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Geotechnical Investigation
Proposed Building
1818 Bradley Side Road
Ottawa (Carp), Ontario

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Submitted to:

Morley Hoppner Limited
1818 Bradley Side Road
Carp, Ontario
K0A 1L0

Geotechnical Investigation
Proposed Building
1818 Bradley Side Road
Ottawa (Carp), Ontario

August 30, 2022
Project: 101817.001

experience • knowledge • integrity

GEMTEC Consulting Engineers and Scientists Limited
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August 30, 2022 File: 101817.001

Morley Hoppner Limited
1818 Bradley Side Road
Carp, Ontario
K0A 1L0

Attention: Ken Hoppner

Re: Geotechnical Investigation
Proposed Building
1818 Bradley Side Road
Ottawa (Carp), Ontario

Enclosed is our geotechnical investigation report for the above noted project, prepared in accordance with our email proposal dated April 20, 2022. This report was prepared by Emma Weatherby, EIT (NB), and reviewed by Alex Meacoe, P.Eng.

Emma Weatherby

W. Alex Meacoe

Emma Weatherby, EIT (NB) Alex Meacoe, P.Eng.

EW/WAM/BW

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed building and house to be located at 1818 Bradley Side Road in 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.

2.0 PROJECT DESCRIPTION AND SITE GEOLOGY

2.1 Project Description

Plans are being prepared for a new building to be located at 1818 Bradley Side Road in Ottawa (Carp), Ontario. The proposed development will consist of a one storey, 700 square metre agricultural open-air storage steel framed building and will be of slab-on-grade construction (i.e., no basement level). A future residence, is also proposed for the site. GEMTEC was not provided with details of the proposed new house, however, it is assumed that the house will of wood framed construction and have one basement level.

The site is currently occupied with one house along with farmland and vacant tree-covered areas. The site is irregular in shape with an area of approximately 116,800 square metres. The site is bordered to the northwest by Bradley Side Road, to the northeast by Huntmar Drive, to the southeast by Richardson Side Road, and to the southwest by vacant land and a developed site.

2.2 Review of Geology Maps

Based on a review of surficial geology maps, along with our experience in the vicinity of the site, the overburden materials at the site are likely composed of silty clay over glacial till. Bedrock geology maps indicate that the site is underlain by interbedded limestone and shale of the Verulam formation. Bedrock mapping indicates that the bedrock surface is expected at depths ranging from about 15 to 25 metres.

3.0 METHODOLOGY

The fieldwork for the geotechnical investigation was carried out on May 31, 2022. At that time, three boreholes (numbered 22-01, 22-02, and 22-03) were advanced at the locations shown on the Site Plan, Figure 1.

The boreholes were advanced using a track mounted hollow stem auger drill rig supplied and operated by CCC Geotechnical and Environmental Drilling of Ottawa, Ontario. The boreholes were advanced to depths ranging from about 3.7 to 7.6 metres below the existing ground surface.

Standard penetration tests were carried out in the boreholes at regular intervals of depth and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler.

The fieldwork was supervised throughout by a member of our engineering staff who directed the drilling operations, logged the samples and boreholes, and carried out the in-situ testing. Following completion of the drilling, the soil samples were returned to our laboratory for examination by a geotechnical engineer and for laboratory testing. Selected soil samples were tested for water content and grain size distribution testing.

One soil sample, obtained from borehole 22-02, was sent to Paracel Laboratories Limited for basic chemical testing relating to corrosion of buried concrete and steel.

The borehole locations were selected by VELD Architect Inc. and positioned on site by GEMTEC personnel relative to existing features. The borehole locations and elevations were surveyed by GEMTEC using our precision Global Positioning System unit. Elevations referenced in this report and on the attached logs are based on geodetic datum CGVD28.

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 classification testing are provided on the Record of Borehole sheets and in Appendix B. The results of chemical testing completed on one soil sample are provided in Appendix C. The approximate locations of the test holes are shown on the Site Plan, Figure 1.

4.0 SUBSURFACE CONDITIONS

4.1 General

The soil conditions logged in the boreholes from the current investigation are provided on the Record of Borehole Sheets in Appendix A. The soil stratigraphy presented in the borehole logs are representative of subsurface conditions at the specific borehole 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.

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.

In addition to soil variability, fill of variable physical and chemical composition may be present over portions of the site or on adjacent properties. Fill material should be expected within the existing house footprint and surrounding areas.

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

4.2 Topsoil

Topsoil was encountered at ground surface in boreholes 22-02 and 22-03. The thickness of the topsoil is approximately 200 and 100 millimetres at these locations, respectively.

4.3 Silty Sand

Native deposits of silty sand were encountered at ground surface at borehole 22-01 and below the topsoil in boreholes 22-02 and 22-03. The silty sand extends to depths of about 1.5 metres below existing ground surface.

Standard penetration tests carried out in the silty sand gave N values ranging from 3 to 5 blows per 0.3 metres of penetration, which indicates a very loose to loose relative density.

The water content measured on two samples of the silty sand is about 14 and 18 percent.

4.4 Glacial Till

Native deposits of glacial till were encountered below the silty sand at each borehole location. The glacial till deposit was not fully penetrated, but was proven to depths ranging from about 3.7 to 7.6 metres below the existing ground surface. Glacial till can be described as a heterogeneous mixture of all grain sizes, which at this site is described as a silty sand with varying amounts of gravel and clay. The glacial till in this area is also known to contain cobbles and boulders.

Standard penetration tests carried out in the glacial till gave N values ranging from 14 to greater than 50 blows for less than 0.3 metres of penetration, but more generally between 23 and 40 blows, which indicates a compact to dense relative density. The high blow counts likely represent the presence of cobbles or boulders within the glacial till deposit or the bedrock surface rather than the relative density of the soil matrix.

Two grain size distribution tests were carried out on samples of the glacial till. The results are provided in Appendix B and are summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Test (Glacial Till)

Borehole Number	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
22-01	4	2.3 – 2.9	1	59	32	8
22-02	6	3.8 – 4.4	1	59	32	8

The moisture content of six glacial till samples ranges from about 10 to 14 percent.

4.5 Auger Refusal

Practical auger refusal occurred in boreholes 22-01 and 22-02 at depths of about 5.7 and 7.6 metres below the existing ground surface, respectively. Auger refusal could indicate the presence of cobbles and boulders, or possible bedrock.

A summary of the refusal depths and elevations is provided in Table 4.2.

Table 4.2 – Summary of Auger Refusal Depth and Elevation

Borehole/Test Pit Number	Ground Surface Elevation (metres)	Depth to Refusal (metres)	Refusal Elevation (metres)
22-01	104.5	5.7	98.8
22-02	105.7	7.6	98.1

4.6 Groundwater Levels

Groundwater seepage was observed during drilling at 3.8 and 3.1 metres below the existing ground surface in boreholes 22-01 and 22-02, respectively.

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 relating to corrosion of buried concrete and steel are provided in Appendix C and are summarized in Table 4.3.

Table 4.3 – Summary of Corrosion Testing

Parameter	Borehole 22-02 Sample 3
Chloride Content (µg/g)	<5
Resistivity (Ohm.m)	111
pH	6.8
Sulphate Content (µg/g)	<5

5.0 GUIDELINES AND RECOMMENDATIONS

5.1 General

This section of the report provides engineering guidelines on the geotechnical design and construction aspects of the project based on our interpretation of the borehole information and the project requirements. 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.

5.2 Grade Raise Restrictions

Based on the results of the borehole investigation, the site is underlain by native deposits of silty sand over glacial till. As such, there are no grade raise restrictions at the site, from a geotechnical perspective. The settlement due to compression of the native soils as a result of fill placement should be relatively small and should occur during or shortly after the fill placement.

5.3 Excavations

The excavations for the proposed buildings will be carried out through the native deposits of silty sand and into the glacial till. It is noted that the existing topsoil and any existing fill material is not considered suitable for the support of loads from the buildings or the slabs-on-grade and should be completely removed from the building footprints.

The sides of the excavations within overburden soils should be sloped in accordance with the requirements in Ontario Regulation (O.Reg.) 213/91 under the Occupational Health and Safety Act. According to the Act, the overburden soils can be classified as Type 4 soils. Therefore, for design purposes, allowance should be made for 3 horizontal to 1 vertical, or flatter, excavation slopes within the overburden. Cobbles and boulders should be anticipated in the glacial till. As such, allowance should be made for removal of boulders from the glacial till during excavation.

Excavation of the native soils above the groundwater should not present any excavation constraints. In contrast, excavation in the native sandy deposits below the groundwater level could present constraints. Groundwater inflow from the sandy deposits could cause sloughing of the sides of the excavation and disturbance to the soils at the bottom of the excavation.

Based on our observations on site, groundwater inflow from the overburden deposits into the excavations should be controlled by pumping from filtered sumps within the excavations. It is not expected that short term pumping during excavation will have any significant affect on nearby structures and services.

5.4 Groundwater Management

Based on the groundwater level observed during drilling (approximately 3.1 to 3.8 metres below existing surface grade), the groundwater level will likely not be encountered during excavations.

However, perched groundwater was observed during drilling in the silty sand in borehole 22-03. Groundwater inflow from the sandy overburden deposits into the excavations could be controlled by pumping from filtered sumps within the excavations. It is not expected that short term pumping during excavation will have any significant affect on nearby structures and services.

If excavations below the groundwater level are required for the proposed building or site services, an Environmental Activity and Sector Registry (EASR) in accordance with Environmental Protection Act Part II may be required, depending on the depth and size of the excavation. Further details could be provided as the design progresses.

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

5.5 Foundation Design

Based on the subsurface conditions which were encountered during the investigation, it is considered that the proposed buildings could be founded on spread footings bearing on or within the native silty sand or glacial till. The topsoil and any fill materials are not considered suitable for the support of the proposed structures (i.e., foundations or rigid concrete slab-on-grade). Therefore, all topsoil and any fill material should be removed from the proposed building areas.

In areas where the underside of footing level is above the subgrade surface or where sub-excavation of soil is required, the grade below the proposed buildings could be raised with granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type II. The granular material should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. To provide adequate spread of load below the footings, the granular material should extend at least 0.3 metres horizontally beyond the edge of the footings and down and out from this point at 1 horizontal to 1 vertical, or flatter.

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

Table 5.1 – Foundation Bearing Pressures

Subgrade Material	Geotechnical Reaction at Serviceability Limit State, SLS (kilopascals)	Factored Geotechnical Resistance at Ultimate Limit State, ULS (kilopascals)
Native deposits of silty sand	100	200
Native deposits of glacial till	150	250
A pad of engineered fill (minimum 0.6 metres thick) above native overburden deposits	150	250

The post construction total and differential settlement of footings at SLS should be less than 25 and 20 millimetres, respectively, provided that all loose or disturbed soil is removed from the bearing surfaces.

For adjacent footings founded at different elevations, we recommend that the underside of the adjacent lower footing not encroach within a zone extending 0.5 metres horizontally beyond the underside of the upper footing and then down and out from this point at 1 horizontal to 1 vertical, or flatter.

5.6 Frost Protection of Foundations

All exterior footings for heated portions of the structures should be provided with at least 1.5 metres of earth cover for frost protection purposes. Footings located within unheated portions of the buildings 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.

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

5.7 Foundation Wall Backfill and Drainage

5.7.1 Slab-on-Grade Backfill

To avoid frost adhesion and possible heaving, the foundations should be 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 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.

5.7.2 Basement Foundation Wall Backfill and Drainage

In accordance with the Ontario Building Code, the following alternatives could be considered for drainage of the basement foundation walls:

- Damp proof the exterior of the foundation walls and backfill the walls with free draining, non-frost susceptible sand or sand and gravel such as that meeting OPSS requirements for Granular B Type I or II; or,
- Damp proof the exterior of the foundation walls and install an approved proprietary drainage material on the exterior of the foundation walls and backfill the walls with native material or imported soil.

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

5.8 Seismic Site Class and Liquefaction Potential

Based on the results of the subsurface investigation, the proposed buildings will likely be founded on native glacial till. In accordance with the 2015 National Building Code of Canada (NBCC) and the Ontario Building Code (OBC), Site Class D should be used for the design of the proposed building.

Provided all very loose soils are removed from below the foundations and slab areas, and that the water table is below the very loose soils, there is no potential for liquefiable soils at the site.

5.9 At Rest Lateral Earth Pressures

Foundation and basement walls that are backfilled with 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:

$P_o = 0.5\ K_o\ \gamma\ H^2$

where;

- P_o: Static "At Rest" thrust (kilonewtons per metre);
- γ: Moist material unit weight (kilonewtons per cubic metre);
- K_o: "At Rest" earth pressure coefficient;
- H: Wall height (metre).

Seismic shaking can increase the forces on the retaining wall. The total "At Rest" thrust acting on the walls (P_{oe}) during a seismic event should be calculated using the following formula:

$P_{oe} = 0.5\ K_{oe}\ \gamma\ H^2$

where;

- P_{oe}: Total "At Rest" thrust (kilonewtons per metre);
- γ: Moist material unit weight (kilonewtons per cubic metre);
- K_{oe}: Dynamic "At Rest" earth pressure coefficient;
- H: Wall height (metres).

The static thrust component (P_o) acts at a point located H/3 above the base of the wall. During seismic shaking, the total "At Rest" thrust (P_{oe}) acts at a point located about H/2 above the base of the wall. It should be noted that the total "At Rest" thrust, P_{oe}, is composed of a static component (P_o) and a dynamic component (P_e).

For design purposes, the parameters provided in Table 5.2 can be used to calculate the thrust acting on the walls during static and seismic loading conditions.

Table 5.2 – Summary of Design Parameters (Building Foundation Walls)

Parameter	OPSS Granular B Type I	OPSS Granular B Type II
Material Unit Weight, γ (kN/m^3)	22	22
Estimated Friction Angle (degrees)	34	38
“At Rest” Earth Pressure Coefficient, K_o, assuming horizontal backfill behind the structure	0.44	0.38
Dynamic “At Rest” Earth Pressure Coefficient, K_{oe}, assuming horizontal backfill behind the structure	0.48[1]	0.41[1]

Notes:

1) According to the 2015 National Building Code of Canada, the peak ground acceleration (PGA) for this site is 0.28 (corrected for Site Class D). The dynamic at rest earth pressure coefficient was calculated using the method suggested by Mononobe and Okabe, assuming a horizontal seismic coefficient, kh, of 0.28 (taken as the corrected PGA) and assuming that the vertical seismic coefficient, kv, is zero.

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

5.10 Slab-on-Grade Support

To provide predictable settlement performance of the slab-on-grade, all topsoil, any existing fill material, organic material, or disturbed soil and debris should be removed from the slab areas. The base for the floor slab should consist of at least 150 millimetres of OPSS Granular A. OPSS documents allow recycled asphaltic concrete and Portland cement concrete to be used in Granular A material. Since the source of recycled material cannot be determined or controlled, it is suggested that any imported Granular A materials be composed of 100 percent crushed rock 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 level is above the finished exterior ground surface.

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.

5.11 Basement Concrete Slab Support

To provide predictable settlement performance of the basement slab, all topsoil, existing fill material, organic material, or disturbed soil and debris should be removed from the slab areas.

The base of the floor slab should consist of at least 150 millimetres of 19 millimetre clear crushed stone.

The clear crushed stone should be nominally compacted in maximum 300 millimetre thick lifts with at least 2 passes of a diesel plate compactor. In areas where the subgrade consists of sand, a suitable nonwoven geotextile should be placed over the subgrade prior to the placement of clear stone to prevent ingress of fines into voids in the clear stone and possible settlement/cracking of the slab.

If clear crushed stone is used below the basement floor slab, drains are not considered essential provided that the clear stone can outlet to the sump and drains are installed to link any hydraulically isolated areas in the basement. The drains should outlet by gravity to a sump from which the water is pumped. If well graded granular material (such as OPSS Granular B Type II) is used below the basement floor slab, we suggest that drainage be provided by means of plastic perforated pipes spaced at about 6 metres horizontally or as required to link any hydraulically isolated areas in the basement.

The basement floor slab should be constructed in accordance with guidelines provided in ACI 302.1R-04 “Guide for Concrete Floor and Slab Construction”.

A polyethylene vapour barrier should be installed below the basement floor slab.

5.12 Site Services

5.12.1 Excavation

Excavation for any site services within the overburden should be carried out as described in Section 5.3.

However, 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. It is noted that some unavoidable inward horizontal movement and settlement of the ground behind the trench box should be anticipated, which could affect existing services located behind the trench box. We recommend that that the excavations not encroach within a line extending downwards and outwards at an inclination of 1 vertical to 1 horizontal from the base of any existing services. Where this is not possible, a more rigid shoring system may be required to support the excavation. Additional information could be provided as the design progresses, if required.

5.12.2 Pipe Bedding

The bedding for service pipes should be in accordance with OPSD 802.010 and OPSD 802.032 for flexible and rigid pipes, respectively. The pipe bedding material should consist of at least 150 millimetres of granular material meeting OPSS for Granular A.

In areas where the subsoil is disturbed or where unsuitable material (such as fill material or organic soil) exists below the pipe subgrade level, the disturbed or unsuitable material should be removed and replaced with a sub-bedding layer of compacted granular material, such as OPSS Granular A or Granular B Type II. To provide adequate support for the pipes in the long term in areas where sub-excavation 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. The use of clear crushed stone as bedding or sub-bedding material should not be permitted.

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 sub-bedding materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value.

5.12.3 Trench Backfill

To reduce the potential for differential frost heaving between the area over the trenches, acceptable native materials should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetration (i.e., 1.8 metres below finished grade). The backfill materials within the zone of frost penetration should match the materials exposed on the trench walls. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material, imported granular material conforming to OPSS Granular B Type I or II, or well shattered and graded rock fill.

If rock fill is used as backfill within the service trenches, it should be well graded material having a maximum particle size of 300 millimetres. To prevent ingress of fine material into voids in the blast rock, the upper surface of the blast rock should be blinded (covered) with compacted, well graded crushed stone, such as OPSS Granular B Type II. Rock fill should be placed in maximum 500 millimetre thick lifts and compacted with a large steel drum roller and the haulage and spreading equipment.

To minimize future settlement of the backfill and achieve an acceptable subgrade for areas of hard surfacing, the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. In landscaped areas, the overburden backfill could be compacted to at least 90 percent of the standard Proctor dry density value, provided that some settlement of the finished ground surface is acceptable.

5.13 Corrosion of Buried Concrete and Steel

The measured sulphate concentration in the sample of soil recovered from borehole 22-02 was less than 5 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 native soil could be batched with General Use (GU) cement. The effects of freeze thaw in the presence of de-icing chemical (sodium chloride) used on the roadway should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

Based on the resistivity and pH of the sample, 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 of sodium chloride (salt) for de-icing.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Effects of Construction Induced Vibration

Some of the construction operations (such as excavation, granular material compaction, 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.

6.2 Winter Construction

Provision must be made to prevent freezing of any soil below the level of any footings, slabs or services. Freezing of the soil could result in heaving related damage.

Any service trenches should be opened for as short a time as practicable and the excavations should be carried out only in lengths which allow all of the construction operations, including backfilling, to be fully completed in one working day. The materials on the sides of the trenches should not be allowed to freeze. In addition, the backfill should be excavated, stored and replaced without being disturbed by frost or contaminated by snow or ice.

6.3 Design Review

It is recommended that the final design drawings be reviewed by GEMTEC 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 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 proposed building, house and any 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.

Emma Weatherby

Emma Weatherby, EIT (NB)
Geotechnical Engineer-in-Training

W. Alex Meacoe

Alex Meacoe, P.Eng.
Senior Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
W. A. MEACOE
100162115
Aug 30, 2022
PROVINCE OF ONTARIO

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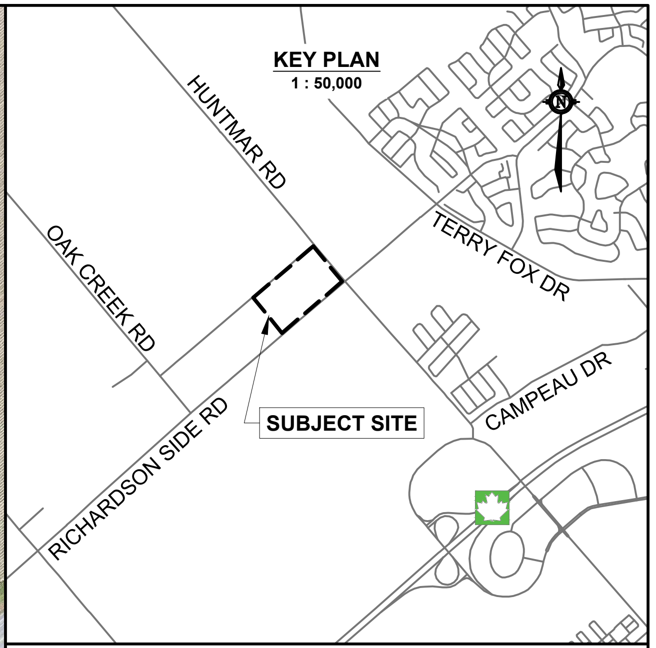

LEGEND

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

Notes:

1. The elevations reference geodetic datum CGVD28

Scale
1:2500
0 50 100 150m

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Drawing
SITE PLAN

Client
MORLEY HOPPNER LIMITED

Project
101817.001

GEOTECHNICAL INVESTIGATION
PROPOSED NEW BUILDING
1818 BRADLEY SIDE ROAD
OTTAWA, ONTARIO

Drwn by
S.L.

Chkd by
W.A.M.

Date
JUNE, 2022

Rev.
0

FIGURE 1

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APPENDIX A

Record of Borehole Sheets
List of Abbreviations and Terminology
Boreholes 22-01, 22-02, and 22-03

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

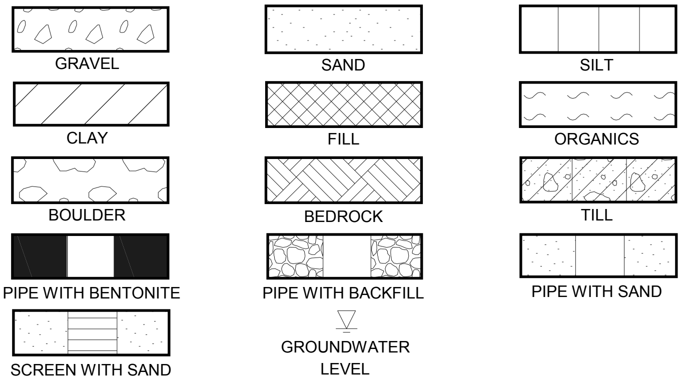
PENETRATION RESISTANCE

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.

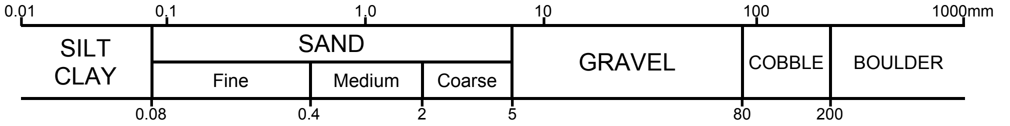
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

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

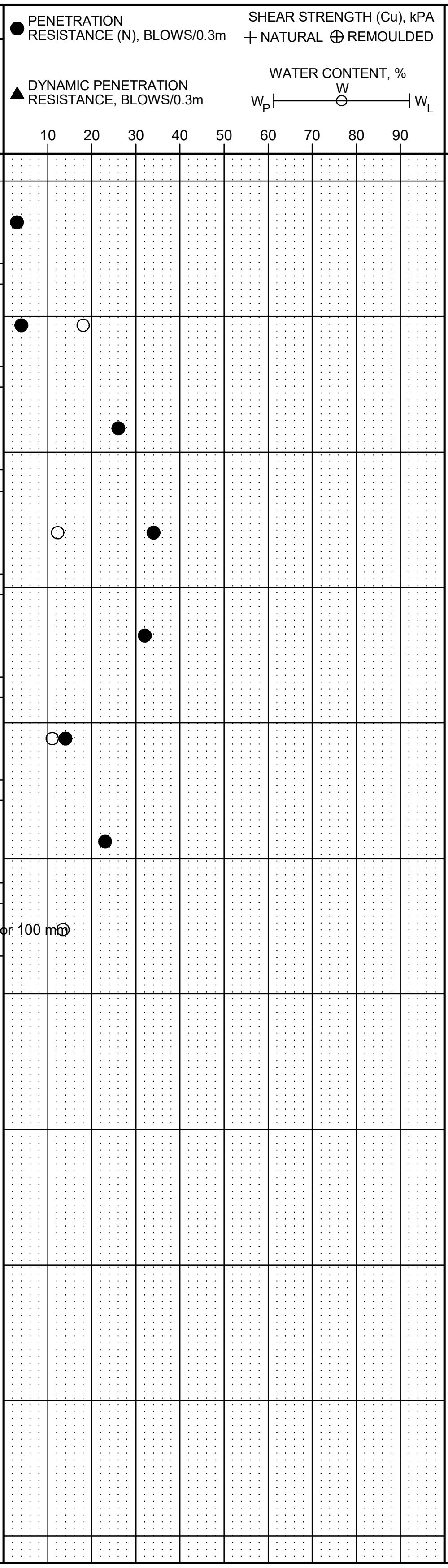
RECORD OF BOREHOLE 22-01

CLIENT: Morley Hoppner Limited
PROJECT: Geotechnical Investigation, Proposed New Building, 1818 Bradley Side Road, Ottawa (Carp), Ontario
JOB#: 101817.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 31 2022

BORING METHOD: Power Auger, Hollow Stem Auger (210mm OD)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Ground Surface	104.51						
	Very loose to loose, brown SILTY SAND		1	SS	405	3		
1			2	SS	555	4		
	Compact to very dense, grey SILTY SAND, trace to some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)	102.99 1.52	3	SS	505	26		
2			4	SS	485	34	MH	Borehole loosely backfilled with auger cuttings at the time of investigation
3			5	SS	535	32		
4			6	SS	505	14		
5			7	SS	430	23		
			8	SS	280	>50 for 100 mm		
6	End of Borehole Auger Refusal	98.79 5.72						



LOGGED: O.E./M.L.

CHECKED: W.A.M.

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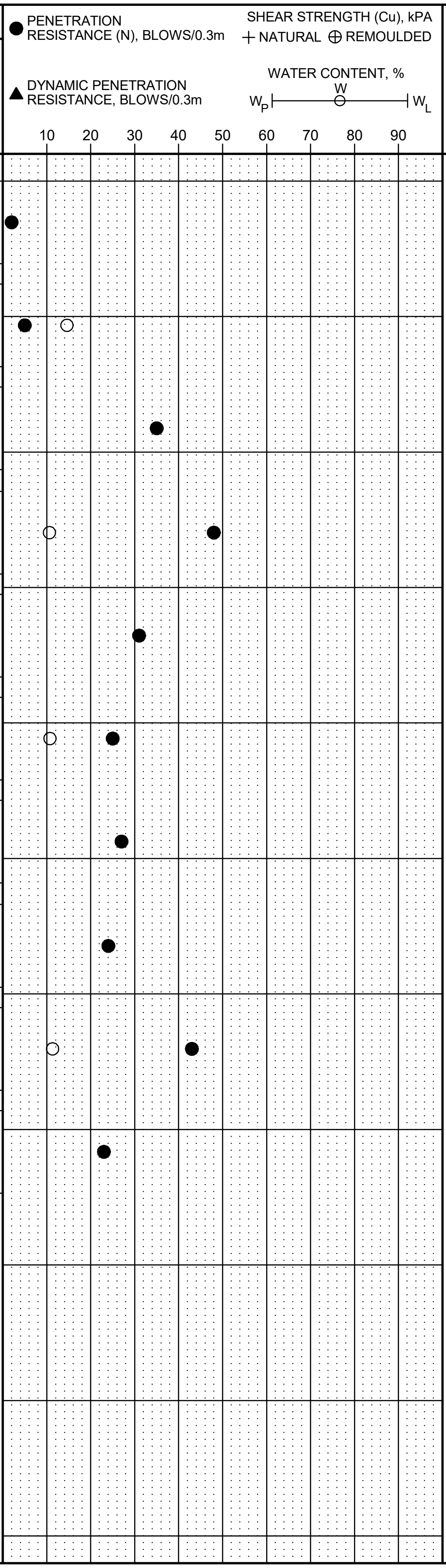
RECORD OF BOREHOLE 22-02

CLIENT: Morley Hoppner Limited
PROJECT: Geotechnical Investigation, Proposed New Building, 1818 Bradley Side Road, Ottawa (Carp), Ontario
JOB#: 101817.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 31 2022

BORING METHOD: Power Auger, Hollow Stem Auger (210mm OD)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
Ground Surface	105.71					
TOPSOIL	105.51 0.20					
Very loose to loose, brown SILTY SAND, trace gravel		1	SS	560	2	
		2	SS	430	5	
Dense to compact, grey brown SILTY SAND, trace gravel, trace clay, with cobbles and boulders (GLACIAL TILL)	104.19 1.52	3	SS	455	35	
		4	SS	510	48	
		5	SS	480	31	
		6	SS	455	25	MH
		7	SS	455	27	
Dense to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)	100.37 5.34	8	SS	330	24	
		9	SS	480	43	
		10	SS	355	23	
End of Borehole Auger Refusal	98.12 7.59					



PIEZOMETER OR STANDPIPE INSTALLATION

Borehole loosely backfilled with auger cuttings at the time of investigation

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
22/05/31	3.1 ▽	102.7

GEMTEC
Consulting Engineers and Scientists

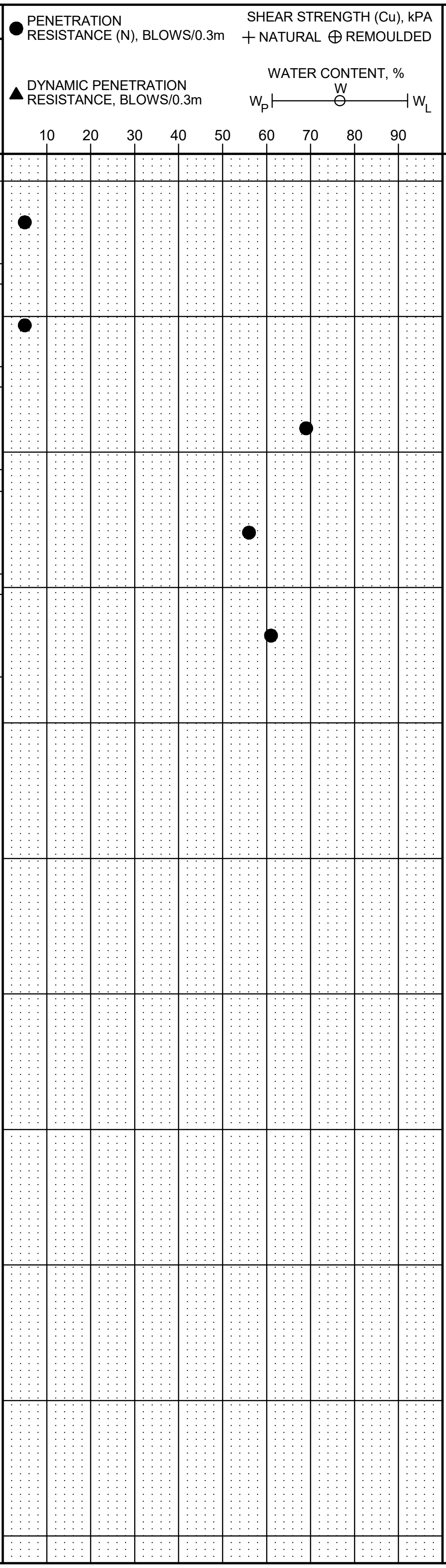
LOGGED: J.R./M.L.
CHECKED: W.A.M.

RECORD OF BOREHOLE 22-03

CLIENT: Morley Hoppner Limited
PROJECT: Geotechnical Investigation, Proposed New Building, 1818 Bradley Side Road, Ottawa (Carp), Ontario
JOB#: 101817.001
LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 31 2022

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface	108.66						
		TOPSOIL	0.10						
		Loose, brown SILTY SAND, trace gravel		1	SS	255	5		
1				2	SS	305	5		
		Very dense, grey brown SILTY SAND, trace gravel, with cobbles and boulders (GLACIAL TILL)	107.14 1.52	3	SS	405	69		Borehole loosely backfilled with auger cuttings at the time of investigation
2				4	SS	610	56		
3				5	SS	610	61		
		End of borehole	105.00 3.66						
4									
5									
6									
7									
8									
9									
10									



GEO - BOREHOLE LOG 101817.001_MAY 31 2022_BOREHOLE LOGS.GPJ GEMTEC 2018.GDT 6/22/22

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: M.L.
CHECKED: W.A.M.

APPENDIX B

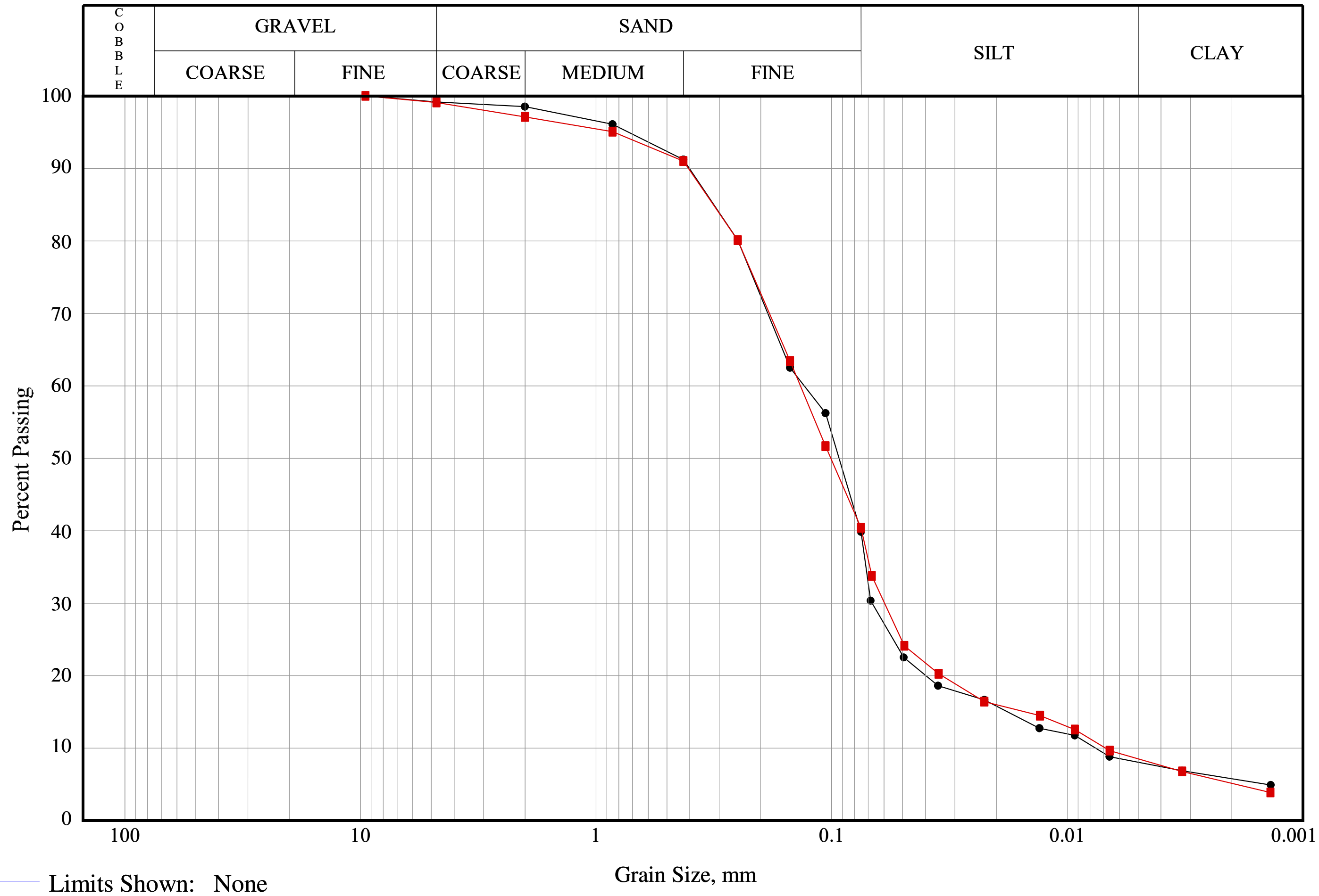
Laboratory Test Results
Soils Grading Chart

Report to: Morley Hoppner Limited
Project: 101817.001 (August 30, 2022)

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Client: Morley Hoppner Limited
Project: Geotechnical Investigation, Proposed New Building, 181
Project #: 101817001

Soils Grading Chart (LS-702/ ASTM D-422)



Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	GLACIAL TILL	BH22-01	4	2.3 - 2.9 m	0.8	59.3	31.8	8.0
—■—	GLACIAL TILL	BH22-02	6	3.8 - 4.4 m	0.9	58.7	31.9	8.5

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Silty sand , trace gravel, trace clay	N/A	0.01	0.02	0.07	0.09	0.13	0.32	31.8
—■—	Silty sand , trace gravel, trace clay	N/A	0.01	0.02	0.06	0.10	0.14	0.32	31.9

APPENDIX C

Chemical Analysis of Soil Samples
Samples Relating to Corrosion
(Paracel Laboratories Limited Order No. 2224089)

Report to: Morley Hoppner Limited
Project: 101817.001 (August 30, 2022)

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 13-Jun-2022

Order Date: 6-Jun-2022

Project Description: 101817.001

	Client ID:	BH22-02 SA-3	-	-	-
	Sample Date:	06-Jun-22 12:05	-	-	-
	Sample ID:	2224089-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	89.8	-	-	-
General Inorganics					
Conductivity	5 uS/cm	90	-	-	-
pH	0.05 pH Units	6.76	-	-	-
Resistivity	0.10 Ohm.m	111	-	-	-
Anions					
Chloride	5 ug/g dry	<5	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

experience • knowledge • integrity

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

expérience • connaissance • intégrité