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Geotechnical Investigation
Proposed Alternate Parking Lot D
The Ottawa Hospital - Riverside Campus
1967 Riverside Drive

Ottawa, Ontario

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Submitted to:

Parsons Corporation
1223 Michael Street North, Suite 100
Ottawa, Ontario
K1J 7T2

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Proposed Alternate Parking Lot D
The Ottawa Hospital - Riverside Campus
1967 Riverside Drive
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March 13, 2025
Project: 100016.030

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed parking lot (Alternate Parking Lot D) to be constructed at the Ottawa Hospital, Riverside Campus in Ottawa, Ontario (‘the Site’). The purpose of the investigation was to identify the general subsurface conditions at the Site by means of a limited number of boreholes. Based on the factual information obtained, preliminary engineering guidelines were to be provided on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This investigation was carried out in general accordance with our proposal dated May 10, 2024.

This report is subject to the Conditions and Limitations of This Report which follows the text of the report and which are considered an integral part of the report.

2.0 BACKGROUND

2.1 Project Description

Plans are being prepared for the construction of an employee parking lot at the Ottawa Hospital, Riverside Campus. Based on the preliminary details provided to GEMTEC at the time of reporting, it is understood that the proposed location of the parking lot is within a grassed area bounded by Riverside Drive to the west, the Smyth Road access ramp to the north, the Transitway and the existing hospital building to the east, and the existing laneway linking Riverside Drive to the transitway to the south.

2.2 Site Geology

A review of surficial geology maps as well as previously completed geotechnical investigations at the site indicate that the area is generally underlain by sands and gravels and glacial till over shale bedrock.

Bedrock geology maps in the area of the site indicate that shale bedrock of the Billings formation is present at depths ranging from about 5 to 10 metres below the existing ground level.

3.0 METHODOLOGY

The fieldwork for this investigation was carried out on June 19, 2024. At that time, eight boreholes (numbered 24-01 to 24-07, including 24-03A and 24-03B) were advanced at the approximate locations shown on the Borehole Location Plan (see Figure A1 in Appendix A).

The boreholes were advanced using a rubber track mounted GeoProbe drilling unit supplied and operated by George Downing Estate Drilling Ltd. of Calumet, Quebec.

The boreholes were advanced to depths of about 1.0 to 6.0 metres below ground surface. Standard penetration tests were carried out at select borehole locations within the overburden deposits. Samples of the soils encountered were recovered using drive open or direct push sampling equipment.

The fieldwork was observed by a member of our engineering staff who directed the drilling operations, observed the in-situ testing, and logged the samples and test holes.

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.

The borehole locations were selected by the GEMTEC personnel in consultation with Parsons and positioned at the site relative to existing site features. The locations and ground surface elevations of the borehole locations were determined using a GPS survey instrument. The coordinates of the boreholes are referenced to NAD83 (CSRS) Epoch 2010, vertical network CGVD28.

4.0 SUBSURFACE CONDITIONS

The approximate locations of the boreholes are shown on the Borehole Location Plan on Figure A1 in Appendix A. Descriptions of the subsurface conditions logged in the boreholes are provided on the Record of Borehole sheets in Appendix B.

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

4.1 Topsoil

A layer of topsoil was encountered at the ground surface at all the borehole locations with the exception of borehole 24-03B. The thickness of the topsoil ranges from about 80 to 250 millimetres.

4.2 Fill Material

Fill material was encountered below the topsoil at all the boreholes (from ground surface in borehole 24-03B). Boreholes 24-02, 24-03A, 24-03B, 24-04, 24-05 and 24-07 were terminated within the fill material at depths ranging between 1.0 and 3.7 metres below ground surface (boreholes 24-03B was terminated due to refusal). The fill was fully penetrated in boreholes 24-01 and 24-06 at depths of 5.5 and 4.3 metres below ground surface, respectively (elevations 57.6 and 58.5 metres). The fill material is highly variable in composition but can generally be described as silty sand to sandy silt, with varying amounts of gravel and clay. At boreholes 24-01, 24-02, 24-03A, 24-04, 24-06 and 24-07, items such as wood fragments, glass, metal, and rubber were observed in the material.

Standard penetration tests carried out in the fill material at boreholes 24-01 and 24-06 gave N values ranging from 2 to 24 blows per 0.3 metres of penetration, which reflect a very loose to compact relative density.

The measured water content of the fill ranges between about 6 and 30 percent.

4.3 Organic Soil (Peat)

A deposit of organic soil was encountered below the fill material in borehole 24-06 at a depth of 4.3 metres. Borehole 24-06 was terminated within the deposit at a depth of 5.5 metres below ground surface (elevation 57.2 metres).

The soil can be described as dark brown to black highly organic soil, with sand content and woods pieces; likely being an amorphous peat.

Standard penetration tests carried out in the deposit gave N values ranging from weight of hammer to 3 blows per 0.3 metres of penetration, which reflect a very loose relative density.

The measured water content of two samples of the peat is 86 and 137 percent.

4.4 Silty Sand / Sand

A native deposit of silty sand to sand with some silt was encountered below the fill material at borehole 24-01 at a depth of 5.5 metres below ground surface (elevation 57.6 metres).

Borehole 24-01 was terminated within the deposit due to refusal to casing advancement at a depth of 6.0 metres below the existing ground surface (elevation 57.1 metres).

The measured water content of one sample of the silty sand is 55 percent.

4.5 Groundwater Seepage

The boreholes were dry upon completion of drilling and prior to backfilling.

Groundwater conditions may vary seasonally, or because of precipitation and construction activities in the area. Shallow groundwater may also be locally affected by the presence of underground utility corridors, bedrock conditions, building foundations, and / or fill materials.

5.0 DISCUSSIONS AND RECOMMENDATIONS

5.1 General

As indicated, no details for the proposed development were available to GEMTEC at the time of reporting. As such, the information provided in the following sections should be considered as preliminary.

5.2 Proposed Storm Sewers

5.2.1 Overview

Details for a storm sewer system (if planned) were not available at the time of preparation of this report. The following information should therefore be considered as preliminary and for initial planning and design stages.

5.2.2 Excavation

Based on the results of the investigation, together with assumed storm sewer system invert levels at 2 to 3 m depth, excavations for the proposed storm sewers will generally extend through the topsoil and fill material and possibly into the silty sand deposits.

These soil units should be excavatable using conventional hydraulic excavation equipment, noting that fill material can contain more problematic material such as construction debris, boulders, or other hard material which may increase excavation effort and cause over-excavation (both laterally and in depth). As such, an allowance should be made for removal of boulders from the excavated materials during excavation. Also, additional backfill and bedding material may be required to fill any voids left from the removal of boulders.

In the fill and overburden soils, 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 fill and overburden soils should be sloped in accordance with the requirements outlined in Section 5.2.3.

5.2.3 Temporary Excavation Side Slopes

The sides of the excavations within the fill and 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, most of 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. In the instances where excavation in the fill will extend below the groundwater level, these soils may be classified as Type 4 soils, and therefore allowance should be made for excavation side slopes of 3 horizontal to 1 vertical, or flatter, extending upwards from the bottom of the excavation (inspection at the time of construction may be required to identify if Type 4 soils conditions apply to the fill materials, or any granular soils, either above or below the groundwater level).

As an alternative, the service installations could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose. In order to advance the trench box, even boulders that partially intrude into the sides of the excavation must be removed, which may result in a wider excavation than anticipated. Further, additional backfill and bedding material may be required to fill any voids left from the removal of boulders. 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. Additional information on impacts to adjacent services is provided in Section 5.2.9.

5.2.4 Groundwater Management

It is anticipated that groundwater seepage / inflow from the fill materials and the overburden deposits into the excavations will be minor, if any, and could be feasibly controlled using typical construction dewatering techniques. It is not expected that short term pumping during excavation will have a significant effect on nearby structures and services.

5.2.5 Subgrade Preparation and Sub-Bedding

In areas where the subsoil is disturbed or where unsuitable material (such as fill or organic material) exists below the pipe subgrade level, for predictable performance, the disturbed/unsuitable material should be removed to expose a suitable native soil or bedrock subgrade surface and the grade raised to design subgrade level (underside of sub-bedding or bedding, as applicable) with a layer of compacted granular material, such as that meeting OPSS Granular B Type I or II. In this case, to provide adequate support for the pipes in the long term, the excavations should be sized to allow a 1 horizontal to 1 vertical spread of the sub-bedding granular material, down and out from the design subgrade level (i.e. underside of the pipe).

Given the depth of the fill at the site, the complete removal of the fill below the alignment of the service trenches may not be feasible and consideration could be given to leaving some of the fill in place where a higher risk of post-construction settlement is acceptable. As a minimum, if fill is to be left in place below services, it is recommended that a 300 mm sub-bedding layer of compacted OPSS Granular B Type II (100 mm minus) be placed on the fill surface, below the bedding layer of Granular A. The use of a geogrid, placed between the sub-bedding layer and bedding, could also be considered as an added measure to mitigate the differential settlements along the pipe.

5.2.6 Pipe Bedding

The service bedding should be in accordance with City of Ottawa Standard Drawing Nos. S6 and S7. The pipe bedding material should consist of well graded crushed stone meeting OPSS requirements for Granular A. The minimum bedding thickness should be 150 millimetres for excavation in overburden and increased to 300 millimetres for excavation within bedrock. In accordance with City of Ottawa standards (refer to S.P. No: F-3147), granular materials used in the service trenches should be composed of virgin (i.e., not recycled) material only.

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.

5.2.7 Trench Backfill

To reduce the potential for differential frost heaving between the area over the trench and the adjacent soils (i.e., below pavements), the trench backfill materials within the zone of seasonal frost penetration (i.e., 1.8 metres below finished grade) should match the 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.

5.2.8 Compaction Requirements

To minimize future settlements, the grade material, sub-bedding, bedding and cover materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value for the applicable material.

5.2.9 Excavation Adjacent to Existing Services

As previously indicated, some unavoidable inward horizontal movement and settlement of the ground behind any trench boxes used should be anticipated, which could affect existing services located behind the trench box. We recommend that the overburden excavations not encroach within a line extending downwards and outwards at an inclination of 1 vertical to 1 horizontal from the base of the existing services supported in overburden. 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.

5.3 Proposed Retaining Walls

The locations, height and details of the retaining walls were not available at the time of this report. The guidance below should be updated as the design progresses.

5.3.1 Seismic Design

Based on the determined subsurface conditions at the Site, it is our opinion that Site Class D is appropriate for the Site according to the 2012 Ontario Building Code (as currently amended).

Based on the SPT values, the depth of the groundwater level being greater than 6 metres, and the high percentage of finer soil content in the fill material, it is considered that there is a low potential for liquefaction of the overburden deposits at this site.

5.3.2 Bearing Resistances

For predictable performance, the spread footing foundations for the retaining wall(s) should be constructed on the native deposits or bedrock, or, where required, on a pad of engineered fill material placed above the native deposits and/or bedrock. Any topsoil, fill, organic or deleterious material should be removed from beneath the footings.

Spread or strip footings, up to 2 m in maximum width, founded on the (undisturbed) native deposits or on a pad of compacted granular fill may be sized using ULS bearing reaction and ULS bearing resistances of 175 and 125 kPa, respectively. For larger footings a more detailed assessment of the allowable bearing capacity / geotechnical bearing resistance would be required.

The post construction total and differential settlements should be less than 25 and 15 millimetres respectively, provided that all loose or disturbed soil is removed from the bearing surfaces.

Where complete removal of the fill material is not practical, the fill (partially or fully) can remain below the structures provided the design and selection of the type of retaining wall(s) accounts for some settlement and heaving (i.e., selection of a non-rigid option such as armourstone). To help lessen the effects of settlement and heaving, a compacted granular sub-bedding layer, as described in Section 5.1.5, can be placed beneath the bedding layer at retaining wall(s).

5.3.3 Sliding Resistance

For preliminary design purposes, the resistance to sliding of retaining walls may be calculated using an unfactored interface friction angle of 22 degrees and a friction coefficient of 0.4, assuming that the footings are founded directly on native soil; however, if the footings are founded on a pad of compacted granular material, the unfactored interface friction angle could be increased to 30 degrees with a friction coefficient of 0.58.

5.3.4 Subgrade Preparation

Allowance should be made to remove and replace any fill material, disturbed native deposit with compacted sand and gravel, such as that meeting OPSS Granular A or Granular B Type II, where required.

Granular material, where required, should be compacted to at least 98 percent of the standard Proctor dry density in maximum 200-millimetre-thick lifts using suitable vibratory compaction equipment. In the instance that a pad of engineered fill material is placed below the foundations, the material should extend out at least 0.3 metres beyond the edges of the retaining wall footing and slope downwards from this point at 1 horizontal to 1 vertical, or flatter.

During construction the subgrade surface should be inspected by GEMTEC (prior to placement of any granular material).

5.3.5 Frost Protection

All footings for the retaining wall should be provided with at least 1.8 metres of earth cover for frost protection purposes. If the required depth of earth cover is not practicable a combination of earth cover and polystyrene insulation could be considered. The grade of insulation used, if placed below the footing, should be suitable for the applied foundation loads. Further details regarding the insulation of foundations could be provided upon request.

5.3.6 Retaining Wall Backfill and Drainage

To provide drainage and avoid frost adhesion and possible horizontal frost heaving which could occur behind the wall causing the wall to be pushed or rotated outward, the wall should be backfilled with imported, free-draining, non-frost susceptible granular material meeting OPSS Granular B Type I or II requirements. From a geotechnical point of view, the material encountered on site is not considered suitable for reuse as backfill material due to potential of frost heaving.

The non-frost susceptible backfill material should extend at least 1.8 metres horizontally outward from the back of the retaining wall. 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 future landscaped areas will exist next to the proposed structure 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.

Based on the underlying sandy soils, the depth to the groundwater level, the paved and relatively impervious surfacing, drains behind the retaining walls are likely not required. This assumes that the parking lot drainage is directed away from the retaining walls and water will not pond in these areas or flow over the retaining wall.

Where areas of hard surfacing (concrete, sidewalk, pavement, etc.) abut the proposed retaining wall, 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 1.8 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 3 horizontal to 1 vertical, or flatter.

5.3.7 Lateral Earth Pressures

The guidance for lateral earth pressures provided below assumes that the backfill behind a wall structure is flat (i.e., level with the top of the wall) and that the back side of the wall is vertical. Further guidance can be provided for those design cases if needed.

5.3.7.1 Active Earth Pressures

The following earth pressure parameters could be used for somewhat flexible (yielding) retaining walls.

The static active pressure acting on the wall at a specified depth, d, should be calculated using the following formula:

$$\sigma_h = K_a (\gamma\ d+q)$$

where;

- σ_h : lateral earth pressure at depth d (kPa)
- γ: Moist material unit weight (kN/m^3);
- K_a: “Active” earth pressure coefficient; and,
- q: Surcharge at the top of the wall (kPa).

Seismic shaking can increase the forces on the wall. The total pressure due to combined static and seismic loads acting at a specified depth, d, below the top of the wall may be calculated using the following equation:

$$\sigma_h = K_a \gamma d + (K_{ae} - K_a) \gamma (H-d)$$

where;

- σ_h : lateral earth pressure at depth d (kPa);
- γ: Moist material unit weight (kN/m^3);
- K_{ae}: Dynamic “active” earth pressure coefficient; and,
- H: Wall height (metres).

The ratio of wall movement to wall height required to mobilize the active conditions would be approximately 0.002 for a yielding structure with respect to the assessment of seismically induced lateral earth pressures.

For design purposes, the soil parameters provided in Table 5.1 can be used to calculate the active earth pressures acting on the wall.

Table 5.1 – Summary of Soil Parameters for Active Wall

Parameter	OPSS Granular B Type I	OPSS Granular B Type II
Material Unit Weight, γ (kN/m^3)	21	22
Internal Friction Angle (degrees)	34	38
“Active” Earth Pressure Coefficient, K_a, assuming horizontal backfill behind the structure	0.28[1]	0.24[1]
Dynamic “Active” Earth Pressure Coefficient, K_{ae}	0.39[1]	0.34[1]

Notes:

1) According to the 2012 Ontario Building Code, the peak ground acceleration (PGA) for Ottawa is 0.32 g for firm ground conditions (i.e., for Site Class C). The corrected PGA for Site Class D is 0.35. The dynamic at rest earth pressure coefficient was calculated using the method suggested by Mononobe and Okabe, assuming a horizontal seismic coefficient, k_h, of 0.175 (taken as the one half the PGA for site class D) and assuming that the vertical seismic coefficient, k_v, is 0.

5.3.7.2 At Rest Earth Pressures

The following earth pressure parameters could be used for rigid retaining walls.

The static at-rest earth pressures acting on the wall should be calculated using the following formula:

$$\sigma_h = K_o (\gamma\ d+q)$$

where;

- σ_h : lateral earth pressure at depth d (kPa)
- γ: Moist material unit weight (kN/m^3);
- K_o: “At-rest” earth pressure coefficient;
- q: Surcharge at the top of the wall (kPa)
-

The total pressure due to combined static and seismic loads acting at a specified depth, d, below the top of the wall may be calculated using the following equation:

$$\sigma_h = K_o\ \gamma\ d + (K_{ae} – K_a)\ \gamma\ (H\text{-}d)$$

where;

- σ_h : lateral earth pressure at depth d (kPa);
- γ: Moist material unit weight (kN/m^3);
- K_{ae}: Dynamic “active” earth pressure coefficient;
- H: Wall height (metres);
- K_a “Active” Earth Pressure Coefficient

For design purposes, the soil parameters provided in Table 5.2 can be used to calculate the at rest thrust components acting on the wall.

Table 5.2 – Summary of Soil Parameters for At Rest Wall

Parameter	OPSS Granular B Type I	OPSS Granular B Type II
Material Unit Weight, γ (kN/m^3)	21	22
Internal Friction Angle (degrees)	34	38
“At Rest” Earth Pressure Coefficient, K_o, assuming horizontal backfill behind the structure	0.44[1]	0.38[1]
Active Earth Pressure Coefficient, K_a, assuming horizontal backfill behind the structure	0.28	0.24

Parameter	OPSS Granular B Type I	OPSS Granular B Type II
Dynamic Earth Pressure Coefficient, K_{ae}, assuming horizontal backfill behind the structure	0.55[1]	0.47[1]

Notes:

1. According to the 2012 Ontario Building Code, the peak ground acceleration (PGA) for Ottawa is 0.32 g for firm ground conditions (i.e., for Site Class C). The corrected PGA for Site Class D is 0.35. The dynamic at rest earth pressure coefficient was calculated using the method suggested by Mononobe and Okabe, assuming a horizontal seismic coefficient, k_h, of 0.35 (taken as the PGA for Site Class D) and assuming that the vertical seismic coefficient, k_v, is 0.

5.4 Proposed Parking Lot

At the time of preparing this draft version of the report some details of the proposed pavements at the site were not available to GEMTEC.

5.4.1 Subgrade Preparation

In preparation for the construction of the access roadway and parking areas at this site, all surficial topsoil, and any loose / soft, wet, organic, debris or deleterious materials should be removed from the proposed subgrade surface. It is not considered necessary to remove all of the fill material from below the roadway / parking areas provided that some settlement of the fill material can be tolerated. Any sub-excavated areas could be filled with compacted earth borrow or imported granular material. The Granular B Type I, II, 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.

The subgrade surfaces should be proof rolled with a large steel drum roller (under dry conditions), and shaped, and crowned to promote drainage of the granular materials.

5.4.2 Flexible Pavement Structures for the Parking Areas and Access Roadway

It is suggested that parking areas, be constructed using the following minimum pavement structure for light duty (i.e., primarily passenger vehicles):

- 60 millimetres of asphaltic concrete; over
- 150 millimetres of OPSS Granular A base; over
- 300 millimetres of OPSS Granular B Type II subbase.

The asphaltic concrete should consist of a single 60-millimetre lift of Superpave 12.5 (Traffic Level B) Hot Mix Asphalt (HMA) meeting the requirements of OPSS 1151.

All HMA materials should incorporate PG 58-34 asphaltic cement meeting the requirements of OPSS 1101 and be constructed to the requirements of OPSS 310.

Where the new pavement will abut existing pavement, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter to match the depths of the granular material(s) exposed in the existing pavement (frost tapers).

If the granular pavement materials are to be used by construction traffic, it may be necessary to increase the thickness of the subbase material, 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.

5.4.3 Compaction Requirements

All imported granular materials should be placed in maximum 200-millimetre thick lifts and should be compacted to at least 98 percent of the standard Proctor dry density value using suitable vibratory compaction equipment.

5.4.4 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 shaped to drain to the catch basins to promote drainage of the pavement granular materials. The catch basins should be provided with minimum 3-metre long perforated stub drains which extend in at least two (2) directions from each catch basin at pavement subgrade level.

5.4.5 Pavement Transitions

As part of the parking lot construction the new pavement will abut the existing pavement at various locations where vehicle access will be provided. 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; and,
- 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.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Grade Raise

Preliminary design information that has been provided to GEMTEC suggests that the final constructed grades will not be notably increased from existing grades. As such, it is GEMTEC's opinion that there are no concerns from a grade raise perspective with the proposed design.

6.2 Effects of Construction Induced Vibration

Some of the construction operations (such as granular material compaction, excavation, rock blasting, etc.) will cause ground vibration on and off the site. The vibrations will attenuate with distance from the source, but may be felt at nearby structures.

We recommend that preconstruction surveys be carried out on the adjacent structures and that vibration monitoring be carried out during the construction so that any damage claims can be addressed in a fair manner.

6.3 Excess Soil Management Plan

This report does not constitute an excess soil management plan. The disposal requirements for excess soil from the site have not been assessed.

6.4 Design Review and Construction Observation

The details for the proposed construction were not available to us at the time of preparation of this report. It is recommended that the final design drawings be reviewed by the Geotechnical Engineer 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 site services and roadways 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.

Mattew Rainville, C.E.T.
Senior Geotechnical Technologist

LICENSED PROFESSIONAL ENGINEER
W. CAVERS
100077934
Mar. 13/25
PROVINCE OF ONTARIO

Bill Cavers, P.Eng.
Principal Geotechnical Engineer

MR/BC

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6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety, and equipment capabilities.

7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in Property Value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.

9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions, misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information

and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

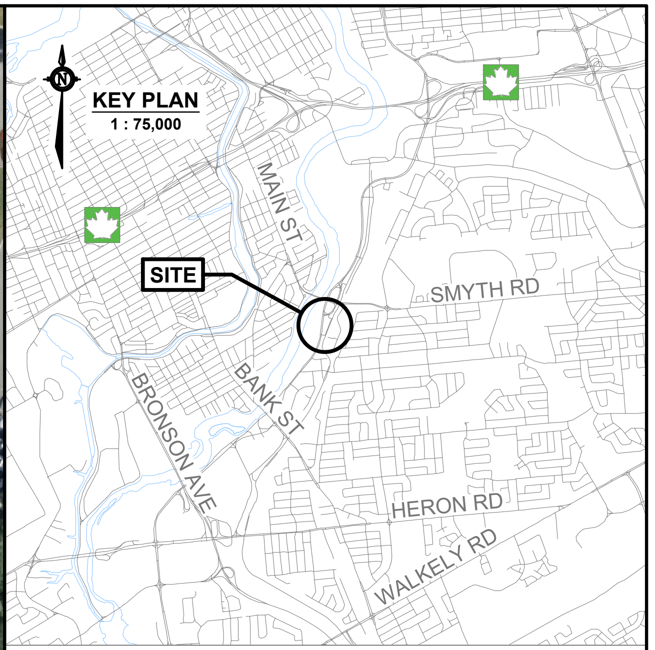
13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A

Figure A1 – Borehole Location Plan

Report to: Parsons Corporation
Project: 100016.030 (March 13, 2025)



LEGEND

BH #	BOREHOLE ID
XX.XX	GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM
⊕	BOREHOLE LOCATION (current investigation by GEMTEC)

GENERAL NOTE(S)

1. Coordinate system: NAD83 (CSRS), UTM ZONE 18N, CGVD28
   Survey Reference base point: PRS87429907110
   Easting: 447562.89m
   Northing: 5025195.07m
   Elevation: 95.23m
2. Distances, elevations, and coordinates are shown in metres unless denoted otherwise
3. This drawing is a schematic representation and should not be taken as a substitute for a legal survey.
4. Image @2024 Google Maps, CNES / Airbus, First Base Solutions, Maxar Technologies
5. Contains information licensed under the Open Government Licence – Ontario
6. Geographic dataset source: Ontario GeoHub

SCALE

1:1,000

0 20 40 60m

DRAWING

BOREHOLE LOCATION PLAN

CLIENT

PARSONS INC.

PROJECT

GEOTECHNICAL INVESTIGATION
PROPOSED ALTERNATE PARKING LOT 'D'
THE OTTAWA HOSPITAL - RIVERSIDE CAMPUS
OTTAWA, ONTARIO

DRAWN BY	CHECKED BY
S.L.	M.R.
PROJECT NO.	REVISION NO.
100016.030	1
DATE	FIGURE NO.
MARCH 13, 2025	**FIGURE A1**

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

32 Steacie Drive
Ottawa, ON, K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

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APPENDIX B

Record of Borehole Logs
List of Abbreviations

Report to: Parsons Corporation
Project: 100016.030 (March 13, 2025)

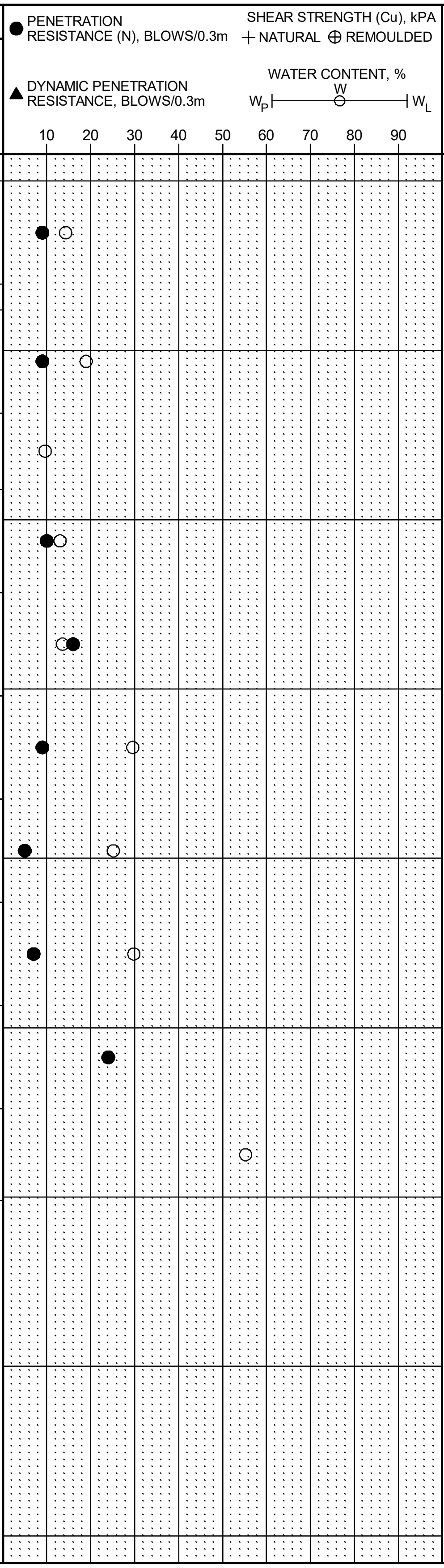
RECORD OF BOREHOLE 24-01

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

BORING METHOD: Direct Push, Casing (89mm (OD)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
Ground Surface	63.10				
TOPSOIL	62.98 0.13				
Loose to compact, light brown/brown/grey brown silty sand to sandy silt with varying gravel and clay content. Wood, glass, metal, brick, rubber observed in some samples (FILL MATERIAL)		1	SS	460	9
		2	SS	305	9
		3	SS	255	-
		4	SS	460	10
		5	SS	460	16
		6	SS	305	9
		7	SS	230	5
		8	SS	255	7
		9	SS	150	24
Grey brown to grey SILTY SAND to SAND some silt.	57.61 5.49	10	SS	255	>50
End of Borehole Casing Refusal	57.08 6.02				



DEPTH SCALE METRES: 0, 1, 2, 3, 4, 5, 6, 7, 8

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Bentonite

No groundwater inflow observed within the borehole at the time of drilling.

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Consulting Engineers and Scientists

LOGGED: PS
CHECKED: MR

RECORD OF BOREHOLE 24-02

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				PENETRATION RESISTANCE (N), BLOWS/0.3m ● / DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m ▲ / SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED / WATER CONTENT, % WP W WL (10 20 30 40 50 60 70 80 90)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m			
0		Ground Surface		60.86							
	Direct Push Casing (89mm (OD))	TOPSOIL		60.61 0.25							Bentonite
		Light brown/brown/grey brown silty sand to sandy silt with varying gravel and clay content. Wood, glass, brick, organics observed in some samples. Possible cobbles and boulders. (FILL MATERIAL)		57.20 3.66	1	CA	865	-			
					2	CA	610	-			
					3	CA	585	-			
		End of borehole									No groundwater inflow observed within the borehole at the time of drilling.

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LOGGED: PS
CHECKED: MR

RECORD OF BOREHOLE 24-03A

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				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)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m			
0		Ground Surface		61.42							
	Direct Push Casing (89mm (OD))	TOPSOIL		61.21 0.20							
		Light brown/brown/grey brown silty sand to sandy silt with varying gravel and clay content. Wood, organics observed in some samples. (FILL MATERIAL)			1	CA	864	-			Bentonite
1					2	CA	203	-			
		End of Borehole		59.75 1.67							No groundwater inflow observed within the borehole at the time of drilling.
2											
3											
4											
5											
6											
7											
8											

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CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: PS

CHECKED: MR

RECORD OF BOREHOLE 24-03B

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

● 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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		61.56						
	Direct Push Casing (89mm (OD))	Brown/grey brown silty sand to sandy silt with varying gravel and clay content. Shale pieces observed in some samples. Possible cobbles and boulders (limestone piece in tip of sampler). (FILL MATERIAL)	▨	60.60 0.96	1	CA	813	-		Bentonite
1		Casing Refusal. End of Borehole								No groundwater inflow observed within the borehole at the time of drilling.
2										
3										
4										
5										
6										
7										
8										

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Consulting Engineers and Scientists

LOGGED: PS
CHECKED: MR

RECORD OF BOREHOLE 24-04

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

● 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

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface	62.68						
	Direct Push Casing (89mm (OD))	TOPSOIL	62.60 0.08						Bentonite
		Light brown/brown/grey brown/grey silty sand to sandy silt with varying gravel and clay content. Wood, glass, brick, organics observed in some samples. (FILL MATERIAL)		1	CA	965	-		
1–2				2	CA	864	-		
3				3	CA	1016	-		
		End of Borehole	59.03 3.65						No groundwater inflow observed within the borehole at the time of drilling.
4									
5									
6									
7									
8									

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LOGGED: PS
CHECKED: MR

RECORD OF BOREHOLE 24-05

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

● 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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		62.20						
	Direct Push Casing (89mm (OD))	TOPSOIL		62.07 0.13						Bentonite
		Grey brown/grey/reddish brown silty sand to sandy silt with varying gravel and clay content. (FILL MATERIAL)			1	CA	889	-		
1					2	CA	457	-		
		End of Borehole		60.53 1.67						
2										No groundwater inflow observed within the borehole at the time of drilling.
3										
4										
5										
6										
7										
8										

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LOGGED: PS
CHECKED: MR

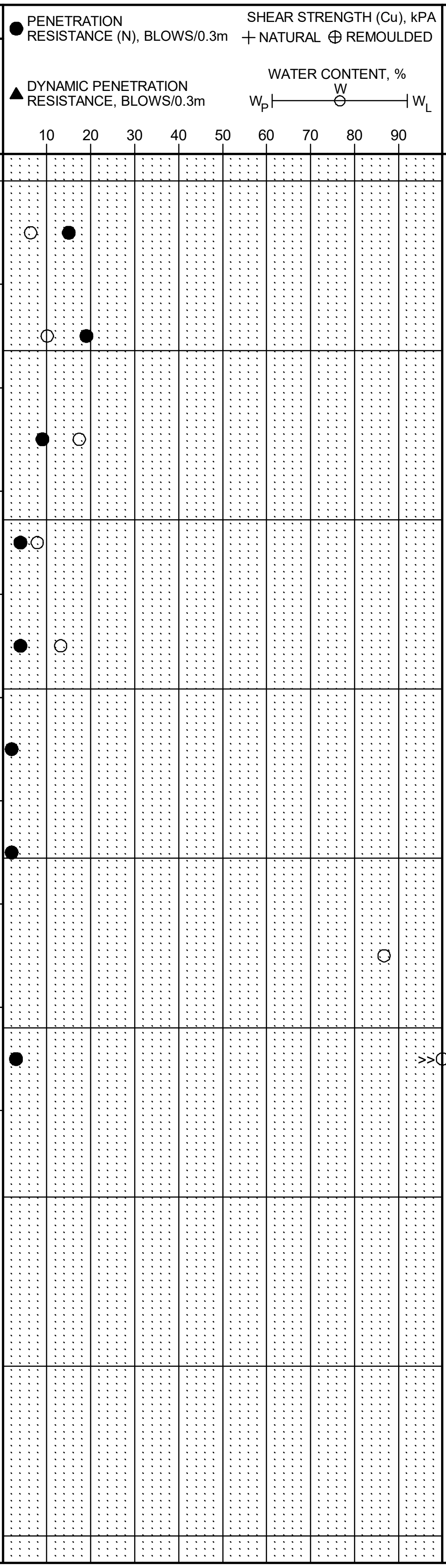
RECORD OF BOREHOLE 24-06

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

BORING METHOD: Direct Push, Casing (89mm (OD))

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
Ground Surface	62.71				
TOPSOIL	62.63 0.08				
Compact to loose, brown/dark brown/grey brown/reddisn brown silty sand to sandy silt with varying gravel and clay content. Wood, glass, rubber, organics observed in some samples. (FILL MATERIAL)		1	SS	405	15
		2	SS	305	19
		3	SS	305	9
		4	SS	330	4
		5	SS	205	4
		6	SS	25	2
		7	SS	75	2
Black organic soil (possible amorphous peat)	58.45 4.26	8	SS	100	WH
		9	SS	280	3
End of Borehole	57.23 5.48				



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Bentonite

No groundwater inflow observed within the borehole at the time of drilling.

DEPTH SCALE METRES: 0, 1, 2, 3, 4, 5, 6, 7, 8

LOGGED: PS

CHECKED: MR

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RECORD OF BOREHOLE 24-07

CLIENT: Parsons Corporation
PROJECT: Geotechnical Investigation, Proposed Parking Lot, The Ottawa Hospital, Riverside Campus, Ottawa
JOB#: 100016.030
LOCATION: See Figure A1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 19 2024

● 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

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	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		63.01						
	Direct Push Casing (89mm (OD))	TOPSOIL		62.91 0.10						
		Brown/grey brown/dark brown/black, silty sand to sandy silt with varying gravel and clay content. Glass, metal, organics observed in some samples. (FILL MATERIAL)			1	CA	965	-		Bentonite
1					2	CA	559	-		
				61.23 1.78						
		End of Borehole								
2										No groundwater inflow observed within the borehole at the time of drilling.
3										
4										
5										
6										
7										
8										

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LOGGED: PS
CHECKED: MR

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

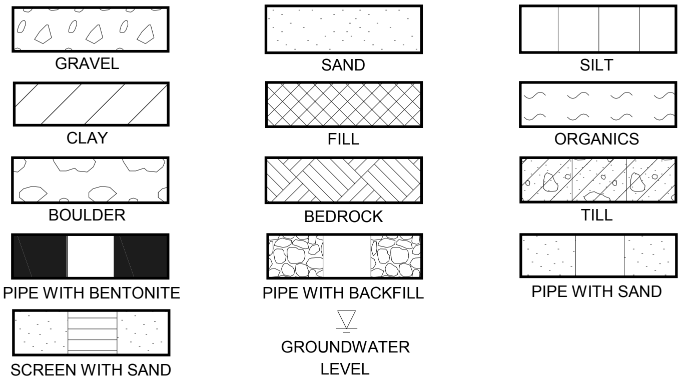
PENETRATION RESISTANCE

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.

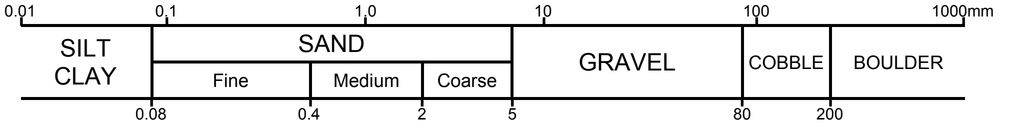
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to ‘A’ size drill rods for a distance of 300 mm (12 in.).

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

experience • knowledge • integrity

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

expérience • connaissance • intégrité