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Geotechnical Investigation
Proposed Residential Development
262 Armstrong Street
Ottawa, Ontario

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Submitted to:

Mr. Lance Lunetta
262 Armstrong Street
Ottawa, Ontario
K1Y 2W6

Geotechnical Investigation
Proposed Residential Development
262 Armstrong Street
Ottawa, Ontario

April 26, 2022
Project: 65071.01

experience • knowledge • integrity

GEMTEC Consulting Engineers and Scientists Limited
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April 26, 2022 File: 65071.01

Mr. Lance Lunetta
262 Armstrong Street
Ottawa, Ontario
K1Y 2W6

Attention: Mr. Lance Lunetta

Re: Geotechnical Investigation
Proposed Residential Development
262 Armstrong Street
Ottawa, Ontario

Enclosed is our geotechnical investigation report for the above noted project, in accordance with our proposal dated February 3, 2020. This report was prepared by Gregory Davidson, P.Eng. and Brent Wiebe, P.Eng.

p.p. Greg Davidson, P.Eng.
Geotechnical Engineer

Brent Wiebe P.Eng.
VP Operations – Ontario
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GD/BW

Enclosures
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for a proposed residential development, located at 262 Armstrong Street in the City of Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of boreholes and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This investigation was carried out in general accordance with our proposal dated February 3, 2020.

2.0 PROJECT DESCRIPTION AND SITE GEOLOGY

2.1 Project Description

It is understood that plans are being prepared to construct a 4-unit residential, mid-rise building at 262 Armstrong Street in Ottawa, Ontario. The proposed structure will have a footprint of about 325 square metres and will include a basement level unit. Currently, a two (2) storey dwelling with a basement exists on the property. Plans are being prepared to demolish the existing dwelling prior to construction of the proposed residential structure.

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was provided with drawings for this project dated January 28, 2021 prepared by Paul A. Cooper Architect

2.2 Site Geology

Surficial geology maps of the Ottawa area indicate that the site is underlain by glacial till. Bedrock geology maps indicate interbedded limestone and dolostone bedrock of the Gull River formation at depths of about 2 to 3 metres below surface grade. Fill material associated with previous development at the site should also be anticipated.

3.0 METHODOLOGY

3.1 Geotechnical Investigation

The field work for this investigation was carried out on June 9, 2021. At that time, one (1) borehole, numbered 21-1 was advanced at the site by CCC Geotechnical and Environmental Drilling Ltd. of Ottawa Ontario, to a depth of about 6.5 metres below existing grade (elevation 56.1 metres, geodetic).

Standard penetration tests (SPT) were carried out in the borehole and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler. Bedrock coring was carried out using NQ diamond core rotary drilling.

One (1) standpipe piezometer was installed and sealed in the bedrock at borehole 21-1 to facilitate groundwater level measurements.

Following completion of the drilling, the soil and bedrock samples were returned to our laboratory for examination by a geotechnical engineer. One (1) soil sample was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

The results of the borehole are provided on the Record of Borehole sheet in Appendix A. The approximate location and ground surface elevation of the borehole are shown on the Borehole Location Plan, Figure 1. The results of grain size distribution testing are provided in Appendix B. The results of unconfined compressive strength test of the bedrock core and a picture of the recovered bedrock core are provided in Appendix C. The results of the chemical analysis of a soil sample relating to corrosion of buried concrete and steel are provided in Appendix D.

The borehole location was selected by GEMTEC and positioned on site relative to existing features. The ground surface elevation at the location of the borehole was determined using a Spectra SP60 global positioning system. The elevation is referenced to geodetic datum and is considered to be accurate within the tolerance of the instrument.

4.0 SUBSURFACE CONDITIONS

4.1 General

As previously indicated, the soil, bedrock and groundwater conditions identified in the borehole are given on the Record of Borehole sheet in Appendix A. The log indicates the subsurface conditions at the specific test location only. Boundaries between zones on the log are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the method of drilling, the frequency and recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at other than the borehole location may vary from the conditions encountered in the borehole. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties.

The soil and bedrock descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and GEMTEC does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. Groundwater conditions may vary seasonally or as a consequence of construction activities in the area.

The following presents an overview of the subsurface conditions encountered in the borehole.

4.2 Asphaltic Concrete

A layer of asphaltic concrete was encountered from ground surface. The asphaltic concrete has a thickness of about 50 millimetres.

4.3 Fill Material

Fill material was encountered below the asphaltic concrete. The fill material can generally be described as dark brown to brown silty sand/sandy silt with varying amounts of gravel, clay and organic material.

Standard penetration tests carried out in the fill material gave N values ranging from 4 to 6 blows per 0.3 metres of penetration, which reflect a loose relative density.

Moisture content testing carried out on samples of the fill material indicate moisture contents ranging between about 7 and 33 percent.

4.4 Glacial Till

Glacial till was encountered below the fill material at about 1.4 metres below existing grade. Glacial till is a heterogeneous mixture of all grain sizes; however, at this site, the glacial till can generally be described as grey brown silty sand with some gravel and clay with possible cobbles transitioning to grey brown silty gravel and sand with possible cobbles.

Standard penetration tests carried out in the glacial till gave N values ranging from 8 to 42 blows per 0.3 metres of penetration, which reflect a loose to dense relative density. It should be noted that the higher blow counts may be due to the presence of cobbles and boulders within the glacial till. The glacial till has a thickness of about 3.1 metres and extends to a depth of about 4.5 metres below existing grade.

The results of grain size analysis testing carried out on selected samples of glacial till are presented in Tables 4.1 and 4.2 and are provided in Appendix B.

Table 4.1 – Summary of Grain Size Distribution Testing

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt & Clay (%)
21-1	5	3.05 – 3.66	40.8	38.5	20.7

Table 4.2 – Summary of Hydrometer Testing

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
21-1	3	1.52 – 2.13	10.9	52.0	24.7	12.4

Moisture content testing carried out on samples of the glacial till indicate moisture contents ranging between about 4 and 10 percent.

4.5 Bedrock

The bedrock was cored using NQ sized coring equipment from about 4.5 metres below existing grade (elevation 58.0 metres). The bedrock was cored to a depth of about 6.5 metres below ground surface (elevation 56.1 metres). A photograph of the recovered bedrock core samples are provided on Figure C1 in Appendix C.

The bedrock can be described as grey, fresh to faintly weathered, thinly laminated to thinly bedded, very close to close discontinuity, limestone bedrock interbedded with shale bedrock. The solid core recovery (SCR) value was 85 percent, and the rock quality designation (RQD) value was 79 percent indicating a bedrock quality of fair to excellent.

One (1) bedrock core sample was tested for unconfined compressive strength and the results are summarized in Table 4.3 below and provided in Appendix C.

Table 4.3 – Unconfined Compressive Strength of Bedrock Cores

Borehole	Sample No.	Depth (metres)	Unconfined Compressive Strength (MPa)
21-1	RC 7	4.72 – 4.93	266.30

Based on the unconfined compressive strength test results presented in Table 4.1, the bedrock strength may be classified as very strong.

4.6 Groundwater

The groundwater level was measured in the well screen installed in borehole 21-1 and is summarized in Table 4.4.

Table 4.4 – Groundwater Level Observations

Borehole	Date	Well Screen	Groundwater Depth (metres)	Groundwater Elevation (metres)
21-1	June 15, 2021	Bedrock	2.95	59.57

It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

4.7 Soil Chemistry Relating to Corrosion

The results of chemical testing of a soil sample from borehole 21-1 are provided in Appendix D and summarized in Table 4.5.

Table 4.5 – Chemical Testing of Soil Sample

BH	pH	Sulphate Content (micrograms per gram)	Chloride Content (micrograms per gram)	Resistivity (Ohm metres)	Conductivity (mircosiemens per centimetre)
21-1	7.95	142	25	40.8	245

5.0 GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS

5.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the borehole advanced as part of this investigation and the project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous uses or activities of this site or adjacent properties, and/or resulting from the introduction onto the site from materials from offsite sources are outside the terms of reference for this report and have not been investigated or addressed.

A Phase One Environmental Site Assessment (ESA) was carried out at this site by GEMTEC. The results are provided in our report titled: “Phase One Environmental Site Assessment, proposed Residential Dwelling, 262 Armstrong Street, Ottawa, Ontario”, dated June 1, 2021.

5.1 Proposed Residential Building

5.1.1 Overburden Excavation and Temporary Shoring

Based on the boreholes advanced in the vicinity of the proposed residential building, the overburden excavations will be carried out mostly through fill material and glacial till. The sides of the excavation should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the fill material at this site can be classified as Type 3 soil and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical, or flatter.

Where space constraints prevent 1 horizontal to 1 vertical side slopes, the sides of the excavation could be supported using a shoring system, such as a soldier pile and lagging shoring wall, or driven interlocking steel sheet piles. If a shoring system is used, the shoring system should be suitably tied back with tensioned rock anchors. For design and costing purposes, allowance should be made to socket the soldier piles for a pile lagging wall into the bedrock using predrilled holes. The shoring system should be designed to resist lateral earth pressures imposed on the shoring from the weight of the retained soil and any other surcharge loads. The design should also consider soil stratigraphy, the groundwater conditions, the permissible ground movements associated with the excavation and construction of the shoring system, and potential impacts on adjacent structures and utilities. Some unavoidable inward horizontal movement and settlement of the ground behind the retaining walls should be anticipated, which could affect the existing structures and services behind the shoring walls. Further details could be provided if required.

In the event that a granular pad is necessary below the foundations, the excavations should be sized to accommodate a pad of imported granular material which extends at least 0.5 metres horizontally beyond the edge of the footings and down and out from this point at 1 horizontal to 1 vertical, or flatter.

5.1.2 Bedrock Excavation

At the time of preparation of this report, the underside of footing level is understood to be at about 59.4 metres. Bedrock was encountered at a depth of about 4.5 metres below existing grade (elevation 58.0 metres), therefore, bedrock excavation may not be required for the proposed development. If however, unsuitable soil conditions (e.g. fill material) are encountered below proposed founding level or if design changes occur bedrock excavation may be necessary.

Bedrock removal at this site could be carried out using hoe ramming techniques in conjunction with line drilling on close centres. The sides of the bedrock excavation should stand near vertical, however, to protect workers, the sides of the excavation should be scaled to remove all loose rock material.

In order to reduce over break and/or under break of the bedrock in areas where the excavation will be carried out next to an existing site service and along the perimeter of the excavation, it is suggested that the limit of excavation be defined by line drilling on close centres. For the bedrock at this site, it is suggested that allowance be made for line drilling 75 to 100 millimetre diameter holes on 200 to 300 millimetre centres.

The vibration effects of hoe ramming are usually minor and localized. Monitoring of the hoe ramming could be carried out, at least initially, to measure the vibrations to ensure that they are below the acceptable threshold value. Further details on vibration monitoring are provided in Vibration Monitoring section of this report.

Provided that good bedrock excavation techniques are used, the limestone bedrock could be excavated using vertical side walls. It is noted that the bedrock contains near vertical joints and bedding planes. Therefore, some vertical and horizontal over break of the bedrock should be expected. The bedrock below founding level will likely break at a horizontal bedding plane below the design depth of the footings, which may necessitate thickening of the footings and/or lowering of the footings.

5.1.3 Excavation Adjacent to Existing Structures

The existing adjacent structures are likely founded on glacial till or bedrock. For adjacent existing structures founded on glacial till, excavation for the proposed building should not encroach within a line extending downwards and outwards from adjacent foundations at an inclination of 1 vertical to 1 horizontal. For adjacent structures founded on bedrock, this zone could be revised such that no excavation is carried out within 2 vertical to 1 horizontal from the edge of the existing foundations.

We recommended that the foundation type and geometry for the adjacent buildings be obtained to confirm the excavation requirements. The conditions should be assessed by GEMTEC, along with the proposed underside of footing elevation for the new building to ensure that our recommendations are interpreted as intended.

5.1.4 Groundwater Management

The groundwater level on June 15, 2021 was about 2.95 metres below existing grade (elevation 59.6 metres). The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation. As such, some groundwater pumping may be required at the time of the construction of the footings, if the underside of footing elevation is below the groundwater level.

Groundwater inflow from the overburden or bedrock excavation should be controlled by pumping from filtered sumps within the excavations to a suitable outlet. It is not expected that short term pumping during excavation will have a significant effect on nearby structures and services.

Based on the measured groundwater levels and anticipated excavation depths (i.e., about 2 metres), it is not expected that a water taking permit (e.g., EASR or PTTW) from the Ministry of the Environment, Conservation and Parks will be required. This can be confirmed once the excavation depths are finalized.

Long term groundwater management should include a perimeter foundation drain (discussed below) which outlets to the storm sewer by gravity. If an outlet to the storm sewer by gravity is not feasible, consideration could be given to raising the proposed underside of footing elevation such that the underside of the basement floor slab is at least 0.3 metres above the groundwater level.

5.1.5 Foundations

As previously indicated, we recommend that the foundation conditions for the existing buildings be obtained. This information can be used to identify suitable founding depths for the proposed building. The proposed foundations should not encroach within a line extending downwards and outwards from the existing foundations of the adjacent buildings at an inclination of 1 vertical to 1 horizontal, assuming the foundations for the existing buildings are founded on or within glacial till.

Based on the results of the investigation, the proposed building could be founded on or within glacial till or bedrock. All fill material should be removed below the proposed foundations and floor slabs.

In areas where subexcavation of disturbed material or fill is required below proposed founding level, the grade could be raised with compacted granular material (engineered fill). The engineered fill should consist of granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type II and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. To provide adequate spread of load beneath the footings, the engineered fill should extend horizontally at least 0.5 metres beyond the footings and then down and out from this point at 1 horizontal to 1 vertical, or flatter. The excavation for the foundation should be sized to accommodate this fill placement.

The spread footing foundations should be sized using the bearing pressures provided in Table 5.1.

Table 5.1 – Foundation Bearing Pressures

Subgrade Material	Geotechnical Reaction at Servicability Limit State (kilopascals)	Factored Geotechnical Resistance at Ultimate Limit State (kilopascals)
Native, undisturbed glacial till or a pad of engineered fill above native glacial till	120[1]	250
Pad of engineered fill above competent bedrock	250[1]	450
Competent bedrock	n/a[2]	1,000[3]

Notes:

1. Provided that the subgrade surface and engineered fill are prepared as described in this report, the post construction total and differential settlement of the footings at SLS should be less than 25 and 15 millimetres, respectively.
2. The geotechnical reaction at SLS for 25 millimetres of settlement will be greater than the factored resistance at ULS; as such, ULS conditions will govern for footings founded directly on the competent bedrock surface.
3. The ULS value for beerock assumes that all soil, and disturbed or loosened bedrock is removed from the bearing surface. Allowance should be made in the contract for concrete fill below the foundations due to vertical overbreak of the bedrock.

5.1.6 Frost Protection of Foundations

All exterior footings for heated portions of the structure should be provided with at least 1.5 metres of earth cover for frost protection purposes. Footings located within unheated portions of the building or isolated footings outside the building footprint should be provided with at least 1.8 metres of earth cover for frost protection purposes. If the required depth of earth cover is not practicable, a combination of earth cover and polystyrene insulation could be considered.

The requirement for minimum depths of soil cover for frost protection could likely be waived for footings founded on or within relatively sound bedrock. An evaluation of the frost susceptibility of the bedrock at subgrade level could be carried out by geotechnical personnel at the time of construction.

Further details regarding the insulation of foundations, if required, could be provided upon request.

5.1.7 Basement Foundation Wall Backfill and Drainage

To avoid frost adhesion and possible heaving, the foundations should be dampproofed and backfilled with imported, free-draining, non-frost susceptible granular material meeting OPSS Granular B Type I or II requirements. The backfill should be placed in maximum 200 millimetre thick lifts and compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

Where areas of hard surfacing (concrete, sidewalk, pavement, etc.) abut the proposed building, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible native materials to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from the bottom of the excavation or 1.5 metres below finished grade, whichever is less, to the underside of the granular base/subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

The roof downspout outlets should be configured so as not to saturate the soil below adjacent hard surfaced areas such as roadways or sidewalks. Discharging roof drainage to soft landscaping (e.g. gardens) that are contained by sidewalks could result in significant heaving/cracking of the sidewalks.

A perforated plastic foundation drain with a surround of clear crushed stone should be installed on the exterior of the foundation walls below the level of the basement floor slab. The drain should outlet by gravity to a storm sewer or a sump from which the water is pumped. To avoid loss of sand backfill into the voids in the clear stone (and possible post construction settlement of the ground around the building), a nonwoven geotextile should be placed between the clear stone and any sand backfill material.

5.1.8 Lateral Earth Pressure

Foundation walls that are backfilled with a granular material such as that meeting OPSS Granular B Type I or II requirements should be designed to resist “at rest” earth pressures calculated using the following formula:

- $P_o = K_o (\gamma H + q)$

Where,

- P_o = At rest earth pressure at the bottom of the foundation wall (kilopascals)
- K_o = At rest earth pressure coefficient (0.50)
- γ = Unit weight of backfill material (22 kilonewtons per cubic metre)
- H = Height of foundation wall (metres)
- q = Uniform surcharge at ground surface behind the wall to take into account traffic, equipment, or stockpiled soil (typically 10 kilopascals)

Where conditions dictate, allowance should be made in the structural design of the foundation walls for loads due to ground supported vehicles/equipment. For example, the horizontal active load due to a uniform, vertical live load adjacent to the foundation wall could be determined using a horizontal earth pressure coefficient, K_o, of 0.50, times the vertical live load. The effects of other vertical loads (point loads, line loads, compaction loads, etc.) adjacent to or near the foundation walls could be provided, if required.

Heavy construction traffic should not be allowed to operate adjacent to foundation walls for the proposed building (within about 2 metres horizontal) during construction, without the approval of the designers.

5.1.9 Seismic Site Class and Liquefaction Potential

According to Table 4.1.8.4.A of the Ontario Building Code, 2012, Site Class C could be used for the seismic design of the structure. It is pointed out that based on available shear wave velocity mapping, the site could potentially be classified as Site Class A or B provided the structures are founded within 3 metres of bedrock; however, site specific testing would be required to confirm this opinion. Multi-Channel Analysis of Surface Waves (MASW), a non-intrusive geophysical test method could be considered for this purpose.

In our opinion the soils at this site are not considered to be liquefiable or collapsible under seismic loads.

5.1.10 Basement Slab Support (Heated Areas Only)

To provide predictable settlement performance of the basement slab, all fill and debris should be removed from the slab area. The base for the floor slab should consist of at least 200 millimetres of OPSS Granular A or 19 millimetre clear crushed stone, overlying undisturbed, native glacial till or bedrock.

City of Ottawa documents allow recycled asphaltic concrete and concrete to be used in Granular A and Granular B Type II materials. Since the source of recycled material cannot be determined, it is suggested that any granular materials used beneath the floor slab be composed of virgin material (100 percent crushed rock) only, for environmental reasons.

OPSS Granular A material placed below the proposed floor slab should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value. Compaction of clear crushed stone is not considered essential.

If well graded granular material (such as OPSS Granular A) is used, rather than clear crushed stone below the basement floor slab, we suggest that drainage be provided by means of perforated plastic pipes spaced at about 6 metres horizontally or as required to link any hydraulically isolated areas to the perimeter drain or sump area. For clear crushed stone, perforated plastic pipes should be used to link any hydraulically isolated areas in the basement. The drains should outlet to a sump from which the water is pumped or by gravity to the storm sewer.

If any areas of the building are to remain unheated during the winter period, thermal protection of the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

The floor slab should be wet cured to minimize shrinkage cracking and slab curling. The slab should be saw cut to about 1/3 the thickness of the slab as soon as curing of the concrete permits, in order to minimized shrinkage cracks.

Proper moisture protection with a vapour retarder should be used for any slab on grade where the floor will be covered by moisture sensitive flooring material or where moisture sensitive equipment, products or environments will exist. The "Guide for Concrete Floor and Slab Construction", ACI 302.1R-04 should be considered for the design and construction of vapour retarders below the floor slab. The sulphate content of any imported granular material placed below the floor slab should be assessed to determine the appropriate exposure class for the concrete.

5.1.11 Excavation for Site Services

Excavation for the site services should be carried out as described in Sections 5.1.1 and 5.1.2.

5.1.12 Corrosion of Buried Concrete and Steel

The measured sulphate concentration from the soil sample recovered from borehole 21-1 was 142 micrograms per gram. According to Canadian Standards Association (CSA) "Concrete Materials and Methods of Concrete Construction", the concentration of sulphate can be classified as low. Therefore, any concrete in contact with the groundwater could be batched with General Use (GU) cement.

Based on the resistivity and pH of the samples, the soil in this area can be classified as non-aggressive towards unprotected steel. It should be noted that the corrosivity of the soil/groundwater could vary throughout the year due to the application sodium chloride for de-icing.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Effects of Construction Induced Vibration

Some of the construction operations (such as excavation, hoe ramming, etc.) will cause ground vibration on and off of the site. The vibrations will attenuate with distance from the source, but may be felt at nearby structures. Assuming that any excavating is carried out in accordance with the guidelines in this report, the magnitude of the vibrations will be much less than that required to cause damage to the nearby structures or services in good condition, but may be felt at the nearby structures. We recommend that preconstruction surveys be carried out on the adjacent structures so that any damage claims can be addressed in a fair manner and that that vibration monitoring be carried out to measure the vibrations during any bedrock excavation to confirm that they are below the acceptable threshold value of 50 millimetres per second.

6.2 Winter Construction

Provision must be made to prevent freezing of any soil or any frost susceptible bedrock below the level of any existing structures or services. Freezing of the soil or bedrock could result in heaving related damage to structures or services.

6.3 Excess Soil Management Plan

This report does not constitute an excess soil management plan.

6.4 Design Review

It is recommended that the design drawings be reviewed by the geotechnical engineer as the design progresses to ensure that the guidelines provided in this report have been interpreted as intended.

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed excavation do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design. The subgrade surface for the proposed building should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

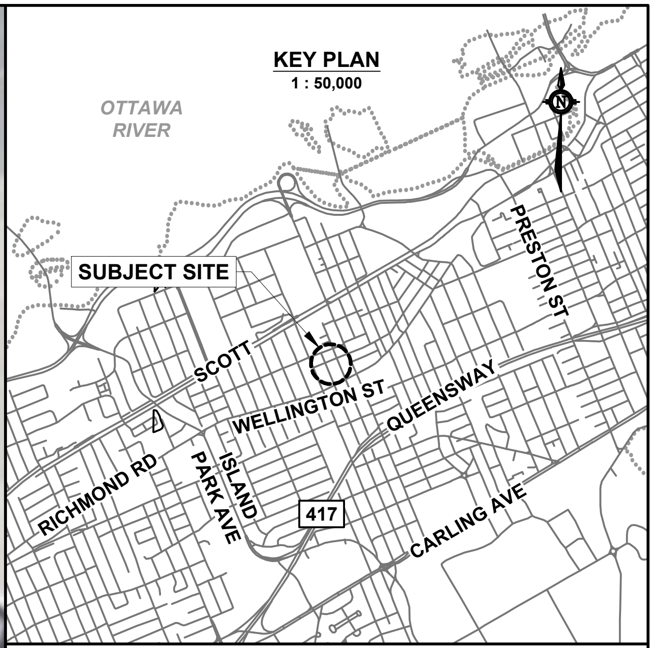
7.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

p.p. Greg Davidson, P.Eng.
Geotechnical Engineer

Brent Wiebe, P.Eng.
VP Operations – Ontario
Senior Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
B.D. WIEBE
100060438
26 Apr 2022
PROVINCE OF ONTARIO



LEGEND

BH # ←	BOREHOLE ID
XX.XX ←	GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM
⊕	**BOREHOLE** (current investigation by GEMTEC)
— - - — - - —	**APPROXIMATE PROPERTY BOUNDARY**

Scale
1:300
0 10 20m

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Drawing
SITE LOCATION PLAN

Client
LANCE LUNETTA

Project
65071.01

Drwn by
S.L.

Chkd by
A.S.

GEOTECHNICAL INVESTIGATION
262 ARMSTRONG STREET
OTTAWA, ONTARIO

Date
APRIL, 2022

Rev.
1

FIGURE 1

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APPENDIX A

List of Abbreviations and Terminology
Record of Borehole Sheet

Report to: Mr. Lance Lunetta
Project: 65071.01 (April 26, 2022)

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

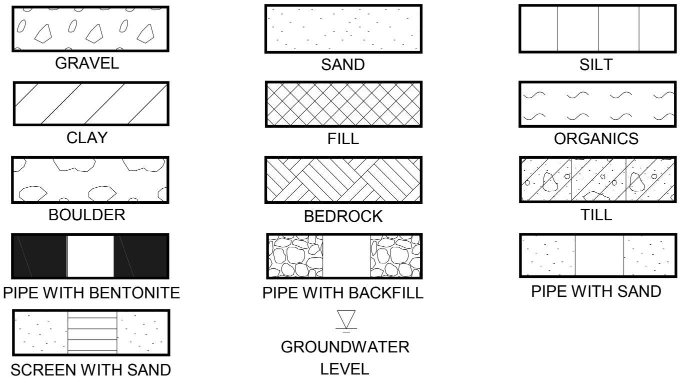
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

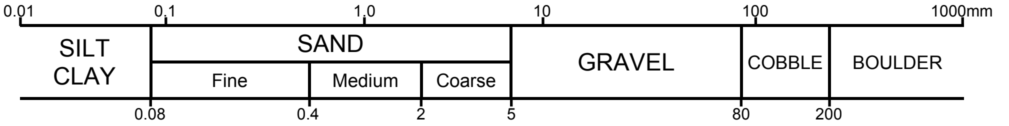
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to ‘A’ size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	**Description**	**Cu, kPa**	**Description**
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)

0	10	20	35
TRACE	SOME	ADJECTIVE	noun > 35% and main fraction
trace clay, etc	some gravel, etc.	silty, etc.	sand and gravel, etc.

GEMTEC

descriptive terms.pub
Modified May 2018

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE	
Fresh	No visible sign of rock material weathering
Faintly weathered	Weathering limited to the surface of major discontinuities
Slightly weathered	Penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material
Moderately weathered	Weathering extends throughout the rock mass but the rock material is not friable
Completely weathered	Rock is wholly decomposed and in a friable condition but the rock and structure are preserved

CORE CONDITION
Total Core Recovery (TCR) The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run
Solid Core Recovery (SCR) The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.
Rock Quality Designation (RQD) The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completed broken core to 100% for core in solid segments.

BEDDING THICKNESS	
Description	**Thickness**
Thinly laminated	< 6 mm
Laminated	6 - 20 mm
Very thinly bedded	20 - 60 mm
Thinly bedded	60 - 200 mm
Medium bedded	200 - 600 mm
Thickly bedded	600 - 2000 mm
Very thickly bedded	2000 - 6000 mm

DISCONTINUITY SPACING	
Description	**Spacing**
Very close	20 - 60 mm
Close	60 - 200 mm
Moderate	200 - 600 mm
Wide	600 -2000 mm
Very wide	2000 - 6000 mm

ROCK QUALITY	
RQD	**Overall Quality**
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

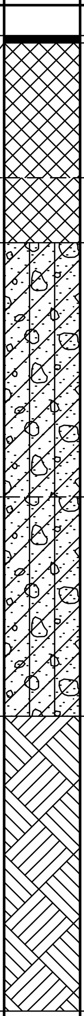
ROCK COMPRESSIVE STRENGTH	
Comp. Strength, MPa	**Description**
1 - 5	Very weak
5 - 25	Weak
25 - 50	Moderate
50 - 100	Strong
100 - 250	Very strong

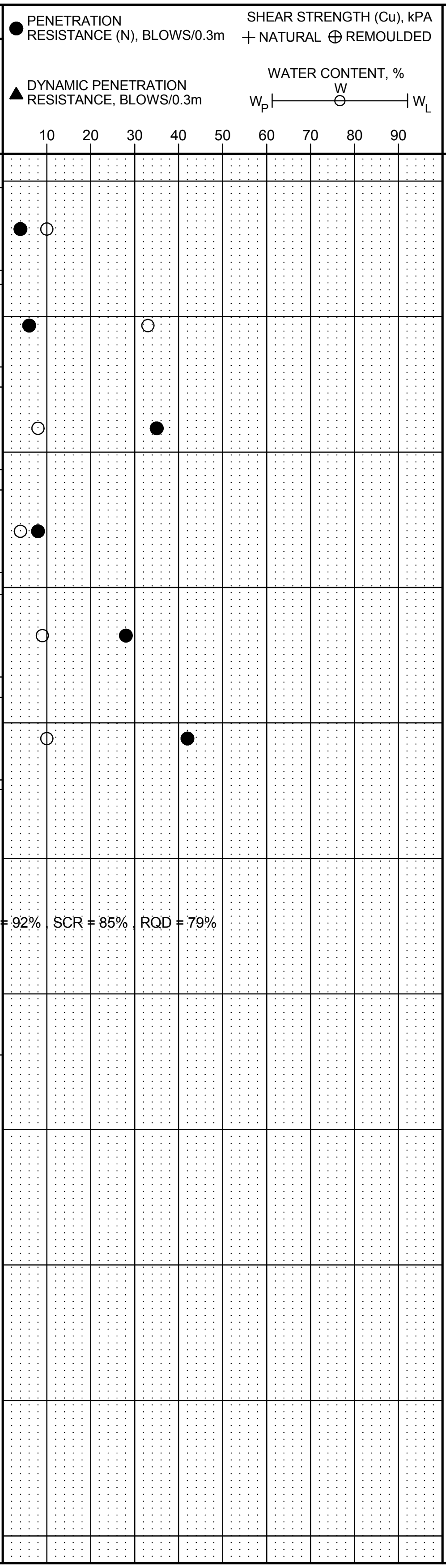
RECORD OF BOREHOLE 21-1

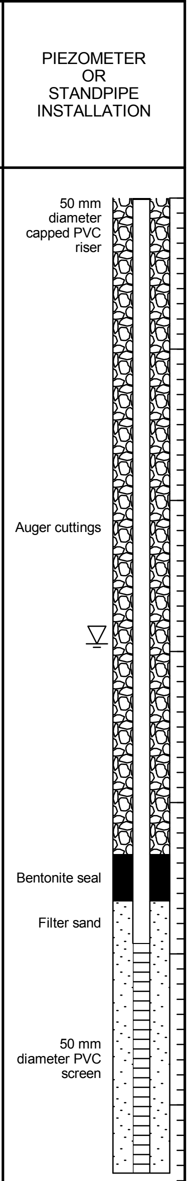
CLIENT: Lance Lunetta
PROJECT: Geotechnical Investigation, 262 Armstrong Street, Ottawa, ON
JOB#: 65071.01
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 9 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
0		Ground Surface	62.52					
	Power Auger Hollow Stem Auger (210mm OD)	ASPHALTIC CONCRETE	0.05					
		Brown sandy silt/silty sand, with trace to some clay and gravel (FILL MATERIAL)		1	SS	152	4	
1		Dark brown sandy silt, with trace to some clay, gravel and organics (FILL MATERIAL)	61.58 0.94	2	SS	305	6	
		Grey brown silty sand, with some clay, gravel and possible cobbles (GLACIAL TILL)	61.15 1.37	3	SS	406	35	MH
2				4	SS	178	8	
3		Grey brown silty gravel and sand with possible cobbles (GLACIAL TILL)	59.47 3.05	5	SS	178	28	M
4				6	SS	381	42	
5	Diamond Rotary Core NQ (70mm OD)	Fresh to faintly weathered, thinly laminated to thinly bedded, very close to close discontinuity, grey interbedded SHALE and LIMESTONE BEDROCK	58.02 4.50	7	RC		TCR = 92% SCR = 85% RQD = 79%	UC
6		End of Borehole	56.07 6.45					
7								
8								
9								
10								







GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
21/06/15	3.0 ▽	59.6

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LOGGED: AS
CHECKED: GD

APPENDIX B

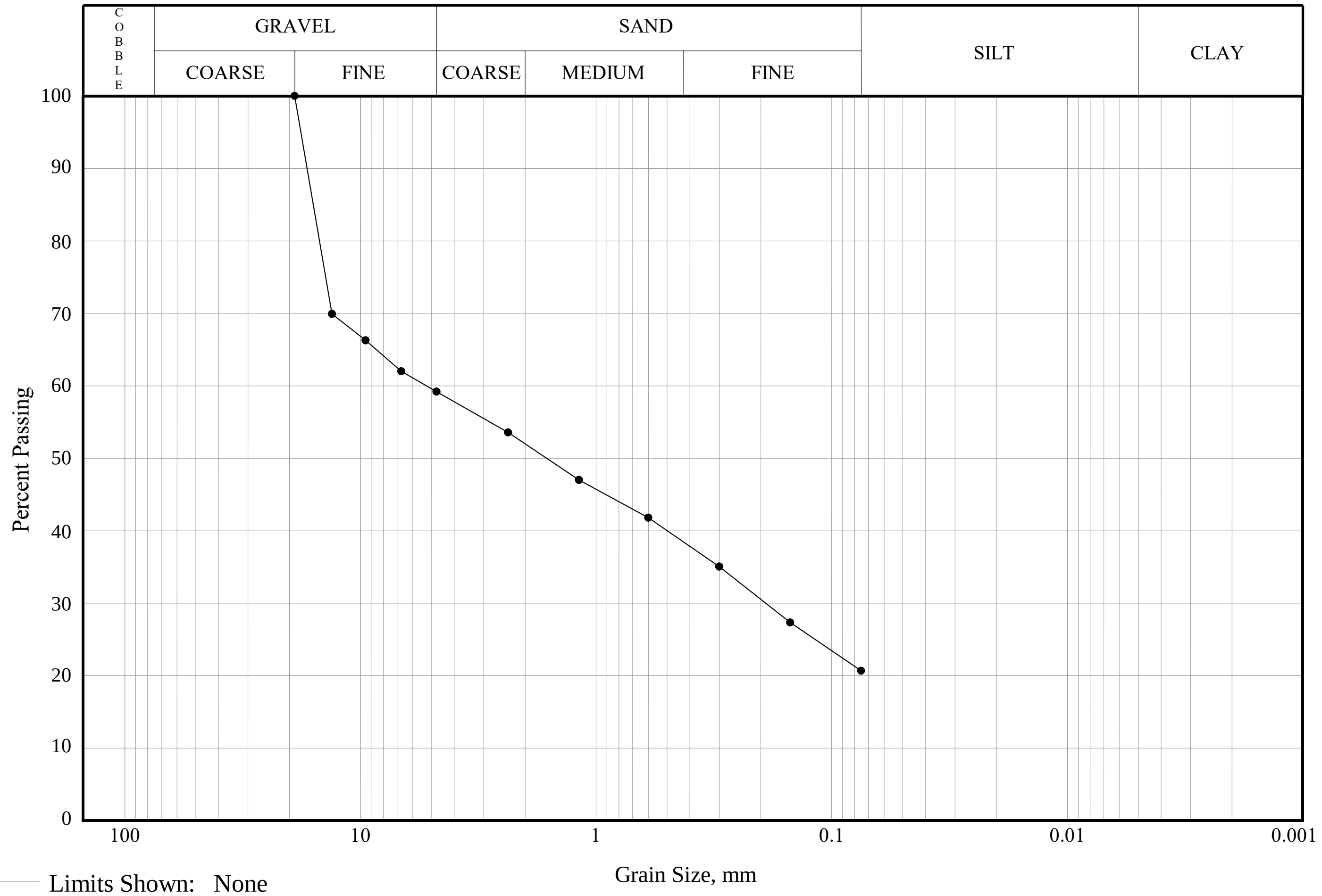
Laboratory Test Results
Soils Grading Chart

Report to: Mr. Lance Lunetta
Project: 65071.01 (April 26, 2022)

GEMTEC
Consulting Engineers and Scientists

Client: Lance Lunetta
Project: Geotechnical Investigation, 262 Armstrong Street
Project #: 65071.01

Soils Grading Chart



Limits Shown: None

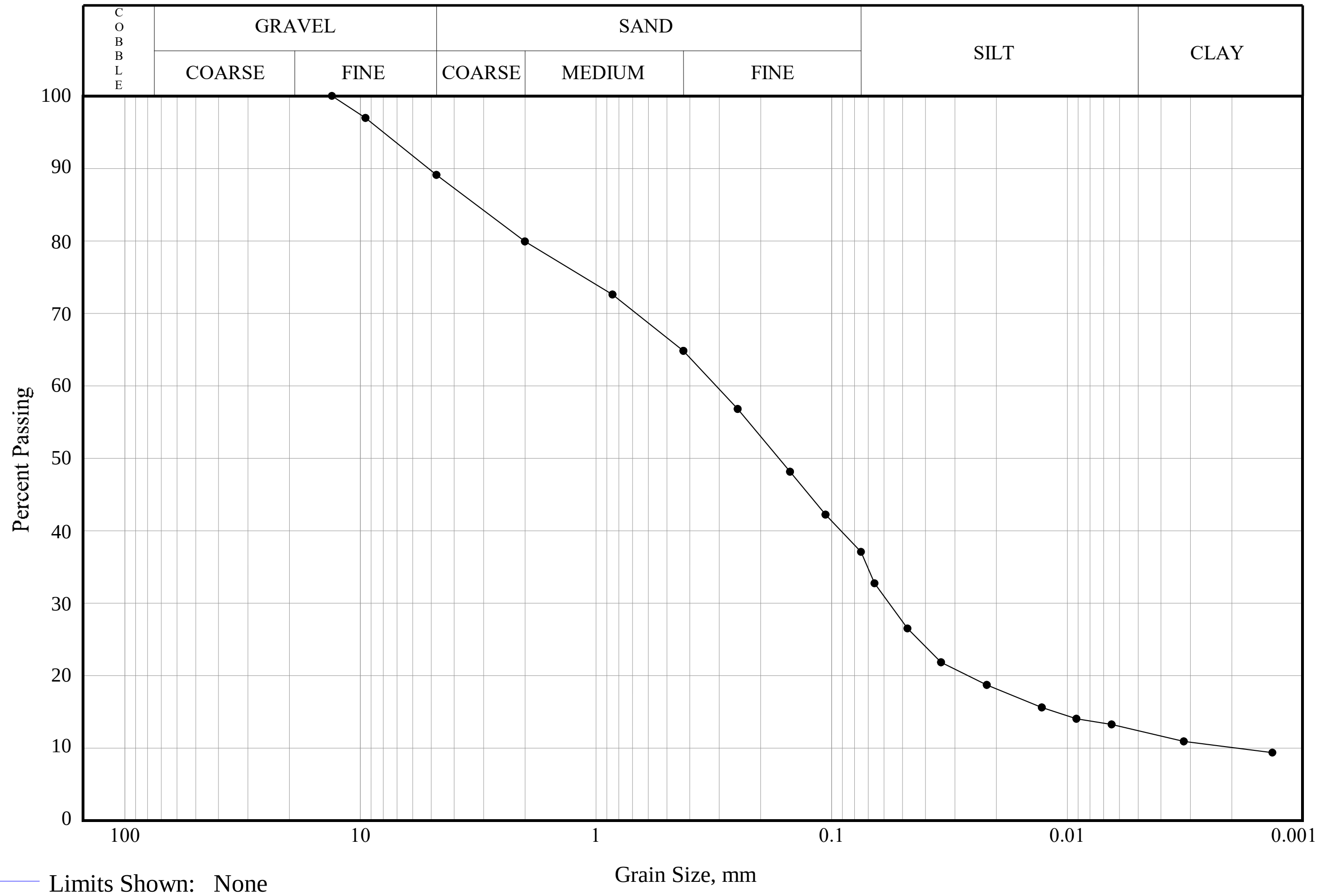
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	Glacial Till	21-1	5	3.05-3.66	40.8	38.5	20.7	

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75μm
—●—	Silty gravel and sand	N/A	---	---	0.19	1.62	5.25	15.85	---

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Client: Lance Lunetta
Project: Geotechnical Investigation, 262 Armstrong Street
Project #: 65071.01

Soils Grading Chart



Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	Glacial Till	21-1	3	1.52-2.13	10.9	52.0	24.7	12.4

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Silty sand , some gravel, some clay	N/A	0.00	0.01	0.06	0.17	0.31	3.23	24.7

APPENDIX C

Unconfined Compressive Strength Results
Bedrock Core Photograph
Figure C1

GEMTEC
Consulting Engineers and Scientists

GEMTEC Consulting Engineers and Scientists Limited
32 Steacie Drive
Ottawa, ON
K2K 2A9
Tel.: 613-836-1422
Fax.:613-836-9731

COMPRESSIVE STRENGTH of ROCK CORE

CLIENT: Lance

PROJECT No.: 65071.01

Project: 262 Armstrong Street

REPORT NO:

Date Received: 9-Jun-21

Date Tested: 10-Jun-21

Lab no.						
Cylinder ID	21-1 RC 7					
Depth (m)	4.72-4.93					
Cut length (mm)	89.52					
Ground length (mm)	89.20					
Diameter (mm)	44.76					
Ground Mass (kg)	0.36					
Length:Diameter ratio	1.99					
Correction factor	1.00					
Failure load (kN)	419.06					
Uncorrected Strength (MPa)	266.30					
Corrected Strength (MPa)	**266.30**					

Remarks

More information may be provided upon request

Checked by: Krystle Smith, Laboratory Manager

Reviewed by: Steve Goodman, Ph.D., P.Eng.

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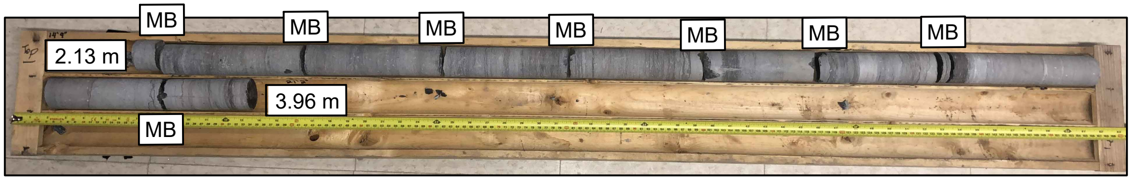
BOREHOLE 21-1
BORING DATE: JUNE 9, 2021
DEPTH: 4.50 to 6.45 METRES



*MB = Mechanical Break

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CONSULTING ENGINEERS
AND SCIENTISTS
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T: (613) 836-1422 | www.gemtec.ca | ottawa@gemtec.ca

Project
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL BUILDING
262 ARMSTRONG STREET
OTTAWA, ONTARIO

FIGUREC1

File No.
65071.01

ROCK CORE PHOTOGRAPH
BOREHOLE 21-1

APPENDIX D

Chemical Analysis of Soil Relating to Corrosion
(Paracel Order No. 2124562)

Report to: Mr. Lance Lunetta
Project: 65071.01 (April 26, 2022)

Certificate of Analysis

Client: **GEMTEC Consulting Engineers and Scientists Limited**

Client PO:

Report Date: 16-Jun-2021

Order Date: 10-Jun-2021

Project Description: 65071.01

	Client ID:	BH21-1, SS-6	-	-	-
	Sample Date:	10-Jun-21 13:30	-	-	-
	Sample ID:	2124562-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	89.8	-	-	-
General Inorganics					
Conductivity	5 uS/cm	245	-	-	-
pH	0.05 pH Units	7.95	-	-	-
Resistivity	0.10 Ohm.m	40.8	-	-	-
Anions					
Chloride	5 ug/g dry	25	-	-	-
Sulphate	5 ug/g dry	142	-	-	-

experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

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