GEOTECHNICAL INVESTIGATION REPORT
PROPOSED MIXED-USE DEVELOPMENT
PHASE 4
WATERIDGE VILLAGE
OTTAWA, ONTARIO

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1 INTRODUCTION

Alston Associates, the previous Geotechnical Division of Terrapex Environmental Ltd. **(Terrapex)** was retained by Canada Lands Company CLC Limited (CLC) to carry out a geotechnical investigation for the proposed mixed-use development of Wateridge Village (Phase 4) located at the property of the former Canadian Forces Base (CFB) Rockcliffe in the City of Ottawa, Ontario. Authorization to proceed with this study was given by Mr. Jean Lachance of CLC.

We understand that CLC is seeking approval to develop the land at Wateridge Village referred to as Phase 4 Lands and construct Park 1 located on Block 1.

The Phase 4 area is located north of Registered Plans of Subdivisions 4M-1559 and 4M-1581 in Wateridge Village, as shown on Drawing 2 attached in Appendix B of this report. Drawing 2 also shows the proposed land use of the property sub-divided into blocks according to the type of development. According to the proposed development plan, the site is scheduled to contain three low to mid-rise mixed use Blocks (2, 3 and 4), two low to mid-rise residential Blocks (5 and 6) and Park 1 (Block 1).

A grading plan dated December 2018 was prepared by IBI Group; attached in Appendix B as Drawings 6 and 7. Details regarding building locations, design and municipal infrastructure on Blocks 1-6 were not available at the time of the investigation, and accordingly the recommendations provided in this report are considered to be preliminary in nature, subject for review and revision upon completion of proposed plans.

The geotechnical report prepared by Terrapex dated February 5, 2019, included Phases 2 and 4. CLC requested that in accordance with the City of Ottawa requirements, our original report be separated to reflect only Phase 4 Development Lands.

The purpose of this investigation was to characterize the subsurface soil and groundwater conditions, to determine the engineering properties of the various soil deposits underlying the site, and to provide geotechnical engineering recommendations pertaining to the proposed development.

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

2 BACKGROUND

A number of geotechnical and hydrogeological investigations were completed at the former CFB Rockcliffe property for CLC and documented in the following reports; copies of which were *provided to us by CLC:*

- *"Geotechnical Investigation Phase 1B Development – Site Servicing, Wateridge Village at Rockcliffe, Ottawa, Ontario", dated November 2016 (DST File No: IN-SO-026755);*
- *"Geotechnical Investigation Phase 1A Development – Site Servicing, Former CFB Rockcliffe Development, Ottawa, Ontario", dated November 2015 (DST File No: OE-OT- 015358);*

- *"Final Geotechnical Investigation for Subdivision Approval, Former CFB Rockcliffe Development, Ottawa, Ontario", dated September 2015 (DST File No: OE-OT-015358);*
- *"Preliminary Geotechnical and Hydrogeological Investigation Proposed Stormwater Management Pond, CLC Rockcliff Lands Hemlock Road and Aviation Parkway, Ottawa, Ontario", dated May 2015 (Golder Associates File No: 1521309);*
- *"Geotechnical Investigation Report for Preliminary Assessment for Building Foundation, Services Installation and Grade Raise Analysis Mapping – Phase 1 Development, Former CFB Rockcliffe, Ottawa, Ontario", dated April 2014 (DST File No: GS-OT-015358);*
- *"Hydrogeological Report - Stormwater Management Support Studies, Former CFB Rockcliffe, Ottawa, Ontario, dated October 2013" (DST File No: OE-OT- 017184);*
- *"Preliminary Geotechnical Investigation, Rockcliffe Redevelopment Program", dated March 2006 (DST File No.: OGO6562)*.

The locations of the previous boreholes and test pits advanced in the Phase 4 development area are shown on Drawing 4 attached in Appendix B of this report. The logs of the previous boreholes and test pits are also attached to this report in Appendix D.

According to the previous borehole and test pit findings, topsoil up to about 200 mm in depth is present across the site. Asphaltic concrete, with a thickness of about 40- 100 mm, is present on existing roads and driveways. The topsoil and asphaltic concrete are underlain by fill material consisting of various silty sand, sand and gravel or clay in various areas of the site, with thickness ranging from approximately 0.2 to 2.9 m.

The native overburden soil encountered below the fill generally consisted of variable layers of clay, silt sand and sandy and silty till. Bedrock was encountered at depths ranging from 1.2 to 2.9 m below grade. Boreholes drilled into the bedrock typically encountered horizontally bedded, grey limestone with minor narrow shale bedding, interpreted to be of the Ottawa Group. The bedrock surface is generally unweathered or has a narrow weathered zone, less than one meter thick.

The applicable information from the previous geotechnical investigations are discussed and applied to the comments and recommendations presented in this report.

3 FIELDWORK

The fieldwork for this investigation was carried out during the period between November 13 and 20, and December 14, 2018. It consisted of sixty seven (67) boreholes and twenty four (24) exploratory test pits, advanced by drilling and excavation contractors commissioned by **Terrapex**. Of the sixty seven (67) boreholes and twenty four (24) exploratory test pits, twenty six (26) boreholes and eleven (11) test pits were advanced in or near the Phase 4 development lands. The number and location of the boreholes were chosen by **Terrapex** to provide general coverage of the site for the proposed development, and reviewed and approved by IBI Group and CLC. The locations of the test pits were chosen by **Terrapex** to provide general coverage between the boreholes to confirm the depth of bedrock. The locations of the boreholes and test pits advanced within Phase 4 are shown on Drawing 3; enclosed in Appendix B of this report.

The boreholes; designated as BH109 through BH129, BH131, BH133, BH134 and BH173, were advanced to

depths ranging from 0.6 to 2.9 m below ground surface (mbgs). Three (3) of the boreholes; MW111, MW124, and MW125 were instrumented with monitoring wells to determine the long term groundwater table at the site.

The exploratory test pits (designated as TP204 through TP214) were extended to depths ranging from 0.4 to 1.84 mbgs to confirm the existence and depth of bedrock.

The ground surface elevations at the locations of the boreholes and test pits were established by **Terrapex** using Topcon Hiper V GNSS Receiver and Trimble R10 GNSS Receiver respectively.

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

Groundwater level observations were made in the boreholes and test pits upon completion of each of their advancement, and in the monitoring wells on December 17, 2018. The results of the groundwater measurements are discussed in Section 4.5 of this report.

The fieldwork for this project was carried out under the supervision of an experienced geotechnical technician from this office who laid out the positions of the boreholes and test pits in the field; arranged locates of buried services; effected the drilling, test pit excavation, sampling and in situ testing; observed groundwater conditions; and prepared field borehole and test pit log sheets.

4 LABORATORY TESTS

The soil samples retained from the split spoon sampler were properly sealed, labelled and brought to our laboratory. They were visually classified and water content tests were conducted on all soil samples retained from Boreholes BH114, BH118, MW124 and MW125. The results of the classification, water contents, and Standard Penetration Tests are presented on the borehole logs sheets attached in Appendix C of this report.

Grain-size analyses were carried out on four (4) soil samples; Atterberg Limits test was performed on two. The results of these tests are presented as Figures E-1 through E-6 in Appendix E.

In addition, two (2) soil samples were submitted to an analytical laboratory for chemical analyses for pH and soluble sulphate tests. The results of these tests are enclosed in Appendix G; discussed in Section 6.13 of this report.

5 SITE AND SUBSURFACE CONDITIONS

Full details of the subsurface and groundwater conditions at the site are given on the borehole Log sheets attached in Appendix C of this report.

The following paragraphs present a description of the site and a commentary on the engineering

properties of the various soil materials contacted in the boreholes.

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

5.1 Site Description

The subject site is located at the former CFB Rockcliffe property in the City of Ottawa. The former CFB Rockcliffe property is approximately 310 acres; bounded by Aviation Parkway to the west, Sir George Etienne Cartier Parkway to the North, the National Research Council of Canada campus to the east, and existing residential communities and Montfort Hospital to the south. It is bounded by two bedrock escarpments situated at the south and north boundaries. The Rockcliffe Airport is also located in the vicinity of the site, just north of Sir George Etienne Cartier Parkway.

The report reflects our investigation carried out within the Phase 4 development lands as shown in Drawing 1, attached in Appendix B.

The Phase 4 lands are situated north of Hemlock Road, west of Codd's Road, east of vacant NCC lands, and south of Sir George Etienne Cartier Parkway. It has been divided into Blocks 1 through 6 and include proposed Oshedina Street and Winisik Street. The north escarpment is located along the north boundary of Phase 4. The slope of the escarpment is almost vertical with exposed bedrock. There is a storm management pond at the bottom of the escarpment.

There are several old pathways, roadways and driveways traversing through the Phase 4 lands from past land use, and new storm and sewer lines have been installed along the alignment of Oshedina Street and east towards the storm sewer outfall. Stockpiles of fill material from previous phases and ongoing construction activities are located in and around Block 5, within the northern half of Block 2, and scattered throughout the north area of Block 1. The remainder of Phase 4 is covered with light to moderate vegetation with mature trees predominately outlining the perimeters of the Blocks, and scattered throughout Block 1 (Park1). The ground surface topography of Phase 4 lands slopes down from south to north and from east to west, the ground surface elevations at the borehole and test pit locations ranged between 77.25 at Test Pit TP208 to 89.57 m at Borehole BH120.

5.2 Asphaltic Concrete Pavement

Boreholes BH107, BH108, BH115, and BH121 were advanced through asphaltic concrete pavement. They revealed that the thickness of the asphaltic concrete ranges from approximately 40 to 100 mm.

5.3 Granular Base Course

The base course supporting the asphaltic concrete consists of sandy gravel to gravelly sand. The thickness of this granular soil ranges from approximately 700 mm.

Penetration resistance of the base course material measured N-values ranging from 10 to 44, indicating

its compactness condition is compact. The water content of the tested sample of the granular base from Borehole BH107 was about 5% by weight; being damp in appearance.

5.4 Topsoil

Topsoil was encountered in Boreholes BH114, BH118, BH131 and BH134. The thickness of the topsoil at the boreholes varies between approximately 50 and 250 mm.

It should be noted that the topsoil thickness will vary between boreholes. Thicker topsoil than that found in the boreholes may be present in places.

5.5 Fill Material

Fill material is present in all boreholes below the pavement granular base, the topsoil, or surficial vegetation with the exception of Boreholes BH118, BH127, and BH131. The fill consists of various gravelly sand to sandy gravel, silty sand to sandy silt with trace of gravel, and clayey silt soils; extending to approximate depths ranging from 0.3 to 2.9 mbgs. The fill contains traces of organic, rootlet, and rock fragment. At the locations of Boreholes BH114, BH116, BH118, and BH120, the fill material contains trace cinder.

SPT carried out in the silty, sandy, and gravelly fill material measured N-values ranging from 3 to 50/25 mm penetration; indicating very loose to very dense compactness condition; generally being compact. The higher N-values are likely due to the split spoon sampler striking boulders or construction rubble. SPT carried out in the clayey silt fill material measured N-values ranging from 3 to 36; indicating soft to hard consistency; generally being firm.

The fill material is generally brown to dark brown in color and damp to moist in appearance. The water content of the tested fill samples from Boreholes BH107, BH114, BH118, MW124, and MW125, ranges from 5 to 33% by weight.

5.6 Native Soils

5.6.1 Silty Sand to Sand with trace silt

Silty sand to sand with trace silt soils are present below the fill / topsoil materials in Boreholes BH127 and BH131. The sandy soils contain variable proportions of silt classifying the soil as sand with trace to some silt and silty sand.

The silty sand to sand unit is generally brown in colour and moist in appearance.

Penetration resistance in the silty sand to sand units provided N-values ranging from 12 to 74/50 mm penetration, indicating compact to very dense compactness condition.

5.6.2 Silt with trace sand to sandy silt

Silt with trace sand to sandy silt soils are present below the fill material in Boreholes BH112, BH113, BH116, BH118, BH120, BH124, BH126, BH134, and BH173. This unit contains variable proportions of sand

classifying the soil as silt with trace sand to sandy silt.

The sandy silt to silt unit is generally brown in colour. The water content of the tested silt samples from Boreholes BH124, ranges from approximately 8 to 20% by weight; generally being moist to wet in appearance.

Penetration resistance in the silt unit provided N-values ranging from 12 to 50/25 mm penetration, indicating compact to very dense compactness condition.

Sieve and hydrometer grain size analyses were carried out on three (3) samples of silt soil obtained from Boreholes BH112 and BH120. The test results are enclosed in Appendix E as Figures E-1 and E-2, and summarized below.

Borehole Number	Sample Depth (mbgs) and No.	Sample Description	Gravel %	Sand %	Silt %	Clay %
BH112	0.76 (Sample 2)	Silt, some clay, trace sand, trace gravel	3	8	73	16
BH120	0.76 (Sample 2)	Silt, some sand, trace clay	0	20	71	9

Based on the results of the grain size analysis, the K values of the silt soils range from 10^{-5} cm/sec to less than 10^{-6} cm/sec; low permeability.

5.6.3 Clay and Silt

A deposit of silt and clay to clayey silt ranging in thickness from 1.2 to 1.9 m is present below the fill material in Boreholes BH125, BH133 and BH173.

The clay and silt unit is generally brown in colour. The water content of the tested clay and silt samples tested from Borehole BH125 ranges from approximately 11 to 36% by weight; generally being moist to wet in appearance.

Penetration resistance in the clay and silt soil measured N-values ranging from 6 to 17, indicating firm to very stiff consistencies.

Sieve and hydrometer grain size analyses and Atterberg Limits test were carried out on two (2) samples of clay and silt soils. The test results are enclosed in Appendix E as Figures E-3 through E-6, and summarized below.

Borehole No.	Sample Depth (mbgs) and No.	Sample Description	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plasticity Index	Soil Classification
BH125	1.5 (Sample 3)	Clay and Silt, trace sand	0	1	45	54	58	34	Inorganic clays of high plasticity
BH134	0.8 (Sample 2)	Clay and Silt, trace sand	0	4	37	59	53	28	Inorganic clays of high plasticity

The soil classification was based on the plasticity chart as shown on Figure 3.1 of the CFEM, 4th Edition.

Based on the results of the grain size analysis, the K values of the clay and silt soil is less than 10^{-7} cm/sec; very low relative permeability.

5.6.4 Gravelly Sand

A gravelly sand deposit is present in Borehole BH107; positioned at an approximate depth of 1.8 mbgs and extending to the bedrock at 2.2 mbgs.

SPT in the gravelly sand unit had N-value of 75/254 mm penetration, indicating very dense compactness condition. It is greyish brown in colour and has a moist appearance.

5.7 Bedrock

Bedrock was encountered in all boreholes and test pits at approximate depths ranging from 0.6 to 2.9 mbgs, at approximate elevations 76.27 m at Test Pit TP 208 to 88.37 m at Borehole BH120. The bedrock was proven by auger refusal and observations made in test pits. The test pits confirmed that refusal to further advancement of the boreholes was due to bedrock and not large boulders or buried concrete slabs. The depth and elevation of the bedrock encountered in the test pits is tabulated in the table below.

Test Pit No.	Ground Elevation (m)	Depth of Bedrock (mbgs)	Elevation of Bedrock (m)
TP204	86.64	1.84	84.80
TP205	85.81	1.64	84.17
TP206	84.13	1.60	82.53
TP207	82.29	0.64	81.65
TP208	77.25	0.98	76.27
TP209	83.71	1.70	82.01
TP210	88.84	1.60	87.24
TP211	89.64	1.35	88.29
TP212	89.04	1.07	87.97
TP213	88.05	0.78	87.27
TP214	88.28	1.30	86.98

Based on the ground surface elevations, the surface of the rock dips down from the east to the west and from the central section of the site toward the north and south.

The bedrock at the base of all test pits consists of grey limestone.

Review of available geological mapping and previous geotechnical investigations indicates that the bedrock is of the Ottawa Formation, consisting of limestone with some shale bedding and some sandstone in the basal part. According to the previous investigations at the site, the rock is classified to be strong to very strong.

5.8 Groundwater

Groundwater level and cave-in of the unlined side walls of the boreholes were measured during the course of the borehole drilling and upon completion of the boreholes; shown on the individual borehole

logs. All boreholes were open and dry upon completion with the exception of the ones listed in the following table:

Borehole No.	Groundwater Depth (m)	Cave-in Level (mbgs)
BH107	Dry	1.8
BH108	Dry	1.5
BH110	Dry	0.9
BH133	Dry	1.8
BH134	0.9	Open

Groundwater conditions exposed in the test pit excavations were also observed. All test pits remained dry upon completion of excavation.

Groundwater levels in the monitoring wells were measured on December 17, 2018. The results of the groundwater measurement are shown in the following table.

Borehole No.	Ground Elevation (m)	Bottom of the Monitoring Well Depth (m)	Bottom of the Monitoring Well Elevation (m)	Groundwater Depth (mbgs)	Groundwater Elevation (mbgs)
MW111	86.96	2.6	84.36	Dry	-
MW124	90.15	1.7	88.45	Dry	-
MW125	82.65	2.4	80.25	0.25	82.40

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

6 DISCUSSION AND RECOMMENDATIONS

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

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

On the basis of our fieldwork, laboratory tests and other pertinent information supplied by the client, the following comments and recommendations are made.

6.1 Site Grading

The proposed grading plan prepared and provided for our use by IBI Group and dated December 2018 is included in Appendix B as Drawings 6 and 7.

Based on the proposed grading plan, there will be some modifications to the site grading. The grade will be raised/cut by a maximum of 1m. Given the subsurface conditions at the site; i.e. shallow bedrock, and the absence of thick layers of soft clay, the proposed grade raise will not cause any settlement of the subsoil.

6.2 Engineered Fill

The following recommendations regarding construction of engineered fill should be adhered to during the construction stage:

- All surface vegetation, organic materials, softened and disturbed soils must be removed, and the exposed subgrade soils proof-rolled with an inspection by the Geotechnical Engineer prior to any fill placement.
- In the event that the engineered fill will be used to support structures, the existing fill must be removed in its entirety prior to placement of new fill.
- Soils used as engineered fill should be free of organics and/or other unsuitable material. The engineered fill must be placed in lifts not exceeding 200 mm in thickness and compacted to at least 98% Standard Proctor maximum Dry Density (SPMDD).
- Engineered fill operations should be monitored and compaction tests should be performed on a full-time basis by a qualified engineering technician supervised by the project engineer.
- The boundaries of the engineered fill must be clearly and accurately laid out in the field by qualified surveyors prior to the commencement of engineered fill construction. The top of the engineered fill should extend a minimum of 2.5 m beyond the envelope of the proposed structures. Where the depth of engineered fill exceeds 1.5 m, this horizontal distance of 2.5 m beyond the perimeter of the structure should be increased by at least 1 m for each 1.5 m depth of fill. The edges of the engineered fill should be sloped at a maximum of 3 horizontal to 1 vertical in order to avoid weakening of the engineered fill edges due to slope movement.
- Due to the potential detrimental effects of differential settlement between the engineered fill and the native soils, any buildings where footings are to be placed engineered fill or partly on engineered fill and partly on native soils should include steel reinforcement. The foundation walls of house foundations supported on engineered fill should be reinforced to bridge localized soft spots and zones of non-uniform compaction, and to minimize structural distress due to differential settlement of the engineered fill.
- The engineered fill operation should take place in favorable climatic conditions. If the work is carried out in months where freezing temperatures may occur, all frost affected material must be removed prior to the placement of frost-free fill.
- If unusual soil conditions become apparent during construction, due to subsurface groundwater influences, our office should be contacted in order to assess the conditions and recommend appropriate remedial measures.

6.3 Excavation

Based on the borehole findings, excavation for foundations, potential basements, sewer trenches and utilities will be carried out through fill material, sandy, silty, and clayey native soils, and bedrock. Excavation of the soil strata is not expected to pose any difficulty and can be carried out with heavy hydraulic excavators.

Significant bedrock excavation is anticipated across the site. According to the rock core data from the previous investigations, the bedrock generally consists of strong to very strong limestone with interbedded shale of variable bed thicknesses and depth across the site.

Bedrock excavation is expected to be carried out using line drilling and blasting, hoe ramming or both.

Provision should be made in the excavation contract to include the use of these techniques for excavation in bedrock.

Blasting operations must be carried out in accordance with City of Ottawa Special Provision S.P. No: F-1201 and under the supervision of a blasting specialist engineer. Vibration monitoring of the blasting operation should be undertaken to ensure that the blasting meets the limiting vibration criteria at all times.

The contractor should submit a complete and detailed blasting design and monitoring proposal prepared by a blasting/vibrations specialist prior to commencing blasting. This would have to be reviewed and accepted in relation to the requirements of the blasting specifications. Vibration monitoring of the blasting should be carried out to ensure that the blasting meets the limiting vibration criteria at all times. A pre-blast condition survey should be carried out of surrounding structures and utilities located within 100 m of the excavation site. The condition survey should also include the National Research Council's Montreal Road Campus located east of the subject site.

All excavations must be carried out in accordance with Occupational Health and Safety Act (OHSA). With respect to OHSA, the near surface fill, compact sandy silt to silt and sand to silty sand, and firm clay and silt soils are expected to conform to Type 3 soils. The dense to very dense sandy silt to silt and sand to silty sand, and stiff to very stiff clay and silt soils can be classified as Type 2 soils. The bedrock is classified as Type 1 soil.

Temporary excavations for slopes in Type 3 soil should not exceed 1.0 horizontal to 1.0 vertical. In the event very loose and/or soft soils are encountered at shallow depths or within zones of persistent seepage, it will be necessary to flatten the side slopes as necessary to achieve stable conditions. In wet sandy soils it may be necessary to slope the excavation at inclinations from 1.0 vertical to 2.0 horizontal to 1.0 vertical to 3.0 horizontal. Excavations in Type 2 soil may be cut with vertical side-walls within the lower 1.2 m height of excavation and 1.0 horizontal to 1.0 vertical above this height. Excavations in the bedrock may be cut with vertical side-walls.

For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number designation. Excavation side-slopes should not be unduly left exposed to inclement weather. Excavation slopes consisting of sandy soils will be prone to gullying in periods of wet weather, unless the slopes are properly sheeted with tarpaulins.

It should be noted that the on-site fill material may contain boulders, cobbles and remnants of former buildings in the form of buried concrete. Provisions must be made in the excavation and foundation installation contracts for the removal of possible boulders and concrete.

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

It is anticipated that sufficient space will be available to slope the sidewalls of basement excavations; as such it should not be necessary to shore the basement excavation walls.

6.4 Reuse of On-site Excavated Soil as a Compacted Backfill

On-site excavated inorganic native soils are considered suitable for reuse as backfill material within the roadways and pipeline trench excavations, provided their water content is within 2% of their optimum water contents (OWC) as determined by Standard Proctor test, and the materials are effectively compacted with heavy compaction rollers.

While the quality of the native soils are considered suitable for backfilling; the moisture content of the soils and the lift thickness for compaction must be properly controlled during the backfilling. Alternatively, imported suitable material should be used.

Measured water content ranges from approximately 4 to 36% within the native soils and from 5 to 37% within the fill material; generally being close to the wet side of the material's OWC. On-site native soils that are wetter than their OWC should be dried sufficiently prior to use as backfill in order to achieve the specified degree of compaction. Spreading the material in a wide area and air drying will be required to achieve the specified compaction of the native material. Thorough vertical mixing of the excavated soils will be required to provide a material that can be adequately compacted.

The spoil resulting from excavation through the bedrock will contain a large amount of hard rock slabs which will be virtually impossible to compact. Bedrock crushed on-site can be used as granular material provided that it conforms to OPSS gradation requirements and physical properties.

6.5 Groundwater Control

Based on observations made during drilling of the boreholes and excavation of the test pits, close examination of the soil samples extracted from the boreholes, and groundwater measurements made in the monitoring wells, significant groundwater problems are not anticipated within the presumed excavation depths throughout the site. While some seepage of groundwater from localized permeable layers will occur during construction, it will be possible to remove any such seepage using submersible pumps.

Dewatering can be carried out using existing Permit to Take Water (PTTW) obtained by CLC from the MOECP.

Surface water should be directed away from open excavations.

6.6 Residential and Mixed-Use Buildings

6.6.1 Foundation Design

We understand that the proposed buildings will be constructed over a single level basement. Details regarding the remaining Blocks were not available at the time of the investigation, and accordingly the recommendations provided in this report are considered to be preliminary in nature, subject for review and revision upon completion of proposed plans. Additional boreholes may have to be advanced by the builders at the site once the details of the proposed buildings are finalized.

Conventionally, footing foundations of heated and unheated buildings are positioned at depths of 1.5 m and 1.8 m respectively below exterior grade in the Ottawa area, in order to provide protection to the foundation soil from freezing temperatures.

The foundations for the mid-rise buildings should be installed on the bedrock.

It should also be noted that intact bedrock will not be subjected to frost heave, and provided that footings are extended to non-fractured intact rock, the minimum founding depth of 1.8 m would not apply, and the footings may be placed at shallower depths.

It is not recommended to install the foundations of the proposed low-rise buildings on the existing fill material. Based on the borehole findings, the bearing stratum should consist of the bedrock, native soil or engineered fill. The native soil throughout the site is considered suitable for the support of low rise building foundations. Locally, it will be necessary to deepen the foundations where the native soil is less competent in strength.

Foundations may be constructed on engineered fill provided that the existing fill is removed in its entirety and the engineered fill is constructed in accordance with recommendations provided in Section 6.2 of this report.

Conventional spread and strip footings may be used to support the proposed buildings.

Foundations installed on the native soil or certified engineered fill may be designed based on bearing resistance of 100 KPa at Serviceability Limit States (SLS), and factored geotechnical bearing resistances at Ultimate Limit States (ULS) of 150 kPa.

The geotechnical bearing resistances recommended above are for vertical loads (no inclination) and no eccentricity. The total and differential settlements of spread footing foundations founded on the native soil designed in accordance with the recommendations provided in this report should not exceed the conventional limits of 25 mm and 19 mm respectively.

Foundations installed on the bedrock may be designed for a factored bearing resistance at Ultimate Limit States of 1 MPa (ULS). The serviceability limit state is not applicable as bedrock will not undergo settlement.

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

In the event necessary, the stepping of the footings at different elevations should be carried out at an angle no steeper than 2 horizontal (clear horizontal distance between footings) to 1 vertical (difference in elevation) on the native soil and 1 horizontal to 1 vertical on the bedrock. No individual footing step should be greater than 0.6 m.

Rainwater or groundwater seepage entering the foundation excavations must be pumped away (not allowed to pond). The foundation subgrade soils should be protected from freezing, inundation and equipment traffic at all times. If unstable subgrade conditions develop, **Terrapex** should be contacted in order to assess the conditions and make appropriate recommendations.

The native soils and rock tend to weather and deteriorate rapidly on exposure to atmosphere or surface water, so construction scheduling should consider the amount of excavation left exposed to the elements, during foundation preparation. **Terrapex** recommends that footings placed on the exposed soil should be poured on the same day as they are excavated, after removal of all unsuitable founding materials and approval of the bearing surface. Alternatively, a concrete mud slab could be used to protect a bearing surface where footing construction is to be delayed.

In the absence of a significant clay soil within the residential Blocks (Blocks 2 to 6), a tree planting restriction does not apply for the proposed residential buildings as outlined in the City of Ottawa's, Tree Planting in Sensitive Marine Clay Soils 2017 Guideline.

6.6.2 Concrete Slab-on-Grade

For building(s) without basement construction, the subgrade supporting the ground floor slab should consist of native soil or engineered fill. Subgrade preparation should include the removal of surface vegetation, organic materials, weak and softened soils and all fill soils. After removal of all unsuitable materials, the subgrade should be proof-rolled with heavy rubber tired equipment and adjudged as satisfactory before constructing engineered fill or placement of granular base course. The proof-rolling operation should be witnessed by the Geotechnical Engineer. Any soft or unsuitable subgrade areas which deflect significantly should be sub-excavated and replaced with suitable engineered fill material compacted to at least 98% of SPMDD.

For building(s) that include a single level basement, the basement floor slabs should rest on the native soil, bedrock or engineered fill; suitable for slab-on-grade construction. Subgrade preparation should include the removal of any disturbed soils, followed by proof-rolling to confirm the subgrade conditions. Any unsuitable subgrade areas which deflect significantly should be sub-excavated and replaced with suitable engineered fill material compacted to at least 98% of its SPMDD.

Where new fill is required to raise the grade, the excavated earth fill and native sandy silty clay material from the site or similar clean imported fill material may be used, free from topsoil, organic or deleterious matter, provided the material is placed in large areas where it can be compacted with a heavy vibratory roller. The fill material should not be frozen and should not be too dry or too wet for efficient compaction (moisture content at optimum or 2% greater than optimum). The fill placement should not be performed during winter months when freezing temperatures occur persistently or intermittently. All fill placed below the slab on grade areas of the buildings must be placed in thin lifts of 200 mm thickness or less, and compacted to a minimum of 98% of SPMDD.

Provided the subgrade, under-floor fill and granular base are prepared in accordance with the above recommendations, the Modulus of Subgrade Reaction (ks) for floor slab design will be 25,000 kPa/m.

It is recommended that a combined moisture barrier and a leveling course, having a minimum thickness of 150 mm and comprised of free draining material be provided as a base for the slab-on-grade. For building(s) without basement construction, either Granular "A" or 20 mm crusher run limestone may be used. For building(s) with basement construction, 20 mm clear crushed limestone is recommended as the base course. The Granular "A" should be compacted to 100% of its SPMDD; the 20 mm clear stone must be compacted by vibration to a dense state.

For building(s) containing a basement level, an exterior perimeter drainage system, consisting of 100 mm diameter weeping tile wrapped in filter fabric and covered with a minimum 150 mm clear crushed stone should be placed along the exterior foundation walls, below the level of the granular base of the floor slab. The weeping tiles must be connected to a positive frost free outlet from which the water can be removed, or connected to a sump located in the basement. The water from the sump must be pumped out to a suitable discharge point. The installation of the perimeter drains as well as the outlet must conform to the applicable plumbing code requirements.

For building(s) without basement construction, perimeter drainage at the foundation level is not required provided the finished floor surface is at least 150 mm above the prevailing grade and the surrounding surfaces slope away from the buildings.

For building(s) with basement construction, the basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material such as OPSS Granular "B" Type I. Damp-proofing must be applied to the exterior basement walls.

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

6.7 Park 1: North Community Park

It is understood that the north Community Park will be located on Block 1 along the northern border of the site and occupy an area of 10.34 hectares. It will partially front onto Codd's Road on the east and local roads on the west and south sides. It will overlook the Ottawa River on the north side.

The topography of the park area is not level; generally sloping down from south to north. It contains steep ridges and some significant tree and vegetation groupings along the northern and southern boundaries.

The park will serve as the primary passive-recreational space for the community and contain a multi-use pathway system, a community building, look-out area with water feature, outdoor amphitheatre, shade structure, playground, splash pad, open space free play area, toboggan hill, and community gathering area. The approximate locations of the proposed features are shown on the Facility FIT Plan and provided for our use by CLC; shown on Drawing 5 attached in Appendix B.

According to the proposed grading plan, there will be some minor modifications to the park grades. Details regarding building locations, design and municipal infrastructure on Block 1 are considered to be preliminary in nature, subject for review and revision upon completion of proposed plans.

6.7.1 Community Building

It is anticipated that the proposed community building will be a 3,000 ft^2, single storey above grade structure: constructed on the west side of the park.

The subsurface conditions for the proposed building are represented by Borehole BH127. The borehole reveals that bedrock is situated at an approximate depth of 1.5 mbgs.

Conventional spread and wall footings may be used to support the proposed building. Footing foundations which rest on the bedrock may be designed to apply a factored bearing resistance at Ultimate Limit States of 1 MPa (ULS). The serviceability limit state is not applicable as bedrock will not undergo settlement.

The rock tends to weather and deteriorate rapidly on exposure to atmosphere or surface water, so construction scheduling should consider the amount of excavation left exposed to the elements, during foundation preparation. **Terrapex** recommends that footings placed on the exposed bedrock should be poured on the same day as they are excavated, after removal of all unsuitable founding materials and approval of the bearing surface. Alternatively, a concrete mud slab could be used to protect a bearing surface where footing construction is to be delayed.

The subgrade supporting the floor slab of the community building will consist of native silty sand soil.

Subgrade preparation should include the removal of surface vegetation, organic materials, weak and softened soils. After removal of all unsuitable materials, the subgrade should then be proof-rolled with heavy rubber tired equipment and adjudged as satisfactory before preparing the granular base course. The proof-rolling operation should be witnessed by geotechnical staff. Any soft or unsuitable subgrade areas should be sub-excavated and replaced with suitable approved compacted backfill; placed in maximum lifts of 200 mm and compacted to at least 98% of SPMDD.

Where new fill is required to raise the grade, the excavated earth fill and native sand and silt material from the site or similar clean imported fill material free from topsoil, organic or deleterious matter, may be used, provided the material is placed in large areas where it can be compacted with a heavy vibratory roller. The fill material should not be frozen and should not be too dry or too wet for efficient compaction (moisture content at optimum or 2% greater than optimum). The fill placement should not be performed during winter months when freezing temperatures occur persistently or intermittently. All fill placed below the slab on grade areas of the buildings must be placed in thin lifts of 150 mm thickness or less, and compacted to a minimum of 98% of SPMDD.

It is recommended that a combined moisture barrier and a levelling course, with a minimum thickness of 150 mm and comprised of free draining material be provided as a base for the slab-on-grade, either Granular "A" or 20 mm crusher run limestone may be used and compacted to 100% of its SPMDD.

Perimeter drainage at the foundation level is not required provided the finished floor surface is at least 150 mm above the prevailing grade and the surrounding surfaces slope away from the building at a gradient of at least 2 percent.

6.7.2 Look-Out Area

We understand that it is proposed to construct a look-out area with a prominent water feature along the northern boundary to optimize the views to the Ottawa River.

Test Pit (TP208) was advanced in the proposed look-out area and revealed that the stratigraphy in this area consists of fill material extending to an approximate depth of 1.7 mbgs, followed by bedrock.

Conventional spread and strip footings founded on the bedrock may be used to support the proposed structure. It is recommended that the foundation is designed and prepared in accordance with the recommendations provided in section 6.7.1 of this report.

Due to the proximity of the proposed lookout structure to the crest of the escarpment at the northern boundary of the park, a slope stability analysis must be carried out based on the profile of the existing slope and subsurface soil and groundwater data collected from the current and previous investigations. The proposed structure must be set a safe distance from the crest of the escarpment.

6.7.3 Shade Structure

Borehole BH128 which was advanced in the proposed shade structure area revealed that the soil stratigraphy consists of fill; extending to an approximate depth of 1 mbgs, followed by bedrock.

Conventional spread and strip footings founded on the bedrock may be used to support the proposed structure. It is recommended that the foundation is designed and prepared in accordance with the recommendations provided in section 6.7.1 of this report.

The subgrade supporting the floor slab of the shade structure will consist of fill soil. It is recommended that the subgrade is prepared in accordance with the recommendations provided in section 6.7.1 of this report.

It is recommended that a combined moisture barrier and a levelling course, with a minimum thickness of 150 mm and comprised of free draining material be provided as a base for the slab-on-grade, either Granular "A" or 20 mm crusher run limestone may be used and compacted to 100% of its SPMDD. The granular material must be adequately drained to minimize frost heave or be provided with insulation.

Uplift resistance should be considered for the design of the canopy structure which is subject to wind uplift forces. The uplift resistance should be provided using the dead weight of the foundation as well the soil weight above the footing of the canopy structures. For design purposes, the unit weight of concrete may be taken as 24 kN/m^3 and the backfill placed above the footings is 20 kN/m^3. If increased uplift capacities are required, this may be achieved by increasing the weight (size) of the foundation, or alternatively, with the use of rock anchors.

6.7.4 Playground

It is expected that the playground structures will be lightly loaded frame structures, which will probably be supported on a set of foundations.

Borehole BH129 which was advanced in the vicinity of the proposed playgroundand revealed that the soil stratigraphy consists of fill extending to an approximate depth of 1.5 mbgs, followed by bedrock.

Conventional spread and strip footings founded on the bedrock may be used to support the proposed structure. It is recommended that the foundation is designed and prepared in accordance with the recommendations provided in section 6.7.1 of this report.

The site preparation should consist of removing the existing topsoil layer and profiling the subgrade to the design grades to provide efficient drainage. The fill should provide a satisfactory subgrade to support the playing field.

If any unsuitable fill is contacted at subgrade elevation, this should be removed to contact the underlying competent native sand and silt (till) soil. The sub-excavation should be upfilled with suitable selected fill material (reuse of site excavated soil) and compacted to a dry density of not less than 95% of the materials SPMDD. Construction of turf and the site subgrade systems should be carried out to meet the design requirements of the artificial turf supplier.

6.7.5 Splash Pad

It is anticipated that the splash pad will consist of concrete slab on grade. It is recommended that the subgrade is prepared in accordance with the recommendations provided for in section 6.7.1 of this report.

Once the subgrade soils have been improved, it is recommended that a minimum 300 mm thick levelling granular base course (Granular A or 20 mm crusher run limestone) is constructed to provide uniform support to the concrete slab.

Sub-drains are recommended to prevent accumulation of water within the granular material, to intercept excess subsurface moisture and minimize subgrade softening. The invert of sub-drains should be maintained at least 0.3 m below subgrade level.

The foundation soils should be insulated from freezing conditions in order to mitigate movement of the foundation soils as a result of the freeze-thaw cycle.

A styrofoam insulating layer (about 150 mm thick) may be placed to rest on the granular base layer under the concrete slab extending a minimum of 1.8 m beyond the outside limit of the floor slab and is placed at a slight slope grading away from the structure to encourage drainage.

The insulation should be protected against degradation by sunlight and damage from surface traffic (with about 200 mm thick overlay layer consisting of granular material, topsoil or sod).

6.7.6 Tree Planting Recommendations in Sensitive Clay Soil

A clay soil layer ranging in thickness between 1.2 and 1.8 m is present in Boreholes MW125, BH133, BH134 and BH173, located in the east section of the Park Block. The approximate area containing the clay soil is shown on Drawing 8 attached in Appendix B. Based on the new concept drawing of Park 1 (Kishkabika Park) no structures are proposed for this area of the site with the exception of a toboggan hill and walking trails. Therefore the tree planting restrictions as described in the City of Ottawa's Tree Planting in Sensitive Marine Clay Soils 2017 Guideline, do not apply for the proposed development.

6.8 Slope Stability Blocks 1 and 6

Based on grading plans received from IBI, the existing slope traversing Block 6 is approximately 2.5 m in height and stands at a gradient of 1V:8H. This slope is considered to be stable and no analysis is required. The grading plan for this area is shown on Drawing 6 attached in Appendix B.

Terrapex has been commissioned by CLC to carry out a stability assessment of the slope present in the southeast corner of Block 1. The findings of this assessment will be reported under separate cover.

6.9 Service Trenches

Based on the proposed site grades, sewer pipes and water mains will be supported on the bedrock or undisturbed native sandy and silty soils which are considered suitable for supporting water mains, sewer pipes, manholes, catch basins and other related structures

The type of bedding depends mainly on the strength of the subgrade immediately below the invert levels.

Normal Class 'B' bedding is recommended for underground utilities. Granular 'A' or 19 mm crusher-run limestone can be used as bedding material; all granular materials should meet OPS 1010 specifications. The bedding material should be compacted to a minimum of 95% SPMD. Bedding details should follow the applicable governing design detail (i.e. City of Ottawa, OPSD). Trenches dug for these purposes should not be unduly left exposed to inclement weather.

Pipe bedding and backfill for flexible pipes should be undertaken in accordance with OPSD 802.010. Pipe embedment and cover for rigid pipes should be undertaken in accordance with OPSD 802.030.

If unsuitable bedding conditions occur, careful preparation and strengthening of the trench bases prior to sewer installation will be required. The subgrade may be strengthened by placing a thick mat consisting of 50 mm crusher-run limestone. Field conditions will determine the depth of stone required. Geotextiles and/or geogrids may be helpful and these options should be reviewed by **Terrapex** on a case by case basis.

Sand cover material should be placed as backfill to at least 300 mm above the top of pipes. Placement of additional granular material (thickness dictated by the type of compaction equipment) as required or use of smaller compaction equipment for the first few lifts of native material above the pipe will probably be necessary to prevent damage to the pipe during the trench backfill compaction.

It is recommended that service trenches be backfilled with on-site native materials such that at least 95% of SPMDD is obtained in the lower zone of the trench and 98% of SPMDD for the upper 1000 mm. In areas of narrow trenches or confined spaces such as around manholes, catch basins, etc., the use of aggregate fill such as Granular 'B' Type I (OPSS 1010) is required if there is to be post-construction grade integrity.

Impermeable clay should be provided across the entire width of the service trenches. It is recommended that the seals be at least 1.0 m in length along the trench (in accordance with the city of Ottawa Standard S8). The seals should be constructed at intervals no greater than 100 m along all sewer installations.

6.10 Pavement Design

6.10.1 On-Grade Construction

Based on the existing topography of the site and the proposed grades, re-grading of the subgrade will be required. It is anticipated that the sub-grade material for the pavement will generally comprise of engineered fill.

The subgrade should be thoroughly proof-rolled and re-compacted to ensure uniformity in subgrade strength and support. Lift thicknesses should not exceed 200 mm in a loose state and the excavated site material should be compacted using heavy vibratory rollers. As an alternative, if suitable on-site native material is not available, the upper part of the subgrade could be improved by placing imported granular material.

If construction is carried out in inclement weather, there is a likelihood that some amount of road sub-base supplement will be required (i.e. some sub-excavation followed by granular replacement).

Given the frost susceptibility and drainage characteristics of the subgrade soils, the pavement design presented below is recommended.

Recommended Asphaltic Concrete Pavement Structure Design
(Minimum Component Thicknesses)

Pavement Layer	Compaction Requirements	Light Duty Pavement Local Residential Routes	Heavy Duty Pavement Transit Routes
Surface Course	as per OPSS 310	40 mm Superpave 12.5 Level B Asphalt (PG58-34)	40 mm Superpave 12.5 Level D Asphalt (PG64-34)
Binder Course	as per OPSS 310	50 mm Superpave 19 mm Level B Asphalt (PG58-34)	100 mm Superpave 19 mm Level D Asphalt (PG64-34)
Granular Base	100% SPMDD	150 mm Granular 'A' (OPSS 1010) Pit Run or 19 mm Crusher Run Limestone	150 mm Granular 'A' (OPSS 1010) Pit Run or 19 mm Crusher Run Limestone
Granular Sub-Base	100% SPMDD	450 mm Granular 'B' Type II (OPSS 1010)	600 mm Granular 'B' Type II (OPSS 1010)

The subgrade must be compacted to at least 98% of SPMDD for at least the upper 600 mm and 95% below this level. The granular base and sub-base materials should be compacted to a minimum of 100% SPMDD.

The long-term performance of the proposed pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible when fill is placed and that the subgrade is not disturbed and weakened after it is exposed.

Control of surface water is a significant factor in achieving good pavement life. Grading adjacent to the pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. In addition, the need for adequate drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum gradient of three percent) to provide effective drainage toward subgrade drains. Continuous sub-drains are recommended to intercept excess subsurface moisture at the curb lines and catch basins. The invert of sub-drains should be maintained at least 0.3 m below subgrade level.

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

- As part of the subgrade preparation, the proposed pavement areas should be stripped of vegetation, topsoil, unsuitable earth fill and other obvious objectionable material. The subgrade should be properly shaped and sloped as required, and then proof-rolled. Loose/soft or spongy subgrade areas should be sub-excavated and replaced with suitable approved material compacted to at least 98% of SPMDD.
- Where new fill is needed to increase the grade or replace disturbed portions of the subgrade, excavated inorganic soils or similar clean imported fill materials may be used, provided their moisture content is maintained within 2 % of the soil's optimum moisture content. All fill must be placed and compacted to not less than 98% of SPMDD.
- For fine-grained soils, as encountered at the site, the degree of compaction specification alone cannot ensure distress free subgrade. Proof-rolling must be carried out and witnessed by **Terrapex** personnel for final recommendations of sub-base thicknesses.
- In the event that pavement construction takes place in the spring thaw, the late fall, or following periods of significant rainfall, it should be anticipated that an increase in thickness of the granular sub-base layer will be required to compensate for reduced subgrade strength.

6.10.2 Above Parking Garage Roof

The pavement above the parking garage roof slab may be comprised of a minimum of 75 mm thick layer of granular 'A' topped with asphaltic concrete having a minimum thickness of 80 mm (40 mm HL8 and 40 mm HL3). The asphaltic concrete materials should be rolled and compacted in accordance with OPSS 310 requirements.

The gradation and physical properties of HL-3 and HL-8 asphaltic concrete, and Granular 'A' shall conform to the OPSS standards.

The critical section of pavement will be at the transition between the pavement on grade and the pavement above the garage roof slab. In order to alleviate the detrimental effects of dynamic loading / settlement / pavement depression in the backfill to the rigid garage roof structure, it is recommended that an approach type slab be constructed at the entrance/exit points, by extending the granular sub-base to greater depths along the exterior garage wall.

The granular courses of the pavement should be placed in lifts not exceeding 150 mm thick and be compacted to a minimum of 100% SPMDD.

6.11 Lateral Earth Pressure

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

Soil Parameters

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

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

Soil Parameter Values

Soil	Parameter				
	Φ'	Y	K_a	K_p	K_0
Fill Material	28°	18	0.36	2.77	0.53
Silty Sand to Sand	compact - 32°	19.0	0.31	3.25	0.47
Silt to Sandy Silt	dense to very dense - 36°	19.0	0.26	3.85	0.41
Clay and Silt	30°	20	0.33	3.00	0.5
Bedrock	36°	25	0.26	3.85	0.41

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

$P = K (\gamma h + q)$

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

K = applicable lateral earth pressure coefficient

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

q = the complete surcharge loading (kPa)

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

The coefficient of earth pressure at rest (K_o) should be used in the calculation of the earth pressure on the basement walls.

Resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (R) depends on the normal load on the soil contact (N) and the

frictional resistance of the soil (tan Φ') expressed as: R = N tan Φ'. This is an ultimate resistance value and does not contain a factor of safety.

6.12 Earthquake Design Parameters

The 2012 Ontario Building Code (OBC) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

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

Based on the current and previous borehole and test pit information, the subsurface stratigraphy generally comprises surficial topsoil and asphaltic concrete pavement, underlain by fill material, followed by various native soils consisting of silty sand to sand, sandy silt to silt, and clay and silt soils, underlain by limestone bedrock at shallow depths. Based on the above, the site designation for seismic analysis is estimated to be Class B according to Table 4.1.8.4.A from the quoted code.

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

6.13 Chemical Characterization of Subsurface Soil

Two (2) soil samples obtained from Boreholes BH108 and BH127 were submitted to Maxxam Analytics Inc. for pH index test, water-soluble sulphate, and chloride content to determine the potential of attacking the subsurface concrete and corrosion of steel pipelines. The test results are summarized below:

Soil Parameter	BH108: 0.76 mbgs (Sample 2)	BH127: 0.76 mbgs (Sample 2)
pH	7.58	7.54
Water-soluble Sulphate (%)	0.0098	0.0026
Chloride (%)	ND*	ND

*ND: Not Detected

The pH of the tested samples indicates a slight alkalinity. The concentration of water-soluble sulphate content of the tested samples is below the CSA Standard of 0.1% water-soluble sulphate (Table 12 of CSA A23.1, Requirements for Concrete Subjected to Sulphate Attack). Special concrete mixes against sulphate attack is therefore not required for the sub-surface concrete of the proposed buildings. The chloride content was not detected in the tested samples. .

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

7 LIMITATIONS OF REPORT

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

Yours respectfully

Terrapex Environmental Ltd.

Rachel Herzog, C.E.T
Project Coordinator and Senior Field Inspector

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

APPENDIX A

LIMITATIONS OF REPORT

Limitations of report

The conclusions and recommendations in this report are based on information determined at the inspection locations. Soil and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

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

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

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of inspection locations may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

APPENDIX B

DRAWING 1: SITE LOCATION
DRAWING 2: PROPOSED DEVELOPMENT PLAN
DRAWING 3: BOREHOLE AND TEST PIT LOCATION PLAN
DRAWING 4: PREVIOUS BOREHOLE AND TEST PIT LOCATION PLAN
DRAWING 5: PROPOSED PARK 1
DRAWING 6: PROPOSED GRADING PLAN – PART OF PHASE 4
DRAWING 7: PROPOSED GRADING PLAN – PART OF PHASE 2 & 4
DRAWING 8: EXTENT OF Clay SOILS

TERRAPEX

SITE LOCATION

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada

LEGEND

- FORMER CFB ROCKCLIFFE
- PHASE 4

0 250m 500m

SOURCE: VUMAP FIRST BASE SOLUTIONS, 2017 IMAGERY AND PREFERRED PLAN - LAND USE BY MMM GROUP AND MELOSHE & ASSOCIATES, OCTOBER 2015.

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SK/ SF/ AB
CHECKED	
DRAWING #	DRAWING 1

TERRAPEX

PROPOSED DEVELOPMENT PLAN

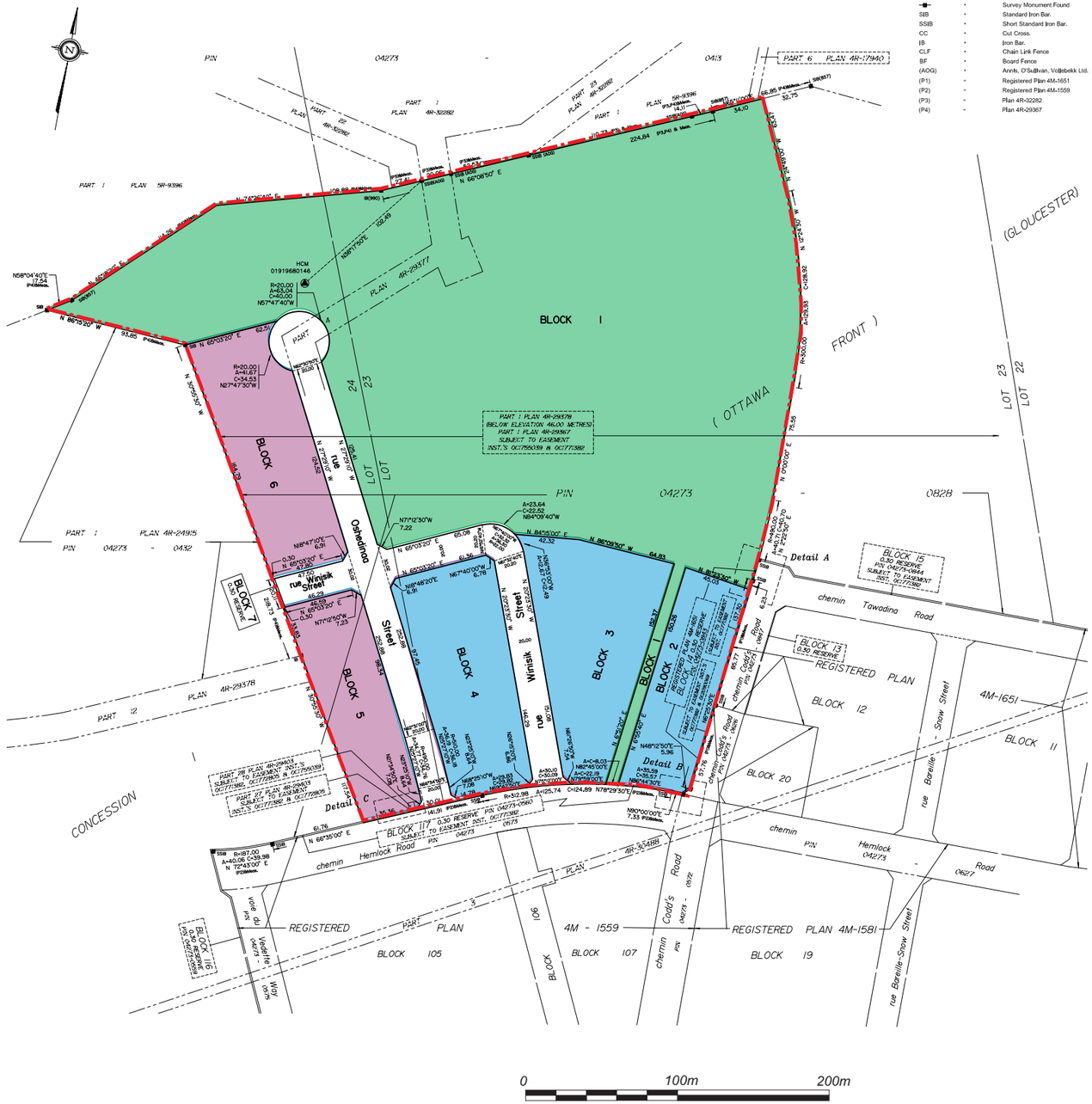
WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada

NOTES AND LEGEND

-O-	denotes	Survey Monument Planted,
-■-	"	Survey Monument Found
SIB	"	Standard Iron Bar.
SSIB	"	Short Standard Iron Bar.
CC	"	Cut Cross.
IB	"	Iron Bar.
CLF	"	Chain Link Fence
BF	"	Board Fence
(AOG)	"	Annis, O'Sullivan, Vollebekk Ltd.
(P1)	"	Registered Plan 4M-1651
(P2)	"	Registered Plan 4M-1559
(P3)	"	Plan 4R-32282
(P4)	"	Plan 4R-29367

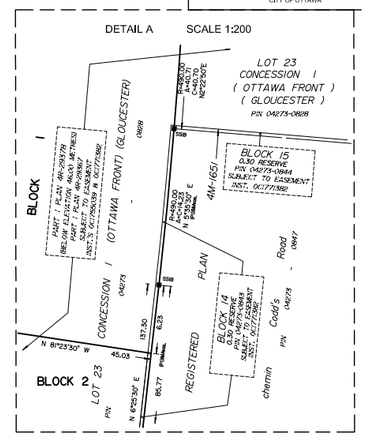


APPROVED UNDER SECTION 51 OF THE PLANNIN
BY THE CITY OF OTTAWA.

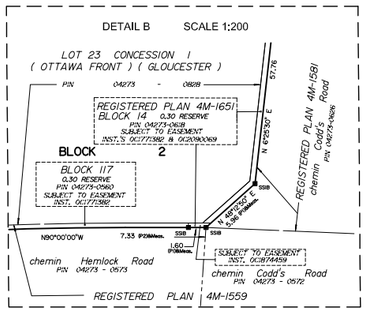
THIS _____ DAY OF _____, 2

STEPHEN WILLIS, MCIP, RPP.
GENERAL MANAGER
PLANNING, INFRASTRUCTURE AND ECONOMI
DEVELOPMENT DEPARTMENT
CITY OF OTTAWA

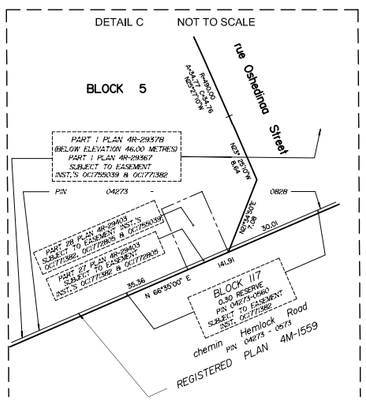
DETAIL A SCALE 1:200



DETAIL B SCALE 1:200



DETAIL C NOT TO SCALE



0 100m 200m

LEGEND

- PARK
- LOW TO MID RISE RESIDENTIAL
- LOW TO MID RISE MIXED USE
- APPROXIMATE LOCATION OF INVESTIGATIONS

SOURCE: VUMAP FIRST BASE SOLUTIONS, 2017 IMAGERY AND DRAFT PLAN OF SUBDIVISION PREPARED BY ANNIS , O'SULLIVAN , VOLLEBEKK LTD., JANUARY 11, 2016.

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SK/ SF/ AB
CHECKED	
DRAWING #	DRAWING 2

TERRAPEX

BOREHOLE AND TEST PIT LOCATION PLAN

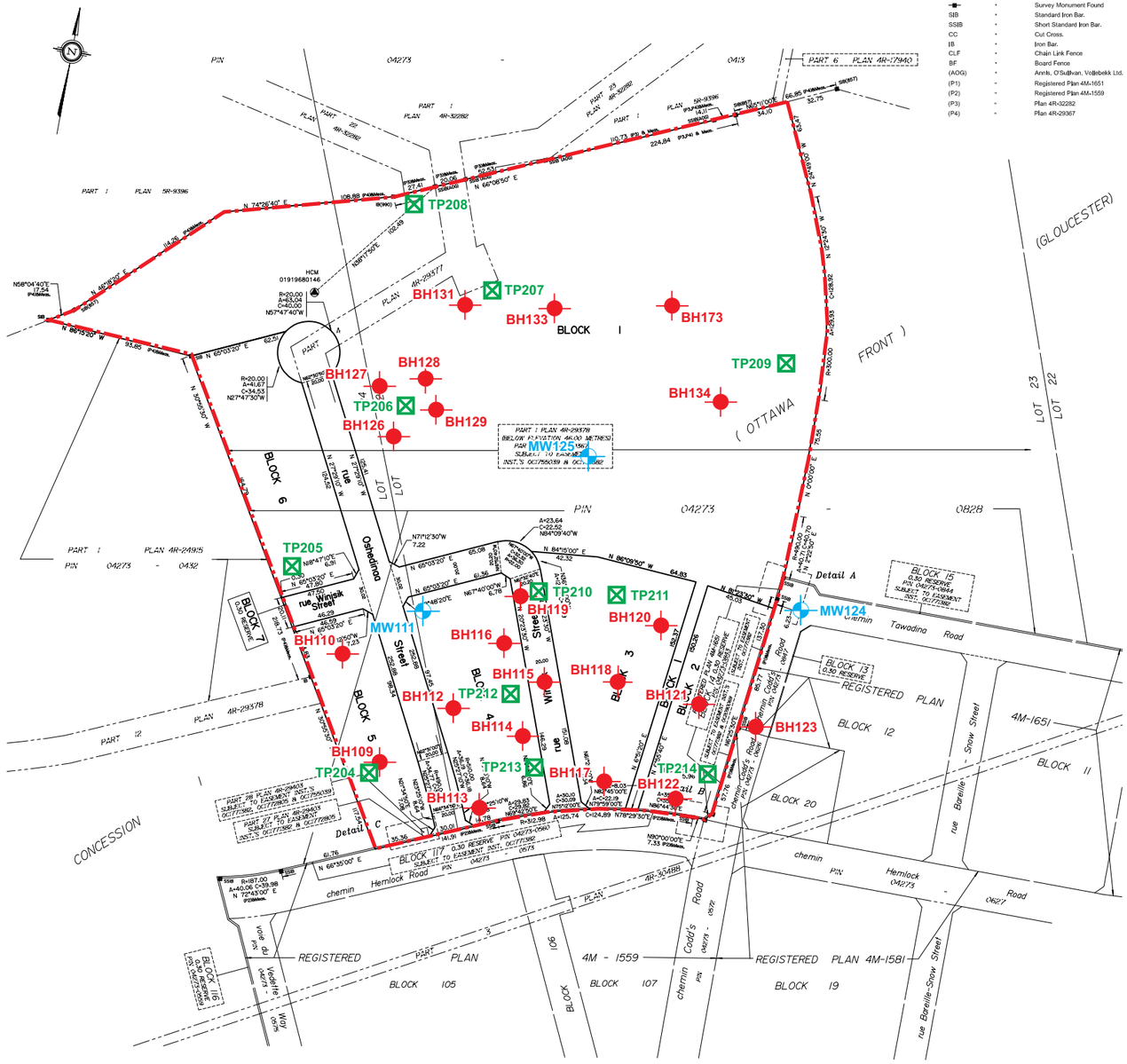
WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada

NOTES AND LEGEND

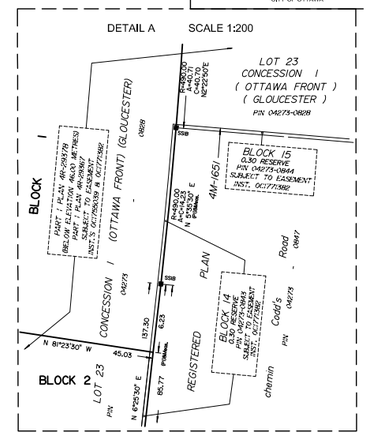
-○-	denotes	Survey Monument Planted,
-■-	"	Survey Monument Found
SIB	"	Standard Iron Bar.
SSIB	"	Short Standard Iron Bar.
CC	"	Cut Cross.
IB	"	Iron Bar.
CLF	"	Chain Link Fence
BF	"	Board Fence
(AOG)	"	Annis, O'Sullivan, Vollebekk Ltd.
(P1)	"	Registered Plan 4M-1651
(P2)	"	Registered Plan 4M-1559
(P3)	"	Plan 4R-32282
(P4)	"	Plan 4R-29367

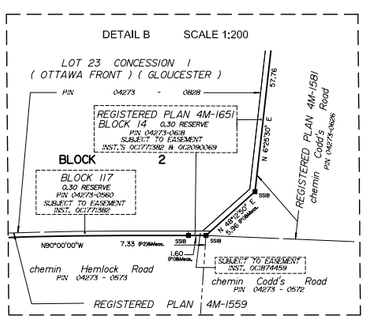


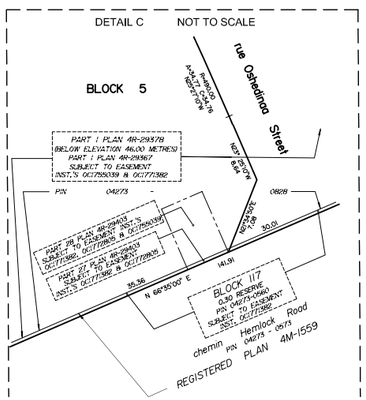
APPROVED UNDER SECTION 51 OF THE PLANNIN
BY THE CITY OF OTTAWA.

THIS _____ DAY OF _____, 2(

STEPHEN WILLIS, MCIP, RPP.
GENERAL MANAGER
PLANNING, INFRASTRUCTURE AND ECONOMI
DEVELOPMENT DEPARTMENT
CITY OF OTTAWA







LEGEND

- TEST PIT LOCATION
- BOREHOLE WITH MONITORING WELL
- BOREHOLE LOCATION
- APPROXIMATE LOCATION OF INVESTIGATIONS

SOURCE: VUMAP FIRST BASE SOLUTIONS, 2017 IMAGERY AND DRAFT PLAN OF SUBDIVISION PREPARED BY ANNIS , O'SULLIVAN , VOLLEBEKK LTD., JANUARY 11, 2016.

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SK/ SF/ AB
CHECKED	
DRAWING #	DRAWING 3

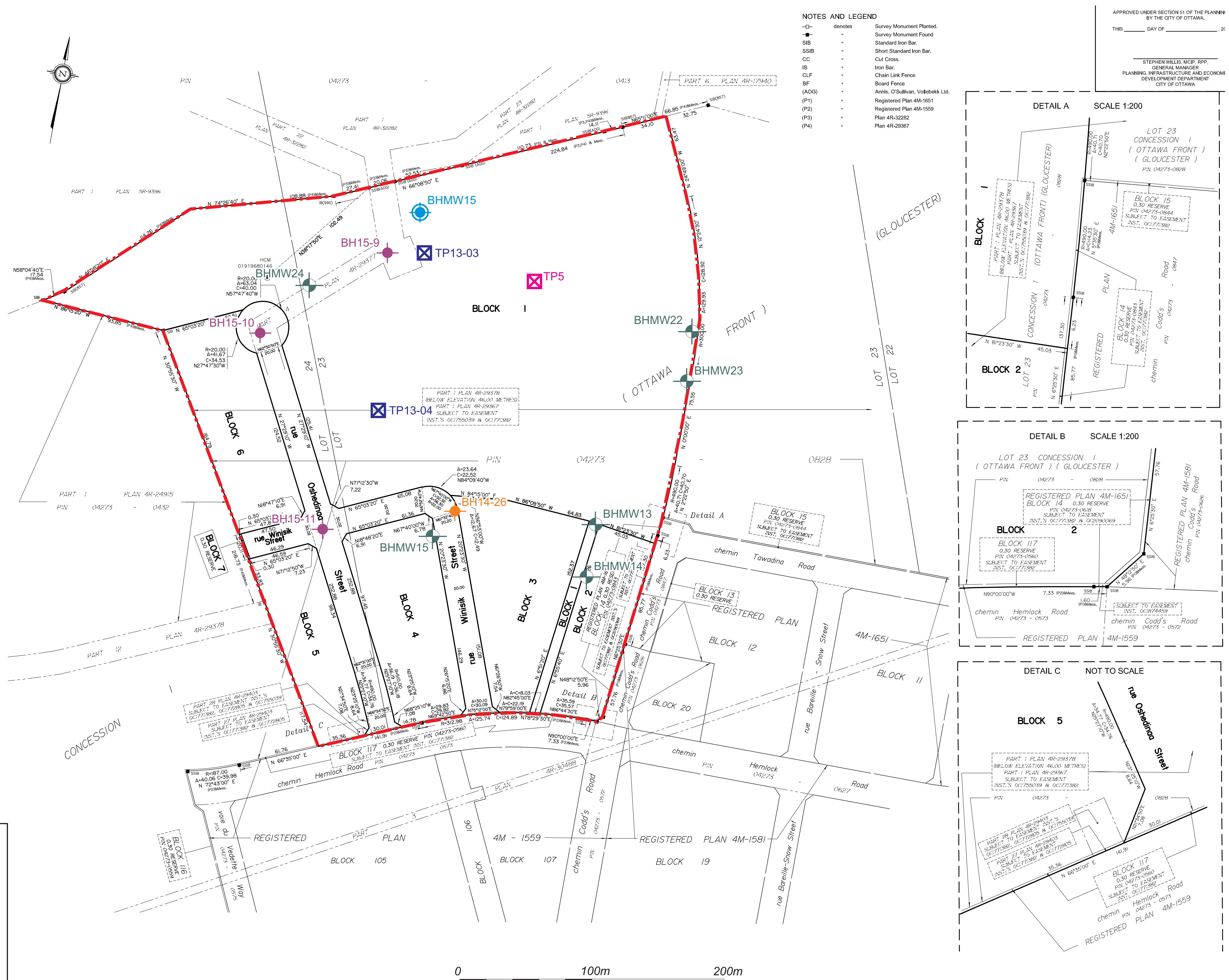
TERRAPEX

PREVIOUS BOREHOLE AND TEST PIT LOCATION PLAN

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada



LEGEND

- BOREHOLE (DST 2016)
- BOREHOLE (DST 2015)
- BOREHOLE (GOLDER, 2015)
- BOREHOLE (DST 2014)
- TEST PIT (DST, 2013)
- BOREHOLE (DST 2006)
- TEST PIT (DST, 2006)
- MONITORING WELL (DST 2004)
- APPROXIMATE LOCATION OF INVESTIGATIONS

SOURCE: VUMAP FIRST BASE SOLUTIONS, 2017 IMAGERY AND DRAFT PLAN OF SUBDIVISION PREPARED BY ANNIS , O'SULLIVAN , VOLLEBEKK LTD., JANUARY 11, 2016.

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SK/ SF/ AB
CHECKED	
DRAWING #	DRAWING 4

TERRAPEX

PROPOSED PARK 1: NORTH COMMUNITY PARK

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada

N

0 100m 200m

SOURCE: SITE PLAN PROVIDED BY CLIENT.

LEGEND

- BOREHOLE WITH MONITORING WELL
- BOREHOLE LOCATION
- TEST PIT LOCATION

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SF/ SK/ AB
CHECKED	
DRAWING #	DRAWING 5

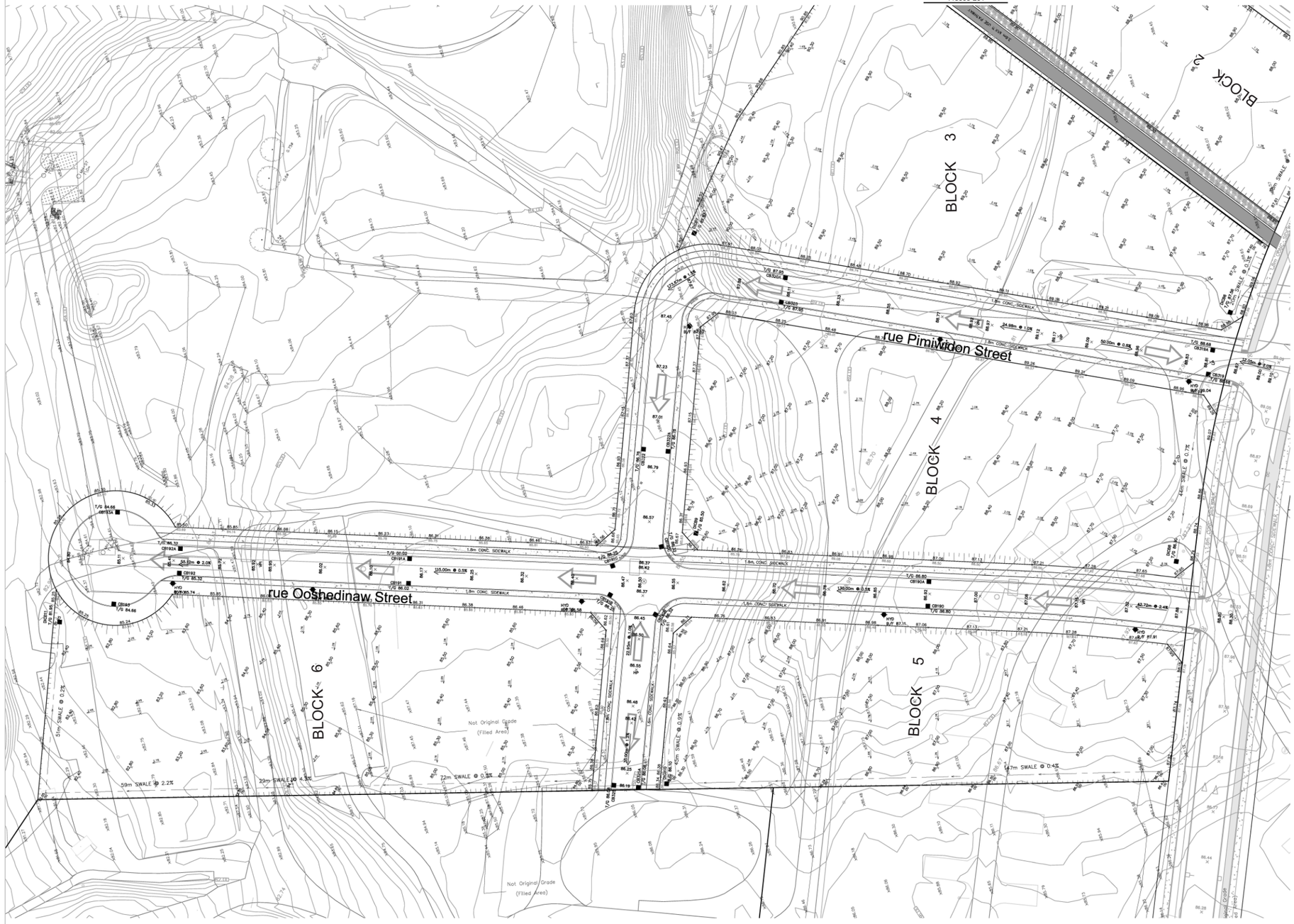
TERRAPEX

PROPOSED GRADING PLAN
PART OF PHASE 4

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada



SOURCE: IBI GROUP, GRADING PLAN-PHASE 2A & 2B, DRAWING #202, DECEMBER 2018.

PROJECT #	CO682.00
SCALE	N.T.S
DATE	OCTOBER 2020
DRAWN	SK/ AB
CHECKED	
DRAWING #	DRAWING 6

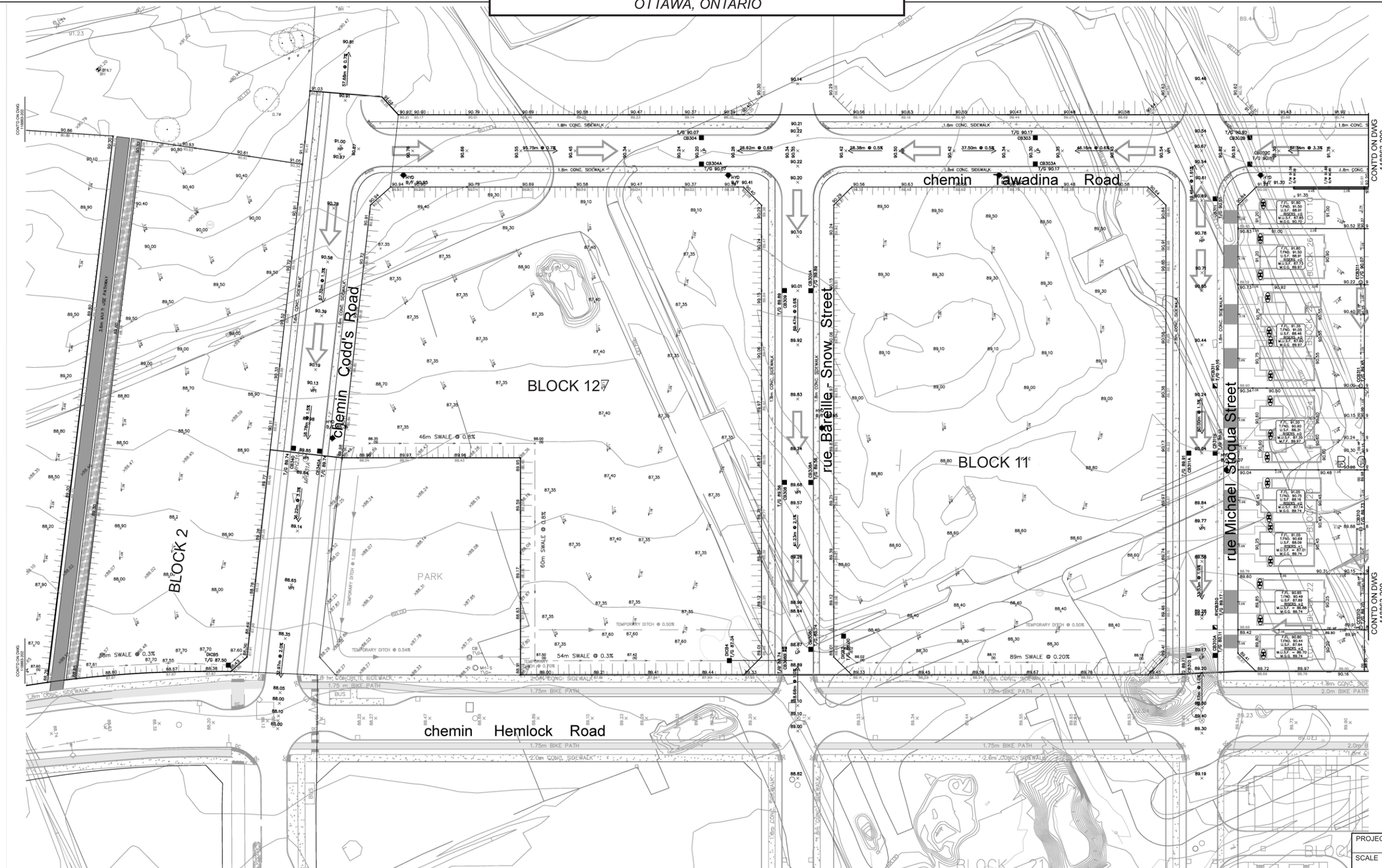
TERRAPEX

PROPOSED GRADING PLAN
PART OF PHASE 4 AND 2

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada



PROJECT #	CO682.00
SCALE	N.T.S
DATE	SEPTEMBER 2020
DRAWN	SK/ AB
CHECKED	
DRAWING #	DRAWING 7

SOURCE: IBI GROUP, GRADING PLAN-PHASE 2A & 2B, DRAWING #201, DECEMBER 2018.

TERRAPEX

EXTENT OF CLAY SOILS

WATERIDGE VILLIAGE
OTTAWA, ONTARIO

CLIENT

Canada Lands Company
Société immobilière du Canada

LEGEND

- BOREHOLE WITH MONITORING WELL
- BOREHOLE LOCATION
- CLAY SOILS

SOURCE: SITE PLAN PROVIDED BY CLIENT.

PROJECT #	CO682.04
SCALE	AS SHOWN
DATE	OCTOBER 2020
DRAWN	SF/ SK/ AB
CHECKED	
DRAWING #	DRAWING 8

APPENDIX C
BOREHOLE AND TEST PIT LOG SHEETS

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 109**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 87.338	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033491	EASTING: 450202	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	soft, moist, dark brown, clayey silt traces of sand, gravel, and organics (FILL)	0	87.25	50/125		1		50/125		Borehole open and dy on completion.
		0.25	87							Rock in spoon tip at 0.3 m bgs
		0.5	86.75							
		0.75	86.5			2A				
		1	86.25	40				40		Difficult augering from 1.0 m bgs to refusal.
		1.25	86			2B				
		1.5	85.75							Relocated drill 1 m S to avoid rocks.
	dense to compact, damp, light brown silty sand, some clay, trace gravel (FILL)	1.75	85.5	23		3		23		
	-----	2	85.25							
	rock fragments	2.25	85							
		2.5	84.75	64		4		64		Auger refusal at 2.9 m bgs.
		2.75	84.5							
	END OF BOREHOLE									

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LOGGED BY: RH | DRILLING DATE: November 19, 2018

REVIEWED BY: VN | Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 110**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 86.374	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033554	EASTING: 450130	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		FROZEN GROUND	0	86.25							Borehole caved-in at 0.91 m bgs and dry on completion.
		very dense, damp, grey gravel, some sand (FILL)	0.25	86	80		1A		80		
			0.5	85.75			1B				
		compact, damp to wet, brown sandy silt, some gravel, trace organics trace oxidization (FILL)	0.75	85.5			2A				
			1	85.25	31				31		Auger refusal at 1.40 m bgs.
		compact to very dense, moist to wet, dark brown, silty gravel, trace sand, trace organics and rock fragments (FILL)	1.25				2B				
		END OF BOREHOLE									

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REVIEWED BY: VN |

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: MW111**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 86.960	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033607	EASTING: 450217	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		soft, moist, grey clayey silt, organic layers (FILL)	0	86.75	3		1		3		Monitoring well was dry on December 17, 2018.
		some sand trace asphalt	0.25	86.5							Bentonite
			0.5	86.25							
			0.75	86	4		2		4		
			1	85.75							sand
			1.25	85.5							
		limestone fragments, trace sand (FILL)	1.5	85.25	26		3		26		sand and screen
			1.75	85							
			2	84.75							Auger refusal at 2.7 m bgs.
			2.25	84.5	61/228		4		61/228		
		END OF BOREHOLE	2.5								

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LOGGED BY: RH	DRILLING DATE: November 19, 2018
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 112**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.479	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033534	EASTING: 450242	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		FROZEN GROUND	0		40 80 120 160 / 20 40 60 80	20 40 60 80					borehole open and dry on completion.
		dense, moist, brown sand and gravel, trace organics (FILL)	0.25	88.25			1A				
			0.5	88	36		1B		36		
		very dense, damp, light brown SANDY SILT trace organics	0.75	87.75							
		rock fragments occassional oxidized pockets	1	87.5	58/228		2		58/228		Auger refusal at 1.2 m bgs.
		END OF BOREHOLE									

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REVIEWED BY: VN | Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 113**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 87.861
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033488	EASTING: 450267
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) 40 80 120 160 / N-Value (Blows/300mm) 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		compact, damp, dark brown sandy gravel mixed with organics (FILL)	0 0.25	87.75 87.5	10		1		10		Borehole open and dry on completion.
		very dense, damp, brown silty sand, large gravel (FILL)	0.5 0.75 1	87.25 87	50/75		2		50/75		Difficult augering to 0.76 m to refusal at 1.0 m bgs
		END OF BOREHOLE									

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LOGGED BY: RH	DRILLING DATE: November 19, 2018
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 114**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.305	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033521	EASTING: 450284	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	TOPSOIL (250 mm)	0	88.25		21	1A		12		Borehole open and dry on completion.
	compact, damp to dry, brown/dark brown sand some silt, trace rootlets, trace gravel, trace cinder (FILL)	0.25	88	12	11	1B				
		0.5	87.75							
		0.75	87.5							
	dense to compact damp light brown mixed dark brown SANDY SILT trace gravel, trace organics	1	87.25	46	7	2		46		
		1.25	87							
		1.5	86.75							
		1.75	86.5	13	4	3		13		Auger refusal at 2.1 m bgs.
		2	86.25							
	END OF BOREHOLE									

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LOGGED BY: RH | DRILLING DATE: November 19, 2018

REVIEWED BY: VN | Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 115**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 89.154	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033555	EASTING: 450293	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		ASPHALTIC CONCRETE (40 mm)	0	89							Borehole open and dry on completion. Relocated drill 1 m N, confirmed bedrock depth of 1.0 m bgs.
		dense, damp, brown gravelly sand, trace asphalt (FILL)	0.25	88.75	44		1		44		
		very dense, damp, brown sandy silt, traces of gravel and rock fragments (FILL)	0.5	88.5	50/100		2		50/100		Auger refusal at 1.0 m bgs.
		END OF BOREHOLE	0.75	88.25							
			1								

Shear Strength (kPa) ● 40 80 120 160; N-Value (Blows/300mm) ▲ 20 40 60 80; Water Content (%) 20 40 60 80

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LOGGED BY: RH | DRILLING DATE: November 19, 2018
REVIEWED BY: VN | Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 116**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 89.153	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033580	EASTING: 450267	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		stiff, moist-wet, grey clayey silt (FILL)	0	89	9		1A		9		Borehole open and dry on completion.
		loose, moist, brown/dark brown sandy silt, traces of organics and cinder (FILL)	0.25 / 0.5	88.75			1B				
		very dense, damp, light brown SANDY SILT occassional oxidized pockets	0.75 / 1	88.5 / 88.25	75/228		2		75/228		Auger refusal at 1.44 m bgs.
		END OF BOREHOLE	1.25	88 / 87.75							

Shear Strength (kPa) ● 40 80 120 160
N-Value (Blows/300mm) ▲ 20 40 60 80
Water Content (%) PL W.C. LL 20 40 60 80

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LOGGED BY: RH | DRILLING DATE: November 19, 2018
REVIEWED BY: VN | Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 117**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.021
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033498	EASTING: 450350
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) 40 80 120 160 / N-Value (Blows/300mm) 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		compact, moist, brown mixed grey sandy silt, traces of clay and gravel (FILL)	0 0.25	88 87.75	12		1A		12		Borehole open and dry on completion.
		loose, moist, dark brown/black sandy silt, some organics (FILL)	0.5 0.75	87.5 87.25			1B				
		firm, moist, brownish grey clayey silt, trace sand (FILL)	1	87	10		2		10		Auger refusal at 1.23 m bgs.
		END OF BOREHOLE									

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LOGGED BY: RH	DRILLING DATE: November 16, 2018
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 118**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.079	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033567	EASTING: 450340	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		TOPSOIL (200 mm)	0	88		37	1A				Borehole open and dry on completion.
		loose, moist, dark brown sandy silt, traces of cinder and rootlet (FILL)	0.25	87.75	5		1B		5		
		dense, moist brown with grey mottling SANDY SILT, some clay, trace gravel occassional oxidized pockets	0.5	87.5							
			0.75	87.25	50/50	12	2		50/50		Auger refusal at 0.96 m bgs.
		END OF BOREHOLE									

Shear Strength (kPa) ● 40 80 120 160
N-Value (Blows/300mm) ▲ 20 40 60 80
Water Content (%) PL W.C. LL 20 40 60 80

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geotechnical division of TERRAPEX

LOGGED BY: RH	DRILLING DATE: November 16, 2018
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 119**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.530
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033613	EASTING: 450267
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) 40 80 120 160 / N-Value (Blows/300mm) 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		very dense, moist, dark brown sand and gravel, large rock in spoon (FILL)	0 0.25 0.5	88.5 88.25 88	90 ▲		1		90		Borehole open and dry on completion. Auger refusal at 0.65 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 120**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 89.574
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033596	EASTING: 450340
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		compact, moist, dark brown/brown gravelly sand, traces of cinder and rootlets (FILL)	0	89.5	13		1A		13		Borehole open and dry on completion.
			0.25	89.25							
		very dense, damp, light brown SILT some sand, trace clay	0.5	89			1B				
			0.75	88.75	100/280		2		100/280		Auger refusal at 1.20 m bgs.
			1	88.5							
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 121**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.554
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033556	EASTING: 450408
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) 40 80 120 160 / N-Value (Blows/300mm) 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		ASPHALTIC CONCRETE (75 mm)	0	88.5							Borehole open and dry on completion.
		compact, moist to wet, dark brown sandy gravel, trace asphalt (FILL)	0.25	88.25	14 ▲		1		14		
			0.5	88							Auger refusal at 0.80 m bgs.
			0.75								
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Split Spoon Sampling		**BH No.: 122**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.020	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033509	EASTING: 450395	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		moist, dark brown/black silt, some sand, some gravel (FILL)	0 – 0.5	88 – 87.5							Borehole open and dry on completion.
		greyish blue, moist, hard clayey silt, trace sand, trace gravel (FILL)	0.5 – 1.5	87.5 – 86.5	36		1		36		Auger refusal at 1.52 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 123**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.589	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033559	EASTING: 450433	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		loose, moist, brown sandy silt, some gravel, trace clay (FILL)	0 0.25 0.5 0.75	88.5 88.25 88 87.75	8 50/25		1 2		8 50/25		Borehole open and dry on completion. Auger refusal at 0.94 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: MW124**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 90.147	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033631	EASTING: 450454	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	compact, damp to moist, dark brown silty sand, some gravel, trace organics (FILL)	0 – 0.75	90 – 89.25	24	13	1		24		Monitoring well was dry on Decemebr 17, 2018.
					27	2A				Bentonite
	compact to dense light brown SANDY SILT	1 – 1.5	89 – 88.5	20	8	2B		20		sand
	moist									sand and screen
	----- wet			50/25	20	3		50/25		Auger refusal at 1.70 m bgs.
	END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: MW125**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 82.655	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033720	EASTING: 450286	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
▽	stiff, moist, dark brown/grey clayey silt, traces of topsoil, gravel and rootlets (FILL)	0 – 0.25 – 0.5	82.5 – 82.25 – 82	12	33	1		12		Groundwater was measured at 0.25 mbgs on December 17, 2018. Bentonite
	firm, moist, grey layered CLAY and SILT trace sand occassional oxidized layers	0.75 – 1 – 1.25 – 1.5 – 1.75	81.75 – 81.5 – 81.25 – 81	9	34	2		9		sand
	----- coarse sand seam	1.75 – 2 – 2.25	81 – 80.75 – 80.5 – 80.25	9 / 50/50	36 / 11	3 / 4		9 / 50/50		sand and screen / Auger refusal at 2.46 m bgs.
	END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 126**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.434	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033711	EASTING: 450163	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		compact, moist, brown gravelly sand, trace rock fragments (FILL)	0 – 0.75	84.25 – 83.75	12		1		12		Borehole open and dry on completion.
		compact, dry, brown SANDY SILT occassional oxidized layers trace rock fragments	0.75 – 1.5	83.75 – 83	25		2		25		
					50/125		3		50/125		Auger refusal at 1.65 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 127**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.156	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033735	EASTING: 450159	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		brown, moist compact to dense SILTY SAND some rock fragments	0 0.25 0.5 0.75 1 1.25 1.5	84 83.75 83.5 83.25 83 82.75	19 74/50		1 2		19 74/50		Borehole open and dry on completion. Difficult augering between the depths of 0.76 and 1.52 m bgs. Auger refusal at 1.52 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 128**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.086
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033735	EASTING: 450193
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		FROZEN GROUND	0	84	40 80 120 160 / 20 40 60 80	20 40 60 80					Borehole open and dry on completion.
		compact, moist, brown silty sand, trace gravel (FILL)	0.25	83.75	15		1		15		
		-----	0.5	83.5							
		rock fragments	0.75	83.25	50/75		2		50/75		Auger refusal at 1.0 m bgs.
		END OF BOREHOLE	1								

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon	**BH No.: 129**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.313
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033718	EASTING: 450203
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		compact, moist, brown silty sand, trace gravel (FILL) ----- rock fragments	0	84.25	10		1		10		Borehole open and dry on completion.
			0.25	84							
			0.5	83.75							
			0.75	83.5	50/50		2		50/50		
			1	83.25							
			1.25	83							Auger refusal at 1.52 m bgs.
			1.5								
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 131**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 83.039	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033795	EASTING: 450201	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		TOPSOIL (50 mm)	0	83							Borehole open and dry on completion.
		compact ----- dense — moist SILTY SAND — brown ----- light brown	0.25	82.75	12		1		12		
			0.5	82.5							
			0.75	82.25	50/75		2		50/75		
			1	82							
			1.25	81.75							Auger refusal at 1.52 m bgs.
			1.5								
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 133**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 81.775	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033799	EASTING: 450270	PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		FROZEN GROUND	0	81.75							Borehole caved-in at 1.83 m bgs and dry on completion.
		compact, moist, brown gravel, trace sand (FILL)	0.25	81.5							
			0.5	81.25	25		1		25		
		firm, moist, dark brown clayey silt, traces of sand, gravel, and organics (FILL)	0.75	81			2A				
			1	80.75	8				8		
			1.25	80.5			2B				
		stiff, moist greyish brown CLAYEY SILT trace gravel trace sand	1.5	80.25							
			1.75	80	17		3		17		
			2	79.75							Auger refusal at 2.28 m bgs.
			2.25	79.5	50/25		4		50/25		
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Split Spoon Sampling		**BH No.: 134**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 82.819	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033758	EASTING: 450381	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	TOPSOIL (150 mm)	0	82.75			1A				On completion of the borehole water was at 0.91 m bgs.
	brownish orange, moist, loose sand some silt trace organics (FILL)	0.25	82.5	6		1B		6		
		0.5	82.25			2C				
	light brown -----	0.75	82							
▼	stiff, moist CLAY and SILT trace sand	1	81.75	13		2		13		
	greyish brown	1.25	81.5							
		1.5	81.25							Difficult augering between the depths of 1.8 m to refusal.
		1.75	81	11		3A		11		Auger refusal at 2.13 m bgs.
	brown, wet, loose SILT, some sand, some gravel	2	80.75			3B				
	END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Holow Stem Auger & Split Spoon	**BH No.: 135**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.928
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033790	EASTING: 450447
		PROJECT NO.: CO682.00

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

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) 40 80 120 160 / N-Value (Blows/300mm) 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		very dense, moist, brown gravelly sand, some silt (FILL)	0 0.25 0.5	84.75 84.5 84.25	50		1		50		Borehole open and dry on completion. Auger refusal at 0.70 m bgs.
		END OF BOREHOLE									

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CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: BH173**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 82.718	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033814	EASTING: 450338	PROJECT NO.: CO682.00

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

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	loose, moist, brown gravelly sand (FILL)	0 – 0.25	82.5	6		1A		6		Borehole open and dry on completion.
	loose, moist, brown silty sand, trace gravel (FILL)	0.25 – 0.75	82.25 – 82			1B				
	firm, moist, grey CLAYEY SILT	0.75 – 2	82 – 81.75 – 81.5 – 81.25 – 81 – 80.75	6		2A		6		
				6		2B				
				6		3		6		
▼	loose to compact, wet, brown SANDY SILT, trace gravel occassional oxidized pockets	2 – 2.5	80.5 – 80.25 – 80	18		4		18		Auger refusal at 2.72 m bgs.
	END OF BOREHOLE									

Shear Strength (kPa) ● 40 80 120 160
N-Value (Blows/300mm) ▲ 20 40 60 80
Water Content (%) 20 40 60 80

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 204**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 86.640	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033484	EASTING: 450194	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				damp, dark brown sand and gravel (FILL)				86.5
0.25										86.25
0.5						damp, brown sandy silt some gravel (FILL)				86
0.75										85.75
1										85.5
1.25						moist light brown mixed grey silty sand, some clay trace limestone fragments (FILL)				85.25
1.5										85
1.75		Refusal @ 1.84 m bgs on Limestone Bedrock				END OF TEST PIT				

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CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 205**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 85.810	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033606	EASTING: 450123	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) 40 80 120 160 ● Static Cone ▲ Tip Resistance (kg/cm 2) 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				moist, grey gravel some to trace sand (FILL)				85.75
0.25										85.5
0.5						damp, dark brown topsoil, trace rootlets (FILL)				85.25
0.75										85
1						damp, brown SANDY SILT trace clay, trace gravel				84.75
1.25										84.5
1.5		Refusal @ 1.64 m bgs on Limestone Bedrock								84.25
						END OF TEST PIT				

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CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 206**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 84.13	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033719	EASTING: 450179	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● Static Cone ○ / Tip Resistance (kg/cm 2)	PL W.C. LL	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.	40 80 120 160 / 50 100 150 200	20 40 60 80		moist, dark brown TOPSOIL some gravel				84
0.25						moist, brown SILTY SAND trace organics				83.75
0.5										83.5
0.75										83.25
1						damp, greyish brown SANDY SILT trace gravel				83
1.25		Refusal @ 1.60 m bgs on Limestone bedrock with thinnly bedded shale layers								82.75
1.5						END OF TEST PIT				

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CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 207**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 82.29	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033801	EASTING: 450221	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				moist, brown SILTY SAND some gravel trace limestone fragments				82.25
0.25										82
0.5		Refusal @ 0.64 m bgs on Limestone Bedrock (weathered at surface)								81.75
						END OF TEST PIT				

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CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 208**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 77.25	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033847	EASTING: 450162	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				moist, dark brown to brown sandy TOPSOIL trace rootlets				77.25
0.25										77
0.5						damp, greyish brown CLAYEY SILT				76.75
0.75		Refusal @ 0.98 m bgs on Limestone bedrock with thinnly bedded shale layers								76.5
						END OF TEST PIT				

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LOGGED BY: RH	DRILLING DATE: December 14,
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 209**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 83.71	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033788	EASTING: 450415	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion water was entering the test pit from an old subdrain at 1.5 m bgs.				limestone fragments, trace sand (FILL)				83.5
0.25						damp, brown sand, trace silt (FILL)				83.25
0.5						moist, light brown sandy silt some gravel (FILL)				83
0.75										82.75
1						wet, greyish brown sandy clayey silt (FILL)				82.5
1.25										82.25
1.5		Refusal @ 1.70 m bgs on Limestone Bedrock				END OF TEST PIT				

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LOGGED BY: RH
REVIEWED BY: VN
DRILLING DATE: December 14,

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 210**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.84	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033616	EASTING: 450282	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) 40 80 120 160 / Static Cone / Tip Resistance (kg/cm 2) 50 100 150 200	PL 20 W.C. 40 60 LL 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				damp, grey crusher run limestone (FILL)				88.75
0.25										88.5
0.5						Asphaltic concrete				88.25
0.75						moist, dark brown organic layer, trace to some sand trace rootlets (FILL)				88
1						damp, light brown SANDY SILT some gravel				87.75
1.25										87.5
1.5		Refusal @ 1.60 m bgs on Limestone Bedrock								87.25
						END OF TEST PIT				

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LOGGED BY: RH	DRILLING DATE: December 14,
REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator	**TP No.: 211**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 89.64
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033621	EASTING: 450332
		PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) 50 100 150 200	PL 20	W.C. 40 60	LL 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was caving in between 0.8- 1.35 m bgs.						damp, dark brown TOPSOIL				89.5
0.25								moist, brownish orange SILTY SAND some shale fragments trace organics				89.25
0.5												89
0.75												88.75
1								damp, light brown SANDY SILT some limestone fragments trace large gravel				88.5
1.25		Refusal @ 1.35 m bgs on Limestone Bedrock										
								END OF TEST PIT				

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LOGGED BY: RH
REVIEWED BY: VN
DRILLING DATE: December 14,

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 212**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 89.04	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033549	EASTING: 450275	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was caving in between 0.18- 0.4 m bgs.				asphaltic concrete				89
0.25						damp, grey sand and gravel (FILL)				88.75
0.5						damp, brown GRAVELLY SAND trace cobbles trace shale fragments				88.5
0.75										88.25
1		Refusal @ 1.07 m bgs on Limestone Bedrock				END OF TEST PIT				88

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REVIEWED BY: VN	Page 1 of 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 213**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.05	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033505	EASTING: 450298	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit remained open and dry.								88
0.25						moist, dark brown TOPSOIL some sand				87.75
0.5		Refusal @ 0.78 m bgs on Limestone Bedrock (fractured at surface)								87.5
0.75						END OF TEST PIT				

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LOGGED BY: RH
REVIEWED BY: VN
DRILLING DATE: December 14,

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 214**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 88.26	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033519	EASTING: 450408	PROJECT NO.: CO682.00

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

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was open and dry.				damp, brownish grey gravelly silt, some sand (FILL)				88.25
0.25						damp, light brownish orange sandy silt trace to some topsoil (FILL)				88
0.5										87.75
0.75						moist, grey SANDY SILT some to trace clay trace large gravel				87.5
1										87.25
1.25		Refusal @ 1.30 m bgs on Limestone Bedrock								87
						END OF TEST PIT				

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LOGGED BY: RH
REVIEWED BY: VN
DRILLING DATE: December 14,

APPENDIX D

PREVIOUS BOREHOLE AND TEST PIT LOG SHEETS

LOG OF BOREHOLE BH15-09

DST REF. No.: **OE-OT-015358**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Phase 1A Development - Site Servicing**
LOCATION: **Former CFB Rockliffe, Ottawa, Ontario,**
SURFACE ELEVATION: 81.20 metres

Drilling Data
METHOD: **Hollow Stem Auger/Core Barrel/NQ**
DIAMETER: **200 mm**
DATE: **26 August 2015**
COORDINATES: **5033823.631** m N, **450194.353** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W_p W W_l (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE / RQD	VANE (kPa) × (20 40 60 80) SPT (N) □ Blows/0.3m DCPT ◆ (20 40 60 80)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	81				CRUSHED GRAVEL.					
1.0	80				SAND, topsoil, dry, brown.	SS1				
2.0	79				Limestone, grey, highly fractured and weathered from top to 2.2 m deep. Sub vertical fracture from top to 1.60 m, oxydized	RC1		41		TCR = 83%
3.0	78				Shale, black with thin limestone partings, become grey at 4.14 m. Highly fractured from 3.22 to 4.16 m	RC2		49		TCR = 92%
4.0	77									
5.0	76				Limestone, dark grey, biomicrite with black shale partings from 4.49 m to 5.38 m and from 5.38 to 5.63 m	RC3		82		TCR = 100%
6.0	75					RC4		100		TCR = 100%
7.0	74				Black shale, highly fractured					
8.0	73				Limestone, dark grey, biomicrite	RC5		43		TCR = 100%
9.0	72				Limestone grey, cristaline with sub-vertical joint 15 degree with core axis from 8.96 to 9.32 m	RC6		92		TCR = 96%
10.0	71				Shale,black					
11.0	70					RC7		100		TCR = 100%
12.0	69				Limestone, green/grey, cristaline, highly fractured from 14.1 to 14.5 m	RC8		100		TCR = 100%
13.0	68									
14.0	67					RC9		75		TCR = 100%
15.0	66				Shale, black with calcite inclusions from 16.5 to 17.4 m. Sub-vertical joint 20 degree with core axis from 16.8 to 17.0 m with thin < 1mm calcite filling. LIMSTONE interbeds from 19.3 to 20.7 m and from 21.8 to 22.1 m. Horizontal joints @ 22.4, 23.0 and 23.3 m. Highly fractured from 23.3 to 23.5 m.	RC10		90		TCR = 100%
16.0	65									
17.0	64					RC11		66		TCR = 93%
18.0	63									
19.0	62					RC12		78		TCR = 100%
20.0	61					RC13		100		TCR = 100%
21.0	60									
22.0	59					RC14		93		TCR = 100%
23.0	58					RC15		75		TCR = 98%

BOREHOLE (STANDARD) - OTTAWA PROJECT.GPJ DST_MIN.GDT 29/9/15

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thin Wall Tube
- Bentonite
- Sand
- Slough

ENCLOSURE 11

LOG OF BOREHOLE BH15-09

DST REF. No.: **OE-OT-015358**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Phase 1A Development - Site Servicing**
LOCATION: **Former CFB Rockliffe, Ottawa, Ontario,**
SURFACE ELEVATION: 81.20 metres

Drilling Data
METHOD: **Hollow Stem Auger/Core Barrel/NQ**
DIAMETER: **200 mm**
DATE: **26 August 2015**
COORDINATES: **5033823.631** m N, **450194.353** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE / RQD	VANE (kPa) × 20 40 60 80; SPT (N) □ Blows/0.3m DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
25.0	57				Sandstone/dolomite, grey. Sub-vertical joint 30 degree with core axis from 26.1 to 26.33 m with calcite filling < 1 mm. Horizontal joint at 26.42, 26.57, 26.62,26.64. Shale interbeds, black from 26.9 to 27.0 and from 27.8 to 28.3 m. Sub-vertical joint 20 degree with core axis from 29.7 to 29.9 and from 31.3 to 31.5 m with thin < 1 mm calcite filling. Horizontal joints @ 31.7, 31.8, 31.9, 31.2, 32.1, 32.4, 32.7 and 32.9 m.	RC16		33		TCR = 100%
26.0	56					RC17		86		TCR = 100%
27.0	55					RC18		95		TCR = 100%
28.0	54					RC19		84		TCR = 100%
29.0	53					RC20		79		TCR = 100%
30.0	52					RC21		73		TCR = 100%
31.0	51					RC22		56		TCR = 100%
32.0	50					RC23		100		TCR = 100%
33.0	49									
34.0	48				Sandstone interbedded with black shale. Sub-vertical joints 20 degree with core axis from 33.3 to 33.4 and from 33.6 to 33.8 m no filling.					
35.0	47				End of Borehole at 35.1 m.					
36.0	46									
37.0	45									
38.0	44									
39.0	43									
40.0	42									
41.0	41									
42.0	40									
43.0	39									
44.0	38									
45.0	37									
46.0	36									
47.0	35									
	34									

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SAMPLE TYPE LEGEND

Auger Sample
Split Spoon Sample
Bulk Sample
Rock Core
Hiller Peat Sampler
70mm Thin Wall Tube
Bentonite
Sand
Slough

ENCLOSURE 12

LOG OF BOREHOLE BH15-10

DST REF. No.:**OE-OT-015358**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Phase 1A Development - Site Servicing**
LOCATION:**Former CFB Rockliffe, Ottawa Ontario**
SURFACE ELEVATION: 83.46 metres

Drilling Data
METHOD: **Hollow Stem Auger/ NQ Size Core Barrel**
DIAMETER: **200 mm**
DATE: **August 21, 2015**
COORDINATES: **5033743.938** m N, **450109.419** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) × / SPT (N) □ Blows/0.3m / DCPT ◆	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0	83				ASPHALT ~ 50 mm					- 19 mm diameter standpipe piezometer installed as shown
					FILL - SAND AND GRAVEL - grey, compact	SS1		24		
1.0					FILL - SILT AND GRAVEL - sandy, brown and dark brown, very dense 75 mm thick gravel seam at 0.9 m	SS2		83		
	82				LIMESTONE BEDROCK - Grey to dark grey					
2.0					RC1 - 1.14 m, TCR = 80%, SCR = 67%, RQD = 33%	RC1				
	81									
3.0										
	80				RC2 - 1.73 m, TCR = 78%, SCR = 71%, RQD = 57%	RC2				
4.0										
	79	▼								- Groundwater level is 4.62 m (Elev. 78.8 m) on October 1, 2015
5.0					RC3 - 1.50 m, TCR = 100%, SCR = 81%, RQD = 81%	RC3				
	78									
6.0										
	77				RC4 - 1.45 m, TCR = 97%, SCR = 84%, RQD = 93%	RC4				
7.0										
	76				RC5 - 0.25 m, TCR = 100%, SCR = 100%, RQD = 92%	RC5				
8.0					End of Borehole at 7.4 m.					
	75									
9.0										
	74									
10.0										
	73									
11.0										
	72									

BOREHOLE (STANDARD) - OTTAWA PROJECT.GPJ DST_MIN.GDT 11/26/15

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thin Wall Tube
- Bentonite
- Sand

ENCLOSURE 13

LOG OF BOREHOLE BH15-11

DST REF. No.:**OE-OT-015358**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Phase 1A Development - Site Servicing**
LOCATION:**Former CFB Rockliffe, Ottawa Ontario**
SURFACE ELEVATION: 85.34 metres

Drilling Data
METHOD: **Hollow Stem Auger/ NQ Size Core Barrel**
DIAMETER: **200 mm**
DATE: **August 21, 2015**
COORDINATES: **5033606.53** m N, **450180.104** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W_p W W_l (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) × (20 40 60 80) SPT (N) □ Blows/0.3m DCPT ◆ (20 40 60 80)	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0	85				TOPSOIL ~ 150 mm FILL - SAND AND GRAVEL - silty, grey, compact			16		
1.0	84				TOPSOIL ~ 50 mm SAND AND GRAVEL - Silty, grey			11		
2.0	83				LIMESTONE BEDROCK - Grey to dark grey RC1 - 1.21 m, TCR = 93%, SCR = 90%, RQD = 65%	RC1				
3.0	82				RC2 - 1.53 m, TCR = 99%, SCR = 90%, RQD = 86%	RC2				
4.0	81				SHALE BEDROCK - Black LIMESTONE BEDROCK - Grey to dark grey RC3 - 1.50 m, TCR = 95%, SCR = 93%, RQD = 87%	RC3				
5.0	80									
6.0	79				SHALE BEDROCK - Black RC4 - 1.55 m, TCR = 100%, SCR = 100%, RQD = 97%	RC4				
7.0	78				LIMESTONE BEDROCK - Grey to dark grey RC5 - 1.12 m, TCR = 97%, SCR = 97%, RQD = 97%	RC5				
8.0	77				End of Borehole at 8.3 m.					
9.0	76									
10.0	75									
11.0	74									

BOREHOLE (STANDARD) - OTTAWA PROJECT.GPJ DST_MIN.GDT 11/26/15

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thin Wall Tube
- Bentonite
- Sand

ENCLOSURE 14

LOG OF BOREHOLE BH14-26

DST REF. No.: **OE-OT-015358**
CLIENT: **Canada Lands Company**
PROJECT: **Former CFB Rockcliffe**
LOCATION: **Ottawa, Ontario**
SURFACE ELEV.: **86.27 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **80 mm ID**
DATE: **March 3, 2014**
COORDINATES: **5033642.48** m N, **450271.46** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80; SPT (N) □ Blows/0.3m DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0	86				TOPSOIL - with grass and roots					
					ASPHALT - 50 mm	AS1				
1.0	85				SAND & GRAVEL	SS2		7		
					SAND - some silt to silty, some gravel, trace clay and roots, occasional cobbles, brown, loose	SS3		100+		
2.0	84				End of Borehole at 1.7 m Auger Refusal					
3.0	83									
4.0	82									
5.0	81									
6.0	80									
7.0	79									
8.0	78									
9.0	77									
10.0	76									
11.0	75									
12.0	74									
13.0	73									
14.0	72									
15.0	71									
16.0	70									
17.0	69									
18.0	68									
19.0	67									

BOREHOLE (STANDARD) - OTTAWA GS-OT-015358 ROCKCLIFFE PHASE I.GPJ DST_MIN.GDT 4/11/14

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thin Wall Tube
- Bentonite
- Sand

ENCLOSURE 1

LOG OF TESTPIT TP13-03

DST REF. No.: **OE-OT-017184**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Stormwater Management Plan**
LOCATION: **Former CFB Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **77.73 metres**

Testpit Data
METHOD: **Excavator**
DATE: **9/6/2013**
COORDINATES: **5033845.5** m N, **450226** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	DEPTH(m)	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80 / CPT (kPa) ◆ 300 600 900 1200	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0					FILL - SAND & GRAVEL - some roots, cobbles and boulders, dark brown					
0.2										
0.4					FILL - SAND - trace gravel and silt, light brown					
0.6					FILL - SAND - Gravelly, light brown					
0.8	77									
1.0					CLAY - Silty, stiff	1				
1.2										
1.4										
1.6									>>✖	130+ kPa
1.8	76									
2.0						2				
2.2					End of Testpit at 2.1 m Refusal					
2.4										
2.6										
2.8	75									
3.0						3				
3.2										
3.4										
3.6										
3.8	74									
4.0						4				
4.2										
4.4										
4.6										
4.8	73									

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SAMPLE TYPE LEGEND

Bulk Sample

ENCLOSURE 3

LOG OF TESTPIT TP13-04

DST REF. No.: **OE-OT-017184**
CLIENT: **Canada Lands Company (CLC)**
PROJECT: **Stormwater Management Plan**
LOCATION: **Former CFB Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **84.31 metres**

Testpit Data
METHOD: **Excavator**
DATE: **9/6/2013**
COORDINATES: **5033718.5** m N, **450202.2** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W_p W W_l (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	DEPTH(m)	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80 / CPT (kPa) ◆ 300 600 900 1200	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0	84				FILL - SAND & GRAVEL - trace roots and silt, some cobbles, dark brown					
0.6					FILL - SAND - some silt, boulders and cobbles, grey	1				
1.2	83				SILT - Sandy, trace gravel					
1.8					End of Testpit at 1.8 m Refusal	2				
2.4	82									
3.0						3				
3.2	81									
4.0						4				
4.2	80									
4.8										

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SAMPLE TYPE LEGEND

Bulk Sample

ENCLOSURE 4

LOG OF BOREHOLE BH12

DST REF. No.: **OG06562**
CLIENT: **Canada Lands Company**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **CFB Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **76.39 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **August 15 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W_p W W_l (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	VANE DATA (KPA)× (100 200 300 400) SPT (N)□ DCPT◆ (10 20 30 40)	REMARKS
0	76				GRASS COVER					Standpipe installed to 3.1 m depth.
					SAND - silty, some gravel, trace boulders, very dense, brown to reddish orange (till)					
			●			SS1		100	>>□	
1										Groundwater level recorded at 1.8 m depth on August 24, 2006.
	75									
					BEDROCK - grey fossiliferous limestone bedrock with narrow horizons of black shale noted at ~ 90 degrees to core axis					Auger refusal at 1.5 m depth.
2										
						CR2				Recovery 98% RQD 87%
	74									
3										
					End of borehole at 3.1 m depth.					
	73									
4										
	72									

BOREHOLE (STANDARD) OG06562.GPJ DST_MIN.GDT 10/3/06

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Thin Wall Tube
- Rock Core
- Side Sampler
- Grab Sample
- Ponar Sample

APPENDIX D

LOG OF BOREHOLE / MONITORING WELL BHMW15 OB

DST REF. No.: **OG06562**
CLIENT: **Canada Lands Company**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **CFB Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **76.22 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **August 08 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE Wp W Wl (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	VANE DATA (KPA)× 100 200 300 400; SPT (N)□ DCPT◆ 10 20 30 40	REMARKS
0	76				GRASS COVER					Well tag A019081
					CLAY - trace silt, olive grey, stiff					
1	75					SS1		13		Standpipe with a diametre of 20 mm installed to 3.4 m depth.
2	74					SS2		100	>>□	
					CLAY - silty, some sand and fragments of limestone, olive grey (till)					
					BEDROCK - possible weathered limestone bedrock	SS3		100	>>□	Groundwater level recorded at 3.2 m depth on August 24, 2006.
3	73				End of borehole at 3.4 m depth due to possible bedrock.					Auger refusal at 3.4 m depth.
4	72									

BOREHOLE (STANDARD) OG06562.GPJ DST_MIN.GDT 10/3/06

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Thin Wall Tube
- Rock Core
- Side Sampler
- Grab Sample
- Ponar Sample

APPENDIX D

LOG OF BOREHOLE / MONITORING WELL BHMW15 BR

DST REF. No.: **OG06562**
CLIENT: **Canada Lands Company**
PROJECT: **Preliminary Geotechnical Investigation**
LOCATION: **CFB Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **76.22 m (Geodetic)**

Drilling Data
METHOD: **CME 75 Drill Rig**
DIAMETER: **200 mm**

DATE: **August 09 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	VANE DATA (KPA)× 100 200 300 400 SPT (N)□ DCPT◆ 10 20 30 40	REMARKS
0	76									Auger advanced to 3.5 m depth.
1	75									Standpipe with a diametre of 20 mm installed to 15.8 m depth.
2	74									
3	73									
4	72				BEDROCK - dark grey shale and limestone bedrock, elongated fragments in a grey clay matrix, lower contact at ~ 80 degrees to core axis	CR1				Auger refusal at 3.5 m depth. Recovery 93% RQD 80%
5	71				BEDROCK - grey fossiliferous limestone bedrock with noted at ~ 90 degrees to core axis, narrow horizons of shale parting throughout, pyrite noted					
6	70					CR2				Recovery 97% RQD 80%
7	69					CR3				Recovery 98% RQD 92%
8	68									
9	67					CR4				Recovery 98% RQD 85%
10	66									
11	65					CR5				Recovery 98% RQD 92%
12	64					CR6				Recovery 97% RQD 87%
13	63									
14	62					CR7				Recovery 95% RQD 92%
15	61					CR8				Recovery 97% RQD 95%
16	60				End of borehole at 15.8 m depth.					Groundwater level recorded at 5.5 m depth on August 24, 2006.
17	59									
18	58									
19	57									

BOREHOLE (STANDARD) OG06562.GPJ DST_MIN.GDT 10/3/06

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SAMPLE TYPE LEGEND

Auger Sample
Split Spoon Sample
Thin Wall Tube
Rock Core
Side Sampler
Grab Sample
Ponar Sample

APPENDIX D

LOG OF BOREHOLE / MONITORING WELL BHMW13

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 15 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
○	0	SS1		6		GRASS COVER FILL - sand,silty, some gravel, trace of clay, loose, brown	0.5			Groundwater level observed 4.8 m below grade on November 25, 2004.
○	0	SS2		29		- sand, silty, gravel, compact, brown	1.0			
		SS3		17			1.5			
		SS4		100		- sand, silty, trace gravel and clay, loose to very dense, brown	2.0			
		RC1				BEDROCK- limestone, grey, fossiliferous, bedding noted at ~90° to core axis, surface highly weathered with limonite staining, narrow black shale horizons throughout	2.5			Recovery = 100% RQD = 65%
		RC2					3.5			Recovery = 85% RQD = 52%
		RC3					5.0			Recovery = 97% RQD = 70%
		RC4					6.0			
						End of borehole at 6.3 m depth.				

GASTECBH (OTTAWA) OE04940.GPJ DST_MIN.GDT 10/3/06

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Poner Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW14

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 16 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
○	0	SS1		4		FILL - sand, silty, some gravel, loose to very dense, brown to reddish-brown				Groundwater level observed 4.3 m below grade on November 25, 2004.
○	0	SS2		>100			0.5			
							1.0			Split spoon refusal at 1.0 m Auger from 1.0 to 1.5m
		SS3				SILT- light brown	1.5			
		RC1				BEDROCK - limestone, grey to dark grey, fossiliferous, bedding at 90° to core axis	2.0			Recovery = 100% RQD = 77%
							2.5			
							3.0			
		RC2					3.5			Recovery = 89% RQD = 70%
							4.0			
							4.5			
		RC3					5.0			Recovery = 98% RQD = 70%
							5.5			
		RC4					6.0			Recovery = 94% RQD = 94%
						End of borehole at 6.2 m depth.				

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW15

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 16 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						GRASS COVER				
	0	SS1		15		FILL - silty, trace gravel, compact to very loose, brown	0.5			Groundwater level observed 3.5 m below grade on November 25, 2004.
	0	SS2		8			1.0			
	0	SS3		8			1.5			
	0	SS4		2		- trace clay	2.0			Strong petroleum hydrocarbon odour noted at approximately 2.7 m
	0	SS5		10		TILL - clay, silty, compact, dark grey	2.5			
	0	SS6		>100			3.0			
	0	RC1				BEDROCK - limestone, grey, fossiliferous, bedding at ~90° to core axis with narrow black shale horizons	3.5			Recovery = 100% RQD = 69%
		RC2					4.0			
							4.5			Recovery = 100% RQD = 86%
		RC3					5.0			
							5.5			Recovery = 100% RQD = 51%
						End of borehole at 6.1 m depth.	6.0			

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW21

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 18 2004**

CCGD * O RKI EAGLE (PPM) 20 40 60 80 □ MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
		SS1		11		ASPHALT - ~100 mm thick FILL - sand, some silt trace gravel compact to loose, brown	0.5			Groundwater level observed 2.8 m below grade on November 26, 2004.
	0	SS2		6			1.0			
	0	SS3		2		TILL - sand, silty, trace gravel, very loose to very dense, grey	1.5			
	0	SS4		>100			2.0			Brick noted at 0.9 m depth
		RC1				BEDROCK - limestone, grey, fossiliferous with narrow black shale horizons, bedding at ~90° to core axis	2.5			Recovery = 100% RQD = 92%
		RC2					3.5			Recovery = 100% RQD = 49%
		RC3					5.0			Recovery = 100% RQD = 81%
						End of borehole at 6.3 m depth.	6.3			

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

GASTECBH (OTTAWA) OE04940.GPJ DST_MIN.GDT 10/3/06

LOG OF BOREHOLE / MONITORING WELL BHMW22

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 18 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						GRASS COVER				
						FILL - sand, silty, some gravel, loose				
○	0	SS1		6		CLAY- silty, firm	0.5			Groundwater level observed 2.0 m below grade on November 26, 2004.
○	0	SS2		9		TILL - silt, sandy, some gravel, reddish seams, loose to very dense, with depth, grey	1.0			
		SS3		23			1.5			
		SS4		>100			2.0			
		RC1				BEDROCK - limestone, dark grey, fossiliferous with narrow black shale horizon bedding noted at ~90° to core axis	2.5			Recovery = 100% RQD = 29%
		RC2					3.0			
							3.5			Recovery = 86% RQD = 68%
							4.0			
							4.5			
		RC3				- fault gouge at 4.6 m, limonite staining noted along fault face	5.0			Recovery = 100% RQD = 77%
							5.5			
		RC4					6.0			Recovery = 100% RQD = 93%
						End of Borehole at 6.3 m depth.				

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW23

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 22 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
○	0	SS1		7		GRASS COVER FILL - sand, silty, organics, loose, black				
○	0	SS2		11		SAND- some silt, trace gravel, loose to compact, reddish seams throughout, light brown matrix	0.5 1.0			
○	0	SS3		7			1.5			Groundwater level observed 1.4 m below grade on November 26, 2004.
○	35	SS4		20			2.0			
○	0	SS5		>100		BEDROCK - limestone, grey, bedding at ~90° to core axis	2.5			
		RC1					3.0 3.5			Recovery = 100% RQD = 77%
		RC2					4.0 4.5 5.0			Recovery = 100% RQD = 79%
						End of borehole at 6.0 m depth.	5.5			

GASTECBH (OTTAWA) OE04940.GPJ DST_MIN.GDT 10/3/06

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SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW24

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 23 2004**

CCGD *		SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 □ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
		SS1		8		GRASS COVER FILL - sand, silty, some gravel, rootlets, loose	0.5			
		SS2		11			1.0			
○	0	SS3		>100		SILT - some sand, gravel, light brown, very dense	1.5			
		RC1				BEDROCK - limestone, grey, highly fractured, fossiferous with narrow black shale horizons, bedding at ~90° to core axis	2.0			Recovery = 73% RQD = 8%
							2.5			
		RC2					3.0			Groundwater level observed 3.1 m below grade on November 26, 2004.
							3.5			Recovery = 100% RQD = 59%
							4.0			
		RC3					4.5			
							5.0			Recovery = 100% RQD = 78%
							5.5			
							6.0			
						End of borehole at 6.2 m depth.				

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SAMPLE TYPE LEGEND

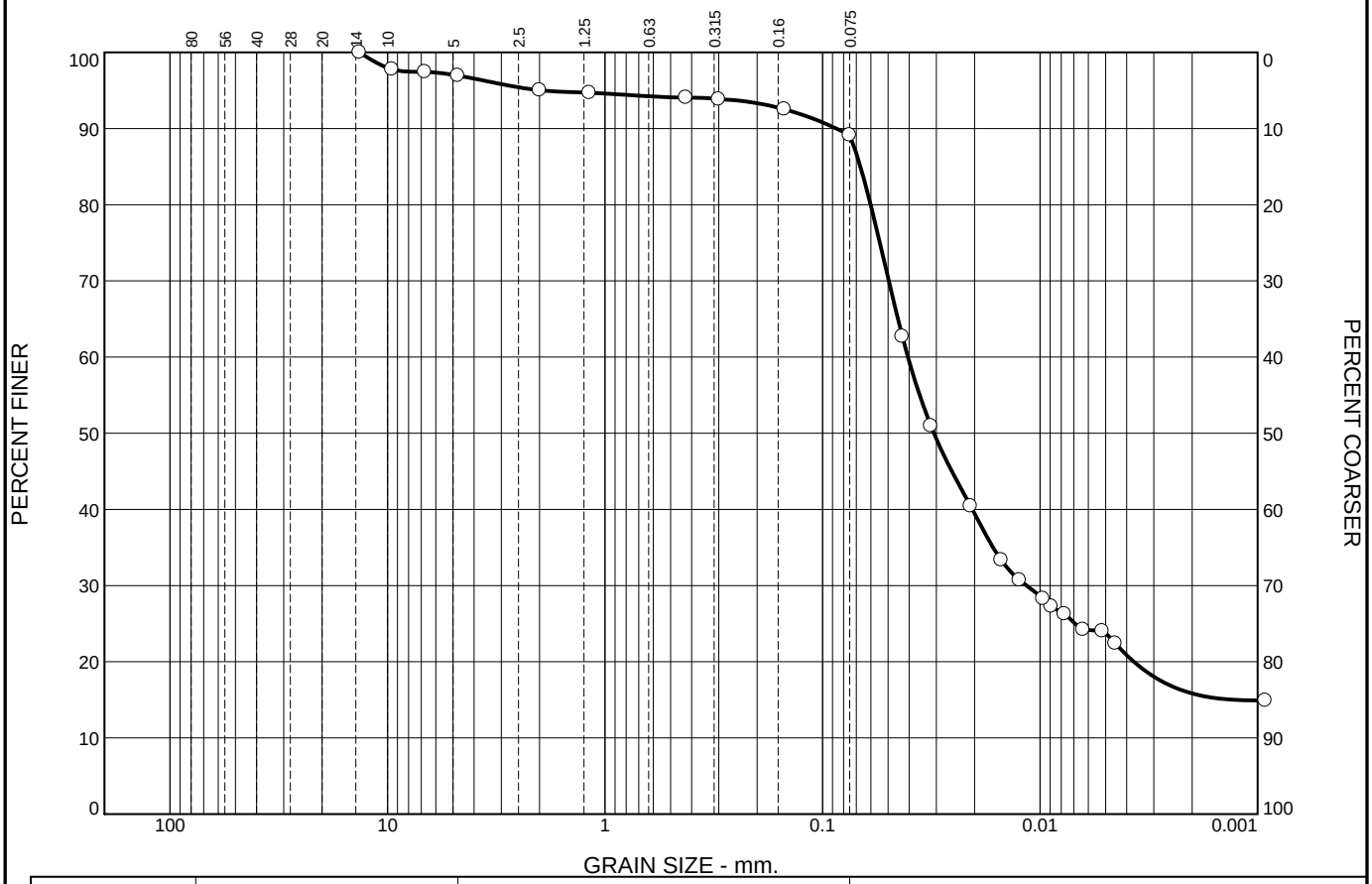
Auger Sample | Rock Core | Poner Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

APPENDIX E

LABORATORY TEST RESULTS

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	3	2	1	5	73	16

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0670	0.0405	0.0308	0.0116	0.0013			

Material Description	USCS	AASHTO
○ SILT, some clay, trace sand, trace gravel		

Project No. CO682.00 **Client:** Canada Lands Company CLC Limited

Project: Wateridge Village

○ **Sample Number:** BH112/S2

Remarks:

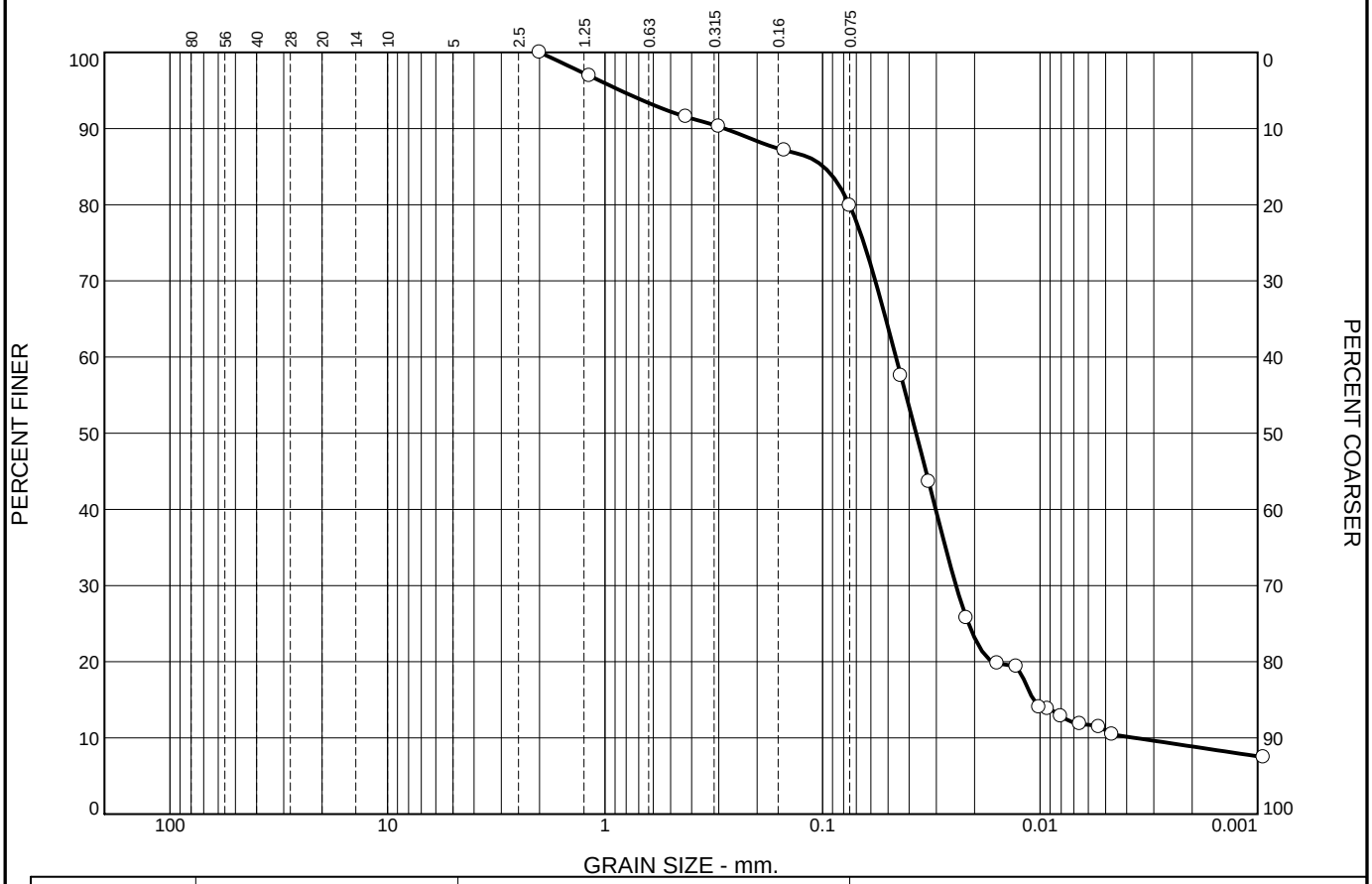
○Tested on November 28, 2018

TERRAPEX

Figure E-1

Tested By: RH

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	0	0	8	12	71	9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0990	0.0460	0.0372	0.0244	0.0107	0.0037	3.53	12.58

Material Description	USCS	AASHTO
○ SILT, some sand, trace clay		

Project No. CO682.00 **Client:** Canada Lands Company CLC Limited

Project: Wateridge Village

○ **Sample Number:** BH120/S2

Remarks:

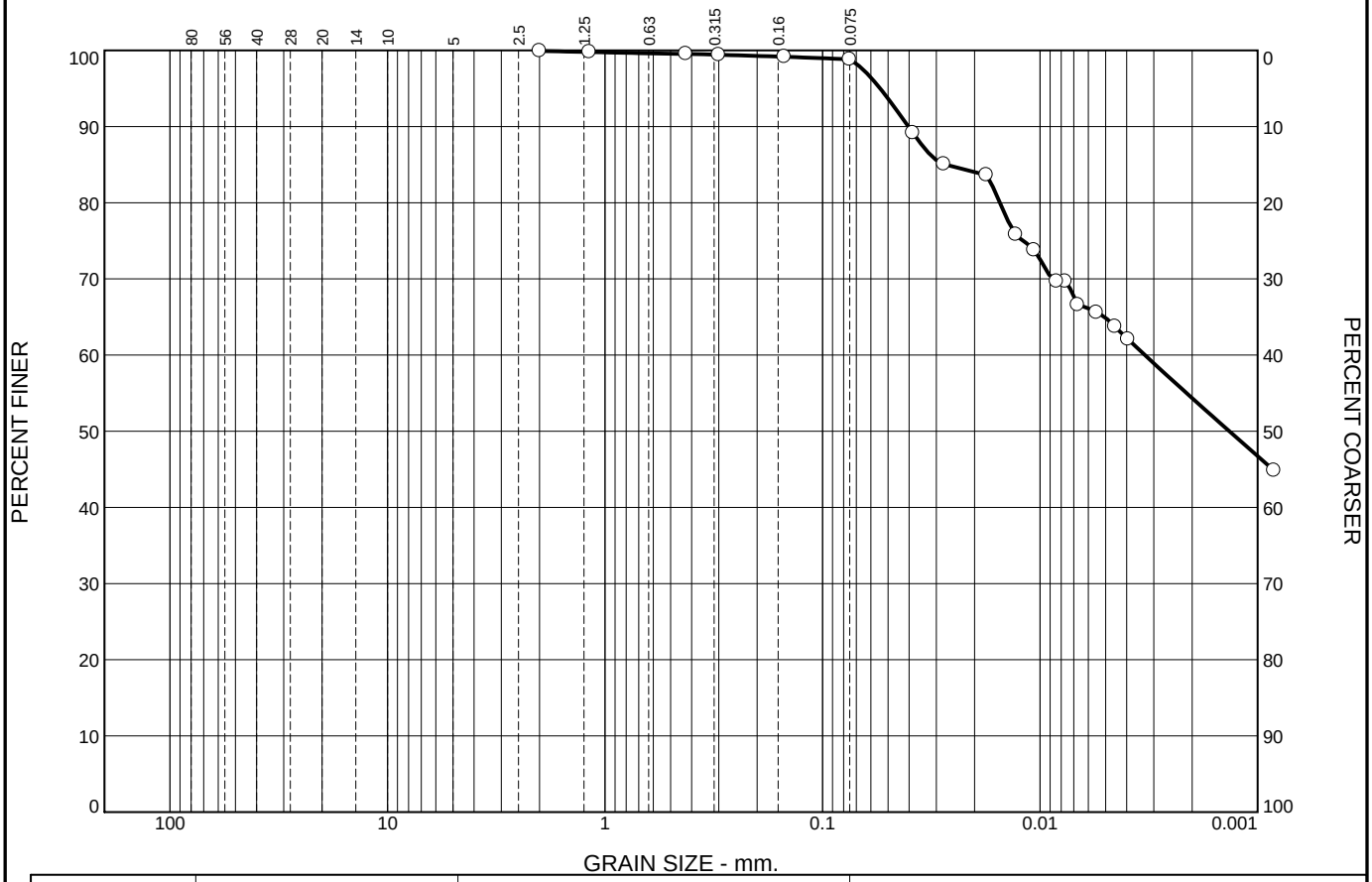
○Tested on November 28, 2018

TERRAPEX

Figure E-2

Tested By: RH

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○					0	1	45	54

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	58	24	0.0272	0.0033	0.0013					

Material Description	USCS	AASHTO
○ CLAY and SILT, trace sand		A-7-6(39)

Project No. CO682.00 **Client:** Canada Lands Company CLC Limited

Project: Wateridge Village

○ **Sample Number:** BH125/S3

Remarks:

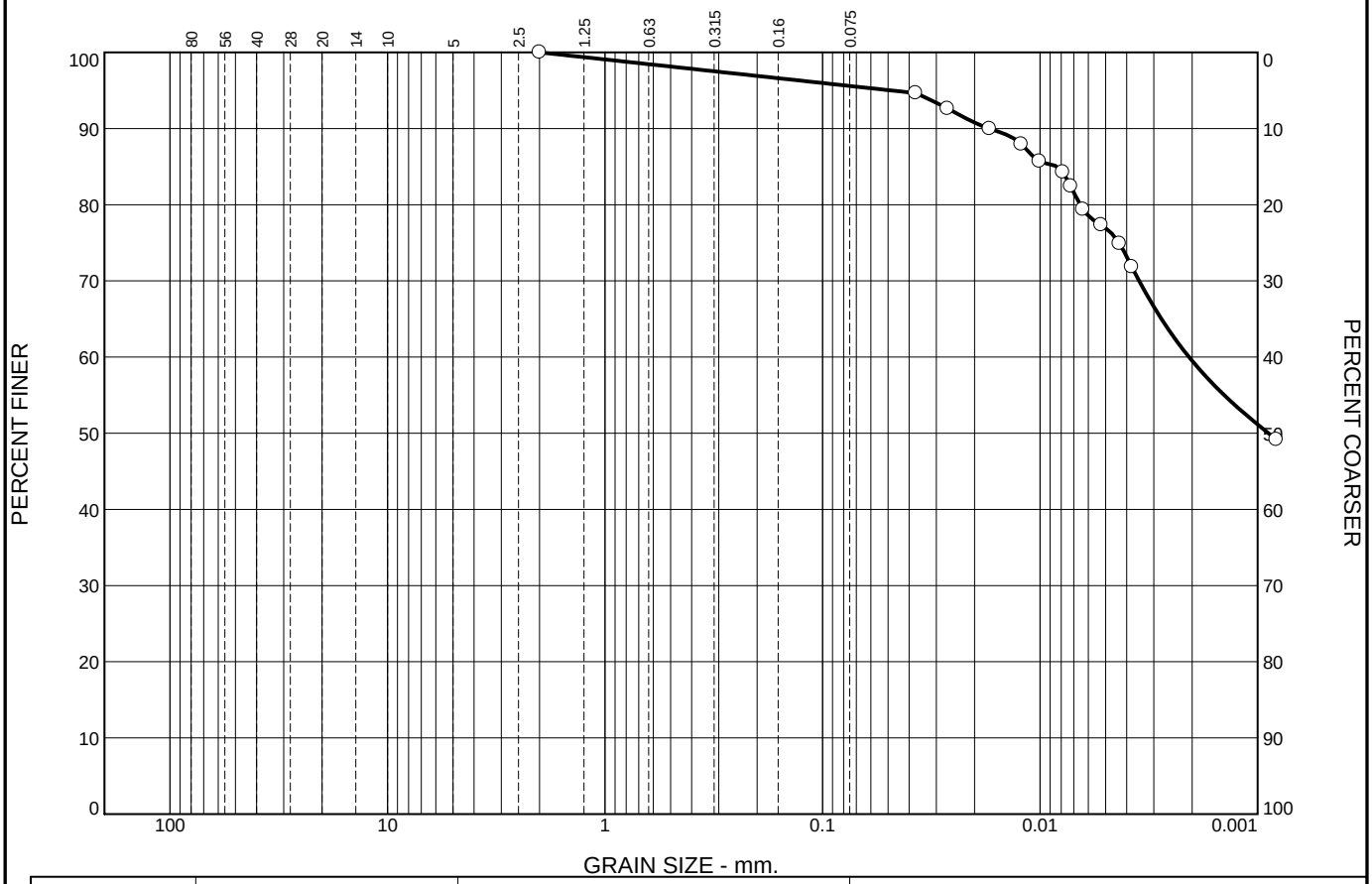
○Tested on November 30, 2018

TERRAPEX

Figure E-3

Tested By: RH

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	0	0	2	2	37	59

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0084	0.0021	0.0009					

Material Description	USCS	AASHTO
○ CLAY and SILT, trace sand		

Project No. CO682.00 **Client:** Canada Lands Company CLC Limited

Project: Wateridge Village

○ **Sample Number:** BH134/S2

Remarks:

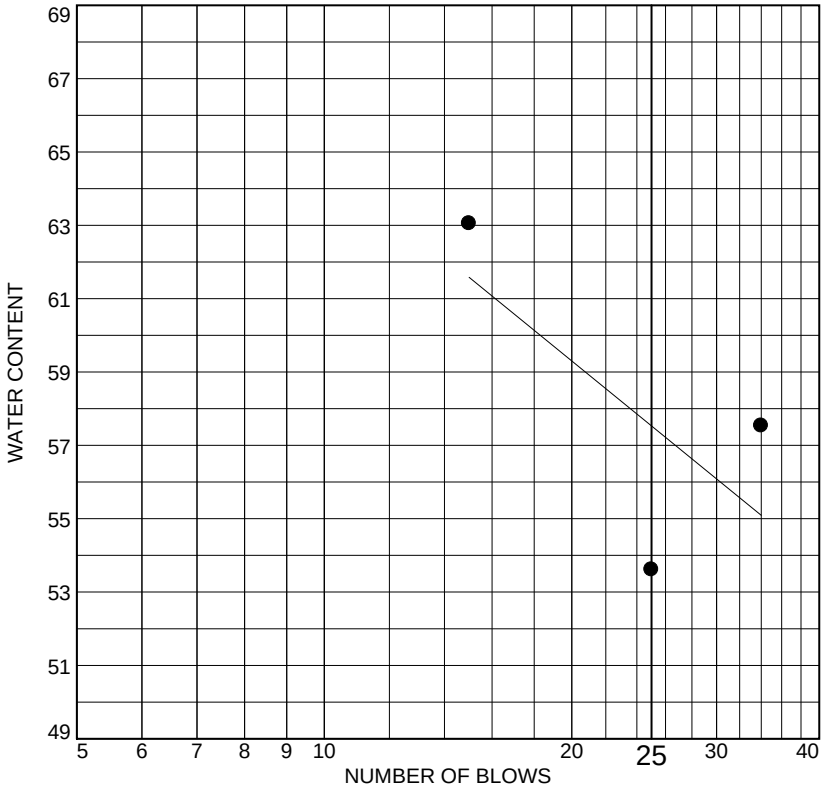
○Tested on November 30, 2018

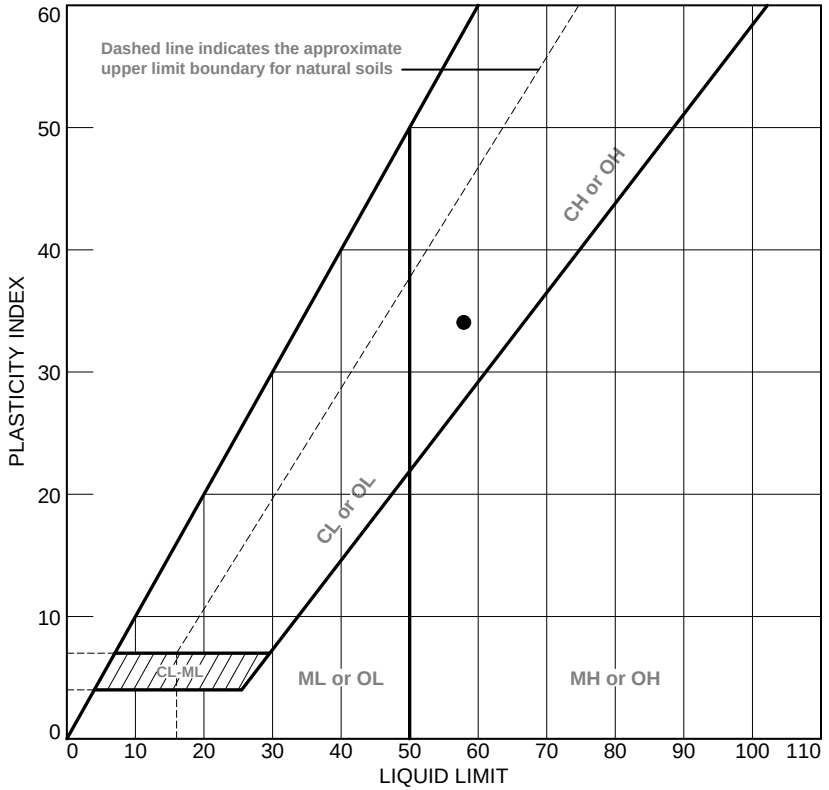
TERRAPEX

Figure E-4

Tested By: RH

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●		BH125-3				CLAY and SILT, trace sand		58	34

Client Canada Lands Company CLC Limited

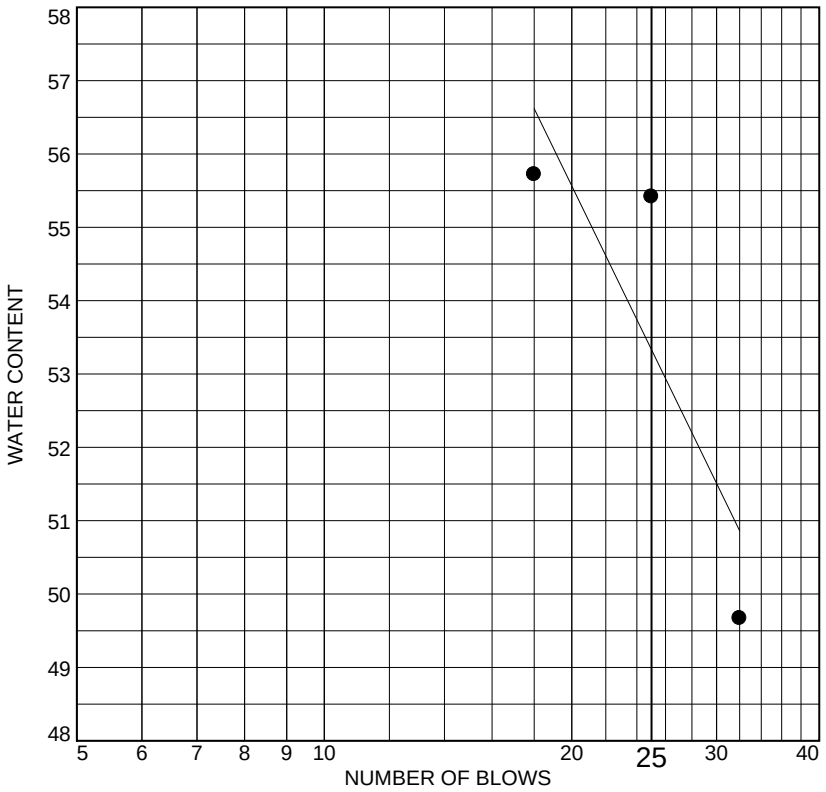
Project Wateridge Village

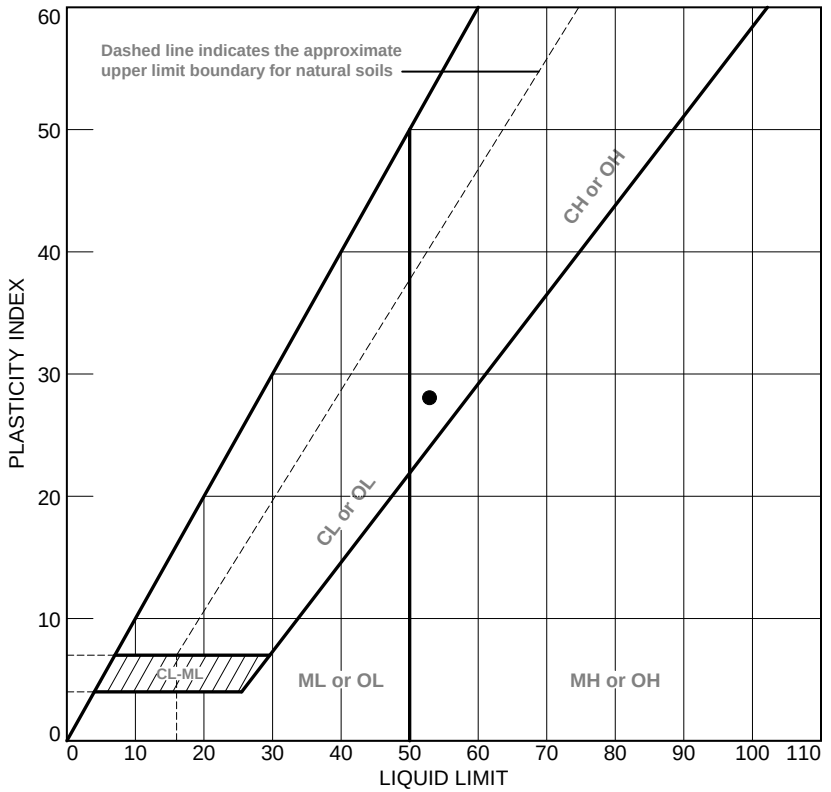
Project No. CO682.00 Figure E-5

TERRAPEX

Tested By: RH

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●		BH134-2				CLAY and SILT		53	28

Client Canada Lands Company CLC Limited

Project Wateridge Village

Project No. CO682.00 Figure E-6

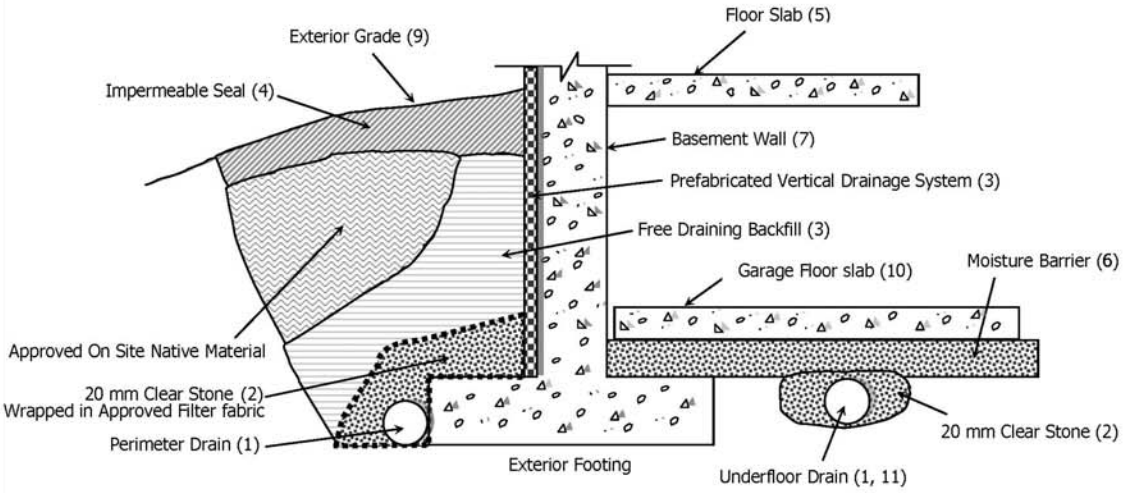
TERRAPEX

Tested By: RH

APPENDIX F

TYPICAL DRAINAGE SYSTEM

Drainage and Backfill Details



Notes

1. Perimeter and underfloor drains shall consist of 100 mm diameter weeping tile with fabric sock or equivalent perforated pipe leading to a positive sump or outlet. Invert to be a minimum of 300 mm below underside of garage floor slab. Perimeter drain is required for sections of garage wall installed below exterior grade.

2. 20 mm Clear Stone – 150 mm top and side of drain, surrounded by approved filter fabric (Terrafix 270R or equivalent).

3. Free Draining backfill – OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm of the wall. Use hand controlled light compaction equipment within 1.8 m of wall. Free draining backfill is not required if a prefabricated vertical drainage system (such as Miradrain 6000) is installed on the exterior of the basement wall.

4. Impermeable backfill seal (min. 600 mm) – relatively impervious compacted silty clay, clayey silt or equivalent. If on-site native backfill is impermeable, seal may be omitted.

5. Do not backfill until wall is supported by garage and floor slabs or adequate bracing.

6. Moisture barrier to be at least 200 mm of compacted 20 mm clear stone or equivalent free draining material.

7. Basement wall to be damp-proofed.

9. Exterior grade to slope away from building at minimum gradient of 2%.

10. Garage floor slab should not be structurally connected to the wall or footing.

11. Underfloor drain invert to be at least 300 mm below underside of floor slab. Drainage tile placed in parallel rows at 10 m centre to centre. Place drain on 100 mm of 20 mm clear stone with 150 mm of clear stone on top and sides. Do not connect the underfloor drains to perimeter drains.

DRAINAGE AND BACKFILL RECOMMENDATIONS
(Not to Scale)

alston associates
geotechnical division of TERRAPEX

APPENDIX G

CERTIFICATE OF CHEMICAL ANALYSES

Maxxam
A Bureau Veritas Group Company

Your Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Your C.O.C. #: 117522

Attention: Rachel Herzog

Terrapex Environmental Ltd
1-20 Gurdwara Rd.
Ottawa, ON
CANADA K2E 8B3

Report Date: 2018/12/20
Report #: R5534330
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8X8071
Received: 2018/12/18, 11:30

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Anions (1)	4	2018/12/20	2018/12/20	CAM SOP-00435	SM 23 4110 B m
Moisture (1)	4	N/A	2018/12/19	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT (1)	4	2018/12/20	2018/12/20	CAM SOP-00413	EPA 9045 D m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Analytics Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Alisha Williamson, Project Manager
Email: AWilliamson@maxxam.ca
Phone# (613) 274-0573

Your Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Your C.O.C. #: 117522

Attention: Rachel Herzog

Terrapex Environmental Ltd
1-20 Gurdwara Rd.
Ottawa, ON
CANADA K2E 8B3

Report Date: 2018/12/20
Report #: R5534330
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8X8071
Received: 2018/12/18, 11:30

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B8X8071
Report Date: 2018/12/20

Terrapex Environmental Ltd
Client Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Sampler Initials: RH

RESULTS OF ANALYSES OF SOIL

Maxxam ID		IOS514	IOS515	IOS516	IOS517			IOS517		
Sampling Date		2018/12/11 14:15	2018/12/11 14:00	2018/12/11 13:30	2018/12/11 13:45			2018/12/11 13:45		
COC Number		117522	117522	117522	117522			117522		
	UNITS	**BH108-2**	**BH127-2**	**BH153-3**	**BH156-2**	**RDL**	**QC Batch**	**BH156-2 Lab-Dup**	**RDL**	**QC Batch**
Inorganics										
Moisture	%	20	15	11	10	1.0	5896681			
Available (CaCl2) pH	pH	7.58	7.54	7.66	7.77		5898613			
Chloride (Cl-)	ug/g	ND	ND	ND	ND	10	5898620	ND	10	5898620
Sulphate (SO4)	ug/g	98	26	ND	ND	20	5898620	24	20	5898620

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

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Maxxam Job #: B8X8071
Report Date: 2018/12/20

Terrapex Environmental Ltd
Client Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Sampler Initials: RH

TEST SUMMARY

Maxxam ID: IOS514 **Collected:** 2018/12/11
Sample ID: BH108-2 **Shipped:**
Matrix: Soil **Received:** 2018/12/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Anions	IC	5898620	2018/12/20	2018/12/20	Fari Dehdezi
Moisture	BAL	5896681	N/A	2018/12/19	Prgya Panchal
pH CaCl2 EXTRACT	AT	5898613	2018/12/20	2018/12/20	Gnana Thomas

Maxxam ID: IOS515 **Collected:** 2018/12/11
Sample ID: BH127-2 **Shipped:**
Matrix: Soil **Received:** 2018/12/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Anions	IC	5898620	2018/12/20	2018/12/20	Fari Dehdezi
Moisture	BAL	5896681	N/A	2018/12/19	Prgya Panchal
pH CaCl2 EXTRACT	AT	5898613	2018/12/20	2018/12/20	Gnana Thomas

Maxxam ID: IOS516 **Collected:** 2018/12/11
Sample ID: BH153-3 **Shipped:**
Matrix: Soil **Received:** 2018/12/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Anions	IC	5898620	2018/12/20	2018/12/20	Fari Dehdezi
Moisture	BAL	5896681	N/A	2018/12/19	Prgya Panchal
pH CaCl2 EXTRACT	AT	5898613	2018/12/20	2018/12/20	Gnana Thomas

Maxxam ID: IOS517 **Collected:** 2018/12/11
Sample ID: BH156-2 **Shipped:**
Matrix: Soil **Received:** 2018/12/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Anions	IC	5898620	2018/12/20	2018/12/20	Fari Dehdezi
Moisture	BAL	5896681	N/A	2018/12/19	Prgya Panchal
pH CaCl2 EXTRACT	AT	5898613	2018/12/20	2018/12/20	Gnana Thomas

Maxxam ID: IOS517 Dup **Collected:** 2018/12/11
Sample ID: BH156-2 **Shipped:**
Matrix: Soil **Received:** 2018/12/18

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Anions	IC	5898620	2018/12/20	2018/12/20	Fari Dehdezi

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Maxxam Job #: B8X8071
Report Date: 2018/12/20

Terrapex Environmental Ltd
Client Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Sampler Initials: RH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C

Results relate only to the items tested.

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Report Date: 2018/12/20

Terrapex Environmental Ltd
Client Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Sampler Initials: RH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5896681	JS9	RPD	Moisture	2018/12/19	2.4		%	20
5898613	GTO	Spiked Blank	Available (CaCl2) pH	2018/12/20		100	%	97 - 103
5898613	GTO	RPD	Available (CaCl2) pH	2018/12/20	0.40		%	N/A
5898620	FD	Matrix Spike [IOS517-01]	Chloride (Cl-)	2018/12/20		NC	%	70 - 130
			Sulphate (SO4)	2018/12/20		NC	%	75 - 125
5898620	FD	Spiked Blank	Chloride (Cl-)	2018/12/20		98	%	70 - 130
			Sulphate (SO4)	2018/12/20		99	%	75 - 125
5898620	FD	Method Blank	Chloride (Cl-)	2018/12/20	ND, RDL=10		ug/g	
			Sulphate (SO4)	2018/12/20	ND, RDL=20		ug/g	
5898620	FD	RPD [IOS517-01]	Chloride (Cl-)	2018/12/20	NC		%	35
			Sulphate (SO4)	2018/12/20	19		%	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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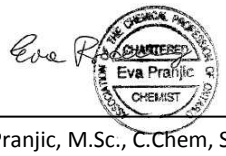
Maxxam Job #: B8X8071
Report Date: 2018/12/20

Terrapex Environmental Ltd
Client Project #: CO682.00
Site Location: WATERIDGE VILLAGE
Sampler Initials: RH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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