.9	4.2	February 21, 2018
BH/MW12	June 19, 2018	Dry	4.2	June 22, 2018

* mbgl meters below ground level

4.0 FOUNDATION DESIGN CONSIDERATIONS

4.1 Shallow Foundations in Native Soils

The fill encountered in the boreholes is not considered suitable as a bearing stratum due to the high risk of unacceptable settlements. It should be noted however, that the fill deposits extend to depths of about 4.5 m below the existing ground level, equating to an elevation of 95.0 m (referenced to TBM), and it is understood that the proposed structure will include a maximum of one level of underground parking.

This given, and based on the ground conditions observed at the borehole locations, it is considered by Landtek that bearing conditions to support the proposed structures on concrete footings can be provided by the native soils underlying the existing fill materials. It should be noted however, that the native silty sand and silt deposits encountered in boreholes BH/MW4, BH/MW6, BH7, and BH/MW8 at a depth of between 3.0 m and 4.5 m are of a loose condition. It is recommended that the footings for this area are extended to the underlying soils.

Table 3 summarizes the recommended geotechnical reactions at the Serviceability Limit State (herein "*SLS*") and factored geotechnical resistances at the Ultimate Limit State (herein "*ULS*") for the native soils. It should be noted that the design parameters have been determined by Landtek for the design stage only.

Where the bearing levels of the footings are at different design elevations, the footing base levels should be stepped along a line of 10H:7V, drawn upwards from the lowest footing, to avoid overlapping stresses.

Subsurface conditions can vary over relatively short distances and the subsurface conditions revealed at the test locations may not be representative of subsurface conditions across the site. Therefore, a Geotechnical Engineer should be engaged during construction to examine the exposed sub-soil quality and condition, and confirm the subsurface conditions are consistent with design assumptions. This is in compliance with field review requirements in the National Building Code, Volume 1, Clause 4.2.2.3.

Table 3: Recommended Limit State Foundation Design Values for Soils

Founding Elevation Range		Founding Stratum	Foundation Design Value	
Depth Range	Elevation[5]		SLS [1,2]	ULS [3,4]
3.0 m to 4.5 m	96.5 m to 95.0 m	Sandy Silt to Sand	100 kPa	150 kPa

Notes:
1. The National Building Code general safety criterion for the serviceability limit states is: SLS resistance ≥ effect of service loads.
2. Recommended SLS bearing values conform to Estimated Values based on soil types given in Tables K-8 and K-9 of the National Building Codes User's Guide.
3. The ULS resistance factor for shallow foundations is 0.5, as given in Table K-1 of the National Building Code User's Guide.
4. The National Building Code general safety criterion for the ultimate limit states is: factored ULS resistance ≥ effect of factored loads.
5. Elevations are referenced to the TBM.

4.2 Deep Foundation Solutions

The results of the Preliminary Phase Two Environmental Site Assessment conducted by Landtek at the site indicate that native soils on-site are impacted at some sections of the site to

depths of greater than 8 m below existing ground level. Remediation at the site might require the removal of soils to significant depths below the proposed underside of basement level.

This given, and should the anticipated loading of the proposed structure be such that native soil is unable to provide adequate support for the foundations, then an alternative, deeper founding solution may be required, such as the following:

- Steel driven piles, for example H-piles or pipe piles. Such piles are deemed feasible but would require input from a specialist contractor to determine the most appropriate pile dimension and profile for the identified soil conditions and anticipated driving depth;
- "*Cast in Place*" concrete caisson piles, which could be constructed without any unexpected difficulties but should incorporate the use of liners. It is anticipated that a dewatering system will not be required if liners are used appropriately; or,
- Pre-treated Continuous Flight Auger (CFA) piles, where the pile location is augured and cased to depth, then filled with 1 MPa to 2MPa sand mix and the CFA pile augured and installed within the sand mix column.

For deep foundation solutions seated on the limestone/dolostone bedrock, it is considered that the bedrock can support a factored geotechnical resistance of 1.5 MPa at the ULS.

Once the preferred foundation design has been established, further information and design parameters can be provided using the investigation findings.

4.3 Frost Susceptibility

The native soils encountered across the site are considered sensitive to water and frost, and their physical and mechanical properties are dependent on in-situ moisture content. As such, the founding soils at the site are considered to have a moderate susceptibility, being classified as Frost Group "*F3*" (Table 13.1 of the "*Canadian Foundation Engineering Manual*", 4th Edition). However, the identified depths for foundations, as given in Section 4.1 are considered to be below the maximum depth for frost penetration of 1.2 m in the Ancaster area.

Should any re-grading be required as part of the proposed development and adjacent to the new structures, it will be important to ensure that the associated exterior footings will have a minimum of 1.2 m of soil cover, or equivalent suitable insulation, for frost protection.

4.4 Settlement Considerations

Based on the outline information provided for the nature of the proposed redevelopment of the site, it is anticipated that the loads to be applied to the ground by any such structure will be generally moderate intensity. As such, associated settlements are not expected to be large. Therefore, the general limiting of the total settlement to 25 mm and the differential settlement to 19 mm by the recommended geotechnical reaction at the SLS is considered appropriate.

Anticipated settlements for foundations seated within the shale bedrock should be considered negligible (i.e. less than 15 mm).

4.5 Seismic Design Considerations

In accordance with Table 4.1.8.4.A. of the current Ontario Building Code (herein "*OBC*") the subject property is considered to be a 'D' Site Class. The acceleration and velocity-based site

coefficients, F_a and F_v, should be determined from Tables 4.1.8.4.B. and 4.1.8.4.C. respectively of the OBC for the above recommended Site Class. The seismic design data given in Table 1.2 of Supplementary Standard SB-1 in Volume 2 of the OBC, for selected Municipal locations, should be used to complete the seismic analysis.

Should a higher classification be required, such as a Site Class 'C', then Shear Wave Velocity Testing should be undertaken using Multichannel Analysis of Surface Waves (MASW) methodologies.

4.6 Existing Buildings Demolition

It is understood that the existing buildings located on site will be demolished prior to construction of the proposed mixed-use structure. For the purposes of this report, it has been assumed that the existing structures and all associated substructures will be removed in full prior to development.

Should there be a need to fill excavations created by the demolition of the existing structures with engineered fill or unshrinkable backfill prior to commencing the proposed development, Landtek should be contacted to determine the most appropriate placement requirements of the fill material.

4.7 Waterproofing Considerations

Above any stabilized groundwater levels, the subsurface wall should be damp proofed and comply with the OBC requirements. As a minimum it is recommended that the damp proofing system include a Delta Drainage Board or MiraDrain 2000 series product, or an approved alternative, along with an asphalt based spray-on wall coating.

It is recommended that all subsurface areas including walls and floor slabs are appropriately waterproofed below any stabilized groundwater levels plus the required buffer zone (nominally 1.0 m to 1.5 m above the stabilized groundwater level.

5.0 FLOOR SLAB AND PERIMETER DRAINAGE CONSIDERATIONS

Based on the borehole soil conditions and preliminary design information provided to Landtek, it should be possible to construct the floor slab level using slab-on-grade methods. However, the depth and variation in fill materials may yield high degrees of differential settlements. Therefore, it is recommended that floor slab subgrades are sub-excavated approximately 0.5 m and engineered fill placed to redevelop the subgrade. Prior to the placement of the engineered fill, it is recommended that the area be assessed by Landtek to determine if there is a need for any local, remedial work. The assessment should include visual observation and proof rolling.

Any required grade raising below floor slabs or localized, 'soft-spot' remediation to the subgrade should be completed using select subgrade material placed per Sections 8.0 and 11.0 of this report. The select subgrade materials are to be compacted to a recommended target compaction of 100 % SPMDD, with no individual test below 98 % SPMDD.

It is recommended that a minimum 150 mm layer of clear 19 mm crushed quarried stone be used as the vapour barrier under the floor slab. The vapour barrier stone should meet the requirements of Ontario Provincial Standard Specifications (herein "*OPSS*") 1004 for 19 mm Type II clear stone. If a graded crushed stone is substituted for clear stone, the material should be limited to a maximum of 5 % fines (passing the 0.075 mm sieve). The floor slab thickness should meet the specifications of the project based on anticipated floor loadings.

The finished exterior ground surface should be sloped away from the buildings at a grade in the order of 2 %.

The concrete properties should meet the requirements of OPSS 1350. Contraction and isolation jointing practices should be in accordance with current Portland Cement Association recommendations, as given in the engineering bulletin "*Concrete Floors on Ground*", second edition, by R. E. Spears, and W. C. Panarese.

Perimeter drainage should be provided around all subsurface floor areas where water may accumulate. Underfloor drains may be required depending on excavation and groundwater seepage conditions. The drainage system should comply with the current OBC and associated amendments.

6.0 EARTH PRESSURE CONSIDERATIONS ON SUBSURFACE WALLS

The earth pressure, p, acting on subsurface walls at any depth, h, in metres below the ground surface assumes an equivalent triangular fluid pressure distribution and may be calculated using expression (1) below. It is assumed that granular material is used as backfill. Allowances for pressure due to compaction operations should be included in the earth pressure determinations and a value of 12 kPa is applicable for a vibratory compactor and granular material.

If the structure retaining soil can move slightly, the active earth pressure case can be used in determining the lateral earth pressure. For restrained structures and no yielding an “at rest” earth pressure condition should be used. The determination of the earth pressures should be based on the following expression:

$$p = K (\delta h + q) \qquad (1)$$

where:

p = the pressure in kPa acting against any subsurface wall at depth, h, in metres (feet) below the ground surface;

K = the at rest earth pressure coefficient considered appropriate for subsurface walls; OPSS 1010 Granular B Type 1 (pit-run sand and gravel) material has an effective angle of friction estimated to be 32° with a corresponding at rest earth pressure coefficient, K_o, of 0.45;

δ = the moist bulk unit weight of the retained backfill; 21.5 kN/m^3

and,

q = the value for any adjacent surcharge in kPa which may be acting close to the wall

h = the depth, in m, at which the pressure is calculated

Granular B backfill should meet OPSS 1010 Type I or Type II material specifications. The granular fill should be compacted to a minimum of 97 % SPMDD, or to the levels and backfilling procedures specified.

7.0 SUBSURFACE CONCRETE

7.1 Soil Corrosivity

A total of four selected soil samples were submitted for chemical analyses to ALS Environmental for analysis of PH, resistivity, redox potential, and concentrations of sulphides, sulphates, and chlorides.

The American National Standards Institute (ANSI)/ American Water Works Association (AWWA) 10-point scoring method was used to determine the soil corrosivity potential. For each given soil sample, points were assigned to the different parameters to evaluate their contribution towards the corrosivity of soil.

Corrosion protection for buried metallic improvements or steel are recommended, when a score of 10 points or greater is reported. The test results are provided in Appendix D and are summarized in Table 4 below, with the respective ANSI/AWWA point rating.

Table 4: Results of Soil Corrosivity Potential

Sample ID	Composite Sample Depth	Parameters Analysed	Measured Value	ANSI/AWWA Point Rating	Total ANSI/AWWA Points
BH2-2	2.5 m – 3.0 m	Sulphide (%)	0.27	0	1
		pH (ph units)	7.83	0	
		Resistivity (ohm.cm)	7930	0	
		Redox Potential (mV)	319	0	
		Moisture (%)	10.5	1	
BH3-2	3.0 m – 3.5 m	Sulphide (%)	<0.20	0	1
		pH (ph units)	7.83	0	
		Resistivity (ohm.cm)	8360	0	
		Redox Potential (mV)	323	0	
		Moisture (%)	12.8	1	
BH5-5	4.5 m – 5.0 m	Sulphide (%)	<0.20	0	2
		pH (ph units)	7.92	0	
		Resistivity (ohm.cm)	7270	0	
		Redox Potential (mV)	293	0	
		Moisture (%)	12.2	2	
MW8-3	3.0 m – 3.5 m	Sulphide (%)	<0.20	0	12
		pH (ph units)	15.9	3	
		Resistivity (ohm.cm)	868	8	
		Redox Potential (mV)	197	0	
		Moisture (%)	15.9	1	

Based on the total ANSI/AWWA values ranging from 1 to 2 within the native soils, it is considered that the native soils have a mild corrosion potential. It should be noted that the soil sample selected from the fill material in borehole BH/MW8 at a depth of between 3.0 m to 3.5 m below existing ground level yielded a value of 12. This given, the fill material on site is considered to have a medium to high corrosion potential.

The contribution of chloride ions to soil corrosivity towards buried metallic improvements or reinforced concrete structures is very significant. According to the Corrosion Guidelines (Caltrans, January 2015, version 2.1), a site is considered corrosive if, "*chloride concentration is 500 ppm or greater, sulphate concentration is 2000 ppm or greater, or the pH is 5.5 or less*. "

In addition, the Canadian Standards Association (CSA) A23.1-09 "*Concrete materials and methods of concrete construction*", Table 3, "*Additional requirements for concrete subjected to sulphate attack*", states that design requirements for sulphate resistant concrete are only necessary when the water soluble sulphate content of the soil in which the concrete is to be embedded is greater than 0.1 % (1,000 mg/kg).

The representative native soil samples at the site contain sulphate and chloride ion concentrations of up to <20 mg/kg and 5.5 µg/g respectively. The results of the representative fill material sample taken from BH/MW8 yielded concentrations of up to 169 mg/kg and 536 µg/g for the sulphate and chloride ions respectively. This given, the soil environment within the native soils should be considered "*mildly*" corrosive and "*moderately to highly*" corrosive within the fill material. Therefore, consideration will be required towards the protection of buried concrete and metal infrastructure from the corrosive soil environments identified.

7.2 Concrete Class Considerations

The requirements for subsurface concrete subject to a sulphate and chloride environment are presented in Canadian Standards Association specification, CSA A23.1-14 *"Concrete Materials and Methods of Concrete Construction, Tables 1-4"*. The results of chemical tests indicate that the soils have a high chloride concentration and generally a mild sulphate environment. It is recommended that subsurface concrete at the site have the following characteristics for a C-1 exposure class:

- minimum 56-day compressive strength = 35 MPa;
- maximum water to cementing materials ratio = 0.40;
- chloride ion penetrability requirement = < 1500 coulombs within 91 days;
- cementing materials; GU (general use hydraulic cement) or GUb (blended general use); and,
- air content; as per CSA A23.1-14 Table 4, air content category 1 (freeze-thaw environment).

The concrete should be placed without segregation and should be consolidated to achieve a uniform dense mass.

7.3 Methods for Specifying Concrete

Alternative methods of specifying concrete for a project are outlined in CSA A23.1-14 and allow for "*Performance*" or "*Prescription*" based methods. Each method attaches different levels of responsibility to the owner, the contractor, and the concrete supplier. The pros and cons of each method should be examined prior to completion of the specifications for the project.

8.0 EXCAVATION AND BACKFILL CONSIDERATIONS

8.1 General Excavation Considerations

All temporary excavations and unbraced side slopes in the soils should conform to standards set out in the Occupational Health and Safety Act, Ontario Regulation 213/91 "*Construction Projects*" (herein "*OHSA*"). The subsurface soils to be encountered during excavation at the site are expected to behave as Type "3" materials according to the OHSA classification in Part III. Type "3" materials are characteristic of the generally compact native sand and silt soils. The very loose and loose native soils and fill soils encountered are considered Type "4" material.

Given the size of the site and the anticipated maximum depths of excavation for the proposed structure, vertical cut excavations are not anticipated during the construction phase. It should be possible to excavate the overburden soils with a hydraulic backhoe. Moist Type 3 soils are expected to be stable for short construction periods at slopes of approximately 45° to the horizontal (i.e. 1V:1H), while the Type 4 soils are expected to be stable at slopes of no greater than 18° to the horizontal (i.e. 1V:3H) for short term construction. Slopes in the sand may undergo progressive sloughing and erosion due to exposure to the elements such that the overall slope becomes flatter than 45°.

Consideration should be given to existing service trenches and backfill that may be present directly behind cut slopes within the fill and native soils that may appear to be stable on first excavation. In these circumstances, slopes can suddenly slough or collapse due to the effects of the adjacent backfill. Consequently, for excavation conditions that cannot satisfy the OHSA requirements for unbraced 1H:1V side slopes, a trench box system should be used, or temporary shoring should be installed to maintain safe working conditions. This may be more applicable to service trench excavations, though may also apply to basement excavations etc., particularly where in close proximity to new road pavements or associated infrastructure.

Groundwater seepage was encountered at depths of below 4.5 m below existing ground surface during drilling, equating to a ground elevation of approximately 95.0 m (referenced to TBM). It is expected that any groundwater seepage during excavation work should be able to be controlled by pumping from sumps at the base of the excavation, however, provisional alternative dewatering methods should be considered given that permeable sands were encountered in the boreholes. If construction dewatering extracts groundwater exceeding 50,000 litres per day and less than 400,000 litres per day, the requirement is to register online with the MOECC Environmental Activity and Sector Registry (EASR). For amounts greater than 400,000 litres per day a Category 3 Permit To Take Water (herein "*PTTW*") will be required.

Excavations for new foundations should satisfy the criteria given in the example shown in Figure 2 to avoid overlapping stresses and minimize the risk of undermining existing adjacent structures, including utilities, and/or triggering additional settlements of the existing structures due to soil disturbance.

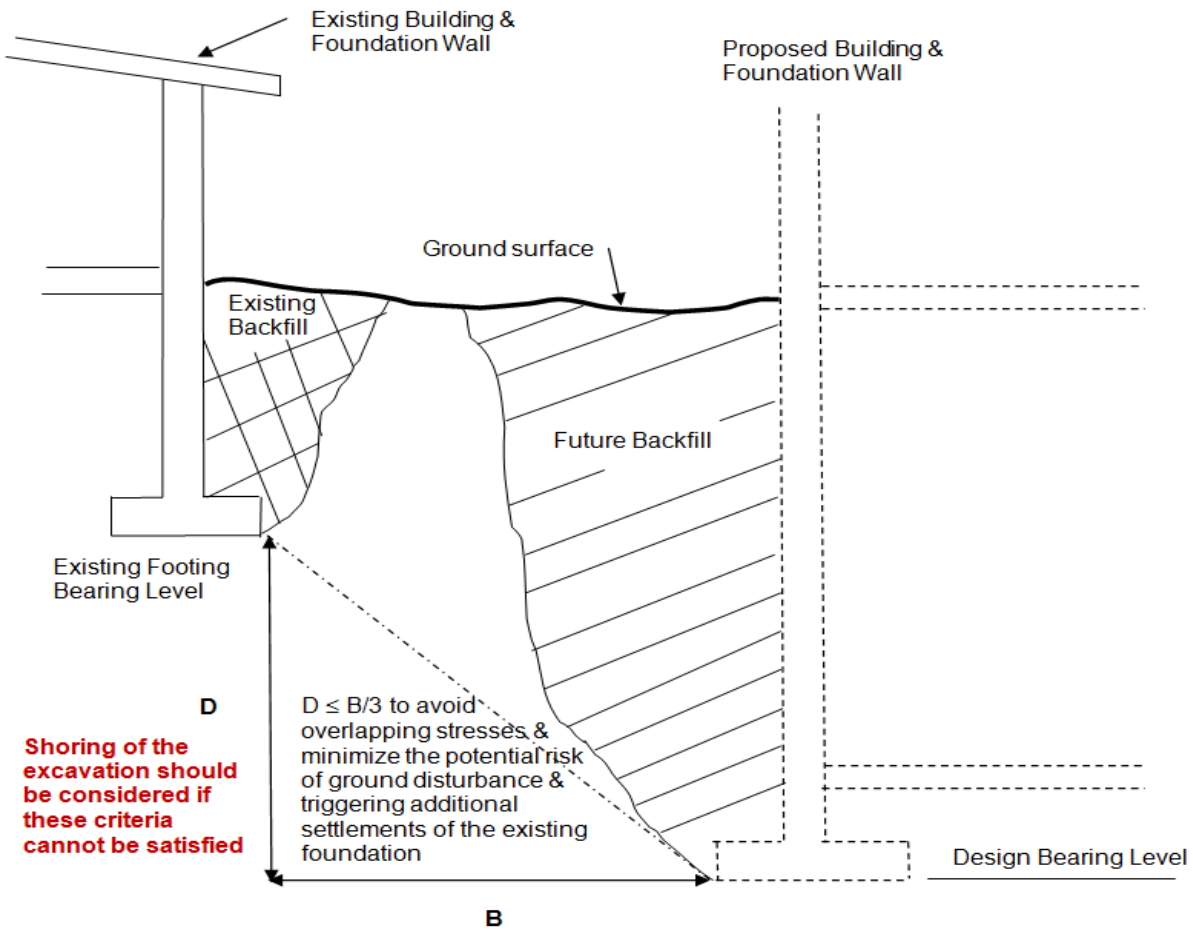


***Figure 2**: Criteria for Assessing Excavation Shoring Requirements (Not to Scale)*

8.2 General Backfill Considerations

Backfill next to foundation walls and in service trenches should be selected to be compactable in narrow trench conditions. The on-site sand and silt soils are expected to be reusable as trench backfill and backfill around the proposed structures on the site. Any variation in the moisture contents of the soils encountered may require selective separation of material to avoid the use of wet soil.

Site servicing trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlements. It is recommended that the target compaction specification for trench backfill be 97 % SPMDD with no individual test below 95 % SPMDD.

During inclement weather the native soils may become too wet to achieve satisfactory compaction. If construction is proposed for late in the year, a reduced level of trench compaction with a higher risk of future settlements is to be anticipated, and it is recommended that provisional contract quantities be established for the supply and placement of imported granular fill under such circumstances. The imported granular should meet the requirements of OPSS 1010 for Granular B Type I material as a minimum requirement.

9.0 TEMPORARY SHORING CONSIDERATIONS

The application of shoring for excavations will be dependent on the required excavation depth and the proximity of existing or newly constructed infrastructure adjacent to the excavation.

Where limited workspace restricts side slope configurations, the excavation side slope should be appropriately protected to support the excavation sidewalls during construction. Soldier piles and timber lagging may be considered as an option for a shoring system, though this type of system may require measures to prevent the loss of soil between the spaces of lagging boards where a wet or flowing soil layer may be present.

The preferred temporary trench support for utility installations, where permissible under the OHSA, is generally in the form of trench boxes. Consideration should be given to the time taken between completing the excavation section and installing the trench boxes; trench boxes are to be installed quickly and efficiently. Once the service pipes have been installed and the required bedding cover placed, the trench box will require repositioning to enable the continuation of the service pipe installation. When the trench box is to be moved, the void space between the trench box's outer walls and the trench is to be backfilled and the backfill compacted, which may require the trench box to be raised sequentially prior to sliding it laterally into its new position.

It is also important to ensure that the trench is not over-excavated so that there is a suitably tight fit between the trench box and the excavated trench walls. Post-construction ground settlements may occur along the line of the trench walls, or adjacent the excavated trench area, if the excavation is not adequately supported throughout the entire service installation procedure.

The earth pressure acting on trench box bracing may be evaluated using apparent earth pressure diagrams presented in the CFEM, 4th Edition, Chapter 26.

It should be noted that the design of a temporary shoring system, should one be required, is the responsibility of the Contractor. Therefore, a specialist shoring contractor should be consulted to provide the most appropriate shoring type method and associated installation procedures. In any event, the shoring design should be based on the procedures outlined in the latest edition of the CFEM. It is also recommended that lateral and vertical movement of the shoring system be monitored during construction to ensure that movements are within the acceptable range.

10.0 SITE SERVICING CONSIDERATIONS

There is no indication that special pipe bedding materials or procedures are required for the installation of services. All bedding cover and backfill materials should be selected in accordance with OPSS 1010 Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

The pipes should be placed with a minimum bedding thickness in conformance of OPSD 802.010 series (typical 150 mm for flexible pipes, OPSD 802.010, 802.013 and 802.014). The use of normal Class B type bedding is applicable for the pipe.

Bedding material shall be placed in layers not exceeding 300 mm in thickness, loose measurement, and compacted to 95 % of the SPMDD before a subsequent layer is placed. Site servicing trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlements. Bedding on each side of the pipe shall be completed simultaneously. At no time shall the levels on each side differ by more than the 300 mm uncompacted layer. The remainder of the trench should be backfilled as per the requirements defined in Sections 8.0 and 11.0.

11.0 SOIL MANAGEMENT CONSIDERATIONS

Construction for the proposed development may involve cut and fill operations. From a geotechnical perspective, and in order to optimize the use of the on-site soils, a Soil Management Plan should be established. The plan objective should be to achieve a self-sustainable development with respect to excavated materials, and control the placement of organic soils so that there is negligible impact on the settlement performance of the compacted fill material.

The soil management criteria should be as follows:

1. Surface vegetation, topsoil and organic soils should not be placed within the proposed roadways, below finished subgrade level for pavement construction or building limits. These materials should be placed in landscaped areas where settlements are not critical;

2. Excavated soils for structural fill in pavement areas and building floor slab areas, which does not have topsoil or organic matter and are compactable with moisture contents within 2 % to 3 % of the optimum value, should be placed and compacted to a target density of 97 % of the SPMDD with no individual test result below 95 % SPMDD; if engineered fill is required to support building foundations, the engineered fill should be placed and compacted in lifts to a target density of 100 % SPMDD with no individual tests below 98 % SPMDD; the soil should be placed in a loose lift thickness not exceeding 250 mm and should be compacted using a large (10 ton or larger) pad-foot type roller with vibratory capability; if engineered fill to support building foundations is being considered it is recommended that a pre-construction meeting be scheduled to review the proposed fill materials, fill placement and compaction procedures, and the testing and inspection requirements;

3. Soils to be placed in landscaped areas where settlements are not critical should receive nominal compaction effort in order to achieve at least 90 % of the SPMDD; and,

4. Prior to the placement of underfloor granular fill, the exposed subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck and traversing the exposed subgrade for full coverage; the proof-rolling should be monitored by a geotechnical representative of this office to delineate any soft areas which may require repair.

12.0 PAVEMENT CONSIDERATIONS

12.1 At- Grade Pavement Design Considerations

The proposed building development includes asphalt pavement for ground level car parking and commercial vehicles. Recommended pavement structure layer thicknesses are provided in Table 5 for a 20 year design life. Site-specific development requirements set out by the City of Hamilton may override the recommendations of this report.

The recommended pavement design section takes into account the accepted design practice that the total pavement structure thickness should meet or exceed one-half the anticipated depth of frost penetration for the geographical area (i.e. 1.2 m) or as close as practicable.

Table 5: Recommended Pavement Structure Layer Thicknesses

Pavement Layer	Light Duty Parking Areas	Access and Fire Routes
Surface Course Asphalt OPSS HL 3	40 mm	40 mm
Binder Course Asphalt OPSS HL 8	50 mm	60 mm
Granular Base OPSS Granular A	150 mm	150 mm
Granular Subbase OPSS Granular B, Type II	250 mm[1]	350 mm[1]
Total Thickness	490 mm	600 mm

Notes:
1. If construction proceeds late in the year (i.e. November and December), the design thickness of pavement granular materials may have to be increased to address potential problems with subgrade instability and facilitate construction vehicle and truck access.

12.2 Deck Pavement Design Considerations

As a minimum, any proposed deck pavement should comprise a minimum 50 mm cover of OPSS HL 3 asphalt. Any bedding or grading material to be placed between the concrete deck and the asphalt pavement surface should comprise either blinding sand or OPSS Granular A material, depending on the thickness of the layer required.

12.3 Pavement Construction Considerations

The overall performance of the pavement structure will greatly depend upon the support provided by the developed subgrade. A number of factors should be considered at the construction stages to ensure that an acceptable subgrade condition is developed and maintained:

- Sub-drains should be installed and should be 100 mm diameter perforated plastic pipe, with outfalls to catch basins at a continuous and uniform grade. The sub-drains should conform to OPSD 216.01;
- Any soft areas of notable deflection to the subgrade should be sub-excavated and replaced with a suitable backfill material approved by a qualified geotechnical engineer and compacted to 98 % of its SPMDD;

- The subgrade should be properly shaped, crowned and then proof-rolled under the full time observation of a geotechnical representative of this office to delineate any soft areas which may require repair before placing the granular materials; and,
- Surface water should not be allowed to pond on the surface of or adjacent to the outside edges of any developed subgrade.

The following consideration should be maintained during paving:

- A tack coat should be applied to all contact surfaces prior to placing any hot mix asphalt layers or between asphaltic layers as per OPSS 308; and,
- The placing, spreading and rolling of the asphalt should be in accordance with current provincial standards.

In general, pavements that are proposed for larger scale, residential developments are constructed as two-stage paving operations. Where this is the case it is important to ensure that the following is undertaken to develop the surface of the binder course being used as a "*temporary*" surface during the construction phase:

- The surface is thoroughly cleaned and power washed to remove all residual contaminants;
- All deficiencies are corrected to meet the required design specifications; and,
- A suitable tack coat is appropriately applied immediately prior to the placement of the upper asphaltic concrete course(s).

Such preparatory works are to be completed in accordance with the appropriate OPSS, as required.

12.4 Pavement Materials

Granular Base Course and Subbase

The granular base course materials should meet OPSS Granular "A" specifications. Quarried 20 mm limestone crushed to Granular "A" gradation specifications is recommended. The granular subbase should meet OPSS Granular B Type II requirements for 100 % crushed quarried bedrock (50 mm crusher-run limestone).

Hot Mix Asphalt

The binder course and surface course asphalt should meet current specifications for HL 8 and HL 3 respectively, as prescribed by the City of Hamilton or, alternatively, OPSS 1150.

The standard asphalt binder grade for the climate conditions in the City of Hamilton is PG 58-28. Given the observed low volume of commercial truck traffic it is considered that there is no requirement for a bump up to a higher PG grade of asphalt cement.

Compaction

Granular base course and subbase course fill material should be compacted to 100 % SPMDD. Hot mix asphalt should be compacted to the criteria set out by the City of Hamilton.

12.5 Subgrade Considerations

The subgrade conditions and bearing strength may be variable along the road section and some subgrade repairs should be anticipated.

It is recommended that, prior to the placement of pavement granular fill, the exposed subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck to traverse the exposed subgrade and provide for full coverage. The proof-rolling should be monitored by a geotechnical representative of this office to delineate any soft areas which may require repair. Repairs should be undertaken to avoid creating "*bathtub*" conditions in the subgrade within the pavement structure.

12.6 Sidewalk Considerations

The design and construction of the proposed concrete sidewalks should be completed to the satisfaction of the City of Hamilton's Engineering Standards, and as detailed in Table 6. The concrete and aggregates should be produced and placed to meet those standards also stipulated by the City of Hamilton's Engineering Standards.

It should be noted that the concrete sidewalk design specified in Table 6 addresses a use by pedestrian traffic only and does not include for use by vehicular traffic.

Table 6: Minimum Concrete Sidewalk Specifications

Materials	Compaction Requirements	Layer Thickness
Normal Portland GU (30 MPa) (CAN3-CSA A23.1) - Class C-2	N/A	125 mm
Granular "A" Base	95 % SPMDD*	150 mm

* Standard Proctor Maximum Dry Density

Where finished sidewalks are on level ground, and to ensure that they remain free of ponding water, a final slope/gradient of the concrete sidewalk surface of at least 2 % should be maintained. In addition, construction joints in the sidewalk concrete should be properly sealed (e.g. bitumen filler) to minimize the water migration.

13.0 CLOSURE

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

Soil samples will be retained and stored by Landtek for a period of three months after the report is issued. The samples will be disposed of at the end of the three month period unless a written request from the client to extend the storage period is received.

We trust this report will be of assistance with the design and construction of the proposed development. Should you have any questions, please do not hesitate to contact our office.

Yours sincerely,

LANDTEK LIMITED

Isaac Asonya, EIT
Author

James Dann, B.Eng. (Hons)
Geotechnical Manager

Ralph Di Cienzo, P. Eng.
Consulting Engineer

REFERENCES

[1] Pleistocene Geology of the Brantford Area, Southern Ontario; Ontario Division of Mines, Map 2240, Geol. Ser. scale 1:63 360.

[2] Paleozoic geology of the Grimsby Area, southern Ontario; Ontario Division of Mines, Map M2343. scale 1: 50 000,

[3] Geotechnical Investigation Report, Proposed Residential Development, 97-111 Wilson Street East, Hamilton (Ancaster), Ontario, Landtek Limited Report #17198, July 5, 2017.

APPENDIX A
LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the borehole locations. Subsurface and ground water conditions between and beyond the Boreholes may be different from those encountered at the borehole locations, and conditions may become apparent during construction that could not be detected or anticipated at the time of the geotechnical investigation. It is recommended practice that Landtek be retained during construction to confirm that the subsurface conditions throughout the site are consistent with the conditions encountered in the Boreholes.

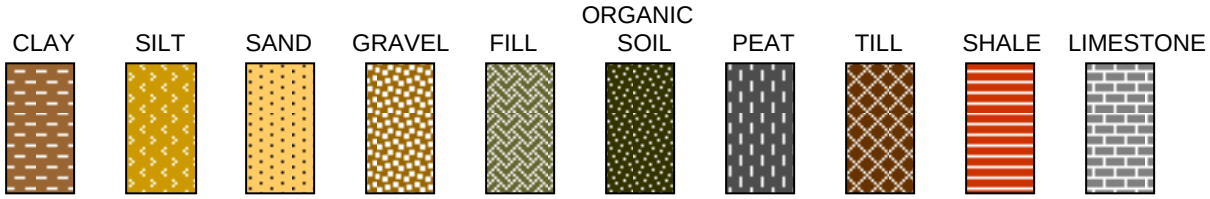
The comments made in this report on potential construction problems and possible remedial methods are intended only for the guidance of the designer. The number of Boreholes may not be sufficient to determine all the factors that may influence construction methods and costs. For example, the thickness and quality of surficial topsoil or fill layers may vary markedly and unpredictably. Additionally, bedrock contact depths throughout the site may vary significantly from what was encountered at the exact borehole locations. Contractors bidding on the project, or undertaking construction on the site should make their own interpretation of the factual borehole information, and establish their own conclusions as to how the subsurface conditions may affect their work.

The survey elevations in the report were obtained by Landtek Limited or others, and are strictly for use by Landtek in the preparation of the geotechnical report. The elevations should not be used by any other parties for any other purpose.

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

This report does not reflect environmental issues or concerns related to the property unless otherwise stated in the report. The design recommendations given in the report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, it is recommended that Landtek Limited be retained during the final design stage to verify that the design is consistent with the report recommendations, and that the assumptions made in the report are still valid.

APPENDIX B
SYMBOLS AND TERMS USED IN THE REPORT



RELATIVE PROPORTIONS

Term	Range
Trace	0 - 5%
A Little	5 – 15%
Some	15 – 30%
With	30 – 50%

CLASSIFICATION BY PARTICLE SIZE

Boulder ---------- > 200 mm
Cobble ---------- 80 mm – 200 mm
Gravel -
Coarse ---------- 19 mm – 80 mm
Fine ---------- 4.75 mm – 19 mm
Sand -
Coarse ---------- 4.75 mm – 2 mm
Medium -------- 2 mm – 0.425 mm
Fine ---------- 0.425 mm – 0.75 mm
Silt ---------- 0.075 mm – 0.002 mm
Clay ---------- < 0.002 mm

DENSITY OF NON-COHESIVE SOILS

Descriptive Term	Relative Density	Standard Penetration Test
Very Loose	0 – 15%	0 – 4 Blows Per 300 mm Penetration
Loose	15 – 35%	4 – 10 Blows Per 300 mm Penetration
Compact	35 – 65%	10 – 30 Blows Per 300 mm Penetration
Dense	65 – 85%	30 – 50 Blows Per 300 mm Penetration
Very Dense	85 – 100%	Over 50 Blows Per 300 mm Penetration

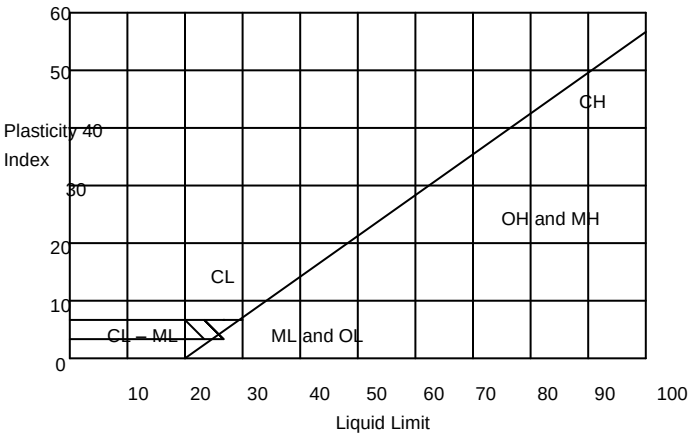
CONSISTENCY OF COHESIVE SOILS

Descriptive Term	Undrained Shear Strength kPa (psf)	N Value Standard Penetration Test	Remarks
Very Soft	< 12 (< 250)	< 2	Can penetrate with fist
Soft	12 – 25 (250 – 500)	2 – 4	Can indent with fist
Firm	25 – 50 (500 –1000)	4 – 8	Can penetrate with thumb
Stiff	50 – 100 (1000 – 2000)	8 – 15	Can indent with thumb
Very Stiff	100 – 200 (2000 – 4000)	15 – 30	Can indent with thumb-nail
Hard	> 200 (> 4000)	> 30	Can indent with thumb-nail

Notes: 1. Relative density determined by standard laboratory tests.
2. N value – blows/300 mm penetration of a 623 N (140 Lb.) hammer falling 760 mm (30 in.) on a 50 mm O.D. split spoon soil sampler. The split spoon sampler is driven 450 mm (18 in.) or 610 mm (24 in.). The “N” value is the Standard Penetration Test (SPT) value and is normally taken as the number of blows to advance the sampler the last 300 mm.

APPENDIX B CONTINUED
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 - 69 AND D 2488 – 69
(Unified Soil Classification System)

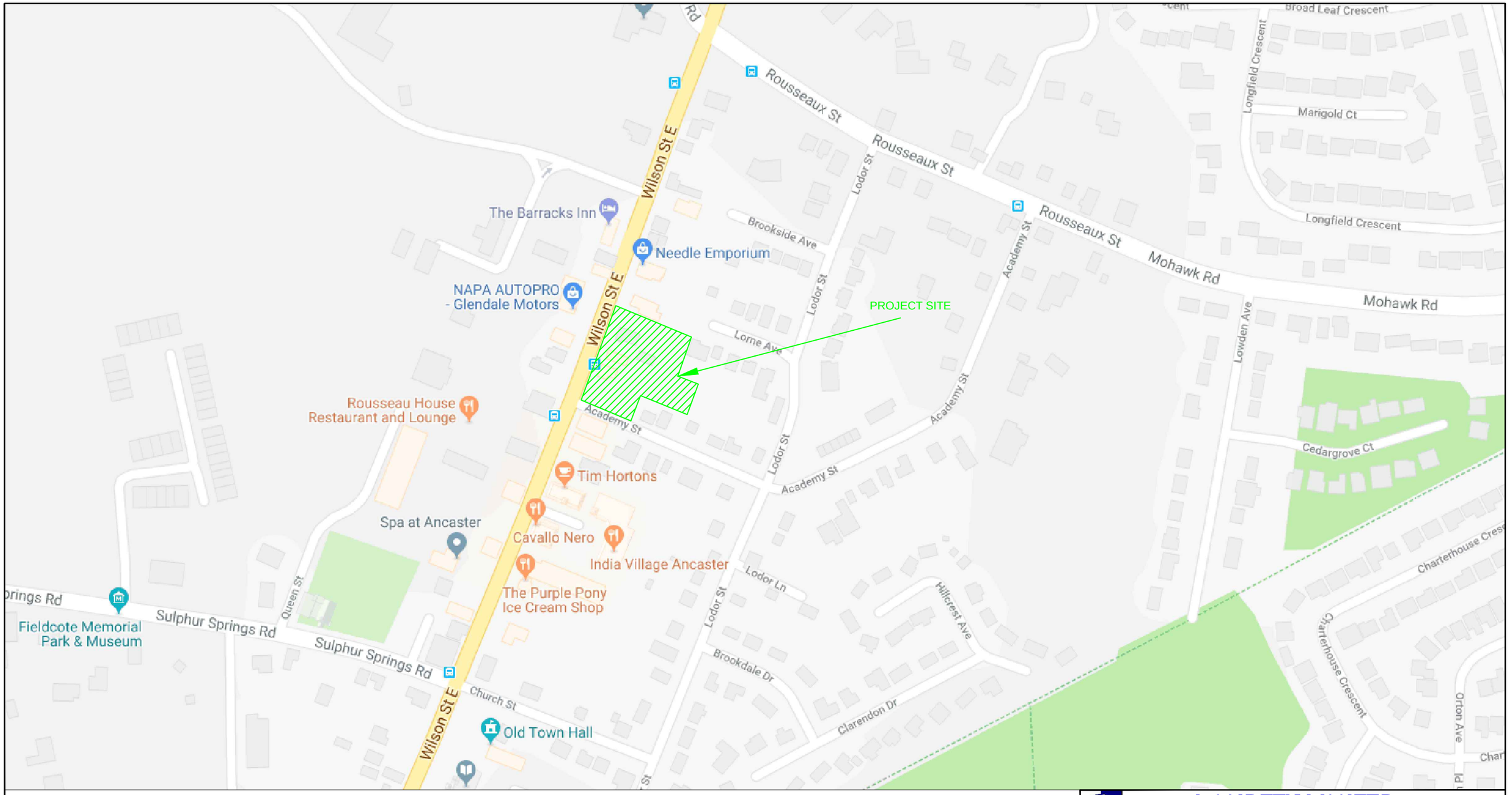
Major Divisions			Group Symbols	Typical Names	Classification Criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% pass No. 200 sieve . . . . . GW, GP, SW, SP More than 12% pass No. 200 sieve . . . . . GM, GC, SM, SC 5 to 12% pass No.200 sieve . . . . . Borderline classifications requiring use of dual symbols	C_u=D60/D10 greater than 4; C_z = $(D30)^2$/(D10xD60) between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines		C_u=D60/D10 greater than 6; C_z = $(D30)^2$/ (D10xD60) between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils 50% or more passes No. 200 sieve *	Silts and clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Plasticity Chart For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols. Equation of A-line: PI=0.73 (LL-20)		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silts			
			OL	Organic silts and organic silts of low plasticity			
	Silts and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
	Highly organic soils		Pt	Peat, much and other highly organic soils	* Based on the material passing the 3 in. (76mm) sieve.		



APPENDIX C

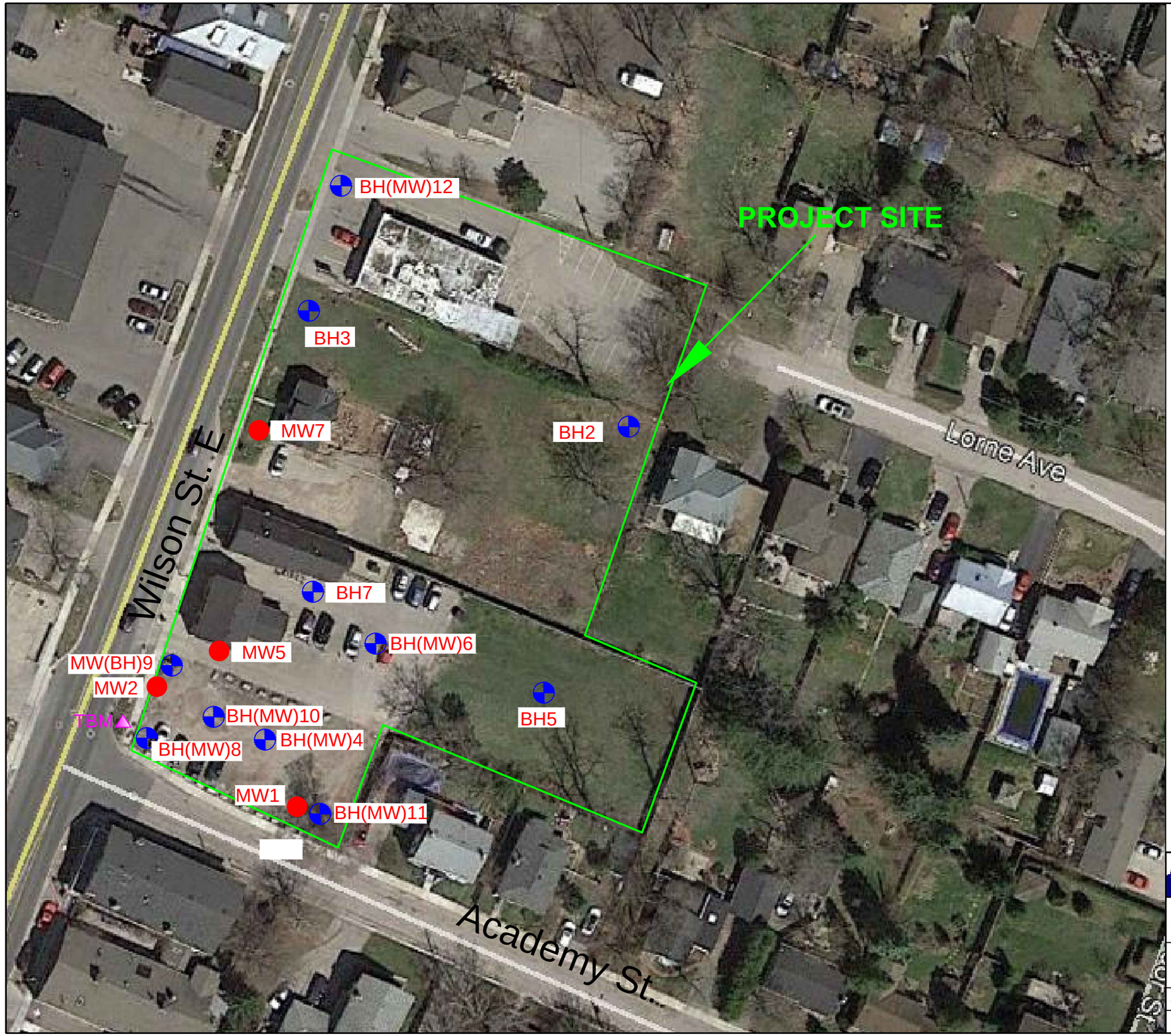
DRAWING 1 - SITE PLAN SHOWING BOREHOLE LOCATIONS

BOREHOLES LOGS



LANDTEK LIMITED
CONSULTING ENGINEERS
205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1

DRAWING:	Site Location		
PROJECT:	Geotechnical Investigation 392,398,400 and 406 Wilson Street East, Hamilton (Ancaster), Ontario.		
SCALE:	NTS	**PROJECT NO.**	17477
DATE:	February, 2018	**DRAWING NO.**	1



N

LEGEND:

- Boreholes and monitoring wells installed by Landtek on January 29 and 31, February 2 and 5, and June 19, 2018.
- Monitoring Wells installed by others (2017)
- TBM: Top of existing bell manhole cover. Assumed TBM=100 m.

LANDTEK LIMITED
CONSULTING ENGINEERS
205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1

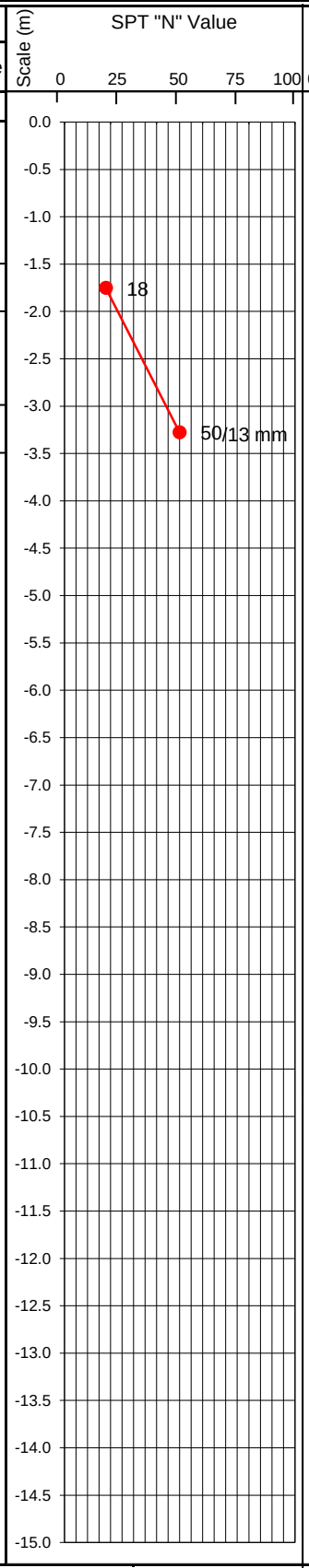
DRAWING:	Borehole and Monitoring Well Location		
PROJECT:	Geotechnical Investigation 392,398,400, 406 and 412 Wilson Street East, Hamilton (Ancaster), Ontario.		
SCALE:	NTS	**PROJECT NO.**	17477
DATE:	August 2018	**DRAWING NO.**	2

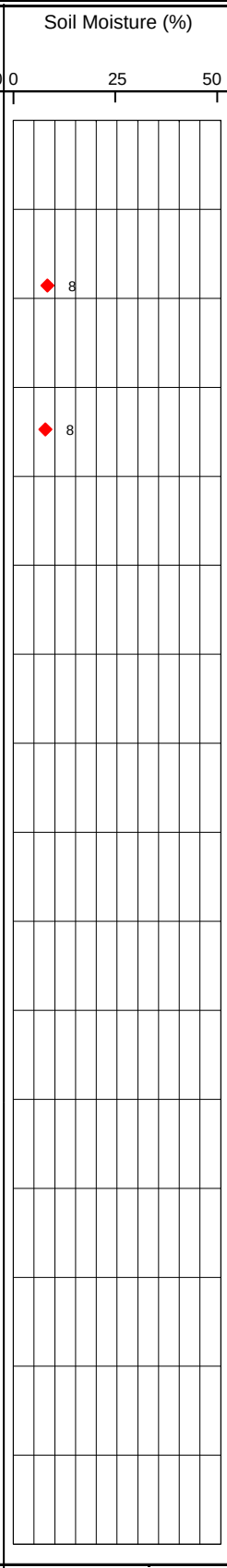
LANDTEK LIMITED

BH 2

Project No.:	17477	Drill Date:	January 29, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		98.9			
±150 mm of topsoil		0.0			
FILL: sand, medium to coarse grained, trace limestone fragments, trace gravel, brown, loose, moist		97.4			
SAND (possible native): coarse grained, brown, compact, moist		1.5	1	SS	
		95.9			
BOULDER fragments, some sand		3.0 95.4	2	SS	
AUGER REFUSAL ON ASSUMED BOULDER **BOREHOLE TERMINATED**		3.5			





GWL

Monitor Details

Borehole backfilled with Bentonite

Notes:
1. On completion, borehole open to 3.5 m.
2. No wet soils encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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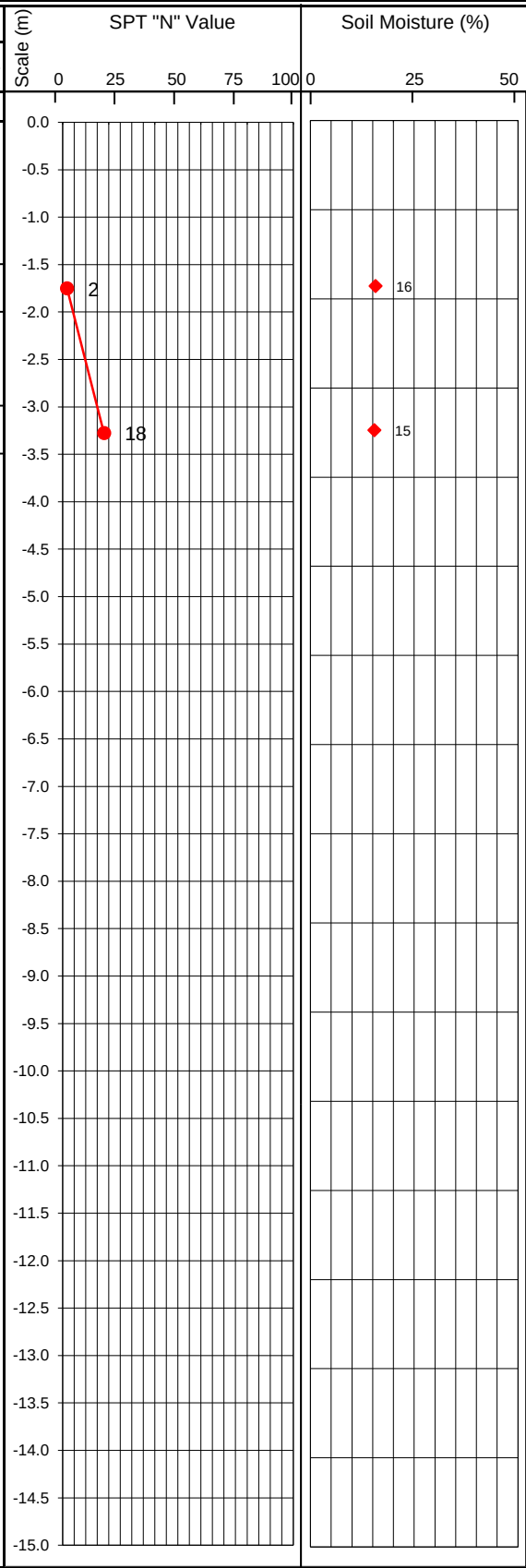
LANDTEK LIMITED

BH 3

Project No.:	17477	Drill Date:	January 29, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		99.7			
±150 mm of topsoil		0.0			
FILL: sand, medium to coarse grained, trace gravel, brown, very loose, moist		97.2	1	SS	
SAND: medium to coarse grained, trace shale, trace silt, brown, compact, moist		2.5	2	SS	
		95.3			
AUGER REFUSAL ON ASSUMED BOULDER **BOREHOLE TERMINATED**		4.4			



GWL

Monitor Details: Borehole backfilled with Bentonite

Notes:
1. On completion, borehole open to 4.4 m.
2. No wet soil encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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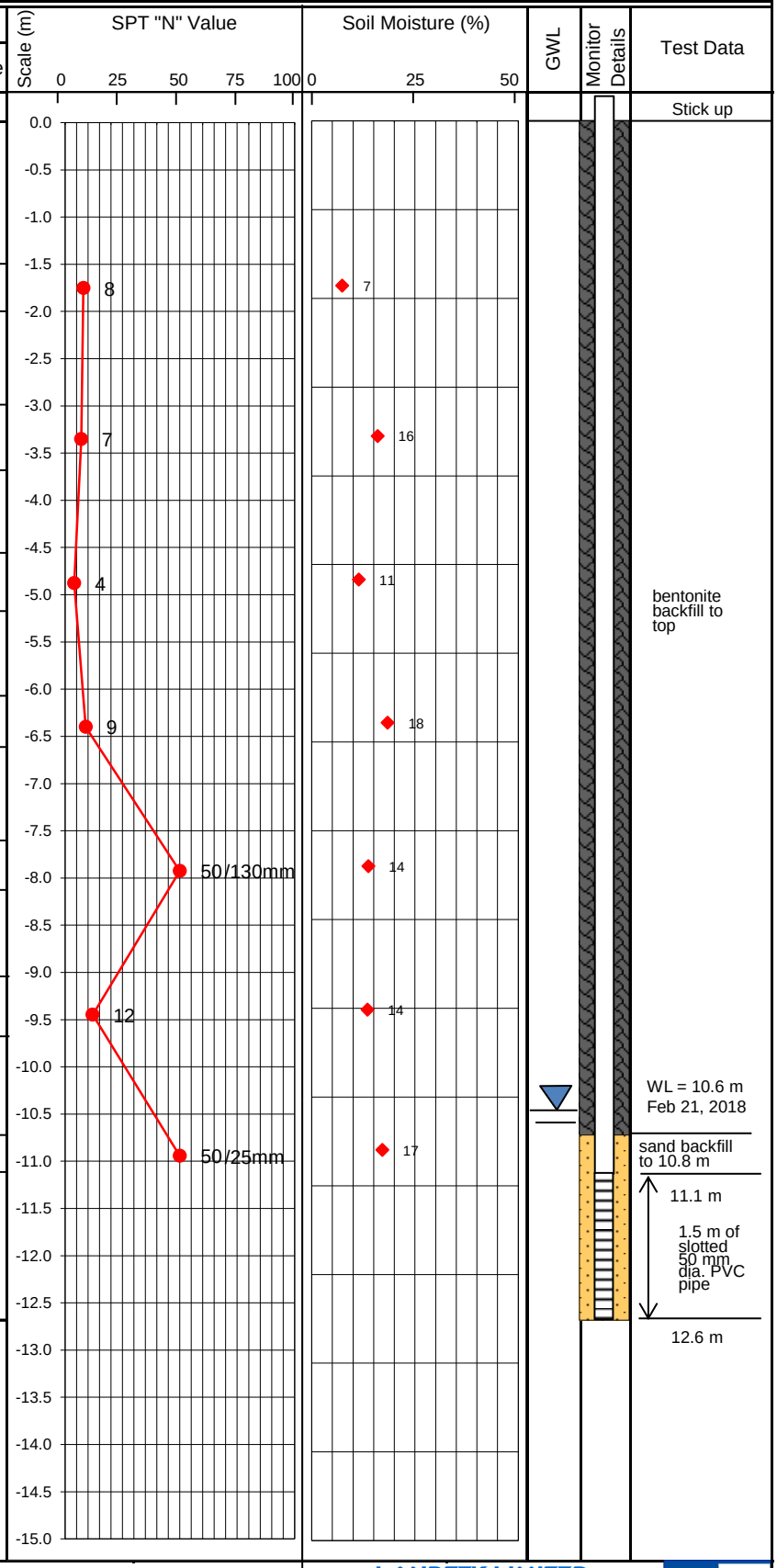
BH/MW 4

Project No.:	17477	Drill Date:	February 2, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		100.0			Stick up
±100 mm of gravel (Fill)		0.0			
FILL: sand, some gravel, trace wood, brown, loose, moist			1	SS	
		97.0			
FILL: silty sand, trace clay, trace rootlets, trace brick fragments, brown, loose, moist		3.0	2	SS	
		95.5			
SAND (Possible Native): medium to coarse grained, brown, very loose to loose, moist		4.5	3	SS	bentonite backfill to top
		94.4			
SILTY CLAY: brown, firm to stiff, moist		5.6	4	SS	
		93.6			
SAND: coarse grained, trace gravel, trace shale, trace limestone fragments, brown, compact, wet to saturated		6.4	5	SS	
		91.5			
SAND: coarse grained, brown, compact, saturated		8.5	6	SS	
		89.8			
SAND: coarse grained, gravelly, trace shale, trace limestone fragments, brown, compact, wet to saturated		10.2	7	SS	
		88.9			
LIMESTONE/DOLOSTONE BEDROCK (Lockport Formation) recovery = 100 %; RQD = 83 % medium strong to strong, slightly weathered to fresh, grey		11.1	CORE RUN #1	47 mm Dia. Core	sand backfill to 10.8 m; 11.1 m; 1.5 m of slotted 50 mm dia. PVC pipe
		87.4			
BOREHOLE TERMINATED		12.6			12.6 m



Notes:
1. On completion, borehole open to 11.9 m.
2. Wet soil encountered at 6.4 m.
3. Water level measured at 10.6 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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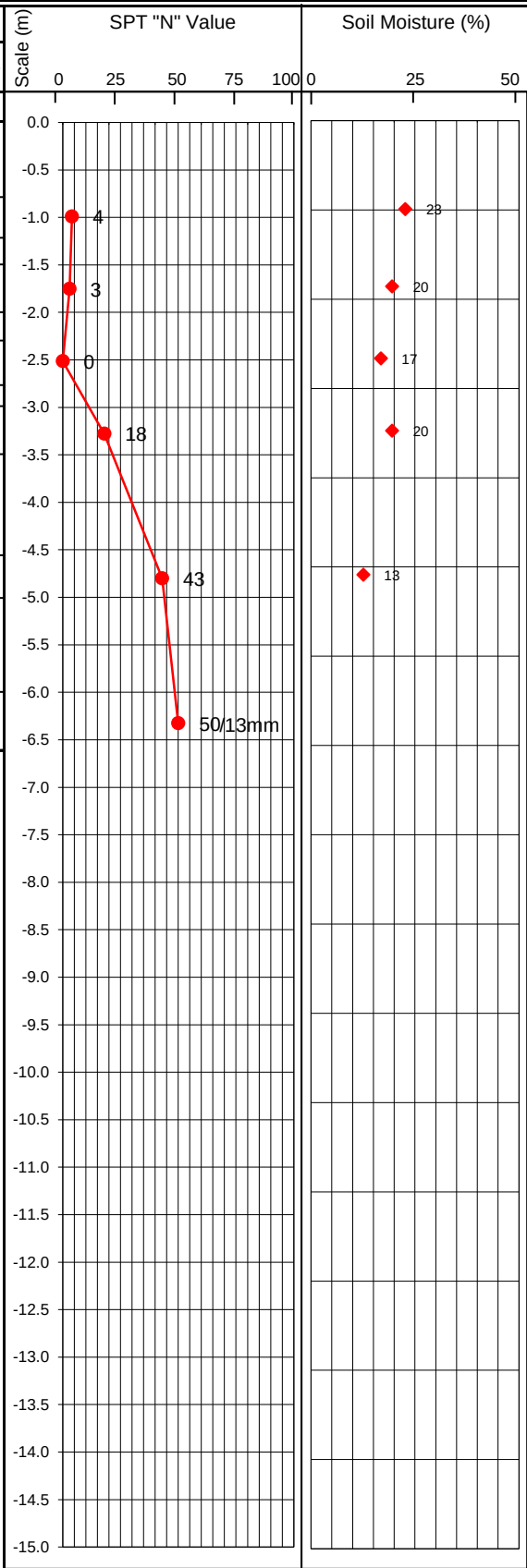
BH 5

Project No.:	17477	Drill Date:	January 29, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. / Depth	Sample No.	Sample Type	Test Data
Ground Surface		98.1			
±150 mm of topsoil		0.0			
FILL: silty sand, some gravel, trace clayey silt, brown, very loose, moist			1	SS	
		96.4	2	SS	
SAND: medium to coarse grained, trace silt, trace clay, brown, compact, moist		1.7			
1.7 m to 2.7 m: very loose			3	SS	
			4	SS	
4.5 m to 6.6 m: trace shale, trace limestone fragments, dense, wet			5	SS	
		91.5	6	SS	
AUGER REFUSAL ON ASSUMED BOULDER **BOREHOLE TERMINATED**		6.6			



GWL

Monitor Details

Borehole backfilled with Bentonite

Notes:
1. On completion, borehole open to 6.0 m.
2. Wet soils encountered at 4.5 m.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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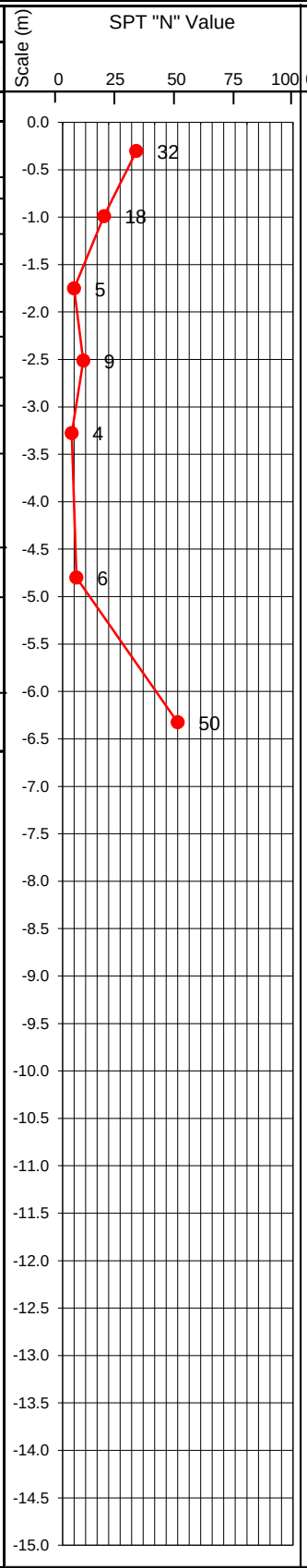
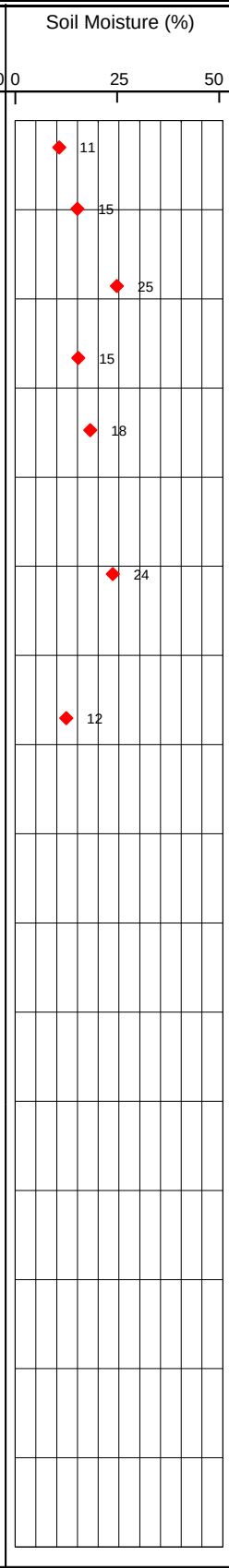
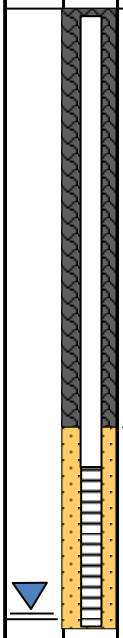
BH/MW 6

Project No.:	17477	Drill Date:	January 29, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		99.3			Flushmount
±100 mm of Asphalt		0.0	1	SS	
±100 mm of Sand and Gravel					
FILL: clayey silt, some sand, trace gravel, trace shale, trace asphalt, trace brick fragments, brown, compact to dense, moist			2	SS	
			3	SS	
		97.5			
SILT: some sand, brown, loose, moist		1.8			
		96.9			
SILTY SAND: medium to coarse grained, trace clayey silt pockets, brown, loose, moist		2.4	4	SS	
			5	SS	
4.5 m to 5.0 m: trace limestone fragments, trace shale fragments, very moist			6	SS	
5.5 m to 6.6 m: wet					
6.0 m to 6.6 m: coarse grained			7	SS	
		92.7			
BOREHOLE TERMINATED		6.6			







Notes:
1. On completion, borehole open to 6.0 m.
2. Wet soils encountered at 5.5 m.
3. Water level measured at 6.0 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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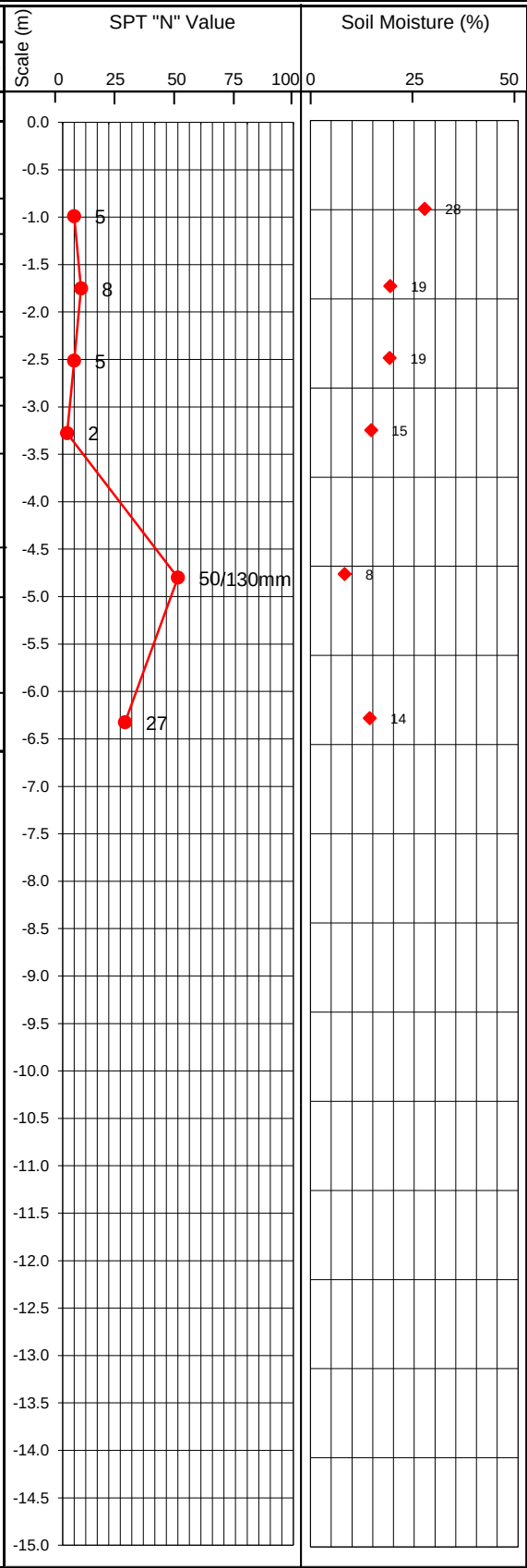
BH 7

Project No.:	17477	Drill Date:	January 29, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		99.4			
±100 mm of Asphalt		0.0			
±100 mm of Sand and Gravel					
FILL: silty clay, trace gravel, trace brick fragments, brown, loose, moist			1	SS	
		97.9			
FILL: clayey silt, trace sand, brown, trace black specks, loose, moist		1.5	2	SS	
		97.1			
SILTY SAND (Possible Native)**:** fine grained, trace clay, brown, loose, moist		2.3	3	SS	
		96.4			
SAND: medium to coarse grained, trace clay, trace silt, brown, very loose, moist		3.0	4	SS	
4.5 m to 5.5 m: coarse grained, trace limestone fragments, very dense, moist			5	SS	
at 5.8 m: wet 6.0 m to 6.6 m: coarse grained, compact, wet			6	SS	
		92.8			
BOREHOLE TERMINATED		6.6			



GWL

Monitor Details

Borehole backfilled with Bentonite

Notes:
1. On completion, borehole open to 6.0 m.
2. Wet soils encountered at 5.8 m.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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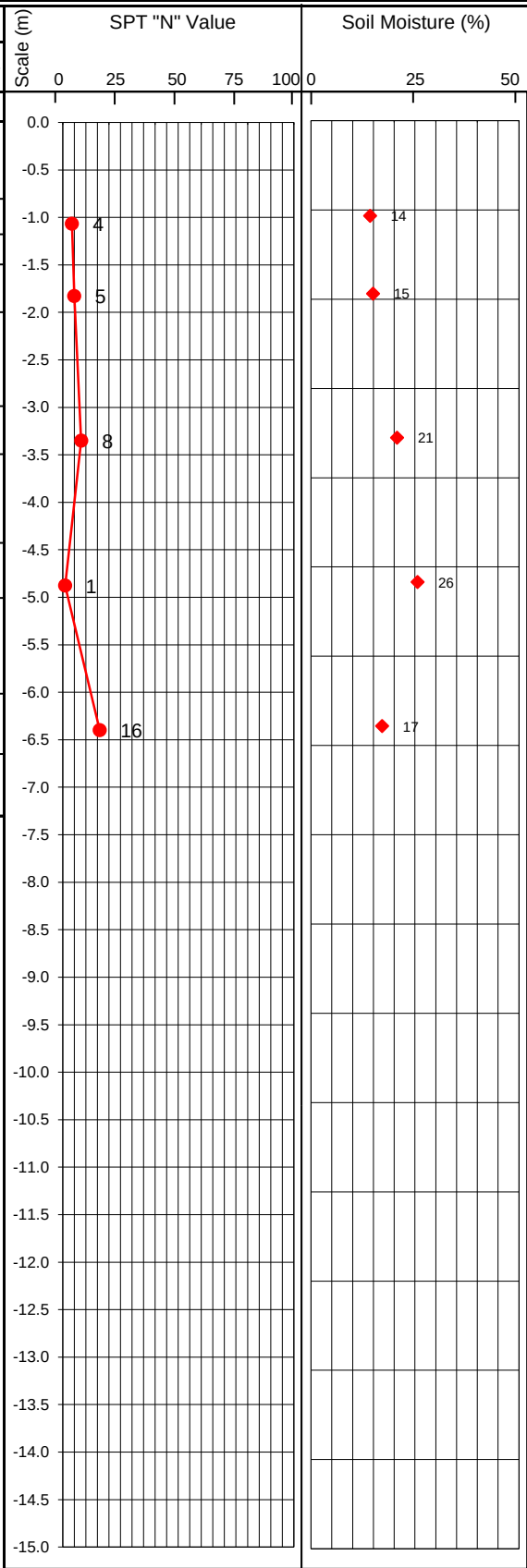
BH/MW 8

Project No.:	17477	Drill Date:	January 31, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Elev. Depth	Samples No.	Type	Test Data
Ground Surface	100.1			Stick up
±100 mm of Gravel (FILL)	0.0			
FILL: clayey silt, trace sand, trace gravel, trace coal, trace glass, brown, loose, moist	98.6	1	SS	
FILL: clayey silt, trace gravel, trace building fragments, trace shale, trace asphalt, brown, loose, moist	1.5 / 97.1	2	SS	bentonite backfill to top
FILL: clayey silt and sand, brown and grey, some iron staining, some black staining, compact, moist, hydrocarbon odour	3.0 / 95.6	3	SS	WL = 5.3 m Feb 21, 2018
SANDY SILT: trace clay, greenish grey, very loose, very moist, hydrocarbon odour	4.5 / 94.5	4	SS	sand backfill to 4.1 m
SILTY SAND: trace clay, brown, compact, very moist to wet, hydrocarbon odour	5.6 / 92.8	5	SS	4.5 m 1.5 m of slotted 50 mm dia. PVC pipe 6.0 m bentonite
REFUSAL ON ASSUMED BOULDER **BOREHOLE TERMINATED**	7.3			7.3 m



GWL

Monitor Details

Notes:
1. On completion, borehole open to 7.0 m.
2. Wet soils encountered at 6.0 m
3. Water level measured at 5.3 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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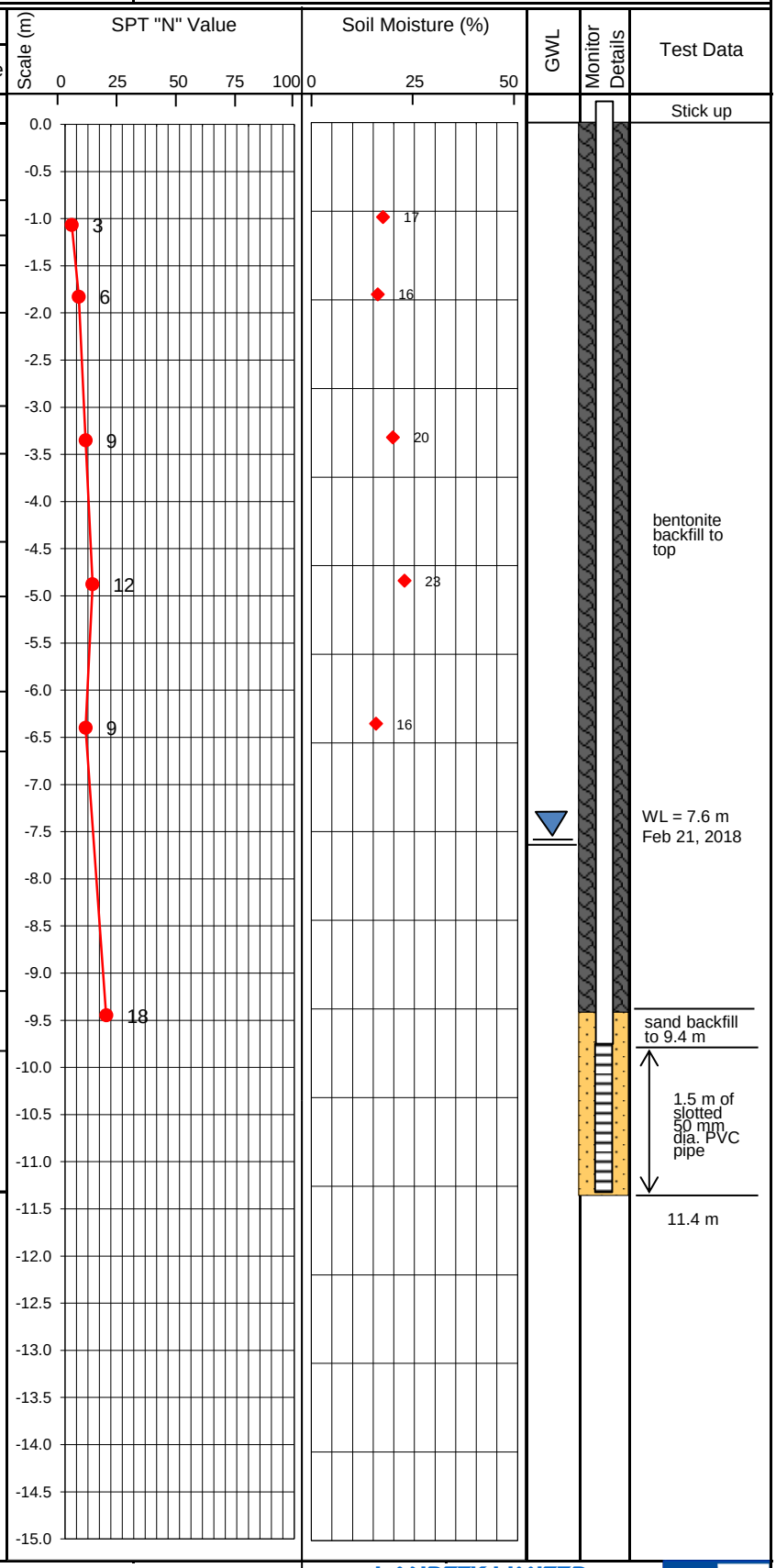
BH/MW 9D

Project No.:	17477	Drill Date:	February 5, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		100.1			Stick up
±100 mm of Gravel (FILL)		0.0			
FILL: silty sand, some clay, brown, very loose, moist			1	SS	
		98.6			
FILL: silty sand, trace gravel, brown, loose, moist		1.5	2	SS	
		97.1			
FILL: clayey silt, trace sand, brown, loose, moist		3.0	3	SS	
		96.4			
SILT (Possible Native): trace clay, trace sand, brown, loose, moist		3.7			
		95.2	4	SS	
SAND: coarse grained, trace gravel, brown, loose to compact, wet		4.9			
			5	SS	
			6	SS	
		88.7			
END OF BOREHOLE ON ASSUMED BEDROCK BOREHOLE TERMINATED		11.4			



Notes:
1. On completion, borehole open to 11.3 m.
2. Wet soils encountered at 6.7 m.
3. Water level measured at 7.6 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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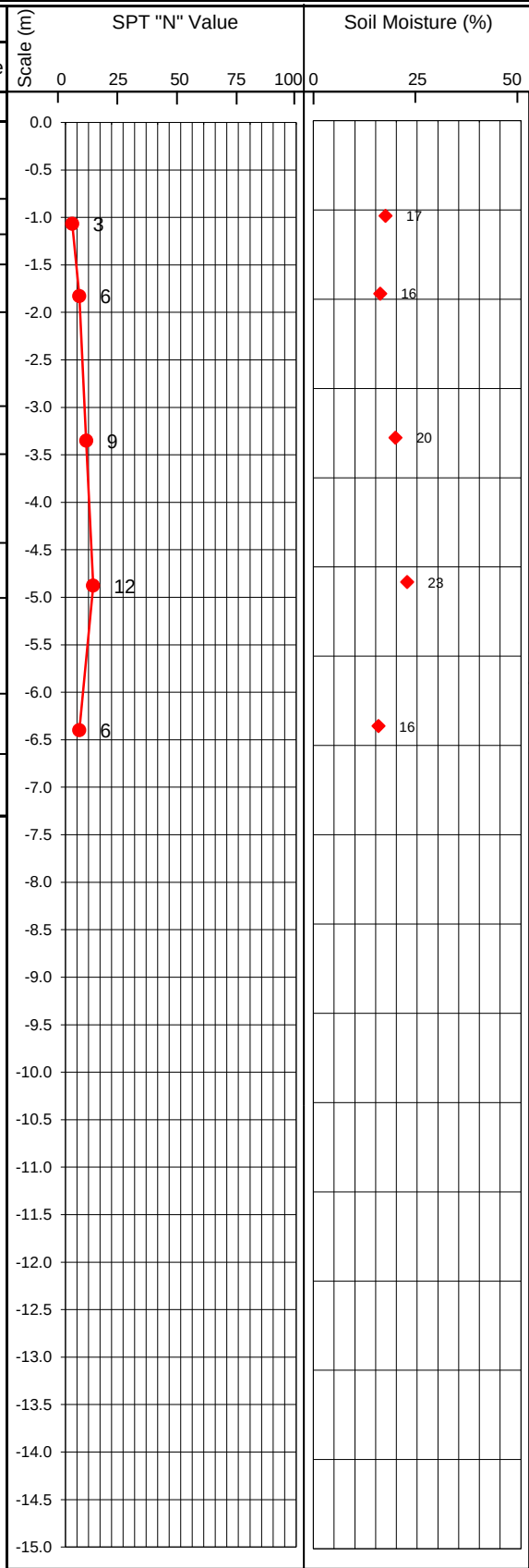
BH/MW 9S

Project No.:	17477	Drill Date:	January 31, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		100.1			Stick up
±100 mm of Gravel (FILL)		0.0			
FILL: silty sand, some clay, brown, very loose, moist		98.6	1	SS	
FILL: silty sand, trace gravel, brown, loose, moist		1.5	2	SS	bentonite backfill to top
		97.1			
FILL: clayey silt, trace sand, brown, loose, moist		3.0	3	SS	
		96.4			WL = 5.8 m Feb 21, 2018
SILT (Possible Native): trace clay, trace sand, brown, loose, moist		3.7			sand backfill to 4.1 m
		95.2	4	SS	4.5 m
SAND: coarse grained, trace gravel, brown, loose to compact, wet		4.9			1.5 m of slotted 50 mm dia. PVC pipe
		92.8	5	SS	6.0 m
BOREHOLE TERMINATED		7.3			bentonite 7.3 m



Notes:
1. On completion, borehole open to 7.3 m.
2. Wet soils encountered at 6.7 m.
3. Water level measured at 5.8 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
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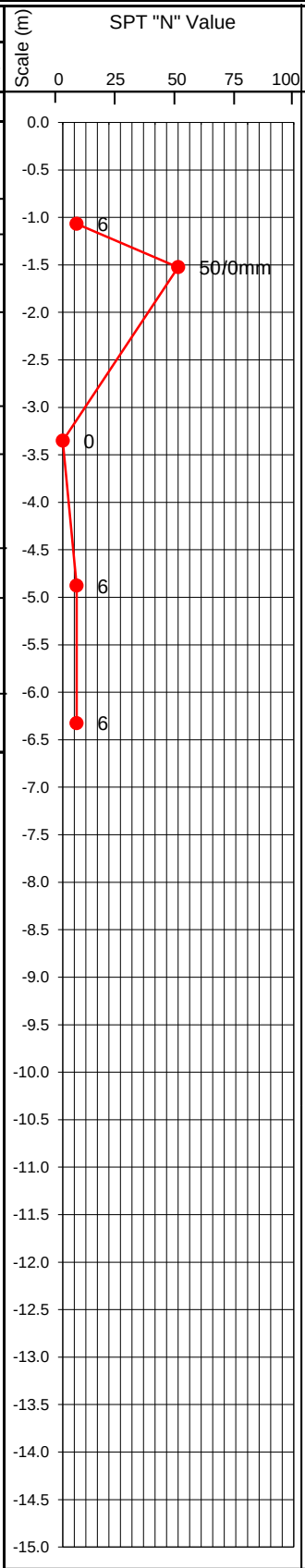
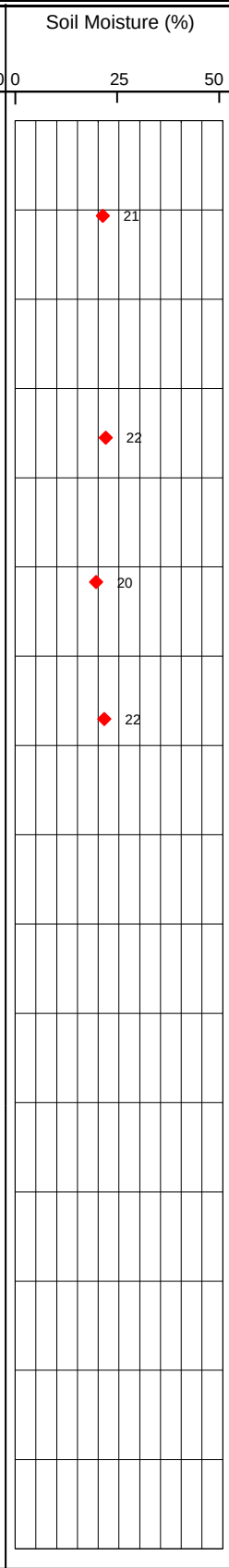
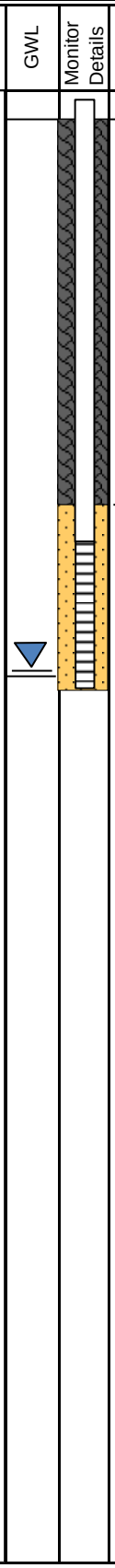
BH/MW 10

Project No.:	17477	Drill Date:	January 31, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		100.1			Stick up
±150 mm of Gravel (FILL)		0.0			
FILL: sandy silt, brown, loose, moist			1	SS	
		98.6			
FILL: Concrete		1.5	2	SS	
		98.1			
FILL: sandy silt, trace clay, trace asphalt, brown, very loose, moist		2.0	3	SS	
		95.6			
SAND: medium to coarse grained, brown, loose, moist		4.5	4	SS	
		93.5	5	SS	
BOREHOLE TERMINATED		6.6			







Notes:
1. On completion, borehole open to 6.0 m.
2. Wet soils encountered at 5.5 m.
3. Water level measured at 5.8 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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BH/MW 11

Project No.:	17477	Drill Date:	January 31, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Elev. Depth	Samples No.	Type	SPT "N" Value	Soil Moisture (%)	Test Data
Ground Surface	99.5					Stick up
±150 mm of Gravel (FILL)	0.0					
FILL: concrete		1	SS	50/0mm		
	98.0					
FILL: Concrete	1.5	2	SS	10		bentonite backfill to top
	96.5					
FILL: sandy silt, brown, very loose, moist	3.0	3	SS	2	22	WL = 4.2 m Feb. 21, 2018
	95.0					sand backfill to 4.1 m
SAND: medium to coarse grained, brown, loose, very moist	4.5	4	SS	9	18	4.5 m
6.0 m to 6.6 m: some shale, some limestone fragments, very dense, wet	92.9	5	SS	52	22	1.5 m of slotted 50 mm dia. PVC pipe
						6.0 m
BOREHOLE TERMINATED	6.6					

Scale (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0, -14.5, -15.0

SPT "N" Value: 0, 25, 50, 75, 100

Soil Moisture (%): 0, 25, 50

GWL | Monitor Details

Notes:
1. On completion, borehole open to 6.0 m.
2. Wet soils encountered at 5.9 m.
3. Water level measured at 4.2 m below ground surface on February 21, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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BH/MW 12

Project No.:	17477	Drill Date:	June 19, 2018
Project:	Geotechnical Investigation Report	Drill Method:	[ ] solid stem [x] hollow stem [ ] DCPT
Location:	392-412 Wilson Street East, Ancaster, Ontario	Datum:	TBM: assumed elevation = 100.00 m

Material Description	Elev. Depth	Samples No.	Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface	100.5							Flush mount
±100 mm of Asphalt	0.0	1	SS	9	12			
FILL: silt, some sand, trace clay, brown, loose	99.8							
CLAYEY SILT: brown, soft, moist	0.7	2	SS	4	24			
	99.0							
SAND: coarse grained, trace silt, brown, brown, loose, moist	1.5	3	SS	6	8			bentonite backfill to top
	98.2							
SILT: brown, trace sand, very loose, moist	2.3	4	SS	2	31			
	97.6							
SANDY SILT: brown, compact, very moist	2.9	5	SS	14	22			
	96.5							sand backfill to 3.6 m
BOULDER: some limestone fragments	4.0							4.0 m
	93.5							WL = 4.2 m June 22, 2018
BOREHOLE TERMINATED	7.0							3.0 m of slotted 50 mm dia. PVC pipe
								7.0 m

Notes:
1. On completion, borehole open to 7.0 m.
2. Water level measured at 4.2 m below ground surface on June 22, 2018.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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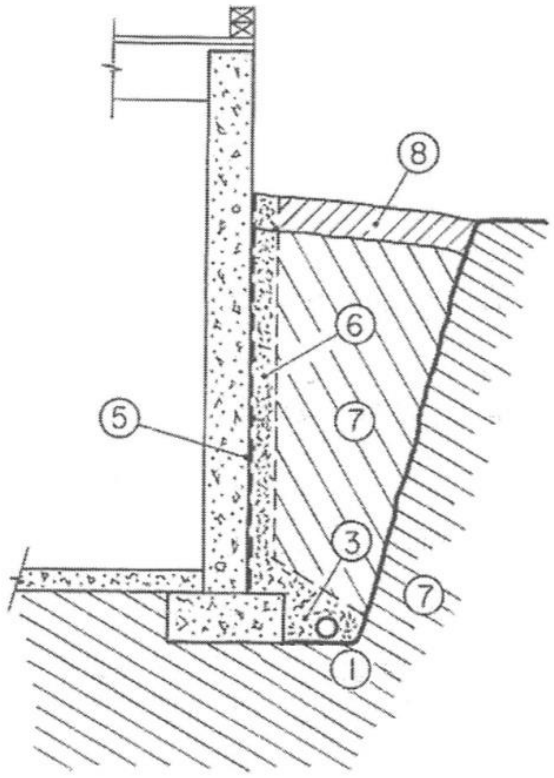
APPENDIX D

DRAWING 2 – ENGINEERING COMMENTARIES – GENERAL REQUIREMENTS FOR DRAINAGE TO BASEMENT STRUCTURES

DRAWING 3 – ENGINEERING COMMENTARIES – GENERAL REQUIREMENTS FOR UNDERFLOOR DRAINAGE SYSTEMS



① 100 mm, perforated or slotted pipe placed below the upper level of the floor slab.;
③ Filter material that is compatible with the grain size characteristics of the fine grained foundation and backfill soils, as well as with the perforations of the pipe;
④ Filter material continuously or intermittently placed next to the foundation wall to intercept water draining from window wells, down exterior walls and from low areas near the building;
⑤ Damp-proofing on wall – optional depending on the quality of the concrete wall;
⑥ Optional use of sheet drain, or synthetic fire blanket, next to the foundation wall to replace the soil filter according to ④;
⑦ Foundation and backfill soils, which may contain fine grained and erosion-susceptible materials;
⑧ "*Topping off*" material is to be graded such that it slopes outwards to lead surface water away from the building. It is usually desirable to use low permeability topsoil to reduce the risk of overloading the drainage pipe.

Based on Figure 12.1, Canadian Foundation Engineers Manual, Fourth Edition, 2006.

Additional Notes:

1. The perforated or slotted drainage pipe is to lead to a positive drainage sump or outlet. The invert of the pipe is to be a minimum of 150 mm below the underside of the proposed floor slab.
2. Backfill materials to the interior of the foundation walls may be clean, organic-free soils that can be compacted to the specified density within in a confined space.
3. Heavy, vibratory compaction equipment should not be used within 450 mm of the foundation wall. Fill is not to be placed or compacted within 1.8 m of the wall unless fill is being placed simultaneously on both sides of the wall.
4. The moisture barrier beneath the floor slab is to comprise at least 200 mm of compacted19mm clear stone or an equivalent free-draining material.
5. Should the 19 mm clear stone require surface blinding then 6mm stone chips are to be used.
6. The slab on grade should not be structurally connected to the foundation wall or footing.

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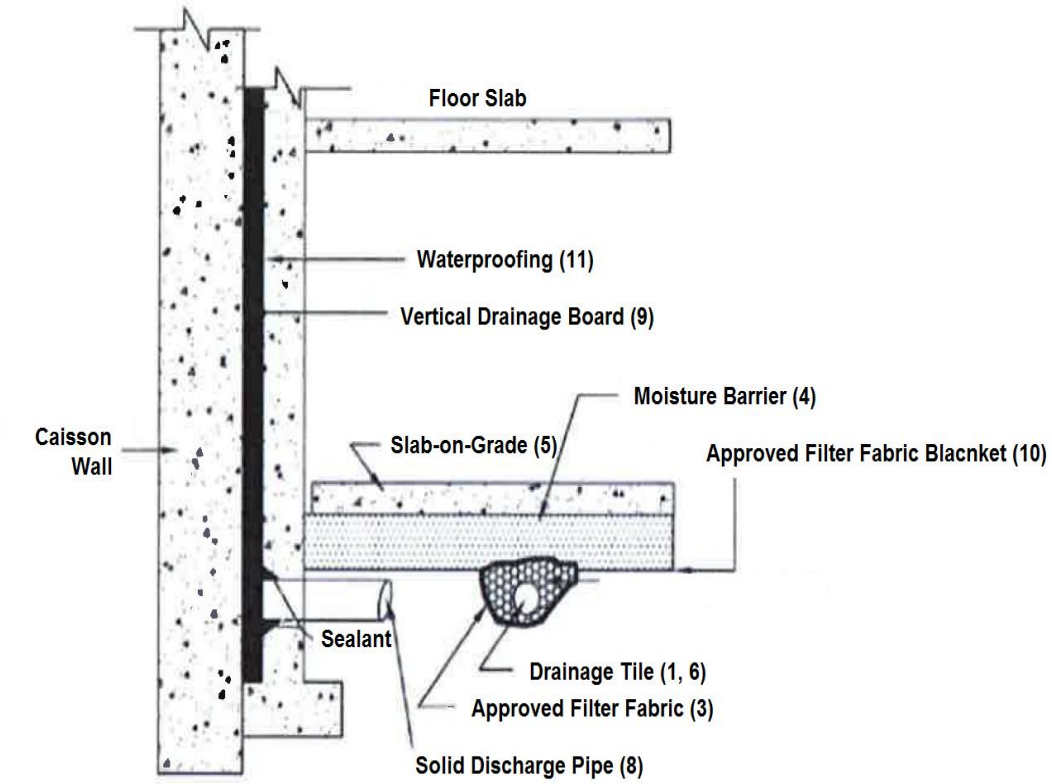
General Requirements for Drainage to Basement Structures

client	Wilson St. Ancaster Inc.
project	392 to 412 Wilson Street East, Ancaster, Ontario
project #	17477
drawing #	2



Notes:

1. Drainage tile to consist of 100 mm diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns;
2. 19 mm clear stone – 150 mm top and side of drain. If the drain is not on the footing then place 100 mm of 19 mm clear stone below the drain;
3. Wrap the clear stone with an approved filter fabric (e.g. Terrafix 270R or equivalent);
4. Moisture barrier to be at least 200 mm of compacted, 19 mm clear stone or equivalent (and approved), free-draining material. A vapour barrier may be required for specialty floor coverings;
5. Typically, the slab-on-grade is not structurally connected to the wall or footing. However, if it is connected to the walls it should be designed accordingly;
6. Underfloor drain invert to be at least 300 mm below underside of floor slab. Drainage tile should be placed in parallel rows 6 m to 8 m centres one way. Place drains on 100 mm of 19 mm clear stone and 150 mm of 19 mm clear stone on top and sides. Enclose clear stone with filter fabric as prescribed in Note (3);
7. Do not connect underfloor drainage to perimeter drainage. The two systems are to remain separate.
8. Locate solid discharge at the middle of each bay between soldier piles;
9. Vertical drainage board (e.g. MiraDrain 6000 or equivalent) with filter cloth should be continuous from bottom to 1.2 m below exterior finished grade;
10. The entire subgrade is to be sealed with an approved filter fabric as in Note (3) where non-cohesive (silty/sandy/granular) soils are encountered below the groundwater table;
11. The basement walls must be waterproofed using bentonite or an equivalent waterproofing system;
12. The Geotechnical Report should be reviewed for site-specific details. Final detail must be approved before system is considered acceptable.

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General Requirements for Underfloor Drainage Systems			
client	Wilson St. Ancaster Inc.		
project	392 to 412 Wilson Street East, Ancaster, Ontario		
project #	17477	drawing #	3

APPENDIX E

ENVIRONMENTAL ANALYTICAL REPORT

Physical Tests - SOIL

		Guide Limits								
Lab ID				L2051326-1	L2051326-2	L2051326-3	L2051326-4	L2051326-5	L2051326-6	L2051326-7	L2051326-8	L2051326-9
Sample Date				29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18	29-JAN-18
Sample ID				BH2-2	BH2-1	BH3-2	BH5 SS5	BH5 SS1	BH5 SS2	MW6 SS1	MW6 SS5	BH7 SS3
Analyte	**Unit**	**#1**	**#2**									
Conductivity	mS/cm	0.7	-	0.126		0.120	0.138	0.0842		1.39		0.464
% Moisture	%	-	-	10.5	9.98	12.8	12.2	16.3	8.56	12.6	14.6	16.1
pH	pH units	-	-	7.83		7.83	7.92	7.18		7.68		7.17
Redox Potential	mV	-	-	319		323	293					
Resistivity	ohm*cm	-	-	7930		8360	7270					

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Physical Tests - SOIL

		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Lab ID				L2051326-10
Sample Date				29-JAN-18
Sample ID				BH7 SS5
Conductivity	mS/cm	0.7	-	
% Moisture	%	-	-	8.68
pH	pH units	-	-	
Redox Potential	mV	-	-	
Resistivity	ohm*cm	-	-	

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Leachable Anions & Nutrients - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	Sample Date	Sample ID
				L2051326-1	29-JAN-18	BH2-2
				L2051326-3	29-JAN-18	BH3-2
				L2051326-4	29-JAN-18	BH5 SS5
Chloride	ug/g	-	-	<5.0	<5.0	5.5

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Anions and Nutrients - SOIL

		Guide Limits				
Analyte	**Unit**	**#1**	**#2**			
Lab ID				L2051326-1	L2051326-3	L2051326-4
Sample Date				29-JAN-18	29-JAN-18	29-JAN-18
Sample ID				BH2-2	BH3-2	BH5 SS5
Sulphate	mg/kg	-	-	<20	<20	<20

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Cyanides - SOIL

		Guide Limits				
Lab ID				L2051326-5	L2051326-7	L2051326-9
Sample Date				29-JAN-18	29-JAN-18	29-JAN-18
Sample ID				BH5 SS1	MW6 SS1	BH7 SS3
Analyte	**Unit**	**#1**	**#2**			
Cyanide, Weak Acid Diss	ug/g	0.051	-	<0.050	<0.050	<0.050

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

Inorganic Parameters - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	Sample Date	Sample ID
				L2051326-1	L2051326-3	L2051326-4
				29-JAN-18	29-JAN-18	29-JAN-18
				BH2-2	BH3-2	BH5 SS5
Acid Volatile Sulphides	mg/kg	-	-	0.27	<0.20	<0.20

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

ANALYTICAL REPORT

Saturated Paste Extractables - SOIL

		Guide Limits				
Analyte	**Unit**	**#1**	**#2**			
Lab ID				L2051326-5	L2051326-7	L2051326-9
Sample Date				29-JAN-18	29-JAN-18	29-JAN-18
Sample ID				BH5 SS1	MW6 SS1	BH7 SS3
SAR	SAR	5	-	<0.12 SAR:DL	9.48	2.09
Calcium (Ca)	mg/L	-	-	3.8	26.8	12.9
Magnesium (Mg)	mg/L	-	-	1.1	3.3	3.8
Sodium (Na)	mg/L	-	-	<1.0	195	33.3

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Physical Tests - SOIL

			Lab ID	L2052527-1	L2052527-2	L2052527-3	L2052527-4	L2052527-5	L2052527-6	L2052527-7	L2052527-8	L2052527-9
			Sample Date	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18
			Sample ID	MW8 SS2	MW8 SS3	MW8 SS5	MW9 SS3	MW9 SS5	MW10 SS5	MW11 SS2	MW11 SS4	MW8 SS1
Analyte	Unit	Guide Limits #1	#2									
Conductivity	mS/cm	0.7	-	1.20	1.15		1.22	0.266		1.23		1.52
% Moisture	%	-	-	10.2	15.9	14.7	14.1	12.1	12.0	20.6	8.93	12.2
pH	pH units	-	-	7.89	7.23		7.10	7.74		7.05		7.78
Redox Potential	mV	-	-		197							
Resistivity	ohm*cm	-	-		868							

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Leachable Anions & Nutrients - SOIL

			Lab ID	L2052527-2
			Sample Date	31-JAN-18
			Sample ID	MW8 SS3
		Guide Limits		
Analyte	Unit	#1	#2	
Chloride	ug/g	-	-	536

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Anions and Nutrients - SOIL

			Lab ID	L2052527-2
			Sample Date	31-JAN-18
			Sample ID	MW8 SS3
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Sulphate	mg/kg	-	-	169

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Cyanides - SOIL

		Guide Limits						
				Lab ID	L2052527-1	L2052527-4	L2052527-5	L2052527-7	L2052527-9
				Sample Date	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18
				Sample ID	MW8 SS2	MW9 SS3	MW9 SS5	MW11 SS2	MW8 SS1
Analyte	Unit	#1	#2						
Cyanide, Weak Acid Diss	ug/g	0.051	-		<0.050	<0.050	<0.050	<0.050	<0.050

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Inorganic Parameters - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2052527-2 Sample Date: 31-JAN-18 Sample ID: MW8 SS3
Acid Volatile Sulphides	mg/kg	-	-	<0.20

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Saturated Paste Extractables - SOIL

			Lab ID	L2052527-1	L2052527-4	L2052527-5	L2052527-7	L2052527-9
			Sample Date	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18	31-JAN-18
			Sample ID	MW8 SS2	MW9 SS3	MW9 SS5	MW11 SS2	MW8 SS1
Analyte	Unit	Guide Limits #1	#2					
SAR	SAR	5	-	6.68	1.45	1.67	12.1	11.1
Calcium (Ca)	mg/L	-	-	12.7	92.1	7.5	15.4	14.0
Magnesium (Mg)	mg/L	-	-	15.7	16.8	1.1	2.2	10.9
Sodium (Na)	mg/L	-	-	151	57.5	18.5	192	229

Guide Limit #1: T2-Soil-Res/Park/Inst. Property Use (Coarse)

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.