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Geotechnical Investigation
Commercial Development
2020 Walkley Road
Ottawa, Ontario

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Submitted to:

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55 Metcalfe Street – Suite 1490
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c/o Canderel Construction Management Inc.
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Montreal, Quebec
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Geotechnical Investigation
Commercial Development
2020 Walkley Road
Ottawa, Ontario

March 12, 2021
Project: 64026.06

experience • knowledge • integrity

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Attention: Eric Cordon

Re: Geotechnical Investigation
Commercial Development
2020 Walkley Road
Ottawa, Ontario

Please find enclosed our geotechnical investigation report for the above noted project based on the scope of work provided in our proposal dated January 4, 2021. This report was prepared by Mr. Alex Meacoe, P.Eng., and reviewed by Mr. Brent Wiebe, P.Eng.

Do not hesitate to contact the undersigned if you have any questions or require additional information.

Alex Meacoe, P.Eng. Brent Wiebe, P.Eng.

WAM/BW

Enclosures
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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed commercial development located at 2020 Walkley Road in Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface and groundwater 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.

2.0 BACKGROUND

2.1 Project Description

Plans are being prepared for a commercial development located at 2020 Walkley Road in Ottawa, Ontario. Based on the preliminary plan provided to us, the proposed development consists of three warehouses with details as follows:

- Phase 1 Building 1 will have a finished floor elevation of about 85.3 metres with an approximate plan area of about 8,550 square metres;
- Phase 2 Building 2 will have a finished floor elevation of about 85.15 metres with an approximate plan area of about 8,500 square metres;
- Phase 3 Building 3 will have a finished floor elevation of about 85.3 metres with an approximate plan area of about 7,650 square metres;
- It is understood that the warehouses will be one-story in height and will be of slab-on-grade construction (i.e., no basement level).
- A total of about 270 at grade parking spaces will be provided for the commercial development.

Based on preliminary information provided, it is understood that the maximum grade raise at the warehouses will be about 0.9 to 1.2 metres above existing grade, with average grade raise around the warehouses expected to be about 0.6 to 1.1 metres above existing grade.

2.2 Site Geology

Based on our previous experience in the area and surficial geology maps, the site is likely composed of a thick deposit of sensitive silty clay over glacial till. Bedrock geology maps indicate that the site is underlain by shale and limestone bedrock of the Carlsbad formation. Drift thickness mapping indicates the bedrock surface is expected at depths ranging from about 5 to 15 metres, sloping down to the south. Fill material associated with previous development should be expected on site.

3.0 SUBSURFACE INVESTIGATION

The fieldwork for this investigation of the entire site was carried out between February 1 and 8, 2021. During that time, a total of nine boreholes (numbered 21-01 to 21-08, 21-08A, and 21-09) were advanced using a track mounted hollow stem auger drill rig supplied and operated by CCC Geotechnical and Environmental Drilling of Ottawa, Ontario.

Details for the boreholes advanced for the detailed design of the commercial development are provided below:

- Boreholes 21-02, 21-03, 21-04, 21-06, 21-07, and 21-09 were advanced to a depth of about 6.1 metres below ground surface.
- Boreholes 21-01 and 21-08 were advanced to depths of about 9.8 and 10.1 metres below ground surface, respectively. Borehole 21-01 was then advanced, without sampling, using dynamic cone penetration testing (DCPT) to refusal at about 20.0 metres below the ground surface.
- Borehole 21-08A was advanced, without sampling, using DCPT to refusal at about 17.8 metres below the ground surface.
- Borehole 21-05 as advanced to the bedrock surface, which was encountered at a depth of about 22.1 metres below the ground surface. Upon reaching the bedrock surface, the borehole was then advanced into the bedrock using rotary diamond drilling techniques to a total depth of about 24.2 metres below the ground surface, while retrieving NQ sized bedrock core.

Standard penetration tests were carried out in the boreholes and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler. In situ vane shear testing was carried out, where possible, in the boreholes to measure the undrained shear strength of the silty clay. Three relatively undisturbed samples of the silty clay deposit were obtained from the boreholes.

Well screens were sealed in the overburden in boreholes 21-02 and 21-08, to measure the groundwater levels. The groundwater levels were measured on February 18, 2021.

The fieldwork was supervised throughout by a member of our engineering staff who directed the drilling operations, logged the samples and carried out the in-situ testing. Following the fieldwork, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of the soil were tested for water content, Atterberg limits, shrinkage limits, and grain size distribution testing. Samples of the soil recovered from boreholes 21-03 and 21-06 were sent to an accredited laboratory for basic chemical testing relating to corrosion of buried concrete and steel.

The borehole locations were positioned in the field by GEMTEC personnel using our Trimble R10 GPS survey instrument. The ground elevations at the boreholes were also determined using our Trimble R10 GPS survey instrument. The elevations are referenced to geodetic datum.

Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole sheets in Appendix A. The results of the laboratory tests are provided on the borehole logs and in Appendix B. Bedrock core photographs are provided on Figure C1 in Appendix C. The results of the laboratory testing related to corrosion of buried elements are provided in Appendix D. The approximate locations of the test holes are shown on the Borehole Location Plan, Figure 1.

4.0 SUBSURFACE CONDITIONS

4.1 General

As previously indicated, the soil and groundwater conditions identified in the boreholes are given on the Record of Borehole sheets in Appendix A. The borehole logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs 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 test locations may vary from the conditions encountered in the boreholes. 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 groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. These conditions may vary seasonally or as a consequence of construction activities in the area.

The soil 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 following presents an overview of the subsurface conditions encountered in the boreholes advanced during this investigation.

4.2 Topsoil

A layer of topsoil was encountered at the ground surface at boreholes 21-01 to 21-04, 21-07, 21-08, and 21-09 with thicknesses ranging from about 50 to 180 millimetres.

The water content of the topsoil is about 24 percent.

4.3 Existing Pavement Structure

Boreholes 21-05 and 21-06 were advanced through the existing at grade parking lot and encountered about 200 and 90 millimetres of asphaltic concrete, respectively.

The asphaltic concrete is underlain by about 710 and 470 millimetres of roadway base material composed of grey brown, sand and gravel. No subbase material was encountered at the borehole locations.

One standard penetration test carried out within the base/subbase material gave an N value of greater than 50 blows per less than 0.3 metres of penetration, which indicates a very dense relative density.

4.4 Fill Material

A layer of fill material was encountered below the topsoil in boreholes 21-02, 21-03, 21-04, 21-07, 21-08, and 21-09. The fill material generally consists of silty sand with varying amounts of gravel to sand and gravel. The fill material has a thickness ranging from about 0.2 to 0.8 metres and extends to depths ranging from about 0.3 to 0.9 metres below the existing ground surface.

Standard penetration tests carried out in the fill material gave N values ranging from 7 to 24 blows per 0.3 metres of penetration, which indicate a loose to compact relative density.

The water content of one sample of the fill material is about 10 percent.

4.5 Silty Sand

Native deposits of silty sand were encountered below the topsoil in borehole 21-01 and below the fill material in borehole 21-09. The silty sand has a thickness of about 20 and 730 millimetres and extends to depths of about 0.2 and 1.0 metres below the ground surface at boreholes 21-01 and 21-09, respectively.

A standard penetration test carried out in the silty sand in borehole 20-09 gave an N value of 7 blows per 0.3 metres of penetration, which indicates a loose relative density.

4.6 Silty Clay

Native deposits of silty clay were encountered in all of the boreholes. Where fully penetrated, the silty clay extends to a depth of about 15.4 metres below ground surface. Based on the results of the dynamic cone penetration testing, it is considered likely that the silty clay extends to depths of about 14.0 and 16.5 metres below ground surface at the borehole locations.

The upper portion of the silty clay in the boreholes is weathered to a grey brown crust. The weathered silty clay crust has a thickness ranging from about 1.6 to 2.9 metres and extends to

depths ranging from about 2.6 to 3.1 metres below the existing ground surface (elevation ranging from about 81.0 to 82.5 metres).

Standard penetration tests carried out in the weathered silty clay crust gave N values ranging from static weight of hammer (WH) to 13 blows per 0.3 metres of penetration, which indicates a stiff to very stiff consistency.

Grain size distribution tests were undertaken on two samples of the weathered silty clay crust from boreholes 21-02 and 21-08. The results are provided in Appendix B and summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Test (Weathered Crust)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
21-02	2	08 – 1.4	0	1	42	57
21-08	3	1.5 – 2.1	0	0	24	76

The results of the Atterberg limit tests carried out on samples of the weathered silty clay crust are provided in Appendix B. The results are summarized in Table 4.2.

Table 4.2 – Summary of Atterberg Limit Test Results (Weathered Crust)

Borehole / Sample No.	Water Content (%)	Liquid Limits (%)	Plastic Limits (%)	Plasticity Index
21-01 / 2	45	56	29	27
21-02 / 3	49	57	29	28
21-03 / 1B	16	23	16	7
21-04 / 2B	40	60	23	37
21-05 / 3	40	59	27	32
21-06 / 3B	41	58	30	28
21-07 / 3	43	54	25	29
21-08 / 2	41	55	26	29
21-09 / 3	46	56	23	33

This testing indicates that the samples of weathered silty clay tested from the boreholes generally have a medium plasticity.

The water content of the weathered silty clay ranges from about 16 to 60 percent.

The silty clay below the weathered zone in is grey in colour. The silty clay was fully penetrated at the location of borehole 21-05, and was found to extend to about 15.4 metres below surface grade. Based on the results of the dynamic cone penetration testing, the unweathered, grey silty clay likely extends to depths of about 14.0 and 16.5 metres below ground surface in boreholes 21-01 and 21-08A, respectively.

Standard penetration tests carried out in the grey silty clay gave N values of static weight of rods to 1 blow per 0.3 metres of penetration. In situ vane shear strength tests carried out in the grey silty clay gave undrained shear strengths ranging from about 27 to 50 kilopascals, which indicate a soft to firm consistency, generally increasing with depth.

The water content of the grey silty clay ranges from about 38 to 91 percent.

4.7 Glacial Till

A deposit of glacial till was encountered below the silty clay in borehole 21-05. The glacial till has a thickness of about 6.7 metres and extends to a depth of about 22.1 metres below the ground surface (elevation of about 62.5 metres). Based on the results of the dynamic cone penetration testing, it is likely that glacial till deposits were encountered in boreholes 21-01 and 21-08A at depths of about 16.5 and 14 metres and extend to depths of about 20.0 and 17.8 metres below the existing ground surface, (elevations of about 64.6 and 67.0 metres), respectively.

The glacial till deposit is considered to be a heterogeneous mixture of all grain sizes, which at this site, can be described as grey silty sand with some gravel. Although not encountered in the borehole locations directly, the glacial till deposits in this area are known to contain cobbles and boulders.

Standard penetration tests carried out in the glacial till deposit gave N values ranging from 7 to 38 blows per 0.3 metres of penetration, which indicates a very loose to dense relative density.

The water content of the glacial till ranges from about 9 to 39 percent.

4.8 Refusal and Bedrock

Refusal to dynamic cone penetration test advancement occurred in boreholes 21-01 and 21-08A at depths of about 20.0 and 17.8 metres below surface grade (elevations of about 64.6 and 67.0 metres). Grey shale bedrock was encountered at borehole 21-05 at a depth of about 22.1 metres below ground surface (elevation of about 62.4 metres).

Table 4.3 summarizes the depth of refusal and corresponding elevations at the borehole locations.

Table 4.3 – Bedrock Surface Summary

Borehole Number	Ground Surface Elevation (metres)	Depth to Bedrock (metres)	Bedrock Elevation (metres)
21-01	84.6	20.0[1]	64.6
21-05	84.5	22.1[2]	62.4
21-08A	84.8	17.8[1]	67.0

Notes:

1. Bedrock elevation inferred from refusal to dynamic cone penetration test advancement. Refusal typically occurs on or within boulders or on the surface of the bedrock, or within very dense soil.
2. Bedrock surface proven by coring.

Grey shale bedrock was encountered at borehole 21-05 at a depth of about 22.1 metres below surface grade (elevation of about 62.4 metres) and cored using rotary diamond drilling techniques while retrieving NQ sized bedrock core. The bedrock was cored to a depth of about 24.2 metres below surface grade (elevation of about 60.3 metres).

The recovered bedrock core samples have total core recovery (TCR) values of about 82 and 87 percent, solid core recovery (SCR) values of about 65 and 87 percent, and rock quality designation (RQD) values of about 0 percent. Based on these values, the bedrock quality is considered to be very poor.

A photograph of the bedrock core is presented on Figure B1 in Appendix B.

4.9 Groundwater Levels

Well screens were installed in the overburden at boreholes 21-02 and 21-08. The groundwater levels measured in the well screens on February 18, 2021 are summarized in Table 4.4.

Table 4.4 – Groundwater Depth and Elevation

Borehole No.	Groundwater Depth Below Existing Ground Surface (metres)	Groundwater Elevation (metres, geodetic datum)	Date of Reading
21-02	2.4	82.2	February 18, 2021

Borehole No.	Groundwater Depth Below Existing Ground Surface (metres)	Groundwater Elevation (metres, geodetic datum)	Date of Reading
21-08	2.1	82.7	February 18, 2021

The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

4.10 Soil Chemistry Relating to Corrosion

Samples of the soil recovered from boreholes 21-03 and 21-06 were sent to an accredited laboratory for basic chemical testing relating to corrosion of buried concrete and steel. The results of the testing are provided in Appendix C and are summarized in Table 4.5.

Table 4.5 – Summary of Corrosion Testing

Parameter	Borehole 20-03 Sample No. 3 Depth: 1.5 to 2.1 m	Borehole 20-06 Sample No. 4 Depth 1.5 to 2.1
Chloride Content (ug/g)	30	389
Resistivity (Ohm.m)	64.3	12.8
pH	7.20	7.57
Sulphate Content (ug/g)	25	131

5.0 GEOTECHNICAL GUIDELINES

5.1 General

The information in the following sections is provided for the guidance of the design engineers and is intended for the design of 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. The 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 addressed.

5.2 Excavation

The excavations for the proposed commercial development will be carried out through the topsoil, fill material, silty sand and into the weathered silty clay deposit. The sides of the excavations 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 overburden soils at this site can be classified as Type 3 and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical, or flatter, above the groundwater level.

Based on the measured groundwater elevations, excavation below the groundwater level as part of the development is not anticipated. Excavation of the native overburden deposits above the groundwater level should not present significant constraints.

The weathered silty clay crust deposit is sensitive to disturbance from ponded water, vibration and construction traffic. As such, it is suggested that final trimming to subgrade level be carried out using a hydraulic shovel equipped with a flat blade bucket. Allowance should be made to remove and replace any disturbed silty clay with compacted sand and gravel, such as that meeting OPSS Granular A or Granular B Type II, where required.

5.3 Groundwater Management

The groundwater levels on February 18, 2021 were measured to be about 2.4 and 2.1 metres below ground surface in boreholes 21-02 and 21-08, respectively.

Any groundwater inflow into the excavation should be handled from within the excavation by pumping from filtered sumps. Suitable detention and filtration will be required before discharging the water to a sewer or ditch. The amount of water entering the excavation for the construction of the foundations at this site should not exceed 50,000 litres per day and therefore it is not anticipated that an Environmental Activity and Sector Registry (EASR) will be required.

5.4 Foundation Design

Based on the results of the investigation, the proposed commercial development could be founded on footings bearing on or within the native undisturbed weathered silty clay crust deposits. The topsoil and fill material are considered to be highly compressible and should be removed from below any foundations and slabs on grade.

Based on plans provided, the proposed commercial buildings will be partially located within the footprints of existing buildings on the site. Although not directly encountered, or sampled, during the drilling fieldwork, a layer of fill material of unknown composition associated with the construction of the existing buildings on site will be located surrounding the buildings to a depth of up to about 2.0 metres below ground surface. As such, the existing foundation elements and fill material associated with the past construction of the buildings will need to be removed from the proposed building footprints.

After the removal of the existing buildings and associated fill material, and where the existing subgrade surface is below the 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.

Based on the results of the subsurface investigation, and the finished floor elevations provided by Novatech, the proposed average and maximum grade raise around the warehouses are provided in Table 5.1 below.

Table 5.1 – Proposed Grade Raise

Phase/Building Number	Proposed Finished Floor Elevation (metres)	Proposed Average Grade Raise (metres)	Proposed Maximum Grade Raise (metres)
1	85.3	0.6	0.9
2	85.15	1.1	1.2
3	85.3	0.7	1.1

Based on the soil conditions encountered across the site, it will be important to limit the stress increase on the soft to firm silty clay layer to an acceptable level to minimize foundation settlement.

Four important parameters in calculating the stress increase on the grey silty clay are:

1. Depth to founding level;
2. Foundation size and type (i.e., pad or strip), and loading of the foundation;
3. The amount of surcharge (fill, etc.) in the vicinity of the foundation; and
4. The amount of post-development groundwater lowering at the site.

There are many possible combinations of founding depths, footing sizes and thickness of fill which might be suitable for this site.

For preliminary design purposes, bearing resistances for various footing types, sizes and embedment depths at each of the warehouses are presented in Tables 5.2, 5.3 and 5.4, below.

The preliminary bearing resistances presented assume that the site grades are not raised above the maximum grade raise provided in Table 5.1, above, and the maximum groundwater lowering is limited to the current lowest measured groundwater reading (i.e. about 2.1 to 2.4 metres below ground surface). Total and differential settlements of 25 and 15 millimetres should be anticipated for the preliminary SLS resistances provided in Tables 5.2, 5.3 and 5.4.

Table 5.2 – Summary of Preliminary Bearing Resistances (Phase 1 Building 1)

Type of Footing	Underside of Footing Elevation (metres)	Maximum Footing Size (metres)	Serviceability Limits States Bearing Resistance, SLS (kilopascals)	Factored Ultimate Limits States Resistance, ULS (kilopascals)
Strip	83.5	2	100	150
Pad	83.5	4.2 square	90	150

Table 5.3 – Summary of Preliminary Bearing Resistances (Phase 2 Building 2)

Type of Footing	Underside of Footing Elevation (metres)	Maximum Footing Size (metres)	Serviceability Limits States Bearing Resistance, SLS (kilopascals)	Factored Ultimate Limits States Resistance, ULS (kilopascals)
Strip	83.5	1.2	100	150
Pad	83.5	4.2 square	80	150

Table 5.4 – Summary of Preliminary Bearing Resistances (Phase 3 Building 3)

Type of Footing	Underside of Footing Elevation (metres)	Maximum Footing Size (metres)	Serviceability Limits States Bearing Resistance, SLS (kilopascals)	Factored Ultimate Limits States Resistance, ULS (kilopascals)
Strip	83.5	1.5	100	150
Pad	83.5	4.2 square	75	150

Notes:

1. The bearing resistances provided in Tables 5.2, 5.3, and 5.4, are for footings founded on the undisturbed, native silty clay weathered crust or on engineered fill bearing on the undisturbed weathered crust, prepared as described above. The bearing resistances provided are also based on the proposed grade raise provided in Table 5.1, above. Any existing fill below the footing areas should be removed.

All other alternatives must be verified by the geotechnical engineer to ensure that overstressing of the softer silty clay soil does not occur, as this could result in excessive settlement and cracking/distress of the structure.

If the above noted bearing resistances are not adequate, raft foundations could be considered as an alternative to reduce the stress on the underlying soft silty clay layer.

To reduce the potential for cracking in the footings, foundation walls, and concrete slab on grade where the footings transition between different subgrade materials (e.g. silty clay to engineered fill), the foundation walls should be reinforced for a distance of 3 metres on both sides of the transition areas or as recommended by the structural engineer.

5.5 Frost Protection of Foundations

All exterior footings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated (unheated) footings that are located in areas that are to be cleared of snow should be provided with at least 1.8 metres of earth cover for frost protection purposes. Alternatively, the required frost protection could be provided by means of a combination of earth cover and extruded polystyrene insulation. An insulation detail could be provided upon request.

If the foundation and/or slab on grade are insulated in a manner that will reduce heat flow to the surrounding soil, the foundation depth shall conform to that required for foundations for an unheated space.

5.6 Seismic Design of Proposed Structures

Based on the results of the investigation, it is anticipated that the proposed foundations will be supported on a deposit of stiff to very stiff weathered silty clay crust or a pad of engineered fill constructed on the weathered crust. As such, in our opinion, the proposed commercial development should be designed for seismic Site Class D.

There is no potential for liquefaction of the overburden deposits at this site.

5.7 Foundation Wall Backfill and Drainage

The native deposits at this site are frost susceptible and should not be used as backfill against foundations. To avoid frost adhesion and possible heaving, the foundations should be backfilled

with imported, free-draining, non-frost susceptible granular material such as that meeting the requirements of OPSS Granular A, or Granular B Type I or II.

Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks or other similar surfaces), the backfill should be placed in maximum 200 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment. Light walk behind compaction equipment should be used next to the foundation walls to avoid excessive compaction induced stress on the foundation walls.

Where future landscaped areas will exist next to the proposed structures and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value. Where areas of hard surfacing (concrete, sidewalks, pavement, etc.) abut the proposed structures, 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 fill material to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below finished grade to the underside of the granular subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter. Further, we recommend that downspouts outlet in such a way as to prevent saturation of soils below hard surfaced areas.

The frost susceptible native soils could be considered for foundation wall backfill purposes in soft landscaped areas provided that a suitable bond break is applied to the surface of the foundations to prevent frost jacking. A suitable bond break could consist of at least 2 layers of 6 MIL polyethylene sheeting or a proprietary plastic drainage system. It is also pointed out that the native soils at this site can be impacted by changes in moisture content and this could affect the ability to compact this material to the required density.

Perimeter foundation drainage is not considered necessary for a slab on grade structure provided that the floor slab level is above the finished exterior ground surface level.

5.8 Slab on Grade Support

As discussed above, the proposed buildings will be partially or fully located within the footprint of the excavation associated with the existing buildings on site and, as such, fill material associated with the construction and backfill of the existing buildings should be anticipated below the proposed slab on grade.

The topsoil and fill material are not considered suitable for support of the slab on grade. To prevent long term settlement of the floor slab, all organic material and any fill should be removed from below the proposed slab to expose the native silty clay deposits.

The grade within the proposed building could then be raised, where necessary, with material meeting OPSS requirements for Granular A and Granular B Type I or II. The granular base for the proposed slab on grade should consist of at least 150 millimetres of OPSS Granular A.

OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A. 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 only, for environmental reasons.

All imported granular materials 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.

Underfloor drainage is not considered necessary provided that the floor slab levels are above the finished exterior ground surface level. If any areas of the buildings 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 slabs 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 minimize shrinkage cracks.

Proper moisture protection with a vapour retarder should be used for floor slabs 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 slabs.

5.9 Proposed Services

5.9.1 Excavation

In the overburden, the excavation for flexible service pipes should be in accordance with Ontario Provincial Standard Drawing (OPSD) 802.010 for Type 3 soil. The excavation for rigid service pipes should be in accordance with OPSD 802.031 for Type 3 soil. The sides of the excavations within overburden soils 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 soils at this site can be classified as Type 3 soils. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes. As an alternative or where space constraints dictate, the service installations could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose.

Groundwater seepage into excavations is expected and should be controlled, as necessary, by pumping from within the excavations. It is not expected that short term pumping during excavation will have a significant effect on nearby structures and services.

5.9.2 Pipe Bedding

The bedding for service pipes should be in accordance with OPSD 802.010 and 802.031 for flexible and rigid pipes in Type 3 soils, respectively. The bedding for service pipes should consist of at least 150 millimetres of crushed stone meeting OPSS requirements for Granular A.

Cover material, from spring line to at least 300 millimetres above the tops of the pipes, should consist of granular material, such as that meeting OPSS Granular A.

In areas where the subsoil is disturbed or where unsuitable material (such as fill or organic material) exists below the pipe subgrade level, the disturbed/unsuitable material should be removed and replaced with a subbedding layer of compacted granular material, such as that meeting OPSS Granular B Type I or II. To provide adequate support for the pipes in the long term in areas where subexcavation of material is required below design subgrade level, the excavations should be sized to allow a 1 horizontal to 1 vertical spread of granular material down and out from the bottom of the pipes.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A. The granular bedding and subbedding materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

The use of clear crushed stone as a bedding, subbedding or cover material should not be permitted on this project.

5.9.3 Trench Backfill

In areas where the service trench will be located below or in close proximity to existing or future areas of hard surfacing (pavement, sidewalk, etc.), acceptable native materials should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetration in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent hard surfaced area. The depth of frost penetration in exposed areas can normally be taken as 1.8 metres below finished grade. Where native backfill is used, it should match the native materials exposed on the trench walls. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type I or II.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the parking areas, sidewalks, etc., the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. The specified density for compaction of the backfill materials may be reduced where the trench backfill is not located below or in close proximity to existing or future areas of hard surfacing and/or structures.

5.10 Roadway Construction

5.10.1 Subgrade Preparation

In preparation for access roadway/parking lot construction at this site, all surficial topsoil, and any soft, wet or deleterious materials should be removed from the proposed roadway areas.

Prior to placing granular material for the roads and parking lots, the exposed subgrade should be inspected and approved by geotechnical personnel. Any soft areas should be subexcavated and replaced with suitable (dry) earth borrow that is frost compatible with the materials exposed on the sides of the area of subexcavation.

In the area of the existing buildings, and any other areas where it will be necessary to raise the roadway/parking lot grades at this site, material which meets OPSS specifications for Select Subgrade Material, Earth Borrow or well shattered and graded rock fill material may be used.

The Select Subgrade material or Earth Borrow should be placed in maximum 300 millimetre thick lifts and compacted to at least 95 percent of the standard Proctor maximum dry density value using vibratory compaction equipment. Rock fill should be placed in maximum 500 millimetre thick lifts and suitably compacted either with a large drum roller, the haulage and spreading equipment, or a combination of both.

Truck traffic should be avoided on the native soil subgrade or the trench backfill within the roadways/parking lot areas especially under wet conditions.

5.10.2 Pavement Structure

For the parking areas to be used by light vehicles (cars, etc.), the following minimum pavement structure is recommended:

- 80 millimetres of hot mix asphaltic concrete (Two 40 millimetre lifts of Superpave 12.5), over
- 150 millimetres of OPSS Granular A base, over
- 300 millimetres of OPSS Granular B, Type II subbase

For parking areas and access roadways to be used by heavy truck traffic, the suggested minimum pavement structure is:

- 100 millimetres of hot mix asphaltic concrete (40 millimetres of Superpave 12.5 over 60 millimetres of Superpave 19.0), over
- 150 millimetres of OPSS Granular A base, over
- 450 millimetres of OPSS Granular B, Type II subbase

The above pavement structures assume that the access roadway and parking lot subgrade surfaces are prepared as described in this report. If the subgrade surfaces become disturbed or wetted due to construction operations or precipitation, the granular subbase thicknesses given above may not be adequate and it may be necessary to increase the thickness of the subbase and/or to incorporate a woven geotextile separator between the subgrade surfaces and the granular subbase material. The adequacy of the design pavement thicknesses should be assessed by geotechnical personnel at the time of construction.

If the granular pavement materials are to be used by construction traffic, it may be necessary to increase the thickness of the granular subbase layer, install a woven geotextile separator between the roadway subgrade surface and the granular subbase material, or a combination of both, to prevent pumping and disturbance to the subbase material. The contractor should be made responsible for their construction access.

5.10.3 Asphalt Cement Type

Performance grade PG 58-34 asphalt cement should be specified for Superpave asphaltic concrete mixes.

5.10.4 Pavement Transitions

As part of the access roadway/parking lot construction, the new pavement will abut the existing pavement at Walkley Road and/or Conroy Road. The following is suggested to improve the performance of the joint between the new and the existing pavements:

- Neatly saw cut the existing asphaltic concrete;
- Remove the asphaltic concrete and slope the bottom of the excavation within the existing granular base and subbase at 1 horizontal to 1 vertical, or flatter, to avoid undermining the existing asphaltic concrete.
- To avoid cracking of the asphaltic concrete due to an abrupt change in the thickness of the roadway granular materials where new pavement areas join with the existing pavements, the granular depths should taper up or down at 5 horizontal to 1 vertical, or flatter, to match the existing pavement structure.
- Remove (mill off) 40 to 50 millimetres of the existing asphaltic concrete to a distance of 300 millimetres at the joint and tack coat the asphaltic concrete at the joint in accordance with the requirements in OPSS 310.

5.10.5 Pavement Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. The subgrade surfaces should be crowned and shaped to drain to the ditches and/or catch basins to promote drainage of the pavement granular materials.

Catch basins should be equipped with minimum 3 metre long stub drains extending in two directions at the subgrade level.

5.10.6 Granular Material Compaction

The granular base and subbase materials should be compacted in maximum 300 millimetre thick lifts to at least 98 percent of the standard Proctor maximum dry density value.

5.11 Corrosion of Buried Concrete and Steel

According to Canadian Standards Association (CSA) “Concrete Materials and Methods of Concrete Construction”, the concentration of sulphate in the soil samples recovered from borehole 21-03 and 21-06 can be classified as low. For low exposure conditions, any concrete that will be in contact with the native soil or groundwater could be batched with General Use (GU) type cement. The effects of freeze thaw in the presence of de-icing chemical (sodium chloride) near the buildings should be considered in selecting the air entrainment and the concrete mix proportions for any exposed concrete.

Based on the resistivity and pH of the soil samples tested the soil can be generally classified as non aggressive to slightly aggressive toward unprotected steel. It is noted that the corrosivity of the soil could vary throughout the year due to the application sodium chloride for de-icing.

5.12 Sensitive Marine Clay – Effects of Trees

The site is underlain by silty clay, a material which is known to be susceptible to shrinkage with a change/reduction in moisture content. Research by the Institute for Research in Construction (formerly the Division of Building Research) of the National Research Council of Canada has shown that trees can cause a reduction of moisture content in the silty clays in the Ottawa area, which can result in significant settlement/damage to nearby buildings supported on shallow foundations, or hard surfaced areas. Therefore, deciduous tree planting should be carried in accordance with the guidelines identified in the City of Ottawa document titled: “Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines”.

The City of Ottawa Tree Planting Guidelines indicates that sensitive marine clay soils with a modified plasticity index of less than 40 percent are considered to have a low/medium potential for soil volume change. Clay soils with a modified plasticity index that exceeds 40 percent are considered to have a high potential for soil volume change.

As part of the geotechnical investigation, soil samples at 150 metre spacing were tested in our laboratory to determine the Atterberg limits for the sensitive marine clay. A summary of the test results is provided in Table 5.3.

Table 5.3 – Summary of Modified Plasticity Index

Borehole / Sample No.	Shrinkage Limit[3] (%)	Plastic Limit[1] (%)	Liquid Limit[1] (%)	Plasticity Index[1] (%)	Modified Plasticity Index[2] (%)
21-01 / 2	-	56	29	27	27
21-02 / 3	-	57	29	28	28
21-03 / 1B	-	23	16	7	7
21-04 / 2B	20	60	23	37	37
21-05 / 3	-	59	27	32	32
21-06 / 3B	-	58	30	28	28
21-07 / 3	-	54	25	29	29
21-08 / 2	-	55	26	29	29
21-09 / 3	-	56	23	33	33

1. Calculated in accordance with ASTM D4318.
2. The modified plasticity index (PI_m) was calculated using the following formula, where PI is the plasticity index determined in accordance with ASTM D4318: PI_m = PI x (% passing the 425 micrometre sieve / 100).
3. Calculated in accordance with ASTM D4943, which was discontinued in 2017 by the ASTM Sponsoring Committee responsible for the standard.

The modified plasticity index of the samples tested ranges from about 7 to 37 percent. As such, the potential for soil volume change, as defined by the City of Ottawa, is low/medium. For this site, the low/medium potential clay soils encompass the entire site.

In accordance with the City of Ottawa Tree Planting Guidelines, tree planting restrictions apply where clay soils with low/medium potential for volume change are present between the underside of footing and a depth of 3.5 metres below finished grade (refer to the City of Ottawa document titled: “Tree Planting in Sensitive Marine Soils - 2017 Guidelines”).

According to the City of Ottawa 2017 Tree Planting Guidelines, the tree to foundation setbacks within the development can be reduced to 4.5 metres for small to medium sized trees (i.e., trees with a mature height of less than 14 metres), provided that all the following conditions are met:

- For footings within 10 metres of the proposed tree, the underside of footing must be 2.1 metres or greater below finished grade;
- The foundations are reinforced with a minimum of two upper and two lower 15M bars in the foundation wall;
- Grading surrounding the tree must promote draining to the tree root zone; and,

- A small size tree (i.e., a tree with a mature height of less than 7.5 metres) must be provided with a minimum of 25 cubic metres of available soil volume. For medium size trees (i.e., trees with a mature height of between 7.5 and 14 metres), a minimum soil volume of 30 cubic metres must be provided.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Effects of Construction Induced Vibration

Some of the construction operations (such as granular material compaction, excavation, 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. The magnitude of the vibrations will be much less than that required to cause damage to the nearby structures or services in good condition.

6.2 Monitoring Well Abandonment

All monitoring wells installed as part of this investigation should be decommissioned by a licensed well technician. The well abandonment could be carried out in advance of or during construction.

6.3 Disposal of Excess Soil

It is noted that 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, including naturally occurring source of contamination, are outside the terms of reference for this report. This report does not constitute a Phase II Environmental Site Assessment (ESA) nor does it constitute a contaminated material management plan.

6.4 Design Review and Construction Observation

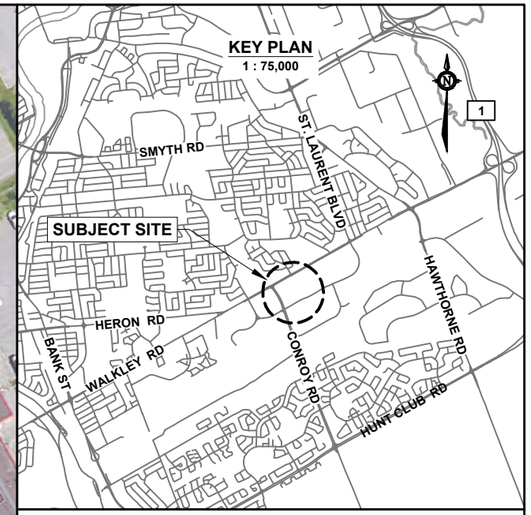
The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed excavations do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design. The subgrade surfaces for the buildings, services, and access roadway/parking areas 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.

Alex Meacoe, P.Eng.
Geotechnical Engineer

Brent Wiebe, P.Eng.
VP Operation - Ontario



LEGEND

BH # — BOREHOLE ID

XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

BOREHOLE LOCATION
(current investigation by GEMTEC)

APPROXIMATE PROPERTY BOUNDARY

WAREHOUSE 1 = PHASE 3 BUILDING 3

WAREHOUSE 2 = PHASE 2 BUILDING 2

WAREHOUSE 3 = PHASE 1 BUILDING 1

Scale
1:1500
0 30 60 90m

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ottawa@gemtec.ca

Drawing
BOREHOLE LOCATION PLAN

Client
CANDEREL CONSTRUCTION MANAGEMENT INC.

Project
64026.06

2020 WALKLEY ROAD
OTTAWA, ONTARIO

Drwn by
S.L.

Chkd by
W.A.M.

Date
FEBRUARY, 2021

Rev.
01

FIGURE 1

\\192.168.0.4\PROJECTSIFILES\64000\64026.06\06_DRAFTING\1_DRAWINGS\64026.06_GEOTECH_SP_FG1_R1_2021-02-26.DWG

APPENDIX A

Record of Borehole Logs
List of Abbreviations and Symbols

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

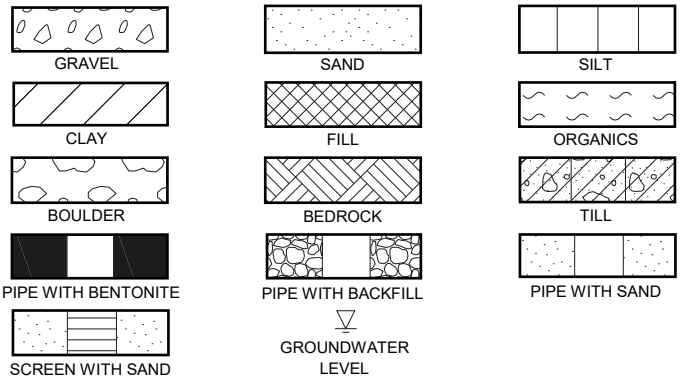
PENETRATION RESISTANCE

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.

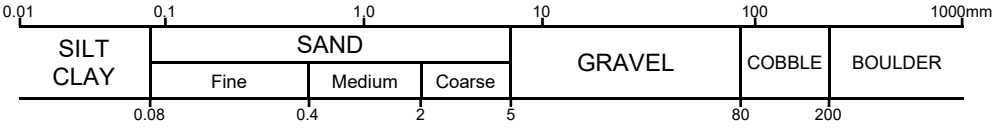
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

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

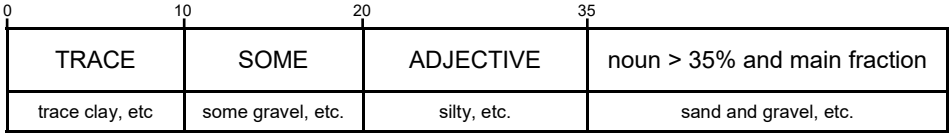


GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)



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 21-01

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 3
DATUM: CGVD28
BORING DATE: Feb 5 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m ● / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m ▲	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.60								
		TOPSOIL		84.42								
		Loose, brown SILTY SAND		0.18	1	SS	280	10	●			
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)										
1					2	SS	460	8	●			
					3	SS	610	3	●			
2					4	SS	610	WH				
3				81.55								
		Firm, grey SILTY CLAY		3.05	5	SS	610	WH	⊕ +			
4									⊕ +			
	Power Auger / Hollow Stem Auger (210mm OD)				6	SS	610	WH				
5									⊕ +			Native Backfill
									⊕ +			
6					7	SS	610	WH				
7									⊕ +			
					8	SS	610	WH				
8									⊕ +			
9					9	TO	355	PM				
		Probable firm, grey SILTY CLAY		74.85 9.75								
10												

WATER CONTENT, % — W_P — W — W_L

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09)_2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-01

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 2 OF 3
DATUM: CGVD28
BORING DATE: Feb 5 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH (Cu), kPA (NATURAL / REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	DCPT											
11												
12												
13												
14												
15												Native Backfill
16												
		Probable silty sand, some gravel, with cobbles and boulders (GLACIAL TILL)		68.14 / 16.46								
17												
18												
19												
20				64.61								

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P W W_L
10 20 30 40 50 60 70 80 90

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CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09)_2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-01

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 3 OF 3
DATUM: CGVD28
BORING DATE: Feb 5 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED); WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		End of Borehole DCPT Refusal		19.99							
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

10 20 30 40 50 60 70 80 90

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Consulting Engineers and Scientists

LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06_CANDERAL_BH(01-09)_2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-02

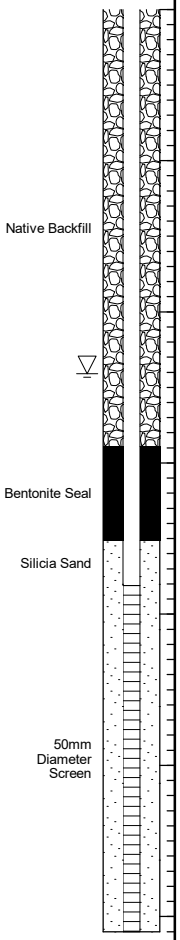
CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 5 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		84.65							
		TOPSOIL		84.55							
		Compact, dark brown SILTY SAND (FILL MATERIAL)		0.10	1	SS	430	23			
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.36	2	SS	405	10			
1											
					3	SS	610	4			
2											
					4	SS	610	2			
3		Firm, grey SILTY CLAY		81.60 / 3.05							
					5	TO	330	PM			
4											
					6	SS	610	WH			
5											
6		End of Borehole		78.55 / 6.10							
7											
8											
9											
10											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL, ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
21-02-18	2.4 ▽	82.2

GEMTEC
Consulting Engineers and Scientists

LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-03

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 5 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.81							
		TOPSOIL		0.10							
		Compact, dark brown SILTY SAND, some gravel (FILL MATERIAL)		0.30	1	SS	355	13	●		
		Stiff to very stiff, grey brown SILTY CLAY (WEATERED CRUST)									
1					2	SS	405	9	●		
2					3	SS	610	4	●		
					4	SS	610	2	●		
3	Power Auger / Hollow Stem Auger (210mm OD)			81.76							Native Backfill
		Firm, grey SILTY CLAY		3.05	5	SS	610	WH	⊕ +		
4									⊕ +		
					6	SS	610	WH			
5									⊕ +		
									⊕ +		
6				78.71					⊕ +		
		End of Borehole		6.10							
7											
8											
9											
10											

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-04

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 8 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		84.91							
		TOPSOIL		84.81							
		Compact, brown SILTY SAND (FILL)		0.10							
		Compact, grey brown SAND and GRAVEL (FILL MATERIAL)		0.30	1	SS	355	24			Native Backfill
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		84.00 0.91	2	SS	255	11			
2					3	SS	460	8			
					4	SS	510	4			
3		Firm, grey SILTY CLAY		81.86 3.05	5	SS	510	1			
4											
5					6	SS	610	WH			
6		End of Borehole		78.81 6.10							
7											
8											
9											
10											

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-05

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 3
DATUM: CGVD28
BORING DATE: Feb 3 2021

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.52							
		ASPHALTIC CONCRETE		84.32							
		Brown sand and gravel (BASE/ SUBBASE MATERIAL)		0.20	1	GS					
				83.61	2	SS	102	>50 for 130 mm			
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.91							
2					3	SS	610	9	●		
					4	SS	610	5	●		
3				81.47							
		Firm, grey SILTY CLAY		3.05	5	SS	610	WH	⊕ +		
4									⊕ +		
					6	SS	610	WH			
5									⊕ + ⊕ +		Native Backfill
6					7	SS	610	WH			
7									⊕ + ⊕ +		
8	Power Auger / Hollow Stem Auger (210mm OD)				8	TO	0	PM			
					9	TO	0	PM			
9					10	SS	610	WR			
10											

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-05

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 2 OF 3
DATUM: CGVD28
BORING DATE: Feb 3 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10											
11					11	SS	610	WR			
12					12	SS	610	WR			
13											
14											
15											Native Backfill
		Loose to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		69.13 / 15.39	13	SS	405	14			
16					14	SS	150	9			
17	Wash Casing / No Casing				15	SS	205	12			
18					16	SS	150	7			
19											
		Dense, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		65.01 / 19.51	17	SS	75	38			
20											

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-05

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 3 OF 3
DATUM: CGVD28
BORING DATE: Feb 3 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20				62.45							
21					18	SS	205	23			
22	Diamond Rotary Core NQ Coring	Grey, thinly bedded, fine grained, SHALE BEDROCK		22.07	19	RC		TCR=82%, SCR=65%, RQD=0%			Native Backfill
23											
24				60.29	20	RC		TCR=87%, SCR=87%, RQD=0%			
		End of Borehole		24.23							
25											
26											
27											
28											
29											
30											

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-06

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 2 2021

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		84.05								
		ASPHALTIC CONCRETE		0.09								
		Very dense, grey brown sand and gravel (BASE/ SUBBASE MATERIAL)			1	SS	0	>50 for 50 mm				
				83.49	2	GR						
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.56								
1					3	SS	330	8	●			
2					4	SS	610	5	●			
					5	SS	510	WH				
3				81.00								Native Backfill
		Firm, grey SILTY CLAY		3.05	6	SS	610	WH	⊕ +			
4									⊕ +			
5					7	SS	610	WH	⊕ +			
									⊕ +			
6				77.95					⊕ +			
		End of Borehole		6.10								
7												
8												
9												
10												

10 20 30 40 50 60 70 80 90

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-07

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 1 2021

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		84.82							
		TOPSOIL		84.67							
		Loose, brown SILTY SAND (FILL MATERIAL)		0.15	1	SS	150	7			
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.30	2	SS	255	12			
1											
2					3	SS	610	8			
					4	SS	610	3			
3				81.77							Native Backfill
		Firm, grey SILTY CLAY		3.05	5	SS	610	WH			
4											
					6	SS	610	WH			
5											
6				78.72							
		End of Borehole		6.10							
7											
8											
9											
10											

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CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-08

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 2
DATUM: CGVD28
BORING DATE: Feb 2 2021

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		84.75							
		TOPSOIL		0.05							
		Compact, brown SILTY CLAY, some sand (FILL MATERIAL)		84.45 / 0.30	1	SS	405	14			
		Compact, brown SILTY SAND		84.04							
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.71	2	SS	405	13			
2					3	SS	610	3			Native Backfill
					4	SS	610	2			
3		Firm, grey SILTY CLAY		81.70 / 3.05	5	SS	610	WH			Bentonite Seal
4											Selicia Sand
5					6	TO	710	PM			50mm Diameter Screen
6											
7					7	SS	610	WH			
8					8	SS	405	WR			Cave
9											
10											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-08

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 2 OF 2
DATUM: CGVD28
BORING DATE: Feb 2 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED); WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		End of Borehole		10.05							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

10 20 30 40 50 60 70 80 90

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
21-02-18	2.1 ▽	82.7

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-08A

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 2
DATUM: CGVD28
BORING DATE: Feb 8 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		84.75							
		Probable grey brown SILTY CLAY (WEATHERED CRUST)									
3		Probable grey SILTY CLAY		81.70 / 3.05							
10	DCPT										Native Backfill

10 20 30 40 50 60 70 80 90

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09)_2021-02.GPJ GEMTEC 2018.GDT 2-19-21

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LOGGED: ML
CHECKED: WAM

RECORD OF BOREHOLE 21-08A

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 2 OF 2
DATUM: CGVD28
BORING DATE: Feb 8 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, mm	SAMPLES: BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10											
11											
12											
13											
14		Probable grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		70.73 / 14.02							Native Backfill
15											
16											
17											
18		End of Borehole DCPT Refusal		67.00 / 17.75							
19											
20											

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, %: W_P — W — W_L
10 20 30 40 50 60 70 80 90

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LOGGED: ML
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

RECORD OF BOREHOLE 21-09

CLIENT: Canderal Construction Management Ltd.
PROJECT: Geotechnical Investigation, 2020 Walkley Road, Ottawa, Ontario
JOB#: 64026.06
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Feb 1 2021

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	PENETRATION RESISTANCE (N), BLOWS/0.3m / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH (Cu), kPA (NATURAL, REMOULDED) / WATER CONTENT, %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (210mm OD)	Ground Surface		85.13							
		TOPSOIL		0.05							
		Loose, dark brown SILTY SAND and gravel (FILL MATERIAL)		84.85 / 0.28	1	SS	355	7			
		Loose, brown SILTY SAND									
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		84.12 / 1.01	2	SS	560	6			
					3	SS	610	4			
2		Firm, grey SILTY CLAY		82.54 / 2.59	4	SS	610	2			
					5	SS	610	WH			Native Backfill
3											
4											
					6	SS	610	WH			
5											
6		End of Borehole		79.03 / 6.10							
7											
8											
9											
10											

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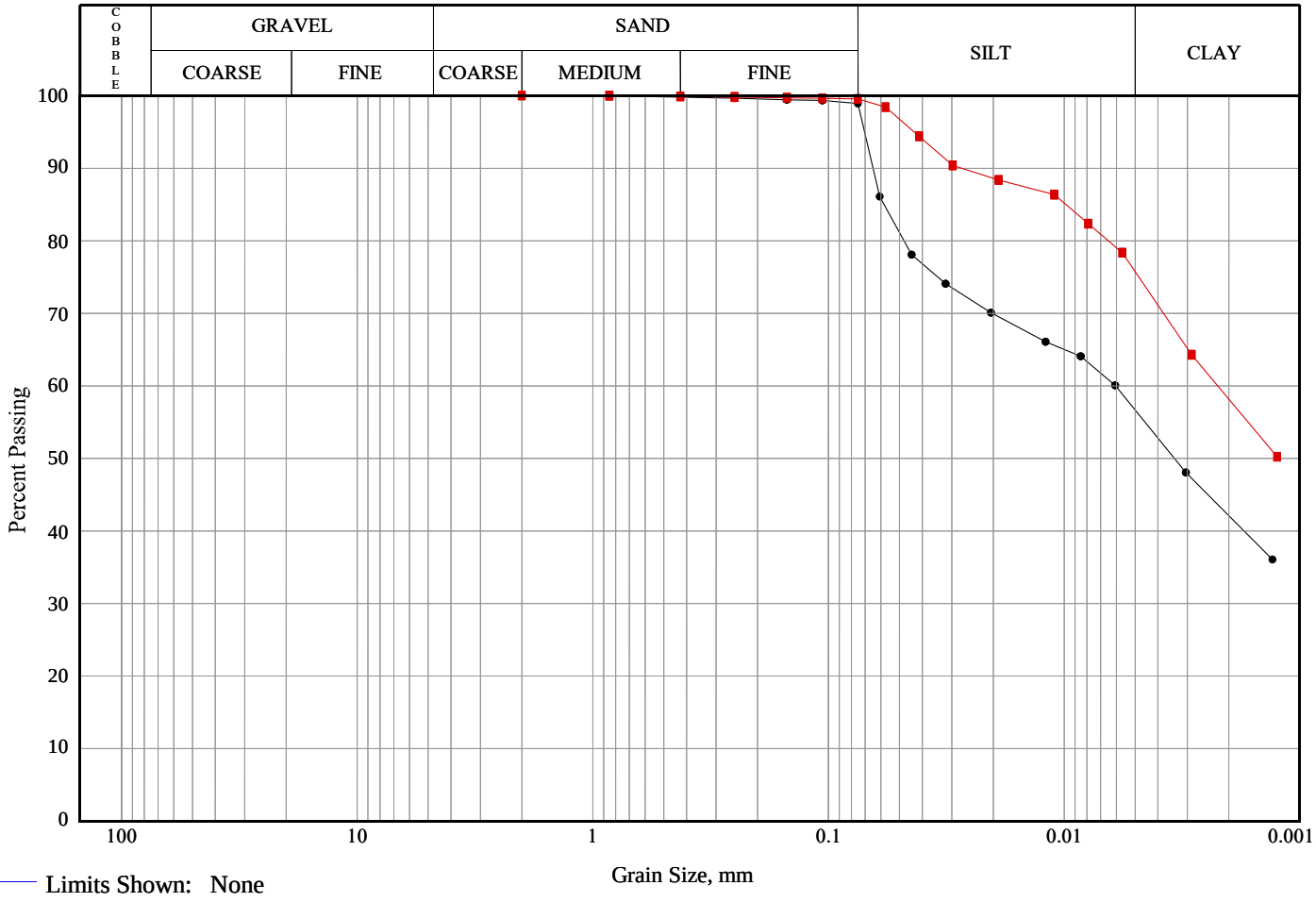
CHECKED: WAM

GEO - BOREHOLE LOG 64026.06 CANDERAL_BH(01-09) 2021-02.GPJ GEMTEC 2018.GDT 2-19-21

APPENDIX B

Laboratory Test Results

GEMTEC Consulting Engineers and Scientists	Client: Canderel Management Inc.	Soils Grading Chart
	Project: Geotechnical Investigation, Proposed Commercial Devel	
	Project #: 6402606	

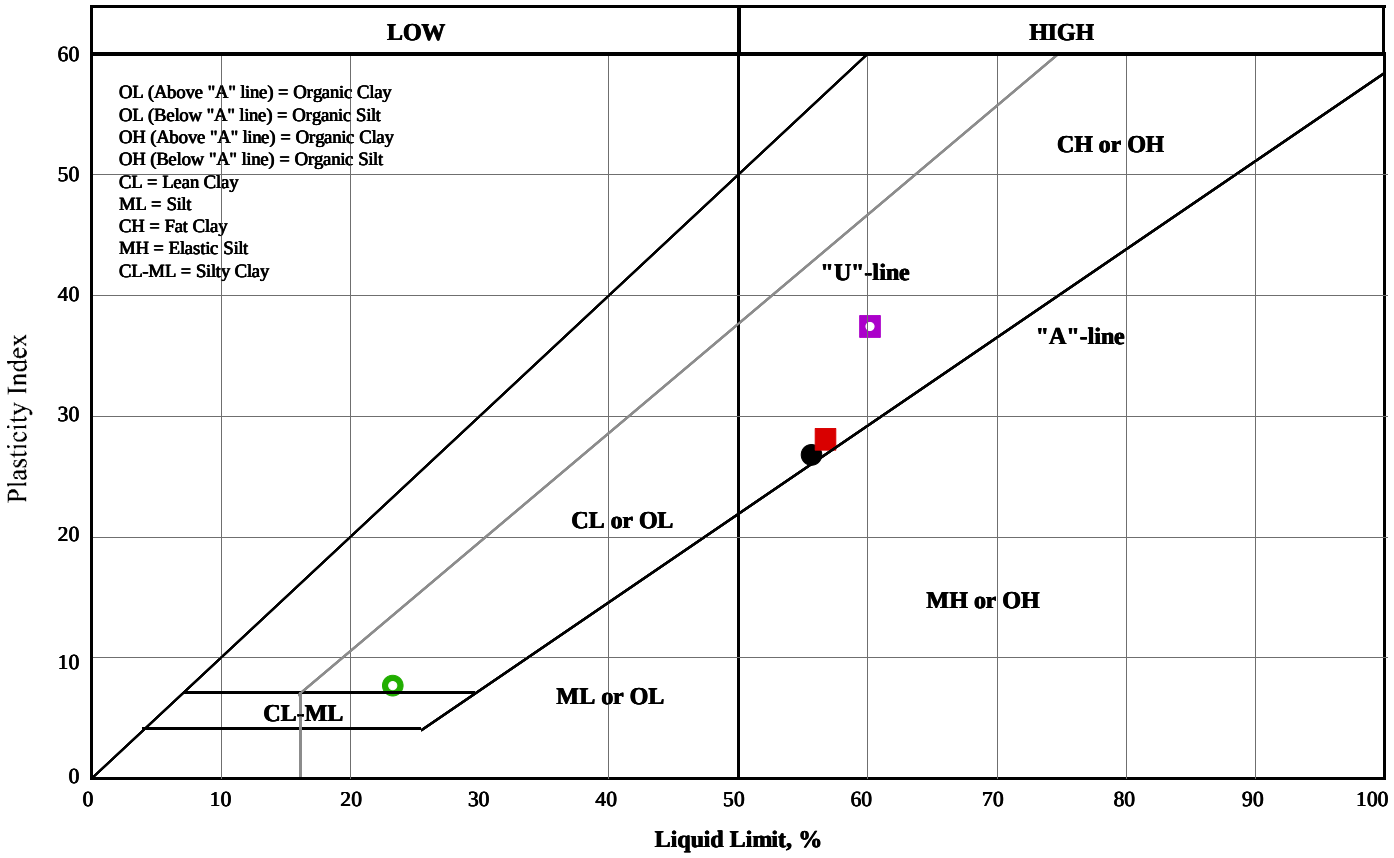


Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●—	Weathered Crust	21-02	SA 2	0.76-1.37	0.0	1.1	42.2	56.7
■—	Weathered Crust	21-08	SA 3	1.52-2.13	0.0	0.5	23.8	75.8

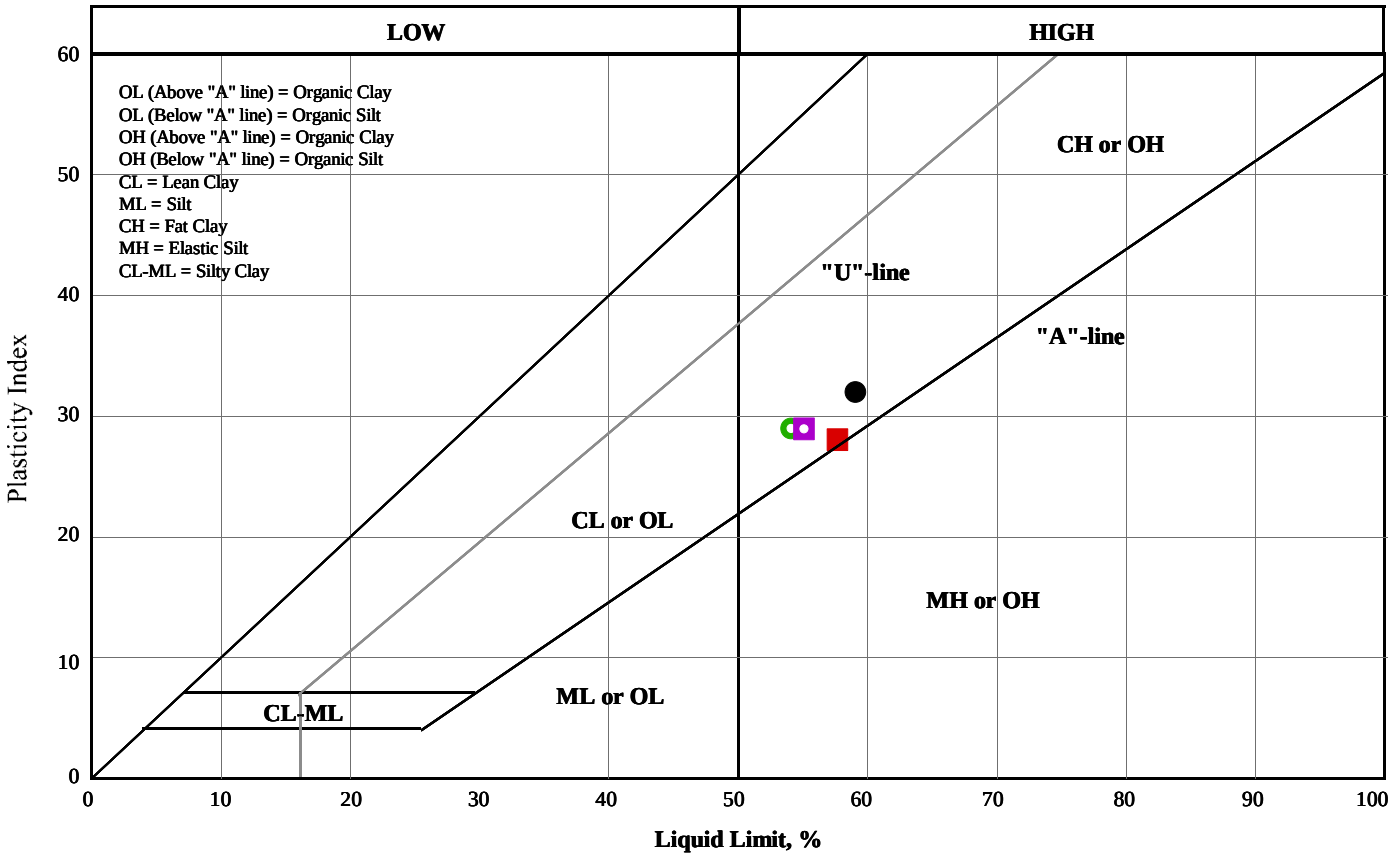
Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●—	Clay and silt , trace sand	N/A	---	---	---	0.00	0.01	0.06	42.2
■—	Silty clay , trace sand	N/A	---	---	---	---	0.00	0.01	23.8

GEMTEC Consulting Engineers and Scientists	Client: Canderel Management Inc.	Plasticity Chart
	Project: Geotechnical Investigation, Proposed Commercial Devel	
	Project #: 6402606	



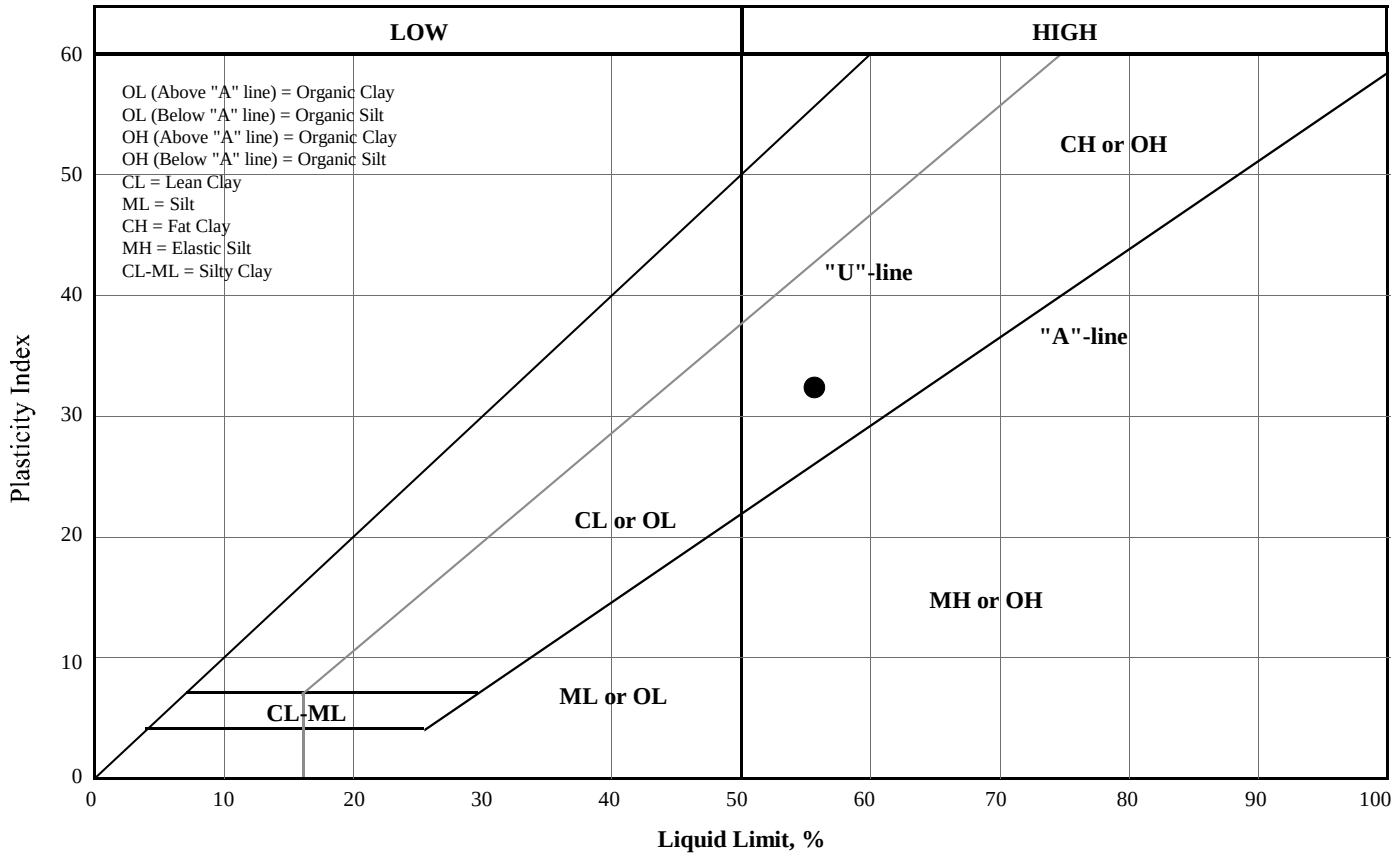
Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	21-01	SA 2	0.76-1.37	55.7	28.9	26.8	☐	45.10
■	21-02	SA 3	1.52-2.13	56.8	28.7	28.1	☐	48.51
○	21-03	SA 1B	0.30-0.61	23.3	15.6	7.7	☐	15.99
◘	21-04	SA 2B	0.91-1.37	60.2	22.8	37.4	☐	40.15

GEMTEC Consulting Engineers and Scientists	Client: Canderel Management Inc. Project: Geotechnical Investigation, Proposed Commercial Devel Project #: 6402606	Plasticity Chart



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	21-05	SA 3	1.52-2.13	59.1	27.1	32.0	☐	39.42
■	21-06	SA 3B	0.76-1.37	57.7	29.6	28.0	☐	41.21
○	21-07	SA 3	1.52-2.13	54.1	25.1	29.0	☐	42.75
◘	21-08	SA 2	0.76-1.37	55.1	26.1	28.9	☐	41.06

GEMTEC Consulting Engineers and Scientists	Client: Canderel Management Inc. Project: Geotechnical Investigation, Proposed Commercial Devel Project #: 6402606	Plasticity Chart



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	21-09	SA 3	1.52-2.13	55.7	23.3	32.4	□	45.52

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Shrinkage Limit

ASTM D4943

Volume of Shrinkage Dish	
Mass of Glass Plate (g):	**37.33**
Mass of Shrinkage Dish (g) (m):	**20.70**
Mass of Shrinkage Dish, Plate, Grease and Water (g):	**75.40**
Mass of Water (g):	**17.37**
Volume of Shrinkage Dish:	**17.0**

Test Specimen	
Specimen No:	**1**
Mass of Shrinakge Dish, m (g):	**20.89**
Mass of Shrinkage Dish and Wet Soil, m_w (g):	**48.99**
Mass of Shrinkage Dish and Dry Soil, m_d (g):	**38.44**
Mass of Wax-Coated Soil in Air, m_{sxa} (g):	**20.47**
Mass of Wax-Coated Soil in Water, m_{sxw} (g):	**7.3**

Calculated Shrinkage Limit	
Specimen No:	**1**
Mass of Dry Soil, m_s (g):	**17.55**
Water Content of Soil when Placed in Dish, w (%):	**60.11**
Mass of Water Displaced by Wax-Coated Soil, m_{wsx} (g):	**13.17**
Volume of Dry Soil and Wax, V_{dx} (cm^3):	**13.17**
Mass of Wax, m_x (g):	**2.92**
Volume of Wax, V_x (cm^3):	**3.24**
Volume of Dry Soil, V_d (cm^3):	**9.93**
Shrinkage Limit, SL	**19.80**

Specific Gravity of Wax = 0.908 at15.5°C

Specific Gravity of Wax = 0.900 at 20°C

Density of Water (g/cm^3) = 1.000 (g/cm^3)

Project No: 64026.06	**Tested By: K.N.**
Project Name: 2935 Conroy Road, Ottawa	**Checked By: K.S.**
Date Tested: Mar 9, 2021	**Sample No: BH 21-04 SA 3**
Sample Date: N/A	**Source:**
Remarks:	**Depth: 1.52-2.13**

APPENDIX C

Bedrock Core Photographs
Figure C1

BOREHOLE 20-05
BORING DATE: FEBRUARY 3, 2021
DEPTH: 22.07 to 24.23 mbgs

22.07m **23.44m**

24.23m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive, Ottawa, ON K2K 2A9
T: (613) 836-1422 | www.gemtec.ca | ottawa@gemtec.ca

Project
GEOTECHNICAL INVESTIGATION
2020 WALKLEY ROAD
OTTAWA, ONTARIO

FIGURE C1

File No.
64026.06

ROCK CORE PHOTOGRAPH
BOREHOLE 20-05

APPENDIX D

Chemical Analysis of Soil Samples
Samples Relating to Corrosion
(Paracel Laboratories Ltd. Order No. 2108109)

Certificate of Analysis

Report Date: 22-Feb-2021

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 17-Feb-2021

Client PO:

Project Description: 64026.06

	Client ID:	BH21-03 SS-3 5'-7'	BH21-06 SS-4 5'-7'	-	-
	Sample Date:	17-Feb-21 08:35	17-Feb-21 09:11	-	-
	Sample ID:	2108109-01	2108109-02	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	71.5	68.3	-	-
General Inorganics					
Conductivity	5 uS/cm	156	779	-	-
pH	0.05 pH Units	7.20	7.57	-	-
Resistivity	0.10 Ohm.m	64.3	12.8	-	-
Anions					
Chloride	5 ug/g dry	30	389	-	-
Sulphate	5 ug/g dry	25	131	-	-

experience • knowledge • integrity

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

expérience • connaissance • intégrité