LANDTEK LIMITED
Consulting Engineers
205 Nebo Road, Unit 3
Hamilton, Ontario
Canada
L8W 2E1
Phone: 905-383-3733
Fax: 905-383-8433
engineering@landteklimited.com
www.landteklimited.com

Geotechnical Investigation
Proposed Forest Breeze Estates Residential Subdivision
204, 212 and 226 Rymal Road West
Hamilton, Ontario

Prepared for:

Urbex Engineering Limited
161 Rebecca St
Hamilton, Ontario
L8R 1B9

Landtek File: 20236
October 9, 2020

EXECUTIVE SUMMARY

SCOPE OF SERVICES

Proposed Development	Preliminary site layout drawing provided to Landtek indicates the proposed residential subdivision will comprise of approximately forty-five (45) single detached residential lots. The development will also include areas of greenspace, new access roads, and full site servicing. It is assumed that the building structures will include either a ground-bearing floor slab or a maximum of one level of basement.
Report Deliverables	The Geotechnical Investigation is required to determine the subsurface conditions underlying the site and to provide design and construction recommendations with regards to building foundations, floor slabs, pavement structures, and subsurface drainage and utilities for the proposed new residential development.

SITE DETAILS AND SETTING

Coordinates	589088, 4784269	**Geodetic (approx.)**	233.4 m to 236.3 m
Site Description	The site is an undeveloped relatively flat-lying parcel of land situated approximately 135 m east of Hazelton Avenue and approximately 190 m west of Konstantine Court. It is bound to the south by Rymal Road West and existing residential premises. The site is covered predominantly by copses of trees and unmaintained grasses.		
Geology	Topsoil was encountered at the ground level. Underlying the topsoil is native clayey silt. The clayey silt deposits extend to the maximum drill depth of approximately 6.5 m below existing ground level. Bedrock was not encountered during this investigation.		
Groundwater	During drilling, groundwater was not encountered, with all boreholes remaining open to full drill depth and dry upon completion. On completion of drilling, two boreholes were converted to monitoring wells.		

ENGINEERING CONSIDERATIONS

Foundations	It is considered by Landtek that the anticipated low loaded foundations for the proposed residential structures can be supported by conventional concrete footings seated within the native soils underlying the site.
Settlements	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 for foundations in native soils.
Earthquake Considerations	Based on the soil conditions encountered, and in accordance with Table 4.1.8.4.A. of the current Ontario Building Code, the site is considered to be a 'D' Site Class.

CONSTRUCTION CONSIDERATIONS

Excavations	The subsurface soils to be encountered during excavation at the site are expected to behave as "*Type 3"* and "*Type 2*" materials according to the OHSA classification in Part III. Type 3 soils are characteristic of the "*fill material*" while the native "*clayey silt*" is considered a Type 2 soil.
Subsurface Concrete	The representative soil samples at the site are reported to contain mild sulphate and low chloride ion concentrations. This given, normal General Use (GU) hydraulic cement can be used for the below grade concrete structures.
Dewatering	If groundwater dewatering volumes generated during construction are to exceed 50,000 litres per day, but are less than 400,000 litres per day, then the project will require registration online with the MECP Environmental Activity and Sector Registry (EASR). For amounts greater than 400,000 litres per day a Category 3 PTTW will be required.

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1.0 INTRODUCTION

Landtek Limited (herein "*Landtek*") is pleased to submit the geotechnical investigation report for the proposed Forest Breeze Estates subdivision development at the site identified as 204, 212, and 226 Rymal Road West in Hamilton, Ontario. Authorization to proceed with the work was received from Mr. Matt Bigness, P. Eng., of Urbex Engineering Limited (herein "*Urbex*").

A preliminary site layout drawing provided to Landtek by Urbex indicates the proposed residential subdivision will comprise of approximately forty-five (45) single detached residential lots. The development will also include areas of greenspace, new access roads, and full site servicing. It is assumed that the building structures will include either a ground-bearing floor slab or a maximum of one level of basement.

The primary objectives of this investigation are:

- 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.

This report has been prepared for the Client, the nominated engineers, designers, and project managers pertaining to the proposed subdivision development at the site identified as 204, 212, and 226 Rymal Road West in Hamilton, Ontario. 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 SITE SETTING

2.1 Site Location and Description

The site is located in Hamilton, Ontario, and is centered at approximate grid reference 589088, 4784269 (UTM 17T coordinates). The Geodetic elevation of the ground surface at the borehole locations ranges between 233.4 m and 236.3 m.

The site location is shown in Figure 2.1.1 below.

Figure 2.1.1: Area of Proposed Redevelopment

The site is an undeveloped relatively flat-lying parcel of land situated approximately 135 m east of Hazelton Avenue and approximately 190 m west of Konstantine Court. It is bound to the south by Rymal Road West and existing residential premises. The site is covered predominantly by copses of trees and unmaintained grasses.

2.2 Published Geology

Based on a review of the existing geological publications for the site area, Ontario Geological Survey (OGS) Map P.993: "*Quaternary Geology of the Grimsby Area*", the native subsurface soil conditions in the area of the site are anticipated to consist of glaciolacustrine silt and clay deposits. According to the OGS Map 2343 "*Paleozoic Geology of the Grimsby area*", the superficial geology is underlain by brown or tan dolostone of the Guelph Formation.

Information provided by wells records in the vicinity of the site, and held by the Ministry of Environment, Conservation and Parks (herein "*MECP*") confirms the anticipated geological conditions beneath the site. Based on the data from records for Well ID number 6803164, located at the project site, the superficial soil profile confirms the presence of silt and clay deposits to a depth of about 18 m. Limestone/dolostone bedrock underlies the overburden soils.

3.0 FIELDWORK AND INVESTIGATION 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 twelve boreholes (boreholes BH1 to BH12) were drilled between August 24th and September 3rd, 2020. The boreholes were logged using those standard symbols and terms defined in Appendix B. The Borehole Location Plan, Drawing 20236-01, and associated borehole logs are provided in Appendix C.

The boreholes were drilled using a Diedrich D-50 track-mounted drilling rig equipped with continuous flight, solid stem augers, and were advanced to depths of approximately 6.0 m 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.

Boreholes BH1 and BH12 were completed as monitoring wells and renamed BH/MW1 and BH/MW12, respectively. The monitoring wells consisted of new and sealed, 50 mm diameter, polyvinyl chloride (PVC) screen with No.10 slots threaded onto a matching riser. The screens and riser were pre-threaded including o-ring seals such that no glues or solvents were used to connect the pipe sections. The annular space between the PVC well and the borehole was backfilled to approximately 0.3 m above the top of the screen section with sand pack, and then with bentonite to the existing ground surface. A J-Plug lockable air-tight cap was installed on the riser and a steel monitoring well protector fitted above the riser.

The borehole logs in Appendix C present the monitoring well installation details and the results of a subsequent water monitoring visit undertaken on September 17th, 2020.

All soil samples were transported to the Landtek's in-house, Canadian Council of Independent Laboratories (CCIL) certified laboratory and visually examined to determine their textural classification. Moisture content testing was carried out on all samples. Selected, composite samples were submitted to AGAT Laboratories Ltd. (herein *"AGAT"*) to be analyzed for Ontario Regulation 153/04 Metal and Inorganic parameters to assist with determining materials reuse option and soil corrosivity to assist with any protective requirements for buried concrete and metal infrastructure.

Approximate ground surface geodetic elevations at the borehole locations were established by Landtek relative to ground geodetic elevations provided by the draft site plan prepared by Urbex, and dated March 9, 2020.

4.0 SUBSURFACE CONDITIONS

4.1 Overview

The borehole information is generally consistent with the geological data identified in Section 2.2, with the predominant native soils comprising of silt and clay deposits.

The detailed borehole logs are presented in Appendix C, with the ground conditions encountered by the boreholes discussed in the following sections.

4.2 Organic Soil

An approximately 100 mm to 225 mm thick layer of topsoil was encountered from ground surface in all the boreholes. Topsoil thicknesses may vary across the site, and the topsoil thicknesses measured at the borehole locations may not be representative of the topsoil depth throughout the site.

4.3 Fill

Fill material was encountered in borehole BH11, underlying the topsoil and extends to a depth of approximately 0.8 m below existing ground level. The fill material generally comprises reworked native clayey silt.

An SPT ‘‘N’’ value of 9 was reported within the fill materials, indicating the fill to be generally poorly compacted and as expected of uncontrolled fill soils.

4.4 Clayey Silt

Native clayey silt was encountered in all boreholes underlying the topsoil and fill and extends to the maximum investigated depth of approximately 6.5 m below existing ground level. The clayey silt is brown and grey at depth in colour, and includes traces of red shale fragments, gravel, iron staining, dark silt seams, cobbles, and rootlets.

SPT ‘N’ values ranging from 6 to 43 were reported, indicating the clayey silt to be of a firm to hard, but generally stiff consistency. Moisture content results of 10 % to 25 % were recorded, which are generally representative of a moist clayey silt till soil. The moisture content results are presented on the borehole logs in Appendix C.

4.5 Bedrock

Bedrock was not encountered during this investigation.

4.6 Groundwater

During drilling, groundwater was not encountered, with all boreholes remaining open to full drill depth and dry upon completion.

On completion of drilling, boreholes BH1 and BH12 were converted to monitoring wells. Groundwater level measurements were taken on September 17, 2020, by which time the water levels were considered stable.

Water level readings recorded in the monitoring wells during the visit are summarized in Table 4.6.1.

Table 4.6.1: Summary of Water Level Measurements

BH ID	Northing	Easting	Ground Elevation	Water Strike Depth (mbgl*)	Well Screen Depth (mbgl*)	Measured Water Level (m)		
						Depth	Elevation	Date
BH/MW1	4784321	589010	236.3 m	-	3.0 to 6.0	-	-	Sept. 17, 2020
BH/MW12	4784223	589169	234.4 m	-	3.0 to 6.0	5.6	228.8	Sept. 17, 2020

* mbgl meters below ground level

Groundwater was not encountered in monitoring well MW1, and a water level of approximately 5.6 m depth below ground level was recorded in monitoring well MW12.

It should be noted that groundwater conditions and surface water flow conditions are expected to vary according to the time of the year and seasonal precipitation levels. Water seepage is also expected from soil fissures above the water table.

5.0 FOUNDATION DESIGN CONSIDERATIONS

5.1 Shallow Foundations in Native Soils

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 site. It is assumed that the building structures will include either a ground-bearing floor slab or a maximum of one level of basement. On this basis, it is anticipated that foundations for the building structures will be seated at depths between approximately 1.2 m and 3.0 m below existing ground level.

Table 5.1.1 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 7V:10H, 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 5.1.1: Recommended Limit State Foundation Design Values

Founding Elevation Range		Founding Stratum	Foundation Design Value	
Depth Range	Geodetic Elevation		SLS [1 2]	ULS [3 4]
1.2 m – 2.0 m	233.2 m – 232.4 m	Clayey Silt	120 kPa	180 kPa
2.0 m – 3.0 m	232.4 m – 231.4 m	Clayey Silt	200 kPa	300 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.

5.2 Foundations on Engineered Fill

If engineered fill is required to support building foundations, it is considered by Landtek that such relatively lightly loaded structures can be adequately supported by conventional strip or pad footings founded on the engineered fill for a geotechnical reaction at the SLS of 120 kPa, and a factored geotechnical resistance at the ULS of 180 kPa. It should be noted however, that this is very much dependent upon the nature and condition of the fill placed, the condition of the sub-grade upon which it is being placed, and the methods adopted for the placement and compaction of the fill materials.

Where there is a requirement to raise the existing grade and generate the necessary founding sub-grade, the engineered fill must be selected with care, then placed and compacted under

strictly controlled conditions. The following recommendations are provided to address the selection of fill material as well as the placement and compaction of engineered fill.

- Processed imported granular material or consistent quality imported clean earth fill, can be considered for engineered fill provided the soil moisture content is within about 2 % of the optimum value of the material. Imported fill should meet the environmental requirements established for the site;
- Engineered fill should only be placed in an area that has been satisfactorily prepared by stripping existing fill and organic soils, and proof rolling the native exposed soil with at least five passes of a minimum 10-ton static pad-foot steel drum type roller;
- Engineered fill should be placed in maximum 300 mm, loose lifts and compacted to a target value of 100 % Standard Proctor Maximum Dry Density (herein "*SPMDD*"). The placement and compaction of each lift should be monitored full time by Landtek, with in-place compaction determined using nuclear moisture/density testing equipment;
- Fill layers that do not meet the compaction requirements, or become wet or frozen, should not be approved for the placement of additional material;
- For engineered fill placement over large areas of varying elevation, the locations of quality control density tests should be recorded by total station survey; and,
- As a precautionary measure and to mitigate cracking, it is recommended that reinforcing steel be provided in footings on engineered fill, and at the top of poured concrete foundation walls. Two 15M bars (continuous) are recommended as a minimum for footing placement. The Structural Engineer should be consulted to confirm the design of such steel reinforcement.

5.3 Frost Susceptibility

The silt and clay soils encountered at shallow depths 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 to high frost susceptibility, being classified as Frost Group "*F4*" (Table 13.1 of the "*Canadian Foundation Engineering Manual*", 4th Edition). However, the identified depths for foundations, as given in Section 5.1 are considered to be below the maximum extents of influence from frost penetration in the Hamilton 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.

5.4 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.

5.5 Seismic Design Considerations

Based on the soil conditions encountered, and in accordance with Table 4.1.8.4.A. of the current Ontario Building Code (herein "*OBC*"), the site 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, then Shear Wave Velocity Testing should be undertaken using Multichannel Analysis of Surface Waves (MASW) methodologies. However, this assessment will not necessarily guarantee a change of classification, as it is wholly dependent on the ground conditions beneath the site.

5.6 Damp Proofing Considerations

The subsurface areas 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.

6.0 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 lowest (i.e. basement) floor slab level using slab-on-grade methods. The subgrade support conditions are anticipated to be primarily clayey silt soils, which should provide competent conditions for placing the vapour barrier material. However, after the subgrade has been prepared to the underfloor design elevation it is recommended that the area be assessed by Landtek to determine if there is a need for any remedial work.

It is recommended that a minimum 200 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.

The design of concrete slabs on native soils may be made on the basis of a value of modulus of subgrade reaction of 30 MPa/m.

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. Based on the assumed maximum of one level of basement, limited groundwater seepage should be anticipated during periods of wet weather. The drainage system should comply with the OBC and associated amendments. Further details pertaining to perimeter and underfloor drainage systems are provided in Drawings 20236-02 and 20236-03 respectively, in Appendix D.

After the subgrade has been prepared to the underfloor design elevation it is recommended that the area be proof-rolled with a loaded tandem axle dump truck to delineate if there are soft or unstable ground conditions that require repair. This operation should be completed before the underfloor vapour barrier granular material is placed.

7.0 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; and,
- 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; and,
- 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.

8.0 SOIL CORROSIVITY AND SUBSURFACE CONCRETE

8.1 Soil Corrosivity

Two selected soil samples obtained from boreholes BH2 and BH12 were submitted to AGAT for analysis of PH, soil conductivity and redox potential, and concentrations of sulphides, sulphates, and chlorides.

The American Water Works Association (AWWA) document, "*Polyethylene Encasement for Ductile-Iron Pipe Systems*" *ANSI/AWWA C105/A21.5-18,* dated December 1, 2018, uses a 10-point scoring method 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. The test results are provided in Appendix E and are summarized in Table 8.1.1.

Table 8.1.1: Results of Soil Corrosivity Potential

Sample ID	Composite Sample Depth	Parameters Analysed	Measured Value	ANSI/AWWA Point Rating	Total ANSI/AWWA Points
BH2-SS1	0.2 – 1.0 (m)	Sulphide (%)	<0.05	0	1
		pH (pH units)	7.85	0	
		Resistivity (ohm.cm)	20400	0	
		Redox Potential (mV)	295	0	
		Moisture (%)	14	1	
BH12-SS1	0.2 – 1.0 (m)	Sulphide (%)	<0.05	0	1
		pH (pH units)	7.60	0	
		Resistivity (ohm.cm)	4950	0	
		Redox Potential (mV)	222	0	
		Moisture (%)	11	1	

Corrosion protection for buried metallic improvements or steel is recommended, when a score of 10 points or greater is reported. Based on the total ANSI/AWWA values of 1, the underlying native soils at the site are considered noncorrosive to ductile-iron pipes. It should be noted that the analytical results only provide an indication of the potential for corrosion

The contribution of chloride ions to soil corrosivity towards buried metallic improvements or steel 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) A23.1-14 "*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 µg/g).

The representative soil samples at the site are reported to contain sulphate and chloride ion concentrations of up to 6 µg/g and 5 µg/g respectively. This given, the test results indicate a negligible degree of sulphate and chloride attack on buried reinforced concrete structures.

8.2 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"*.

Given the mild sulphate and low chloride test results, normal General use (GU) hydraulic cement can be used for the below grade concrete structures.

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

8.3 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.

9.0 EXCAVATION AND BACKFILL CONSIDERATIONS

9.1 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"* and "*Type 2*" materials according to the OHSA classification in Part III. Type 3 soils are characteristic of the "*fill material*" while the "*clayey silt"* is considered a Type 2 soil.

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 and Type 2 soils are expected to be stable for short construction periods at slopes of approximately 45° to the horizontal (i.e. 1V:1H).

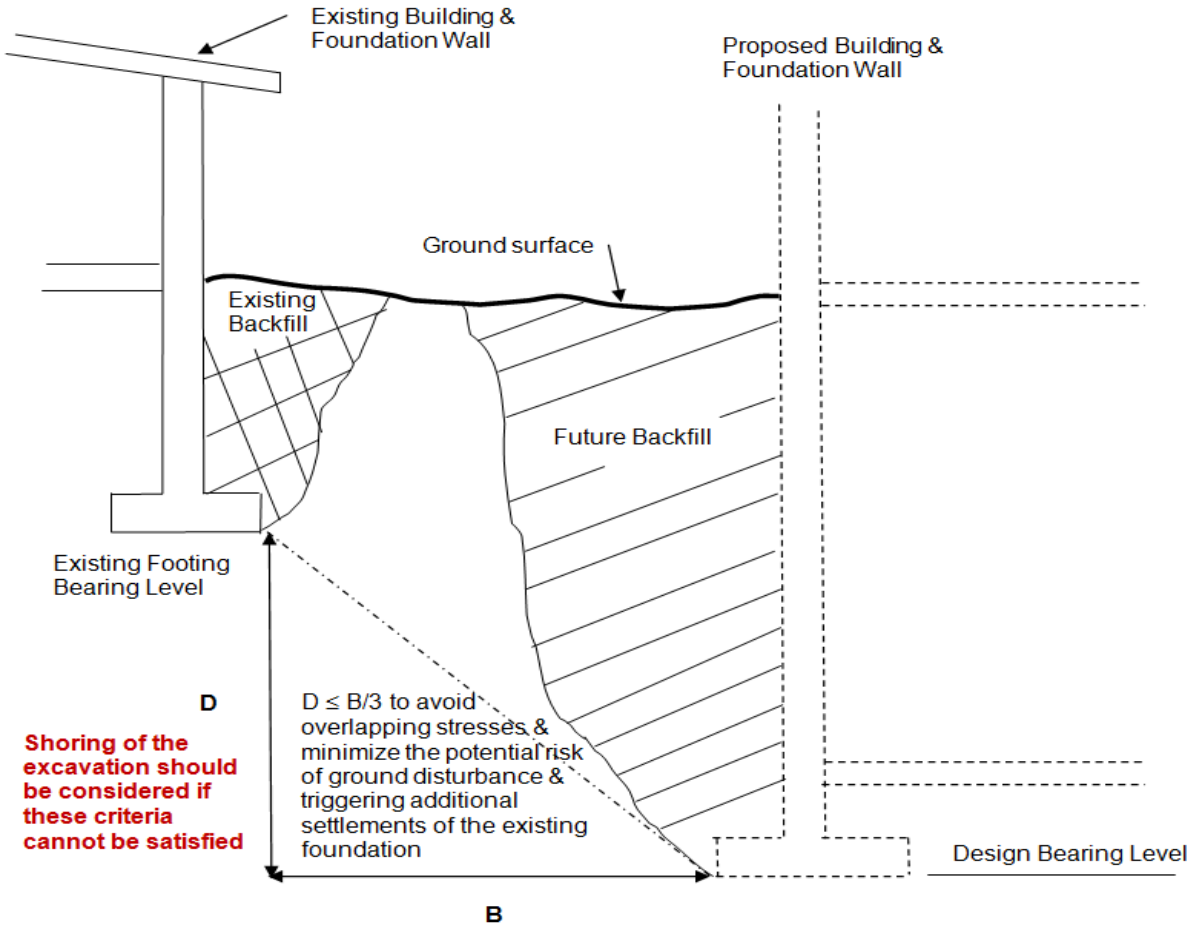


Figure 9.1.1: Criteria for Assessing Excavation Shoring Requirements (Not to Scale)

Excavations for new foundations should satisfy the criteria given in the example shown in Figure 9.1.1 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.

Consideration should be given to any existing trench excavations and associated backfill that may be present directly behind cut slopes within the 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.

It should be noted that the design of any 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 "*Canadian Foundation Engineering Manual*".

9.2 Construction Dewatering Considerations

Groundwater seepage is expected to be variable and will depend upon the depth of the excavations, the time of year, and precipitation levels preceding construction. The site information indicates that groundwater may be expected to be struck at depths of approximately 5.6 m below existing ground level.

If groundwater dewatering volumes generated during construction are to exceed 50,000 litres per day, but are less than 400,000 litres per day, then the project would require registration under the Environmental Activity and Sector Registry (herein "*EASR*") framework or a Permit To Take Water (herein "*PTTW*") for amounts greater than 400,000 l/day.

9.3 General Backfill Considerations

Backfill next to foundation walls, and in service trenches should be selected to be compactable in narrow trench conditions. The clayey silt till and sand soils encountered at the site 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.

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.MUNI 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 for flexible pipe and OPSD 802.030 for rigid pipes. The type of bedding shall be selected to suit the applicable pipe strength and site conditions.

Bedding material shall be placed in layers not exceeding 150 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 150 mm uncompacted layer. The remainder of the trench should be backfilled as per the requirements defined in Section 9.0.

It is assumed all services will have a minimum of 1.2 m of soil cover for frost protection. For services installed at shallower depths, suitable insulation for frost protection is recommended.

11.0 ENVIRONMENTAL CONSIDERATIONS AND SOIL MANAGEMENT

11.1 Environmental Considerations

Selected, soil samples obtained from boreholes BH1 and BH11 were submitted for chemical analyses to AGAT to determine metals and inorganic properties *(Regulation 153/04).* Unusual stains or odours were not noted in any of the samples collected as part of this geotechnical investigation. The results of the chemical analysis are presented on the Certificate of Analysis in Appendix D to this report.

In comparison to O. Reg. 153 Tables 1 to 3: Residential/Parkland/Institutional and Industrial/Commercial/Community (herein *"RPI/ICC")* property use criteria of the Ministry of Environment, Conservation and Parks (herein "*MECP*") document "*Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*", dated April 15, 2011, no soil sample exceeded guideline limits for metals and inorganics. The test results are summarized in Table 11.1 below.

Table 11.1.1: Summary of O. Reg. 153 Metals & Inorganics Test Data (Tables 1 to 3 Comparison)

Sample ID	Composite Sample Depth	Parameters Analyzed	MECP Table Comparison	
			Tables 1 to 3 (RPI/ICC)	Exceedance
BH1-SS1	0.1 m – 1.0 m	O. Reg. 153 Metals & Inorganics	✓	-
BH11-SS1	0.1 m – 1.0 m	O. Reg. 153 Metals & Inorganics	✓	-

Table 1 refers to Full Depth Background Site Condition Standards.
Table 2 refers to Full Depth Generic Site Condition Standards in a Potable Ground Water Condition.
Table 3 refers to Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition.
✓ Meets MECP Tables 1 to 3 (RPI/ICC) soil quality guidelines.

Therefore, based on these results and guidance provided by the MECP, the soils at the selected borehole locations are considered suitable for reuse within the full site area.

The soils may be excavated off-site to sites accepting soils that meet MECP Tables 1 to 3 soils. This is provided that all excavated soils are free of odour, stains or objectionable materials such as debris when it is removed from the subject site. It should be noted that the disposal of soils at any site is contingent upon acceptance of the material by the owner of the receiving site, and the final acceptance of any soil sent off-site for re-use as fill is at the discretion of the owner of the receiving site. As such, additional testing may be required by the receiving site.

If soil suspected to contain environmental impacts is encountered during the excavation operations, Landtek should be contacted so that additional soil samples can be obtained for chemical testing. Any suspected impacted soil should not be removed from the site until the test results have been reviewed.

This testing has been conducted in order to assess possible options for soil disposal only and is not intended to constitute an Environmental Site Assessment of any kind and as such does not comment on the environmental condition of the site. Soil and/or groundwater quality may vary at locations other than those tested.

11.2 Soil Management

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:

- 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;
- 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,
- 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 development is anticipated to include new access road pavements and parking areas. Recommended pavement structure layer thicknesses are provided in Table 12.1.1. Site specific development requirements set out by the Corporation of the City of Hamilton (herein "*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 12.1.1: Recommended Pavement Structure Layer Thicknesses

Pavement Layer	Access and Fire Routes	Light Duty Pavement Areas
Surface Course Asphalt OPSS HL 3	40 mm	40 mm
Binder Course Asphalt OPSS HL 8	80 mm	50 mm
Granular Base OPSS Granular A	150 mm	150 mm
Granular Subbase OPSS Granular B, Type II	350 mm[1]	250 mm[1]
Total Thickness	620 mm	490 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 Subgrade Preparation and Drainage

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.

Should the pavements proposed for the development be constructed as a two-stage paving operation it will 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.

12.3 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. If the option with granular subbase material is used, 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.MUNI 1150.

The standard asphalt binder grade for the climate conditions in the Hamilton area is PG 58-28. Given the anticipated 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.

12.4 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 12.4.1. The concrete and aggregates should be produced and placed to meet those standards also stipulated by the City of Hamilton's Engineering Standards.

Table 12.4.1: 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

It should be noted that the concrete sidewalk design specified in Table 12.4.1 addresses a use by pedestrian traffic only and does not include for use by vehicular traffic.

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

LICENSED PROFESSIONAL ENGINEER
R. DI CIENZO
Oct. 9/20
PROVINCE OF ONTARIO

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

Ralph Di Cienzo, P. Eng.
Consulting Engineer

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.

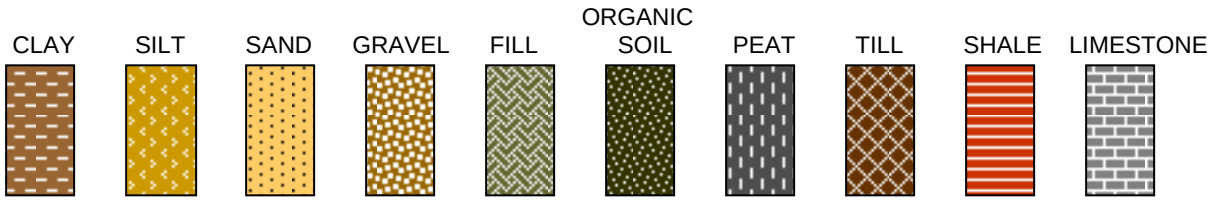
The comments made in this report on potential construction problems and possible remedial methods are intended only for the guidance of the designer. The number of Boreholes may not be sufficient to determine all the factors that may influence construction methods and costs. For example, the thickness 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

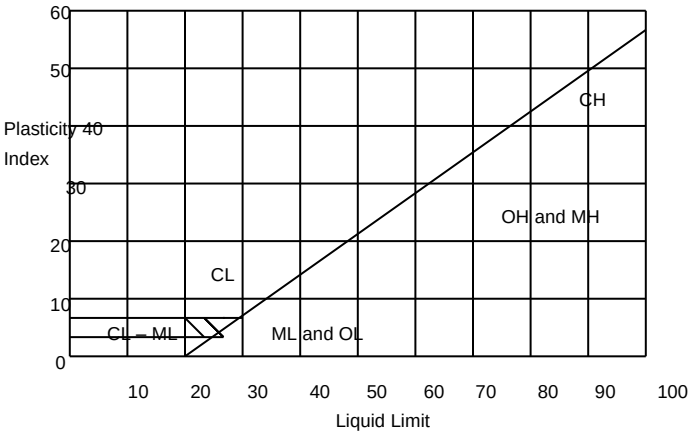
CONSISTENCY OF COHESIVE SOILS

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. 4 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 20236-01 – BOREHOLE LOCATION PLAN

BOREHOLE LOGS

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario L8W 2E1
p: +1 (905) 383-3733 ○ f: +1 (905) 383-8433
engineering@landteklimited.com
www.landteklimited.com

project location

Key plan provided by google earth.

- Approximate location of boreholes as drilled by Landtek Limited between August 24, 2020 and September 3, 2020.
- Approximate location of monitoring wells installed by Landtek Limited August 24, 2020 and September 3, 2020.

Borehole and monitoring well locations are considered approximate.

Base plan provided by Urbex Engineering Limited.

revisions/ submissions

#	date	description
1	September 10, 2020	Issued for report

client
Urbex Engineering Ltd.

municipality
The Corporation of the City of Hamilton

project
Geotechnical Investigation
204, 212, and 226 Rymal Road West

sheet
Borehole Location Plan

date: September 10, 2020
drawn: JD
checked: IA
project #: 20236
scale: NOT TO SCALE

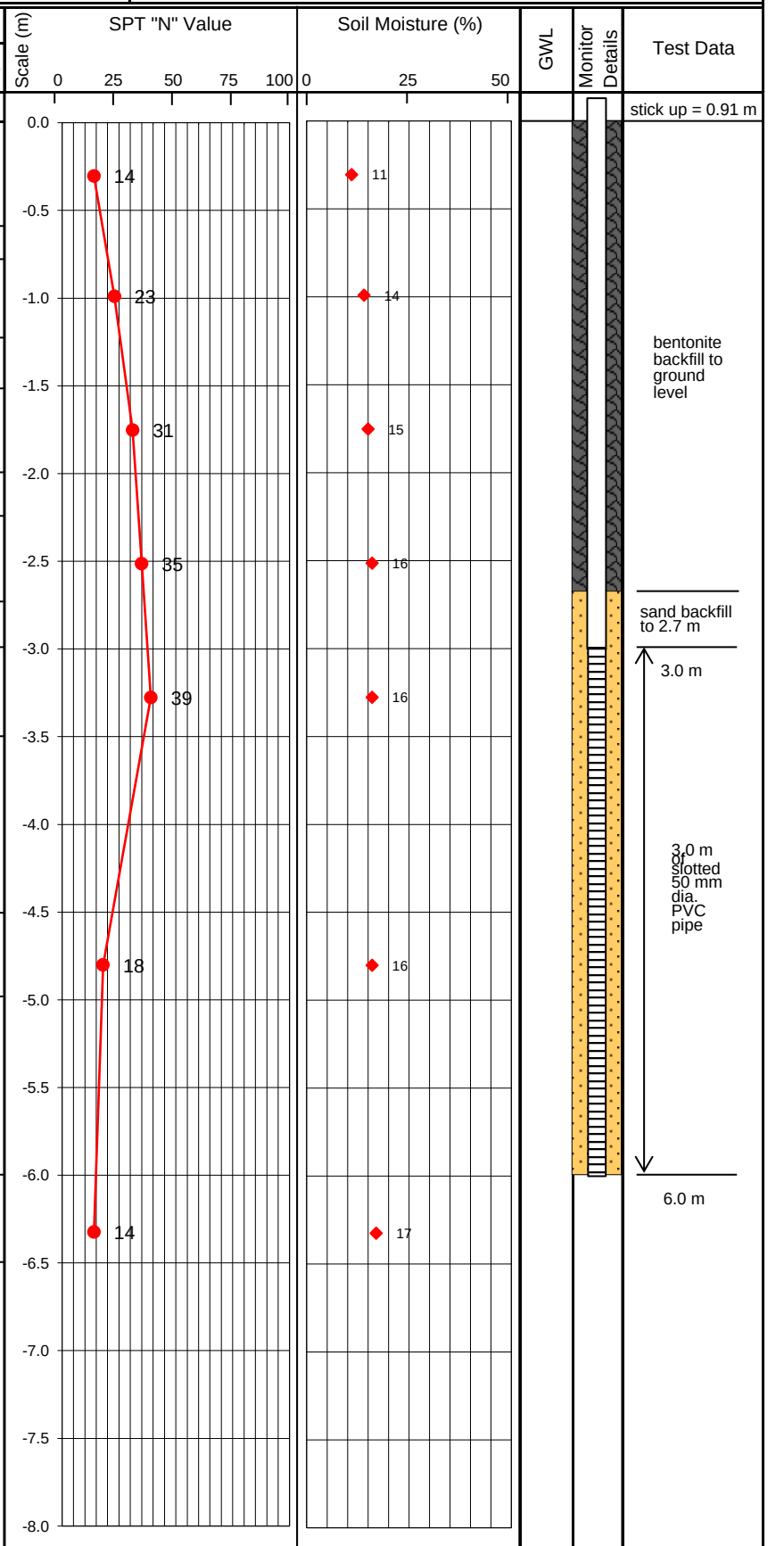
20236-01

LANDTEK LIMITED

BH/MW 1

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Elev. Depth	Sample No.	Sample Type	Test Data
Ground Surface	236.3			stick up = 0.91 m
±225 mm of Topsoil				
CLAYEY SILT: trace iron staining, red shale fragments, gravel, brown, very stiff, moist		1	SS	
at 0.7 m to 1.2 m: trace dark silt seams		2	SS	
at 1.5 m to 2.0 m: hard		3	SS	
		4	SS	
		5	SS	
at 4.5 m to 5.0 m: grey, very stiff, moist		6	SS	
at 6.0 m to 6.5 m: trace red shale fragments, stiff, moist	228.8	7	SS	
BOREHOLE TERMINATED AT TARGET DEPTH	6.5			



Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.
3. Water level reading: Dry on September 17, 2020

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 2

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		235.6								
±200 mm of Topsoil			1	SS	0.0	7	14			
CLAYEY SILT: trace iron staining, red shale fragments, gravel, dark silt seams, brown, firm to stiff, moist					-0.5					
at 0.7 m to 1.2 m: trace sand, very stiff			2	SS	-1.0	18	16			
at 1.5 m to 3.0 m: very stiff					-1.5					
			3	SS	-2.0	21	16			
at 2.3 m to 2.7 m: trace red shale fragments, trace iron staining			4	SS	-2.5	23	17			
at 3.0 m to 3.5 m: trace dark silt, hard			5	SS	-3.0	40	16			
					-3.5					
at 4.5 m to 5.0 m: grey, stiff, moist			6	SS	-4.0	13	16			
					-4.5					
at 6.0 m to 6.5 m: trace gravel, stiff to very stiff		229.1	7	SS	-5.0	15	17			
					-5.5					
BOREHOLE TERMINATED AT TARGET DEPTH		6.5			-6.0					
					-6.5					
					-7.0					
					-7.5					
					-8.0					

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 3

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		236.1								
±225 mm of Topsoil										
CLAYEY SILT: trace iron staining, red shale fragments, gravel, rootlets, brown, stiff, moist			1	SS		10	13			
			2	SS		12	17			
at 1.5 m to 2.0 m: firm to stiff			3	SS		8	23			
at 2.3 m to 2.7 m: very stiff.			4	SS		19	17			
at 3.0 m to 3.5 m: hard			5	SS		37	15			
at 4.5 m to 6.5 m: grey, very stiff, moist			6	SS		18	15			
			7	SS		20	15			
		229.6								
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | 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

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 4

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		235.6								
±200 mm of Topsoil			1	SS	0.0	6	10			
CLAYEY SILT: trace iron staining, red shale fragments, gravel, sand, brown, firm to stiff, moist					-0.5					
at 0.7 m to 1.2 m: stiff			2	SS	-1.0	9	17			
at 1.5 m to 2.0 m: trace gravel, very stiff			3	SS	-1.5	16	15			
			4	SS	-2.0	22	15			
at 3.3 m to 6.5 m: grey			5	SS	-2.5	26	15			
					-3.0					
at 4.5 m to 5.0 m: stiff			6	SS	-3.5	12	16			
					-4.0					
at 6.0 m to 6.5 m: very stiff		229.1	7	SS	-4.5	18	19			
BOREHOLE TERMINATED AT TARGET DEPTH		6.5			-5.0					
					-5.5					
					-6.0					
					-6.5					
					-7.0					
					-7.5					
					-8.0					

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 5

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		235.9								
±200 mm of Topsoil			1	SS	0.0	6	16			
CLAYEY SILT: trace iron staining, red shale fragments, gravel, sand, brown, firm to stiff, moist					-0.5					
			2	SS	-1.0	11	17			
					-1.5					
			3	SS	-2.0	10	19			
at 2.3 m to 3.0 m: very stiff			4	SS	-2.5	20	20			
at 3.0 m to 5.0 m: hard			5	SS	-3.0	30	15			
					-3.5					
					-4.0					
at 4.5 m to 5.0 m: grey, hard			6	SS	-4.5	34	14			
					-5.0					
					-5.5					
at 6.0 m to 6.5 m: trace gravel, very stiff			7	SS	-6.0	18	16			
		229.4			-6.5					
BOREHOLE TERMINATED AT TARGET DEPTH		6.5			-7.0					
					-7.5					
					-8.0					

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 6

Project No.:	20236	Drill Date:	September 3, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		234.6								
±200 mm of Topsoil			1	SS		10	16			
CLAYEY SILT: trace iron staining, gravel, brown, stiff, moist										
at 0.7 m to 1.2 m: trace red shale fragments, dark silt seams, very stiff			2	SS		21	16			
at 1.2 m to 3.0 m: very stiff			3	SS		22	15			
			4	SS		23	15			
at 3.0 m to 3.5 m: grey, hard			5	SS		32	15			
at 4.5 m to 5.0 m: stiff			6	SS		13	14			
at 6.0 m to 6.5 m: trace red shale fragments, very stiff		228.1	7	SS		18	14			
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								

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

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

Soil Moisture (%): 0, 25, 50

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 7

Project No.:	20236	Drill Date:	August 25, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		235.1								
±150 mm of Topsoil										
CLAYEY SILT: brown, firm to stiff, moist			1	SS		6	15			
at 0.7 m to 1.2 m: trace iron staining			2	SS		11	14			
at 1.5 m to 2.0 m: firm			3	SS		7	18			
at 2.3 m to 2.7 m: stiff to very stiff			4	SS		15	16			
at 3.0 m to 3.5 m: very stiff			5	SS		20	15			
at 4.5 m to 6.5 m: grey, stiff			6	SS		14	17			
			7	SS		14	16			
		228.6								
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | 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

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

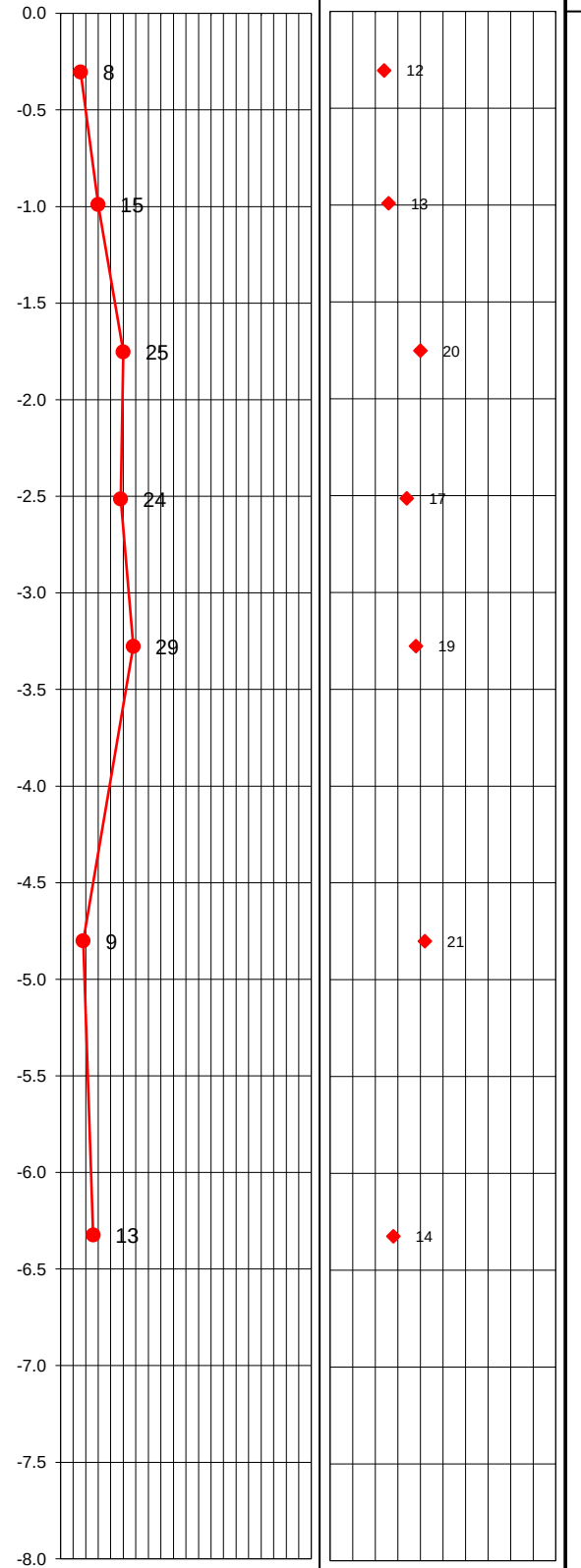
LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 8

Project No.:	20236	Drill Date:	August 24, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		233.5								
±100 mm of Topsoil			1	SS						
CLAYEY SILT: brown, stiff, moist										
			2	SS						
at 0.7 m to 1.2 m: stiff to very stiff.										
			3	SS						
at 1.5 m to 3.5 m: very stiff										
			4	SS						
			5	SS						
at 3.5 m to 6.5 m: grey, stiff										
			6	SS						
at 4.5 m to 5.0 m: trace iron staining										
			7	SS						
		227.0								
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								



Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 9

Project No.:	20236	Drill Date:	August 24, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Existing Ground Level

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		234.9							
±150 mm of Topsoil									
CLAYEY SILT: trace iron staining, brown, firm to stiff, moist			1	SS	5	13			
			2	SS	13	13			
at 1.5 m to 2.0 m: trace gravel, stiff			3	SS	14	17			
at 2.3 m to 2.7 m: trace red shale fragments, very stiff			4	SS	17	16			
at 3.0 m to 3.5 m: hard			5	SS	43	15			
at 4.5 m to 6.5 m: grey, stiff			6	SS	9	20			
			7	SS	12	18			
		229.9							
BOREHOLE TERMINATED AT TARGET DEPTH		6.5							

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

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

Soil Moisture (%): 0, 25, 50

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 10

Project No.:	20236	Drill Date:	August 24, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		234.0								
±100 mm of Topsoil										
CLAYEY SILT: brown, firm to stiff, moist			1	SS		6	13			
at 0.7 m to 1.2 m: trace iron staining, stiff			2	SS		9	15			
at 1.5 m to 2.0 m: firm			3	SS		6	20			
at 2.3 m to 2.7 m: trace gravel, soft, very moist			4	SS		3	21			
at 3.0 m to 3.5 m: stiff, very moist			5	SS		11	20			
at 4.5 m to 5.0 m: trace iron staining, grey, very stiff, moist			6	SS		17	19			
at 6.0 m to 6.5 m: no iron staining, stiff		227.5	7	SS		12	25			
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | 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

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

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BH 11

Project No.:	20236	Drill Date:	August 24, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		233.4								
±100 mm of Topsoil			1	SS		9	12			
FILL: clayey silt, brown, stiff, moist		232.6								
CLAYEY SILT: brown, firm to stiff, moist		0.8	2	SS		8	14			
at 1.5 m to 2.0 m: very stiff			3	SS		16	16			
at 2.3 m to 2.7 m: trace gravel			4	SS		18	12			
at 3.0 m to 3.5 m: trace cobble			5	SS		50 /75 mm	16			
at 4.5 m to 5.0 m: grey, stiff, moist			6	SS		9	18			
at 6.0 m to 6.5 m: very stiff		226.9	7	SS		29	21			
BOREHOLE TERMINATED AT TARGET DEPTH		6.5								

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50 | 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

Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.

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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205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
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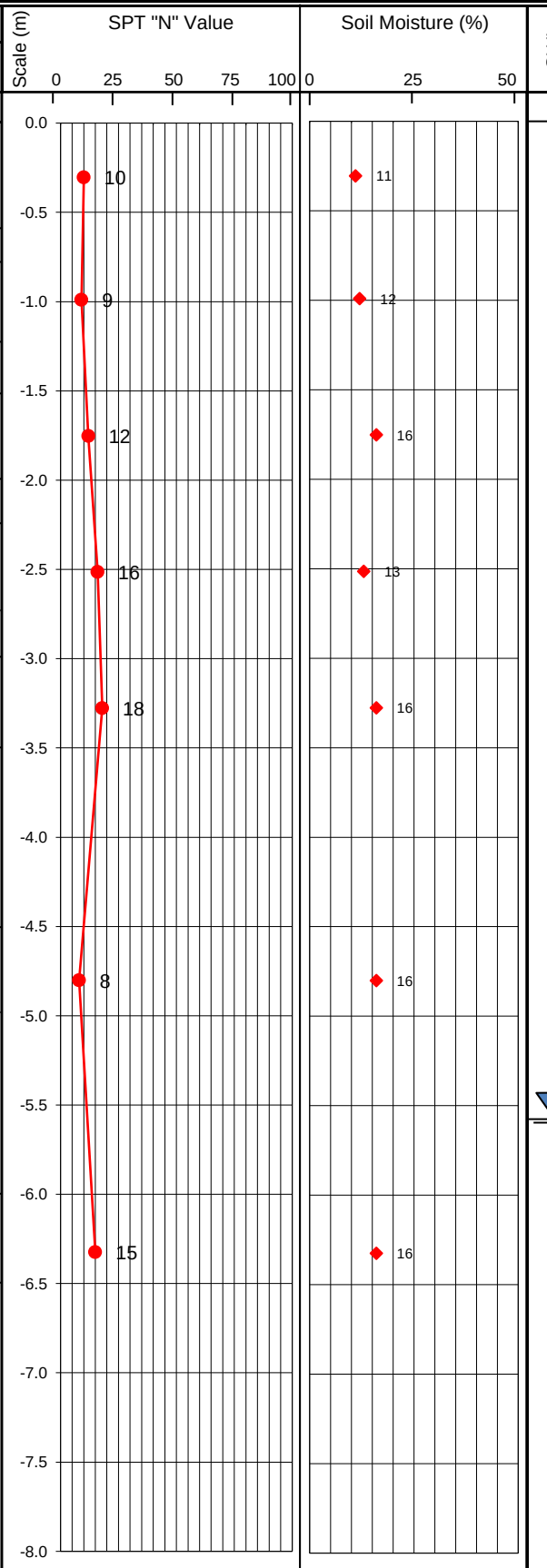
BH/MW 12

Project No.:	20236	Drill Date:	August 24, 2020
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	212 Rymal Road East, Hamilton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Sample No.	Sample Type	Test Data
Ground Surface		234.4			stick up = 1.00 m
±100 mm of Topsoil					
CLAYEY SILT: brown, stiff, moist			1	SS	
at 0.7 m to 1.2 m: trace iron staining.			2	SS	bentonite backfill to ground level
at 1.5 m to 2.0 m: trace red shale fragments			3	SS	
at 2.3 m to 3.5 m: trace gravel, very stiff			4	SS	
					sand backfill to 2.7 m
			5	SS	3.0 m
					3.0 m of slotted 50 mm dia. PVC pipe
at 4.7 m to 6.5 m: grey, stiff			6	SS	
					WL = 5.6 m Sept. 17, 2020
			7	SS	6.0 m
		227.9			
BOREHOLE TERMINATED AT TARGET DEPTH		6.5			



Notes:
1. On completion, borehole open to 6.0 m
2. Groundwater not encountered during the drilling process.
3. Water level reading: WL at 5.6 m depth on September 17, 2020

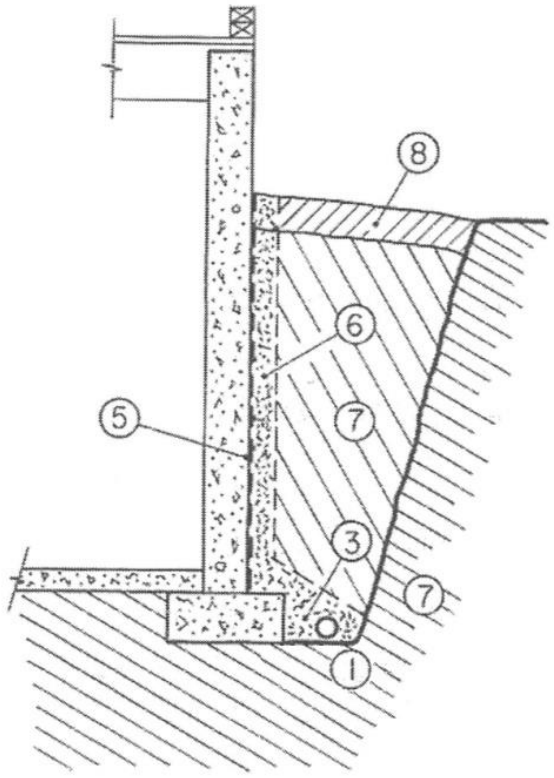
PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

APPENDIX D

DRAWING 20236-02 – ENGINEERING COMMENTARIES – GENERAL REQUIREMENTS FOR DRAINAGE TO BASEMENT STRUCTURES

DRAWING 20236-03 – 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.

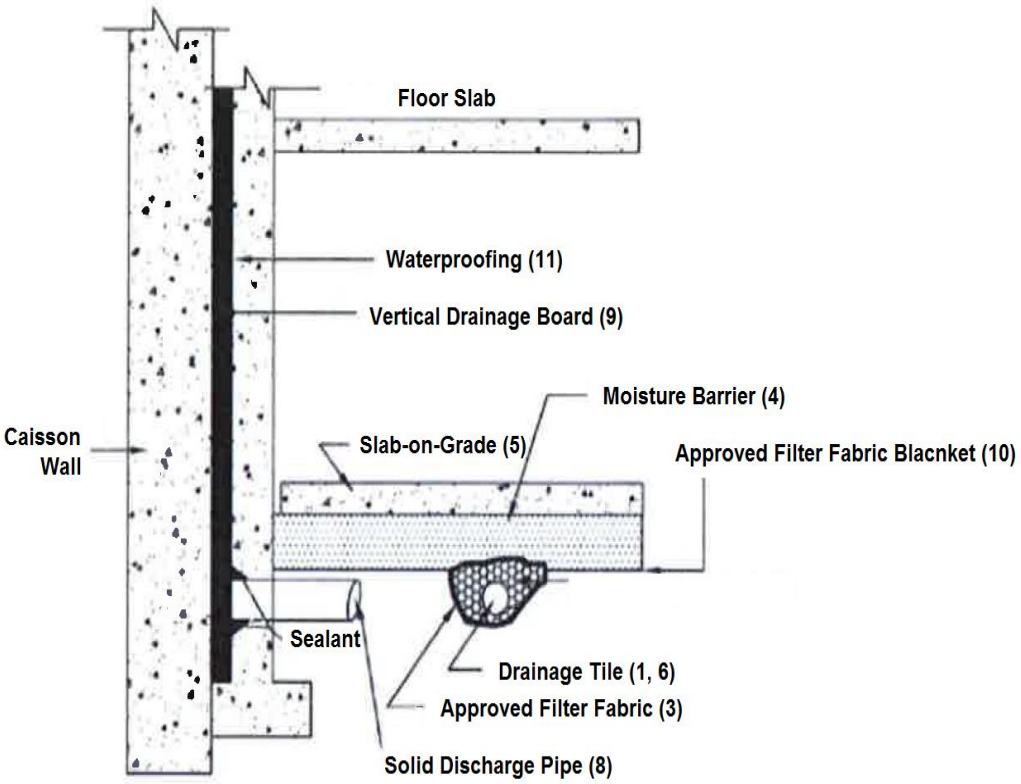
Additional Notes:

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.

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario L8W 2E1
p: +1 (905) 383-3733 ◦ f: +1 (905) 383-8433
engineering@landteklimited.com
www.landteklimited.com

General Requirements for Drainage to Basement Structures

client	Urbex Engineering Limited
project	204, 212 and 226 Rymal Road West, Hamilton, Ontario
project #	20236
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.

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario L8W 2E1
p: +1 (905) 383-3733 ◦ f: +1 (905) 383-8433
engineering@landteklimited.com
www.landteklimited.com

General Requirements for Underfloor Drainage Systems			
client	Urbex Engineering Limited		
project	204, 212, and 226 Rymal Road West, Hamilton, Ontario		
project #	20236	drawing #	3

APPENDIX E

LABORATORY CERTIFICATE OF ANALYSIS

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 20H646880

PROJECT: 20236

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Isaac Asonya

SAMPLING SITE:212 Rymal Rd Hamilton

SAMPLED BY:Joey/ Marco

Corrosivity Package

DATE RECEIVED: 2020-09-04

DATE REPORTED: 2020-09-16

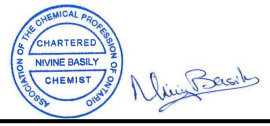
						SAMPLE DESCRIPTION:	BH2 SS1	BH12 SS1
						SAMPLE TYPE:	Soil	Soil
						DATE SAMPLED:	2020-09-03	2020-08-24
Parameter	Unit	G / S: A	G / S: B	G / S: C	RDL		1418020	1418035
Chloride (2:1)	µg/g	NA	NA	NA	2		<2	5
Sulphate (2:1)	µg/g				2		4	6
pH (2:1)	pH Units				NA		7.85	7.60
Electrical Conductivity (2:1)	mS/cm	0.57	0.7	0.7	0.005		0.049[<A]	0.202[<A]
Resistivity (2:1) (Calculated)	ohm.cm				1		20400	4950
Redox Potential 1	mV				NA		292	217
Redox Potential 2	mV				NA		295	222
Redox Potential 3	mV				NA		299	220

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use, B Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils, C Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1418020-1418035 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 20T648862
PROJECT: 20H646880

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Isaac Asonya

(201-042) Sulfide

DATE SAMPLED: Sep 09, 2020 | DATE RECEIVED: Sep 10, 2020 | DATE REPORTED: Sep 14, 2020 | SAMPLE TYPE: Other

	Analyte:	Sulfide
	Unit:	%
Sample ID (AGAT ID)	RDL:	0.05
BH2 SS1-1418020 (1435915)		<0.05
BH12 SS1-1418035 (1435916)		<0.05

Comments: RDL - Reported Detection Limit

Analysis performed at AGAT 5623 McAdam Rd., Mississauga, ON (unless marked by *)

Certified By: Sherin Moussa

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 20H646880

PROJECT: 20236

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Isaac Asonya

SAMPLING SITE:212 Rymal Rd Hamilton

SAMPLED BY:Joey/ Marco

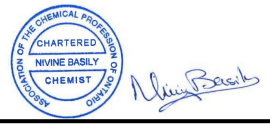
O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2020-09-04

DATE REPORTED: 2020-09-16

						SAMPLE DESCRIPTION:	BH1 SS1	BH11 SS1
						SAMPLE TYPE:	Soil	Soil
						DATE SAMPLED:	2020-09-03	2020-08-24
Parameter	Unit	G / S: A	G / S: B	G / S: C	RDL		1418019	1418034
Antimony	µg/g	1.3	7.5	7.5	0.8		<0.8	<0.8
Arsenic	µg/g	18	18	18	1		5[<A]	6[<A]
Barium	µg/g	220	390	390	2		70[<A]	79[<A]
Beryllium	µg/g	2.5	5	5	0.5		<0.5	<0.5
Boron	µg/g	36	120	120	5		<5	<5
Boron (Hot Water Extractable)	µg/g	NA	1.5	1.5	0.10		<0.10	0.31[<B]
Cadmium	µg/g	1.2	1.2	1.2	0.5		<0.5	<0.5
Chromium	µg/g	70	160	160	5		21[<A]	20[<A]
Cobalt	µg/g	21	22	22	0.5		8.3[<A]	9.3[<A]
Copper	µg/g	92	180	180	1		30[<A]	26[<A]
Lead	µg/g	120	120	120	1		18[<A]	24[<A]
Molybdenum	µg/g	2	6.9	6.9	0.5		<0.5	<0.5
Nickel	µg/g	82	130	130	1		19[<A]	19[<A]
Selenium	µg/g	1.5	2.4	2.4	0.4		<0.4	0.4[<A]
Silver	µg/g	0.5	25	25	0.2		<0.2	<0.2
Thallium	µg/g	1	1	1	0.4		<0.4	<0.4
Uranium	µg/g	2.5	23	23	0.5		0.6[<A]	0.6[<A]
Vanadium	µg/g	86	86	86	1		31[<A]	29[<A]
Zinc	µg/g	290	340	340	5		90[<A]	95[<A]
Chromium, Hexavalent	µg/g	0.66	10	10	0.2		<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.051	0.051	0.040		<0.040	<0.040
Mercury	µg/g	0.27	1.8	1.8	0.10		<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.7	0.7	0.005		0.260[<A]	0.166[<A]
Sodium Adsorption Ratio	NA	2.4	5	5	NA		0.108[<A]	0.141[<A]
pH, 2:1 CaCl2 Extraction	pH Units		5.0-9.0	5.0-9.0	NA		7.24	7.59

Certified By:



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 20H646880

PROJECT: 20236

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Isaac Asonya

SAMPLING SITE:212 Rymal Rd Hamilton

SAMPLED BY:Joey/ Marco

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

DATE RECEIVED: 2020-09-04 **DATE REPORTED: 2020-09-16**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use, B Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils, C Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1418019 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

1418034 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.
Cyanide analysis was performed past hold time due to long weekend.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Results relate only to the items tested. Results apply to samples as received.