



# GEMTEC

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**Geotechnical Investigation  
Proposed Commercial Development  
5506 Manotick Main Street  
Ottawa, Ontario**

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Submitted to:

2538702 Ontario Inc. o/a KGMS Construction  
7116 Bank Street  
Metcalfe, Ontario  
K0A 2P0  
c/o Cedar Sands Holdings Inch.  
184 Redpath Drive  
Ottawa, Ontario  
K2G 6K5

**Geotechnical Investigation  
Proposed Commercial Development  
5506 Manotick Main Street  
Ottawa, Ontario**

March 13, 2020  
Project: 65032.03

GEMTEC Consulting Engineers and Scientists Limited  
32 Steacie Drive  
Ottawa, ON, Canada  
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March 13, 2020

File: 65032.03

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Attention: Mr. Steven Horvath

**Re: Geotechnical Investigation  
Proposed Commercial Development  
5506 Manotick Main Street  
Ottawa, Ontario**

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Enclosed is our geotechnical investigation for the above noted project, in accordance with our proposal dated November 29, 2019. This report was prepared by Mr. Alex Meacoe, P.Eng., and reviewed by Mr. John Cholewa, Ph.D, P.Eng.



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Alex Meacoe, P.Eng.



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for John Cholewa, Ph.D., P.Eng.

WAM/JC

Enclosures  
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## **1.0 INTRODUCTION**

This report presents the results of a geotechnical investigation carried out at the site of a proposed commercial development located at 5506 Manotick Main Street in Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface and groundwater conditions at the site by means of a limited number of boreholes. Based on the factual information obtained, preliminary engineering guidelines were to be provided on the geotechnical aspects of the design of the proposed development, including construction considerations that could influence design decisions.

This investigation was carried out in general accordance with our proposal dated November 29, 2019.

## **2.0 PROJECT AND SITE DESCRIPTION**

### **2.1 Project Description**

Plans are being prepared to construct a two-storey commercial building at 5506 Manotick Main Street in Ottawa, Ontario. The following is known about the site and project:

- The site is located at the south east corner of Manotick Main Street and Highcroft Drive;
- The site is currently occupied with an abandoned one-storey commercial building with at grade parking at the rear of the building;
- The proposed commercial building, which is to be located adjacent to Manotick Main Street, will be of slab on grade construction and two-stories in height with dimensions of about 26 metres by 10 metres, in plan; and,
- At grade parking will be located at the rear of the building with dimensions of about 29 metres by 25 metres, in plan.

### **2.2 Review of Geology Maps**

Based on our previous experience in the area of the site and surficial geology maps of the Ottawa area the subsurface conditions at the site likely consist of silty clay over glacial till. Bedrock geology maps of the area show that the overburden deposits are underlain by dolostone of the Oxford formation. Fill material associated with the existing development of the site should be anticipated.

## **3.0 SUBSURFACE INVESTIGATION**

The fieldwork for this investigation was carried out between October 16 and 18, 2019. During that time, three boreholes (numbered 19-1, 19-2, and 19-3) were advanced at the approximate locations shown on the Borehole Location Plan, Figure 1.

Boreholes 19-1 and 19-2 were advanced using a truck mounted, hollow stem auger drill rig supplied and operated by CCC Geotechnical and Environmental Drilling Ltd. of Ottawa, Ontario. The boreholes were advanced to depths of about 16.2 and 5.9 metres below ground surface, respectively. Practical auger refusal was encountered in borehole 19-1 and wash boring techniques were used to advance through the overburden. Upon reaching the bedrock surface in borehole 19-1, the borehole was advanced into the bedrock using rotary diamond drilling techniques while retrieving HQ sized bedrock core.

Borehole 19-3 was advanced using portable drilling equipment supplied and operated by GEMTEC personnel. The borehole was advanced to a depth of about 1.7 metres below ground surface.

Standard penetration tests were carried out in the boreholes and samples of the soils encountered were recovered using a 50 millimetre diameter drive open sampler.

Well screens were installed in boreholes 19-1 and 19-2, to measure the groundwater levels. The groundwater levels were measured on January 7, 2020.

One soil sample recovered from borehole 19-2 was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

Following the borehole drilling fieldwork, the soil samples were returned to our laboratory for examination by the geotechnical engineer and for geotechnical laboratory testing. Selected samples of the soil were tested for water content and grain size distribution.

The results of the boreholes are provided on the Record of Borehole sheets in Appendix A. The approximate locations of the boreholes are shown on the Borehole Location Plan, Figure 1. The results of the laboratory classification tests on the soil samples are provided in Appendix B. Photographs of the bedrock core samples are provided in Appendix C. The results of the chemical analysis of a sample of soil relating to corrosion of buried concrete and steel are provided in Appendix D.

The borehole locations were selected by GEMTEC and positioned on site relative to existing features. The ground surface elevations at the borehole locations were determined using a Trimble R10 GPS. The elevations are referenced to geodetic datum NAD83 (CSRS) Epoch 2010, vertical network CGVD1928.

## **4.0 SUBSURFACE CONDITIONS**

### **4.1 General**

As previously indicated, the soil and groundwater conditions identified in the boreholes are given on the Record of Borehole Sheets (Appendix A). The logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but

rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the method of drilling, the frequency and recovery of samples, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions at other than the test locations may vary from the conditions encountered in the boreholes and augerholes. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties.

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

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

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

## **4.2 Existing Pavement Structure**

Boreholes 19-1 and 19-2 were advanced through the existing at grade parking lot and driving lane, respectively, at the site. The pavement structure consists of about 10 and 40 millimetres of asphaltic concrete over about 390 and 240 millimetres of sand and gravel base layer in boreholes 19-1 and 19-2, respectively.

## **4.3 Silty Clay**

Native deposits of silty clay were encountered below the pavement structure at boreholes 19-1 and 19-2, and at ground surface at borehole 19-3. The full thickness of the silty clay encountered in the boreholes has been weathered to a grey brown crust. The silty clay extends to depths of about 3.8 and 5.3 metres below ground surface in boreholes 19-1 and 19-2, respectively (elevations of about 84.0 and 83.0 metres). The silty clay was not fully penetrated in borehole 19-3, but was proven to a depth of about 1.7 metres below ground surface (elevation of about 86.0 metres).

Standard penetration tests carried out in the weathered crust gave N values ranging from 4 to 22 blows per 0.3 metres of penetration, which reflect a stiff to very stiff consistency.

The results of Atterberg limit testing carried out on one sample of the weathered silty clay crust are provided on Plasticity Chart in Appendix B and are summarized in Table 4.1.



**Table 4.1 – Summary of Atterberg Limit Testing (Weathered Silty Clay)**

Borehole	Sample Number	Sample Depth (metres)	Water Content (%)	LL (%)	PL (%)	PI (%)
19-2	4	3.1 – 3.7	43	42	18	24

The measured water content of four samples of the weathered silty clay crust ranges from about 29 to 42 percent.

#### **4.4 Clayey Silt**

A deposit of clayey silt with some sand and gravel was encountered below the silty clay in borehole 19-2 at a depth of about 5.3 metres below ground surface (elevation of about 83.0 metres). The clayey silt was not fully penetrated but was proven to about 5.9 metres below ground surface (elevation of about 82.4 metres).

The measured water content of one sample of the clayey silt was about 21 percent.

#### **4.5 Glacial Till**

A native deposit of glacial till was encountered below the silty clay at borehole 19-1 at a depth of about 3.8 metres below ground surface (elevation of about 84.0 metres), and extends to a depth of about 11.6 metres below surface grade (elevation of about 76.3 metres). The glacial till is considered to be a heterogeneous mixture of all grain sizes, which at this site, can be described as grey brown to grey gravelly silty sand with trace clay. Practical auger refusal was encountered on cobbles and boulders within the glacial till deposit and wash boring techniques were required to advance through the glacial till deposit.

Standard penetration tests carried out within the glacial till gave N values ranging from 10 to greater than 50 blows per 0.3 metres of penetration, which reflects a loose to very dense relative density. It is noted that the N values obtained in the glacial till from standard penetration testing may have been impacted by cobble and boulder obstructions.

One grain size distribution test was undertaken on a sample of the glacial till from borehole 19-1. The results are provided in Appendix B and are summarized in Table 4.2.

**Table 4.2 – Summary of Grain Size Distribution Test (Glacial Till)**

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
19-1	6	3.8 – 4.4	22	48	20	10

The moisture content of one sample of the glacial till was about 14 percent.

#### **4.6 Bedrock**

Grey limestone bedrock was encountered in borehole 19-1 at a depth of about 11.6 metres below ground surface (elevation of about 76.3 metres) and cored using rotary diamond drilling techniques while retrieving HQ sized bedrock core. The bedrock was cored to a depth of about 16.2 metres below ground surface (elevation of about 71.7 metres).

The recovered bedrock core samples have solid core recovery (SCR) values ranging from about 81 to 100 percent, and rock quality designation (RQD) values ranging from about 69 to 100 percent. Based on these values, the bedrock quality is considered to be fair to excellent.

Photographs of the bedrock core are presented on Figure C1 in Appendix C.

#### **4.7 Groundwater Levels**

Monitoring wells were installed in boreholes 19-1 and 19-2 to measure stabilized groundwater conditions. Table 4.3 summarizes the groundwater levels observed on January 7, 2020.

**Table 4.3 – Summary of Groundwater Levels**

Borehole	Well Screen	Ground Surface Elevation (metres)	Groundwater Depth (metres)	Groundwater Elevation (metres)
19-1	Bedrock	87.9	3.8	84.4
19-2	Silty Clay	88.3	2.2	86.1

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

#### **4.8 Soil Chemistry Relating to Corrosion**

The results of chemical testing on a soil sample recovered from borehole 19-2 are provided in Appendix D and are summarized in Table 4.4 below.

**Table 4.4: Summary of Corrosion Testing**

Parameter	Borehole 19-2 Sample No. 2
Chloride Content (µg/g)	46
Resistivity (Ohm.m)	66.5
pH	7.4
Sulphate Content (µg/g)	13

## **5.0 RECOMMENDATIONS**

### **5.1 General**

The information in the following sections is provided for the guidance of the design engineers and is intended for the design of this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions 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 off site sources are outside the terms of reference for this report.

GEMTEC has conducted a Phase One and Phase Two Environmental Site Assessment for this property, which are provided in separate reports.

### **5.2 Excavation**

The excavations for the proposed commercial development will be carried out through the topsoil, fill material and into the weathered silty clay crust deposit. The sides of the excavations should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the overburden soils at this site can be classified as Type 3 and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical, or flatter, excavation slopes for soils above the groundwater level.

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

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

### **5.3 Groundwater Management**

The groundwater levels on January 7, 2020 were measured to be about 3.5 and 2.2 metres below ground surface in boreholes 19-1 and 19-2, respectively.

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

### **5.4 Foundation Design**

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

Based on plans provided, the proposed commercial building will be partially or fully located within the footprint of the existing house on site. Although not directly encountered, or sampled, during the drilling fieldwork, a layer of fill material of unknown composition associated with the construction of the existing house on site will be located surrounding the house to a depth of up to about 2.5 metres below ground surface. As such, the existing foundation elements and fill material associated with the past construction of the house will need to be removed from the proposed building area.

After the removal of the existing house and associated fill material, and where the existing subgrade surface is below the proposed founding level, the grade could be raised with compacted granular material (engineered fill) with a Class II non-woven geotextile having an FOS not exceeding 100 microns (OPSS 1860) placed on the subgrade. The engineered fill should consist of granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type II and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. To provide adequate spread of load beneath the footings, the engineered fill should extend horizontally at least 0.5 metres beyond the footings and then down and out from this point at 1 horizontal to 1 vertical, or flatter.

For design purposes, exterior footings bearing on the native, undisturbed weathered silty clay crust, or on a pad of engineered fill above native, undisturbed weathered silty clay crust should be sized using a geotechnical reaction at Serviceability Limit State (SLS) of 100 kilopascals and a factored geotechnical resistance at Ultimate Limit State (ULS) of 300 kilopascals.

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

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

## **5.5 Grade Raise Restrictions**

The site is underlain by native deposits of stiff to very stiff weathered silty clay crust over glacial till. Based on the borehole information, there are no grade raise restrictions at this site, from a geotechnical perspective. The settlement due to compression of the native soils due to fill placement should be relatively small and should occur during or shortly after the fill placement.

## **5.6 Frost Protection of Foundations**

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

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

## **5.7 Seismic Design of Proposed Structures**

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

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

## **5.8 Foundation Wall Backfill and Drainage**

The native deposits at this site are frost susceptible and should not be used as backfill against foundations. To avoid frost adhesion and possible heaving, the foundations should be backfilled with imported, free-draining, non-frost susceptible granular material such as that meeting the requirements of OPSS Granular A, or Granular B Type I or II.

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

Where future landscaped areas will exist next to the proposed structures and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value. Where areas of hard surfacing (concrete, sidewalks, pavement, etc.) abut the proposed structures, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible fill material to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below finished grade to the underside of the granular subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

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

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

## **5.9 Slab on Grade Support**

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

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

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

OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A. Since the source of recycled material cannot be determined, it is suggested that any granular materials used beneath the floor slab be composed of virgin material only, for environmental reasons.

All imported granular materials placed below the proposed floor slab should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

Underfloor drainage is not considered necessary provided that the floor slab levels are above the finished exterior ground surface level. If any areas of the buildings are to remain unheated during the winter period, thermal protection of the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

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

Proper moisture protection with a vapour retarder should be used for floor slabs where the floor will be covered by moisture sensitive flooring material or where moisture sensitive equipment, products or environments will exist. The "Guide for Concrete Floor and Slab Construction", ACI 302.1R-04 should be considered for the design and construction of vapour retarders below the floor slabs.

## **5.10 Proposed Services**

### **5.10.1 Excavation**

In the overburden, the excavation for flexible service pipes should be in accordance with Ontario Provincial Standard Drawing (OPSD) 802.010 for Type 3 soil. The excavation for rigid service pipes should be in accordance with OPSD 802.031 for Type 3 soil. The sides of the excavations within overburden soils should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the soils at this site can be classified as Type 3 soils. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes. As an alternative or where space constraints dictate, the service installations could be carried out within a tightly fitting, braced steel trench box, which is specifically designed for this purpose.

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

### **5.10.2 Pipe Bedding**

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

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

In areas where the subsoil is disturbed or where unsuitable material (such as fill or organic material) exists below the pipe subgrade level, the disturbed/unsuitable material should be removed and replaced with a subbedding layer of compacted granular material, such as that meeting OPSS Granular B Type I or II. To provide adequate support for the pipes in the long term in areas where subexcavation of material is required below design subgrade level, the excavations should be sized to allow a 1 horizontal to 1 vertical or 2 horizontal to 1 vertical spread of granular material down and out from the bottom of the pipes.

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

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

### **5.10.3 Trench Backfill**

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

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



## **5.11 Access Roadway/Parking Lot Areas**

### **5.11.1 Subgrade Preparation**

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

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

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

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

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

### **5.11.2 Pavement Structure**

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

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

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

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

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

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

### **5.11.3 Asphalt Cement Type**

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

### **5.11.4 Pavement Transitions**

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

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

### **5.11.5 Pavement Drainage**

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

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

#### **5.11.6 Granular Material Compaction**

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

#### **5.12 Corrosion of Buried Concrete and Steel**

The measured sulphate concentration in the sample of soil recovered from borehole 19-2 was 13 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) use 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 or groundwater could vary throughout the year due to the application sodium chloride for de-icing.

### **6.0 ADDITIONAL CONSIDERATIONS**

#### **6.1 Effects of Construction Induced Vibration**

Some of the construction operations (such as granular material compaction and excavation) 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. However, the magnitude of the vibrations is expected to be much less than that required to cause damage to the nearby structures or services.

#### **6.2 Winter Construction**

The soils that exist at this site are highly frost susceptible and are prone to significant ice lensing. In the event that construction is required during freezing temperatures, the soil below the footings and floor slabs should be protected immediately from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means.

#### **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 Well Abandonment**

The monitoring wells installed in boreholes 19-1 and 19-2 as part of this investigation should be decommissioned by a licensed well technician. The well abandonment could be carried out in advance of, or during the construction.

## **6.5 Design Review and Construction Observation**

The final details for the proposed construction were not available to us at the time of preparation of this report. It is recommended that the design drawings be reviewed by the geotechnical engineer as the design progresses to ensure that the guidelines provided in this report have been interpreted as intended.

In accordance with Section 4.2.2.2 of the Ontario Building Code (2012), 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 structures, access roadways, and parking areas should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

## 7.0 CLOSURE

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



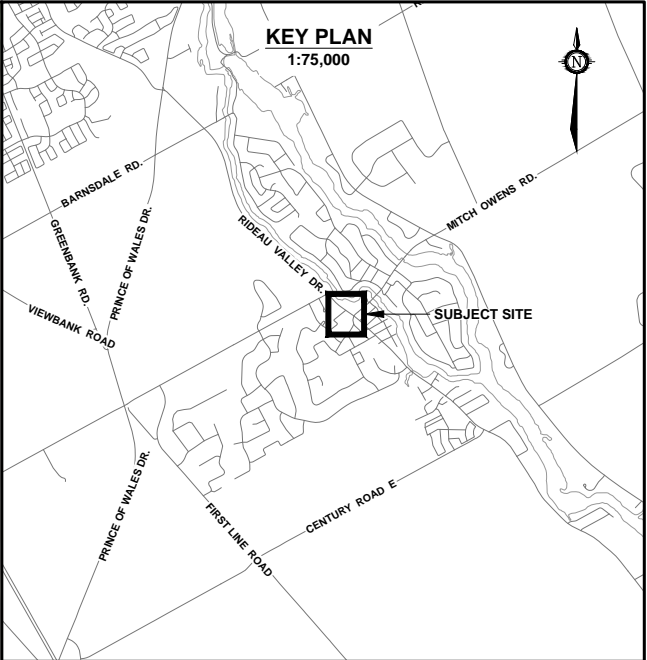
Alex Meacoe, P.Eng.  
Geotechnical Engineer




for John Cholewa, Ph.D., P.Eng.  
Senior Geotechnical Engineer








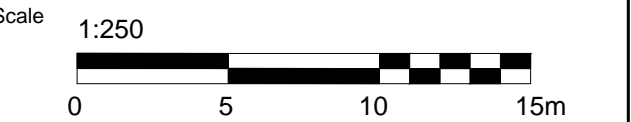
**LEGEND**

 **BOREHOLE LOCATION**  
(current investigation by GEMTEC)

 **BOREHOLE WITH MONITORING WELL LOCATION**  
(current investigation by GEMTEC)

**BH #** ——— BOREHOLE ID  
**XX.XX** ——— GROUND SURFACE ELEVATION, IN METRES  
                    GEODETIC DATUM

NOTE:  
ALL PROPOSED STRUCTURES HAVE BEEN ILLUSTRATED BY USING DRAWING SP1-0, SITE PLAN BY GRANT+HENLEY DESIGN GROUP. THUS, ALL PROPOSED STRUCTURES SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.





**GEMTEC**  
CONSULTING ENGINEERS  
AND SCIENTISTS

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www.gemtec.ca  
ottawa@gemtec.ca

Drawing		BOREHOLE LOCATION PLAN	
Client		KGMS CONSTRUCTION	
Project 65032.03		GEOTECHNICAL INVESTIGATION 5506 MANOTICK MAIN ST. OTTAWA, ONTARIO	
Drwn by P.C.	Chkd by W.A.M		
Date FEBRUARY 2020		Rev. 0	FIGURE 1





## **APPENDIX A**

Record of Borehole Sheets  
List of Abbreviations and Symbols

# RECORD OF BOREHOLE 19-1

CLIENT: KGMS Construction  
PROJECT: 5506 Manotick Main Street, Ottawa, Ontario  
JOB#: 65032.03  
LOCATION: See Figure 1, Borehole Location Plan

SHEET: 1 OF 1  
DATUM: CGVD28  
BORING DATE: Dec 16 2019

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 <sub>p</sub> — W — W <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m						
0	Power Auger Hollow Stem Auger (200mm OD)	Ground Surface		87.88										
		ASPHALTIC CONCRETE		0.01	1	AS								
		Brown sand and gravel, trace to some silt (BASE MATERIAL)		0.41										
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHER CRUST), contains silty sand with gravel			2	SS	430	12						
2					3	SS	610	11						
3	Wash Casing HQ Casing				4	SS	610	5						
4					5	SS	610	7						
4		Loose to very dense, grey silty sand with some gravel, contains cobbles and boulders (GLACIAL TILL)		84.04 3.84	6	SS	585	10					MH	
5					7	RC	355	DD						
6					8	SS	100	45						
7					9	SS	50	33						
8					10	SS	150	23						
9					11	RC	555	DD						
10					12	SS	75	50 for 75mm						
11					13	RC	485	DD						
12	Diamond Rotary Core HQ (96mm OD)				14	SS	250	37						
12		Slightly weathered to fresh, thinly to medium bedded, LIMESTONE BEDROCK		76.32 11.56	15	RC	0	DD						
13					16	RC								
14					17	RC								
15					18	RC								
16					19	RC								
16					20	RC								
17		End of Borehole		71.73 16.15										
18														

▽

Bentonite

Filter Sand

3.05m Long Screen

GROUNDWATER  
OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
20/01/07	3.8	▽ 84.1

GEO - BOREHOLE LOG 65032.03 BOREHOLE LOGS 2020-01-14.GPJ GEMTEC 2018.GDT 14/2/20



# RECORD OF BOREHOLE 19-2

CLIENT: KGMS Construction  
 PROJECT: 5506 Manotick Main Street, Ottawa, Ontario  
 JOB#: 65032.03  
 LOCATION: See Figure 1, Borehole Location Plan

SHEET: 1 OF 1  
 DATUM: CGVD28  
 BORING DATE: Dec 17 2019

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 <sub>p</sub> — W — W <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m						
0	Power Auger  Hollow Stem Auger (200mm OD)	Ground Surface		88.32										
		ASPHALTIC CONCRETE		0.04	1a	GS	-							
		Brown sand and gravel (BASE MATERIAL)		0.28										
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)			1	SS	230	7	●					
2					2	SS	610	8	●					
3					3	SS	610	6	●		○			
4					4	SS	610	5	●		○			
5					5	SS	610	4	●					
6					6	SS	460	9	●		○			
		Stiff, grey CLAYEY SILT, some sand and gravel		82.99										
6				5.33	7	SS	230	5	●		○			
				82.38										
		End of Borehole		5.94										
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														

Bentonite



Filter Sand

3.05m Long Screen

GROUNDWATER OBSERVATIONS		
DATE	DEPTH (m)	ELEV. (m)
20/01/07	2.2	86.1

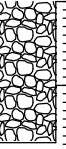
GEO - BOREHOLE LOG 65032.03 BOREHOLE LOGS 2020-01-14.GPJ GEMTEC 2018.GDT 14/2/20

# RECORD OF BOREHOLE 19-3

CLIENT: KGMS Construction  
 PROJECT: 5506 Manotick Main Street, Ottawa, Ontario  
 JOB#: 65032.03  
 LOCATION: See Figure 1, Borehole Location Plan

SHEET: 1 OF 1  
 DATUM: CGVD28  
 BORING DATE: Dec 18 2019

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 <sub>p</sub> — W — W <sub>L</sub>		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m					
0	Portable Drill Rig Open Hole	Ground Surface		87.67									
		Brown silty clay with sand (FILL MATERIAL)		86.88	1	SS	230	5	●				
1		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		86.02	2	SS	355	14	●				
				86.02	3	SS	430	22	●				
2		End of Borehole		1.65									
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													



Native Backfill

GEO - BOREHOLE LOG 65032.03 BOREHOLE LOGS 2020-01-14.GPJ GEMTEC 2018.GDT 14/2/20

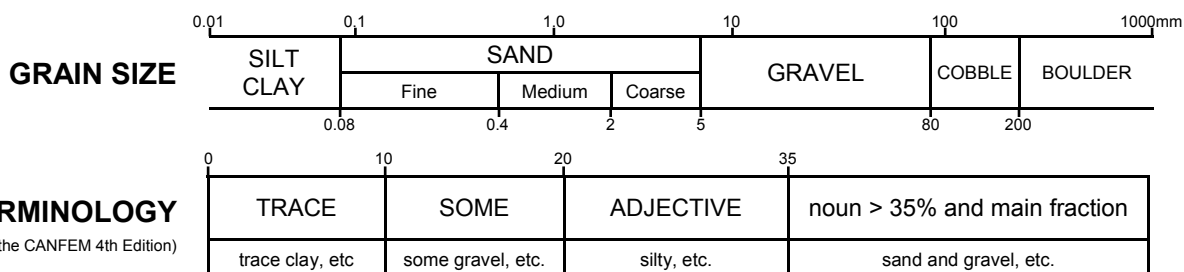
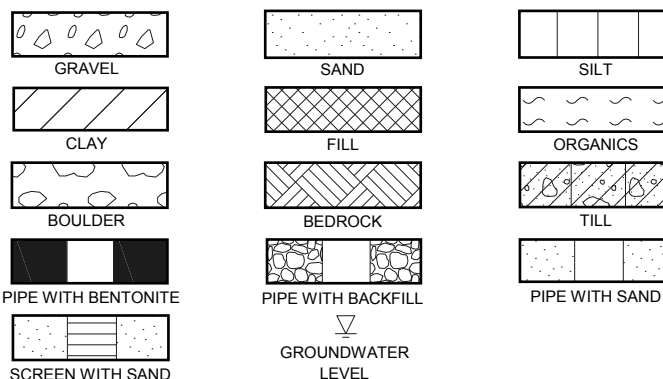
## ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

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
$\gamma$	Unit weight

PENETRATION RESISTANCE	
<b>Standard Penetration Resistance, N</b> 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.	
<b>Dynamic Penetration Resistance</b> 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	$C_u$ , 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



### DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)



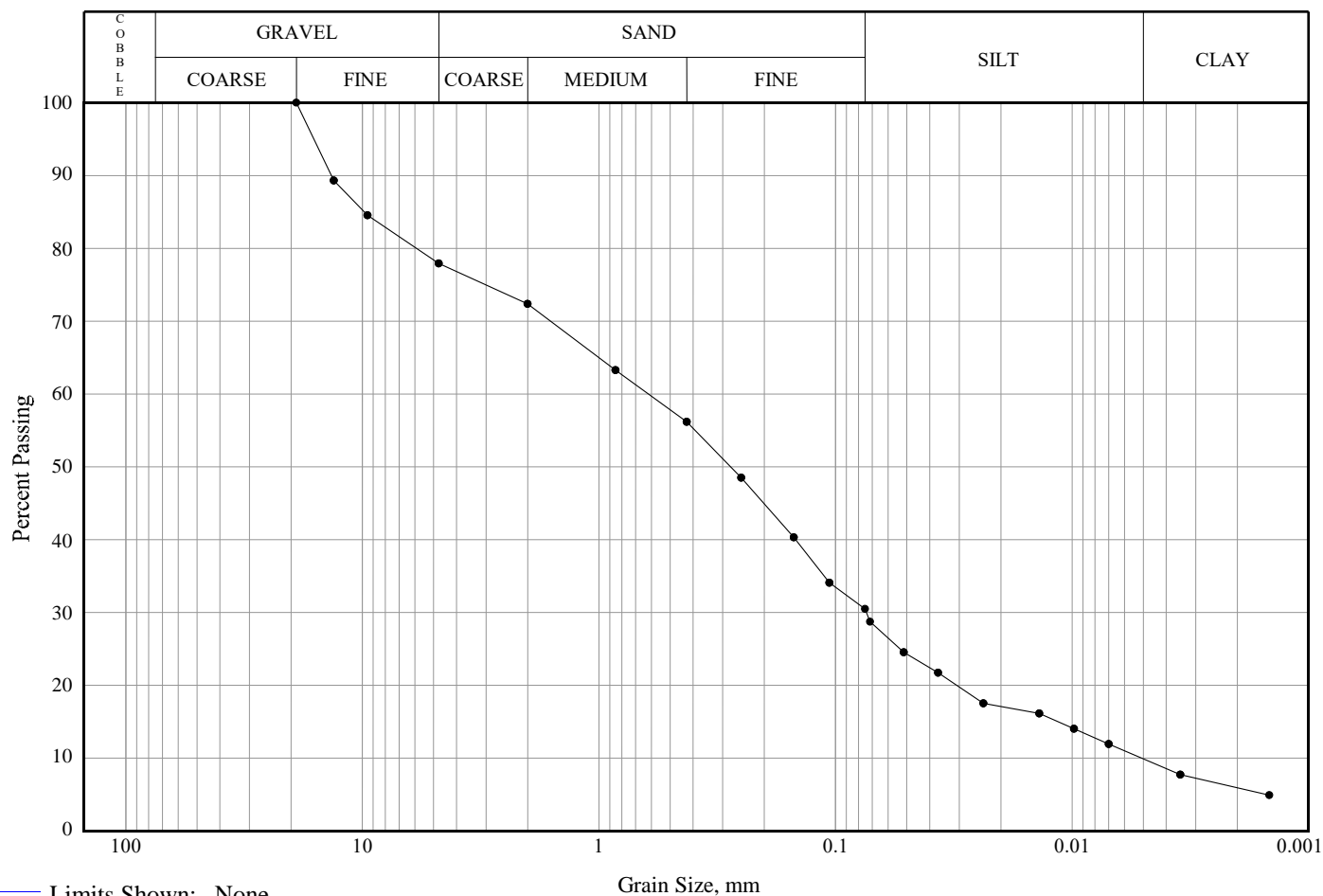
## **APPENDIX B**

### Laboratory Test Results



Project #: 6503203

# Soils Grading Chart



Limits Shown: None

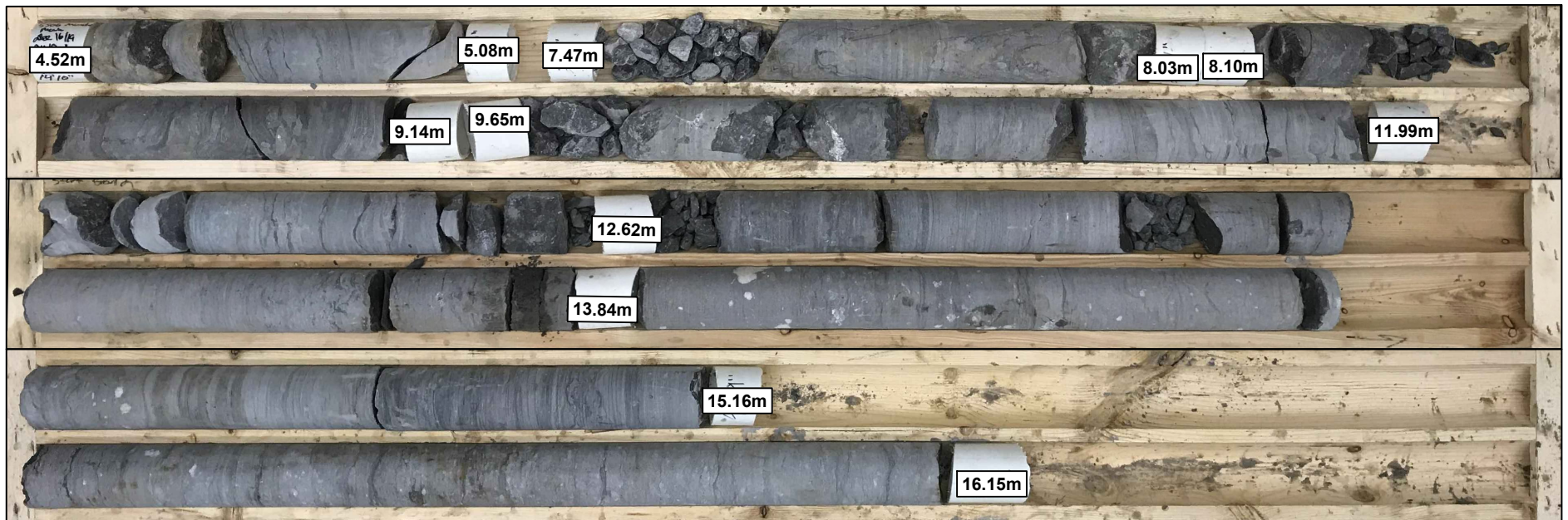
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## **APPENDIX C**

Rock Core Photographs  
Bedrock Description Terminology

**BOREHOLE 19-1**  
**BORING DATE: DECEMBER 16, 2019**  
**DEPTH: 4.52 to 16.15 mbgs**



## LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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

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

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

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

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

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





## **APPENDIX D**

Chemical Analysis of Soil Sample  
Samples Relating to Corrosion  
(Paracel Laboratories Ltd. Order No. 2002044)

**Certificate of Analysis**

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

**Client PO:**

Report Date: 10-Jan-2020

Order Date: 6-Jan-2020

**Project Description:** 65032.03

<b>Client ID:</b>	BH19-2 SA 2	-	-	-
<b>Sample Date:</b>	19-Dec-19 09:00	-	-	-
<b>Sample ID:</b>	2002044-01	-	-	-
<b>MDL/Units</b>	Soil	-	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	63.3	-	-	-
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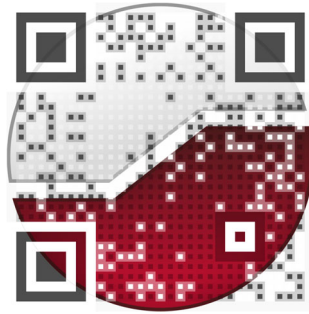
**General Inorganics**

Conductivity	5 uS/cm	150	-	-	-
pH	0.05 pH Units	7.40	-	-	-
Resistivity	0.10 Ohm.m	66.5	-	-	-

**Anions**

Chloride	5 ug/g dry	46	-	-	-
Sulphate	5 ug/g dry	13	-	-	-

experience • knowledge • integrity



civil  
geotechnical  
environmental  
field services  
materials testing

civil  
géotechnique  
environnementale  
surveillance de chantier  
service de laboratoire des matériaux

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