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Geotechnical Investigation Report
Proposed Office/Receiving Building
300 Somme Street
Ottawa, Ontario

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Submitted to:

Novatech
240 Michael Cowpland Drive, Suite 200
Ottawa, Ontario
K2M 1P6

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Ottawa, Ontario

September 9, 2020
Project: 65080.01 - R1

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation conducted by GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) for the proposed development at 300 Somme Street in Ottawa, Ontario. The purpose of the investigation was to identify the general subsurface conditions at the site by means of a limited number of boreholes and, based on the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This investigation was carried out in accordance with our proposal dated March 11, 2020.

2.0 PROJECT AND SITE DESCRIPTION

2.1 Project Description

Plans are being prepared for the construction of a storage yard for vehicles at 300 Somme Street in Ottawa. The approximate area of the site is 17 hectares. Outdoor storage of vehicles will take up the majority of the property. An accessory office and warehouse building is proposed in the northwest corner of the property in support of the storage yard. The building will be serviced with private services including a septic system and a water supply well. The proposed building is about 1,185 square metres with a paved parking area to the south and the 3,800 L/day septic system is to be located on the west side of the building.

2.2 Review of Available Information

A desktop study undertake by GEMTEC was previously provided for this site and summarizes the anticipated subsurface conditions based on past investigations by others. The geotechnical desktop study titled “Geotechnical Report, Proposed Office/Receiving Building, 300 Somme Street, Ottawa, Ontario” dated April 24, 2020 has been submitted to Novatech and can be reviewed for additional details.

3.0 SUBSURFACE INVESTIGATION

The fieldwork for this investigation was carried out on May 19, 2020. At that time, George Downing Estate Drilling Ltd. advanced three (3) boreholes, numbered 20-1 to 20-3, inclusive, at the site using a track mounted drill rig. The boreholes were advanced to depths ranging from about 4.1 to 12.7 metres below surface grade.

Standard penetration tests (SPT) were carried out in the boreholes and samples of the soils encountered were recovered using a 50 millimetre diameter split barrel sampler. A standpipe piezometer was installed at the location of borehole 20-2.

The fieldwork was observed throughout by a member of our engineering staff who directed the drilling operations and logged the samples and boreholes.

Following completion of the drilling, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples were submitted for moisture content and grain size distribution testing. A groundwater sample collected from the well screen in borehole 20-2 was sent to Paracel Laboratories Ltd. for basic chemical testing relating to corrosion of buried concrete and steel.

The approximate locations of the boreholes are shown on the Test Hole Location Plan, Figure 1 in Appendix A. The results of the boreholes are provided on the Record of Borehole sheets in Appendix B. The results of the laboratory classification tests on the soil samples are provided on the Soils Grading Chart in Appendix C. The results of the chemical analysis of the groundwater sample 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 location of the boreholes were determined using our Trimble R10 GPS survey equipment. The elevations are referenced to datum CGVD28.

4.0 SUBSURFACE CONDITIONS

4.1 General

The subsurface conditions described below indicate the conditions at the specific test locations only. Boundaries between zones are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on 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 boreholes.

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

The results of the boreholes are provided on the Record of Boreholes sheet in Appendix B. The following presents an overview of the subsurface conditions.

4.2 Fill Material

Fill and topsoil fill material was encountered from ground surface at all of the borehole locations. The fill material generally consists of brown, grey brown, and black silty sand with varying amounts of cobbles, gravel, and clay. Trace to some organic material, brick and debris were also noted in the fill material.

The fill material extends to depths of about 3.5 to 6.1 metres below ground surface (elevations 84.8 to 88.0 metres, geodetic).

Standard penetration tests carried out in the fill material gave N values ranging between 2 and 72 blows per 0.3 metres of penetration, which reflects a very loose to very dense relative density. The higher N values may reflect the presence of cobbles or other debris within the fill material.

Moisture content testing carried out on samples of the fill material from borehole 20-1 indicate a moisture content ranging between about 4 and 32 percent.

4.3 Peat/Topsoil

An organic deposit of peat/topsoil was encountered below the fill material at borehole 20-1 at a depth of about 6.1 metres below ground surface.

The peat/topsoil deposit consists of dark brown silty sand and contains rootlets. The thickness of the peat/topsoil is about 0.9 metres at the borehole location, and extends to a depth of about 7 metres below ground surface (elevation 83.9 metres, geodetic).

A standard penetration test carried out in the peat/topsoil gave an N value of about 1 blow per 0.3 metres of penetration, which reflects a very loose relative density.

Moisture content testing carried out on a peat/topsoil sample from borehole 20-1 indicates a moisture content of about 69 percent.

4.4 Clayey Silt

A native deposit of grey brown to grey clayey silt with trace sand and gravel was encountered below the peat/topsoil layer in borehole 20-1 at a depth of about 7 metres below ground surface (elevation 83.9 metres, geodetic datum). The thickness of this deposit is about 3.0 metres and extends to a depth of about 9.9 metres (elevation 81 metres, geodetic).

Standard penetration tests carried out in the grey brown clayey silt gave N values ranging from 1 to 10 blows per 0.3 metres of penetration, which reflects a firm to very stiff consistency, based on our local experience in the Ottawa area.

Representative samples of the clayey silt were tested for:

- Moisture content;
- Grain size distribution; and,
- Atterberg limits.

Two (2) grain size distribution tests were undertaken on samples of the clayey silt borehole 20-1. The results are provided in Appendix C and summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Testing – Clayey Silt

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
20-1	11	7.6 – 8.2	0	3	63	34
20-1	13	9.1 – 9.8	1	12	56	31

Two (2) Atterberg limits tests were undertaken on samples of the clayey silt from borehole 20-1. The results are provided in Appendix C and the Record of Borehole sheets (Appendix B) and are summarized in Table 4.2.

Table 4.2 – Summary of Atterberg Limits and Moisture Content Testing

Location	Sample Number	Sample Depth (metres)	Moisture (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
20-1	11	7.6 – 8.2	23	30	18	12
20-1	13	9.1 – 9.8	21	27	16	11

The clayey silt has a low plasticity. The moisture contents of the clayey silt samples range from about 8 to 31 percent. It should be noted that the moisture contents of the clayey silt samples are generally below the liquid limit values.

4.5 Layered Sandy Silt and Clayey Silt

A native deposit of layered grey sandy silt and clayey silt with trace gravel was encountered below the grey clayey silt at borehole 20-1 at a depth of about 9.9 metres (elevation 81.0). The thickness of the layered deposit is about 1.7 metres.

Standard penetration tests carried out in the layered deposit gave N values of 10 and 15 blows per 0.3 metres of penetration, which reflects a compact relative density.

The results of a grain size distribution testcarried out on a sample of the layered deposit recovered from borehole 20-1 are provided on the Soils Grading Chart in Appendix C and summarized in Table 4.3. It should be noted that although the tested sample indicates the soil to consist of clayey silt, visual observations of the samples indicates that sandy silt is the primary component of the layer.

Table 4.3 – Summary of Grain Size Distribution Testing – Layered Sandy Silt and Clayey Silt

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
20-1	15	10.7 – 11.3	0	6	67	27

Moisture content testing carried out on the samples of the layered soil indicates a moisture content of about 24 percent.

4.6 Glacial Till

A native deposit of glacial till composed of grey brown silty sand, some gravel and cobbles, and trace clay was encountered at all of the borehole locations. The glacial till was found below the grey sandy silt/clayey silt in borehole 20-1 at a depth of about 11.6 metres (elevation 79.3 metres), and below the fill material in boreholes 20-2 and 20-3 at depths of 3.5 and 3.9 metres below ground surface, respectively (elevations 88.0 and 87.7 metres, geodetic). Based on inferred bedrock depths due to auger refusal, the thickness of the glacial till ranges from about 0.2 to 1.1 metres.

Standard penetration tests carried out in the glacial till gave N values ranging from 5 to 10 blows per 0.3 metres of penetration, which reflects a loose to compact relative density. An N value of 57 was recorded in borehole 20-3 but likely reflects the inferred bedrock surface.

All of the boreholes were terminated due to auger refusal on the inferred bedrock surface at depths of 4.1 to 12.7 metres below ground surface (elevations 78.2 to 87.5 metres, geodetic).

Moisture content testing carried out on a sample of the glacial till indicates a moisture content of about 14 percent.

4.7 Inferred Bedrock

All of the boreholes encountered refusal on the inferred bedrock surface at depths ranging from about 4.1 to 12.7 metres below ground surface (elevations 78.2 to 87.5 metres, geodetic).

It should be noted that auger refusal can occur on boulders within the glacial till and may not necessarily represent the surface of the bedrock.

4.8 Groundwater Levels

The groundwater level in the well screen installed in borehole 20-2 was measured on May 25, 2020. At that time, the groundwater level was at about 2.3 metres below surface grade (elevation 89.2 metres, geodetic).

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.

4.9 Groundwater Chemistry Relating to Corrosion

The results of chemical testing on a groundwater sample recovered from the well screen in borehole 20-2 are provided in Appendix D and are summarized in Table 4.4.

Table 4.4 – Summary of Corrosion Testing - Groundwater

Parameter	Borehole 20-2
Chloride Content (mg/L)	10
Conductivity (µS/cm)	1250
pH	7.8
Sulphate (mg/L)	314

5.0 GEOTECHNICAL GUIDELINES

5.1 General

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

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions 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 not addressed within the scope of this report.

5.2 Proposed Office/Receiving Building

5.2.1 Overview

The area of the proposed building could be covered by 3.5 to 7.0 metres of fill material and organic material, overlying loose to compact layered deposits of sand, silt and clay or glacial till. The groundwater was measured at about 2.3 metres below the existing ground surface in the area of borehole 20-2, and the inferred bedrock surface ranges between 4.6 and 12.7 metres below ground surface.

The fill material and peat/topsoil are not considered suitable to provide support for the building foundations or slab on grade. As such, if the building is to be founded on shallow (conventional) spread footings, the existing fill and peat/topsoil should be removed from the building area and the zone of influence of the footings to expose native, undisturbed deposits. The removed material could be replaced with compacted, engineered fill. Further details on the removal and replacement of fill material are provided below.

If excavation and replacement of the fill material is not considered practicable, the following alternate foundation options could be considered:

- Steel piles driven to bedrock with a structural slab; or,
- Proprietary ground improvement methods carried out by a specialized contractor in advance of construction of conventional foundations and slab on grade.

Geotechnical guidelines for alternate foundation options could be provided, if required.

5.2.2 Overburden Excavation

The excavation for the proposed structure will be carried out through fill material, organic deposits and possibly native deposits of layered sand, silt, and clay. 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 soil can be classified as Type 3 and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical extending upwards from the base of the excavation.

The native overburden deposits are sensitive to disturbance from ponded water, vibration and construction traffic. Allowance should be made to remove and replace any disturbed native soil, or areas of subexcavation, with compacted sand and gravel such as that meeting OPSS Granular A or Granular B Type II, where required.

Excavation of the overburden deposits at this site below the groundwater level within the fill material and native deposits could present some constraints. Below the groundwater level, the deposits could slough into the excavation, which could result in undermining of the side slopes. Where necessary, the side slopes could be made flatter and/or buttressed with a 0.3 to 0.6 metre thick layer of OPSS Granular B Type 2 or well graded blast rock.

As indicated above, a considerable thickness of fill material exists at this site. The fill material will need to be removed from the building footprint and the zone of influence of the foundations. This will require removal of fill material in the zone extending 0.3 metres horizontally from the edge of the footings and extending down and out at 1 horizontal to 1 vertical from that point. As such, the excavation footprint will be significantly greater than the building footprint.

5.2.3 Groundwater Pumping

In general, groundwater inflow from the overburden deposits into the excavations should be controlled by pumping from filtered sumps within the excavation. Suitable detention and filtration will be required before discharging the water to any ditches.

It is not expected that short term pumping during excavation will have a significant effect on nearby structures and services.

5.2.4 Foundation Design

The following guidelines are provided for the construction of shallow (i.e., conventional) foundations. As indicated above, this will required the removal of a significant amount of fill material. Guidelines on alternative foundation designs could be provided if it is determined that the fill removal is not economically feasible.

Following the removal of fill or otherwise unsuitable material, the grade below the proposed building should be raised to the underside of footing level using engineered fill. The engineered fill should consist of granular material meeting OPSS requirements for Granular B Type II Given the thickness of engineered fill that may be required, consideration could be given to using well graded blast rock for the lower portion of the fill replacement. If blast rock is used, it should consist of well graded material with a maximum particle size of about 300 millimetres. Also, the blast rock should be capped with a minimum of 450 millimetres of material meeting OPSS Granular B Type II.

It is suggested that any granular materials used beneath the proposed structure be composed of virgin material only, for environmental reasons. The OPSS Granular B Type II should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor dry density value. The blast rock should be compacted using the bucket of the excavator and the hauling and spreading equipment under the supervision of geotechnical personnel.

To provide adequate spread of load below the footings, the engineered fill material, and any blast rock should extend at least 0.3 metres horizontally beyond the edge of the footings and down and out from this point at 1 horizontal to 1 vertical, or flatter. The excavation should be sized to accommodate this fill placement.

The following table provides preliminary foundation bearing values based on the available information.

Table 5.1: Summary of Foundation Bearing Values

Footing	Subgrade Surface	Serviceability Limit State (SLS)	Ultimate Limit State (ULS)
Pad or strip	Engineered fill (minimum 0.6 metres thick) overlying native soil	125 kilopascals	250 kilopascals

The above bearing values assume a maximum grade raise of 1 metre above the existing ground surface elevations.

The post construction total and differential settlement at SLS should be less than 25 and 20 millimetres, respectively, provided that fill material and loose or disturbed soil is removed from below the bearing surfaces and that the engineered fill is placed and prepared as described above.

5.2.5 Slab on Grade Support (Heated Areas Only)

Based on the available subsurface information, the area of the proposed building is underlain by a significant thickness of fill material overlying native soil deposits. The fill material is not considered suitable for the support of the slab on grade. To prevent long term settlement and cracking/distortion of the floor slab, all fill or disturbed material encountered should be removed from below the proposed slab.

The grade within the proposed building could be raised, where necessary, with granular material meeting OPSS Granular B Type I or II or OPSS Granular A gradation specifications. The use of OPSS Granular B Type II material is preferred under wet conditions. Given the thickness of engineered fill that may be required, consideration could be given to using well graded blast rock for the lower portion of the fill replacement. If blast rock is used, it should consist of well graded material with a maximum particle size of about 300 millimetres. Also, the blast rock should be capped with a minimum of 450 millimetres of material meeting OPSS Granular B Type II.

The granular base for the proposed slab on grade should consist of at least 150 millimetres of OPSS Granular A.

It is suggested that any granular materials used beneath the floor slab be composed of virgin material (100 percent crushed rock or natural sand and gravel deposits) only, for environmental reasons.

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

Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior grade.

If any areas of the building are to remain unheated during the winter period, thermal protection of the slab on grade may be required. However, if the underside of the slab is backfilled with at least 1.8 metres of non-frost susceptible engineered fill (as required in order to remove all of the fill material), thermal protection of the concrete slab may not be required, even for an unheated condition. The requirement for thermal protection should be assessed as the design progresses.

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

5.2.6 Seismic Design of Proposed Structure

Based on the results of the desktop study, the foundations will likely bear on compacted engineered fill material above the native deposits of loose to compact clayey silt, sandy silt, and/or glacial till. The seismic Site Class at this site will be dependent on the founding depth and subgrade soil at the building location. According to the National Building Code of Canada, in the absence of shear wave velocity measurements within the upper 30 metres, the average standard penetration resistance can be used to determine the Seismic Site Class. Based on the results of borehole 20-1, it is anticipated that the proposed structure could be designed for Seismic Site Class D.

In our opinion, the potential for liquefaction is negligible.

5.2.7 Frost Protection of Foundations

All exterior footings for heated portions of the proposed structure should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated footings located outside of the building footprint or footings located within unheated areas of the building should be provided with at least 1.8 metres of earth cover. If the required depth of earth cover is not practicable, a combination of earth cover and polystyrene insulation could be considered. An insulation detail could be provided upon request. The required depth of frost protection can be reduced by the thickness of the engineered fill beneath the foundations.

If the new foundation and\or concrete slab on grade is insulated in a way that reduces heat loss towards the surrounding soil, the required earth cover over the footings should conform to that of an unheated structure (i.e. 1.8 metres).

5.2.8 Foundation Backfill

The fill and native soils 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 OPSS Granular B Type I or II requirements. In soft landscaped areas, and where some settlement of the foundation wall backfill material is acceptable, consideration could be given to installing a bond break such as a double layer of 6 mil polyethylene sheeting or a proprietary drainage system (e.g. System Platon) on the foundation walls and backfilling with on-site fill material.

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. 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.

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

Based on the measured groundwater elevation on this site, perimeter foundation drainage is not required provided that the finished floor elevation is above the finished exterior grade.

5.2.9 Corrosion of Buried Concrete and Steel

The measured sulphate concentration in the groundwater sample recovered from the well screen at borehole 20-2 was 314 milligrams per litre. According to Canadian Standards Association (CSA) “Concrete Materials and Methods of Concrete Construction”, the concentration of sulphate can be classified as moderate. For moderate exposure conditions, any concrete that will be in contact with the native soil or groundwater should meet CSA Class S-3 requirements. 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 conductivity and pH of the water sample tested, the groundwater in the area of the work can be classified as slightly aggressive. The manufacturer of any buried steel elements that will be in contact with the soil or groundwater should be consulted to ensure that the durability of the intended product is appropriate. It is noted that the corrosivity of the soil/groundwater could vary throughout the year due to the application of sodium chloride for de-icing.

5.3 Proposed Septic System

Due to the variable composition of the fill material at the proposed location for the septic system, it is recommended that the fill be removed below the entire area of the leaching bed to expose native soil and reduce the potential for differential settlement of the distribution pipes.

If raising of the grade below the proposed leaching bed is required (e.g. for site grading purposes, groundwater level), this may be accomplished by importing approved sandy soil and adequately compacting the imported material in maximum 200 millimetre lifts. Whether the leaching bed is installed on the native soil or imported grade raise fill above the native soil, it is recommended that the leaching bed be sized based on the characteristics of the native soil.

6.0 PROPOSED PARKING AREA AND OUTDOOR STORAGE AREA

6.1 Subgrade Preparation

In preparation for the construction of the new asphaltic concrete surfaced parking area and the outdoor storage area, all topsoil, organic material and any loose/soft or wet soil should be removed from the proposed subgrade surface and replaced with suitable compacted earth borrow or granular fill. The site is underlain by fill material which was likely not properly compacted during its initial placement and could compress (settle) following construction.

It is not considered necessary to remove all of the fill material from within the parking area and outdoor storage area provided that some future settlement of the surface can be tolerated. It is however suggested that any exposed fill material which contains an abundance of organic material or otherwise deleterious material be subexcavated and replaced with suitable earth borrow. Prior to placing granular fill for the parking area and outdoor storage area, the exposed subgrade should be heavily proof-rolled with a large (10 tonne) steel drum roller under dry conditions. Any soft areas evident from the proof-rolling should be subexcavated and replaced with suitable, compacted earth borrow.

In order to prevent softening and disturbance of the subgrade fill soils, consideration should be given to the construction of a temporary access road(s) to be used by the construction traffic during the construction of the building, parking area, and outdoor storage area. The temporary access road(s) could be constructed with a minimum of 1 metre of crushed granular material such as OPSS Granular B Type II. This material could be reclaimed for the construction of the parking lot or outdoor storage area.

The above guidelines are intended to reduce, not eliminate the potential for disturbance of the subgrade soil.

The subgrade surfaces should be made smooth and crowned or sloped prior to placing the granular materials to promote drainage of the pavement base and subbase materials. Additional guidelines for the drainage of the outdoor storage area is provided in Section 6.3.

6.2 Grade Raise (Outdoor Storage Area)

As per the Overall Grading, Erosion, Sediment Control and Servicing Plan, provided to us by Novatech (Drawing No. 119181-GS1, Rev#3), it is anticipated that the surface grade near the center of the storage area will be raised as part of the site grading in order to promote surface drainage towards the exterior of the property. The maximum grade raise required at the site will be about 2.3 metres and is located southwest of the center of the property. In general, the center portion of the site will need to be raised by up to 1 metre.

Based on available information, about 3 metres of existing fill material is likely present on site in the area of the required grade raise. The fill material generally overlies native deposits of sandy silt; bedrock is located at depths ranging between 3 and 8 metres below ground surface. Some post construction settlement should be anticipated due to densification of the existing earth fill material. The amount of settlement will be dependant on the thickness, composition, and existing relative density of the fill material. The amount of settlement could be significantly reduced by carrying out a heavy proof roll (as described above in Section 6.1). Nevertheless, allowance should be made for maintenance (re-grading) of the gravel surface access roads and storage area as required to maintain the design grades.

6.3 Drainage (Outdoor Storage Area)

As previously noted, the subgrade surface should be shaped and crowned to promote drainage of the granular base and subbase materials.

Adequate drainage of the granular materials and subgrade is important for the long term performance of the outdoor storage area at this site. Based on the size of the outdoor storage area, additional drainage measures may be required to help promote drainage of the site. As per discussions with Novatech, consideration is currently being given to strategic cut and fill of the site coupled with the construction of “French” drains.

It is understood that the surface water of the outdoor storage area will be drained towards a perimeter swale around the property, from which the surface water will be collected and treated prior to releasing into adjacent ditches. Based on preliminary site grades, in order to minimize the amount of excavation and backfill the site will be divided into 3 sections. The north portion of the site, which will be the largest (9.1 hectares), will drain towards the north swale while the west portion (3.0 hectares) will drain towards the west, and the south and east (5.6 hectares) will drain towards the south and east.

Consideration is currently being given to installing a system of “French” drains that would outlet to the perimeter swale on the north portion of the site. The drainage pipes should be filter wrapped and provided with a surround of a minimum of 150 millimetres of clear, crushed stone. It is recommended that the clear stone should be wrapped on all sides with a non-woven geotextile

(OPSS 1860, Class I). The drains, granular subbase and base layers should extend to the perimeter swales.

The manufacturers of the perforated pipes should be consulted regarding depth and construction traffic (for areas where the drains will cross the access roads) to ensure proper pipe material is selected.

6.4 Pavement Structure (Parking Area)

For the proposed car (light vehicle) parking lot, the following minimum pavement structure is suggested:

- 50 millimetres of asphaltic concrete, over
- 150 millimetres of OPSS Granular A base, over
- 300 millimetres of OPSS Granular B Type II or III subbase

The asphaltic concrete surface should consist of one layer of Superpave 12.5 (Traffic Level B) incorporating PG 58-34 asphalt cement.

For any access roadways, parking areas and loading bays which will be used by heavy trucks (including fire trucks), the following minimum pavement structure is suggested:

- 100 millimetres of asphaltic concrete comprising 40 millimetres of Superpave 12.5 incorporating PG 58-34 asphalt cement placed over 60 millimetres of Superpave 19.0 asphaltic concrete incorporating PG 58-34 asphalt cement), over
- 150 millimetres of OPSS Granular A base, over
- 450 millimetres of OPSS Granular B Type II

The granular thicknesses given above assume that the subgrade surfaces are prepared as described in this report. If the subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase. The contractor should be made responsible for their construction access.

6.5 Outdoor Storage Area Granular Structure

For the proposed outdoor storage area which will be accessed primarily by heavy trucks, the following minimum granular structure is suggested:

- 150 millimetres of OPSS Granular A base, over
- 450 millimetres of OPSS Granular B Type II

The granular thicknesses given above assume that the subgrade surfaces are prepared as described in this report. If the subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase. The contractor should be made responsible for their construction access.

The gravel structure should be graded as required to restore the surface grading.

6.6 Granular Material Placement

The granular base and subbase materials should be compacted in maximum 200 millimetre thick lifts to at least 99 percent of the standard Proctor maximum dry density value.

7.0 ADDITIONAL CONSIDERATIONS

7.1 Construction Observation

The engagement of the services of GEMTEC during construction is recommended to confirm that the subsurface conditions exposed in the 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 for the proposed building and septic system should be inspected and approved by GEMTEC personnel to ensure that the subgrade is suitable. Inspection and testing should be carried out during the placement of imported, granular fill to ensure that the gradation and compaction specifications meet the guidelines provided in this report.

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.

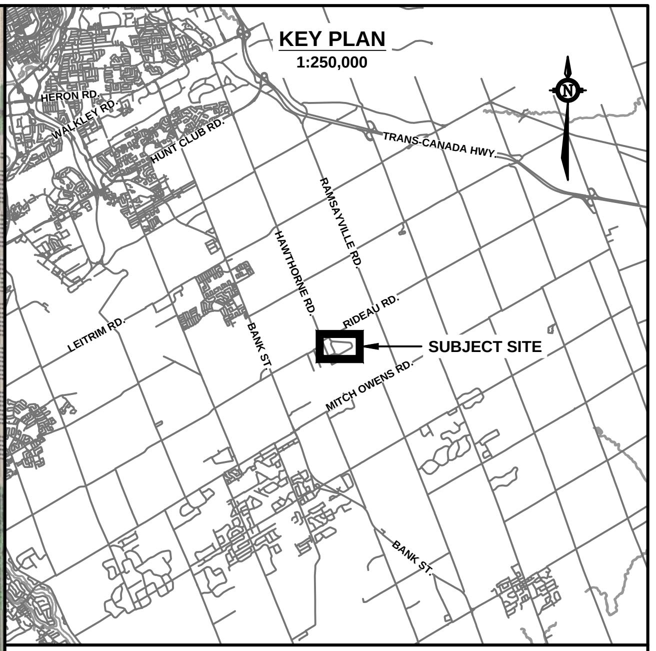
Luc Bouchard

Luc Bouchard, P.Eng., ing.

LICENSED PROFESSIONAL ENGINEER
L.R.J. BOUCHARD
100110839
09 Sep 2020
PROVINCE OF ONTARIO

APPENDIX A

Test Hole Location Plan, Figure 1



LEGEND

BH 20-1	**BOREHOLE LOCATION IN PLAN** (current investigation by GEMTEC)
BH 7	**BOREHOLE LOCATION IN PLAN** (previous investigation by PINCHIN, 2008 (File #249442))
RB7-03	**BOREHOLE LOCATION IN PLAN** (previous investigation by Inspec-Sol, 2008 (Ref # T020556))
TP10-02	**TEST PIT LOCATION IN PLAN** (previous investigation by Inspec-Sol, 2008 (Ref # T020556))
MW8-08	**MONITORING WELL LOCATION IN PLAN** (previous investigation by CRA, 2008 (Project # 45804))

BH/TP ← TEST HOLE ID
(XX.XX) ← GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

Scale 1:3000
0 100 200m

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

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

Client	NOVATECH
Project	65080.01
Location	300 SOMME STREET OTTAWA, ON
Drwn by	P.C.
Chkd by	L.B.
	TEST HOLE LOCATION PLAN
Date	SEPTEMBER 2020
Rev.	0
	FIGURE 1

P:\0. Files\65000\65080.01\06_Drafting\i. Drawings\65080.01_Geotech_FG1_Rev0_2020-04-14.dwg, Figure 1, 2020-05-26 5:59:16 AM

APPENDIX B

Record of Borehole Sheets

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS	auger sample
CA	casing sample
CS	chunk sample
BS	Borros piston sample
DO	drive open
MS	manual sample
RC	rock core
ST	slotted tube
TO	thin-walled open Shelby tube
TP	thin-walled piston Shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Resistance, N

The number of blows by a 63.5 kg hammer dropped 760 millimetre required to drive a 50 mm drive open sampler for a distance of 300 mm. 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 hammer dropped 760 mm to drive a 50 mm diameter, 60^{o} cone attached to 'A' size drill rods for a distance of 300 mm.

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.

SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	sieve and hydrometer analysis
U	unconfined compression test
Q	undrained triaxial test
V	field vane, undisturbed and remoulded shear strength

SOIL DESCRIPTIONS

Relative Density	'N' Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	over 100

LIST OF COMMON SYMBOLS

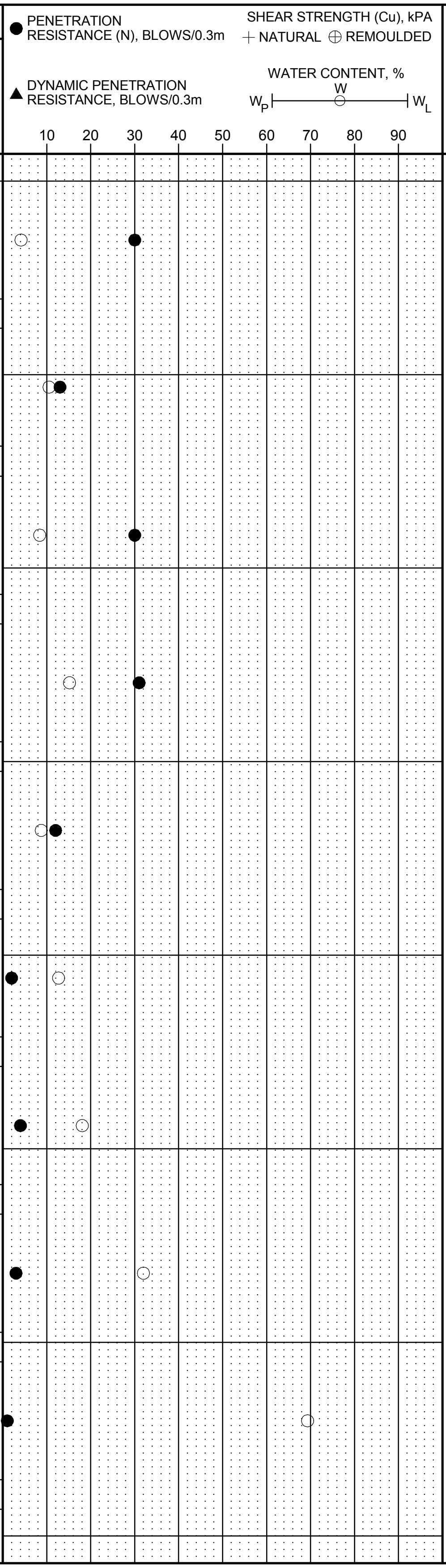
c_u	undrained shear strength
e	void ratio
C_c	compression index
c_v	coefficient of consolidation
k	coefficient of permeability
I_p	plasticity index
n	porosity
u	pore pressure
w	moisture content
w_L	liquid limit
w_P	plastic limit
ϕ^1	effective angle of friction
γ	unit weight of soil
γ^1	unit weight of submerged soil
σ	normal stress

RECORD OF BOREHOLE 20-1

CLIENT: Novatech
PROJECT: Geotechnical Investigation
JOB#: 65080.01
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 2
DATUM: CGVD28
BORING DATE: May 19 2020

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	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		90.88						
		Grey brown silty sand, some gravel, trace cobbles, trace asphalt, trace wood with depth (FILL MATERIAL)			1	SS	500	30		Backfilled with Auger Cuttings
1					2	SS	500	13		
2					3	SS	500	30		
					4	SS	500	31		
3					5	SS	450	12		
4					6	SS	200	2		
5					7	SS	250	4		
					8	SS	100	3		
6		Dark brown PEAT/TOPSOIL, some silty sand		84.78 6.10	9	SS	230	1		
7				83.92						



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LOGGED: A.N.
CHECKED: L.B.

RECORD OF BOREHOLE 20-1

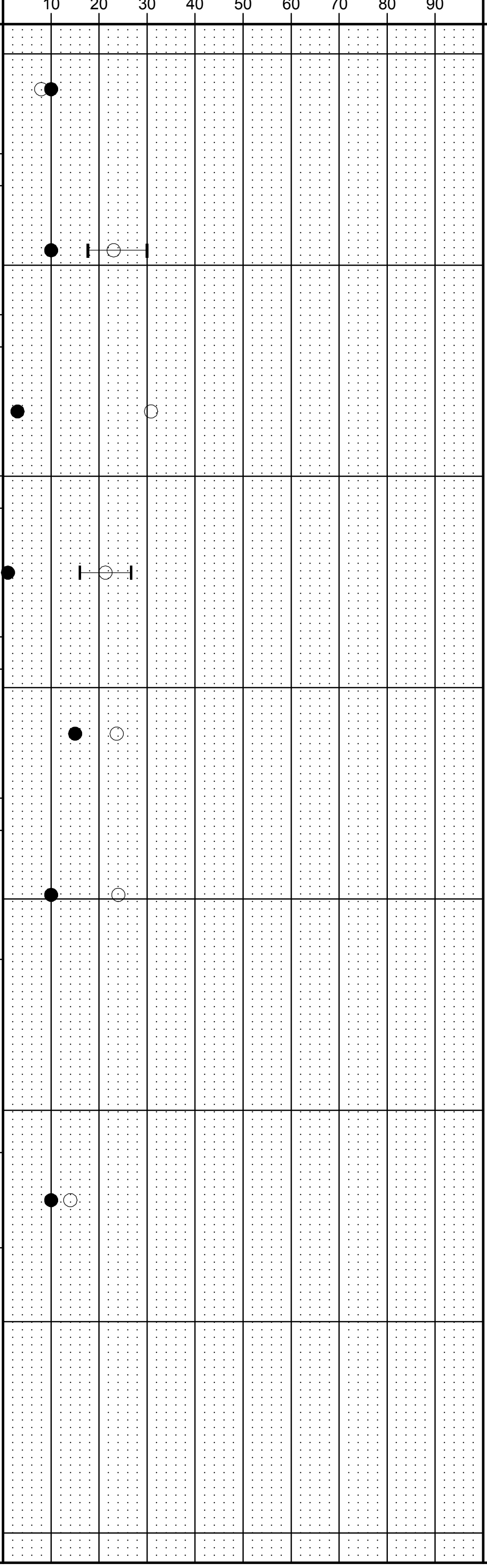
CLIENT: Novatech
PROJECT: Geotechnical Investigation
JOB#: 65080.01
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 2 OF 2
DATUM: CGVD28
BORING DATE: May 19 2020

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
7	Very stiff to stiff, grey brown CLAYEY SILT, trace sand	6.96
9	Firm, grey CLAYEY SILT, some sand, trace gravel	81.73 9.15
10	Compact, grey layered SANDY SILT and CLAYEY SILT, trace gravel	80.97 9.91
11	Compact, grey brown silty sand, some gravel and cobbles, trace clay (GLACIAL TILL)	79.29 11.59
12	Auger Refusal on inferred bedrock End of Borehole	78.22 12.66

SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	SS	500	10	
11	SS	500	10	MH
12	SS	600	3	
13	SS	600	1	MH
14	SS	450	15	
15	SS	600	10	MH
16	SS	230	10	

● PENETRATION RESISTANCE (N), BLOWS/0.3m
▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED
WATER CONTENT, % W_P ⊢ W ○ ⊣ W_L



PIEZOMETER OR STANDPIPE INSTALLATION: Backfilled with Auger Cuttings

GEO - BOREHOLE LOG GINT LOGS 65080.01 MAY 21, 2020.GPJ GEMTEC 2018.GDT 6-1-20

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LOGGED: A.N.
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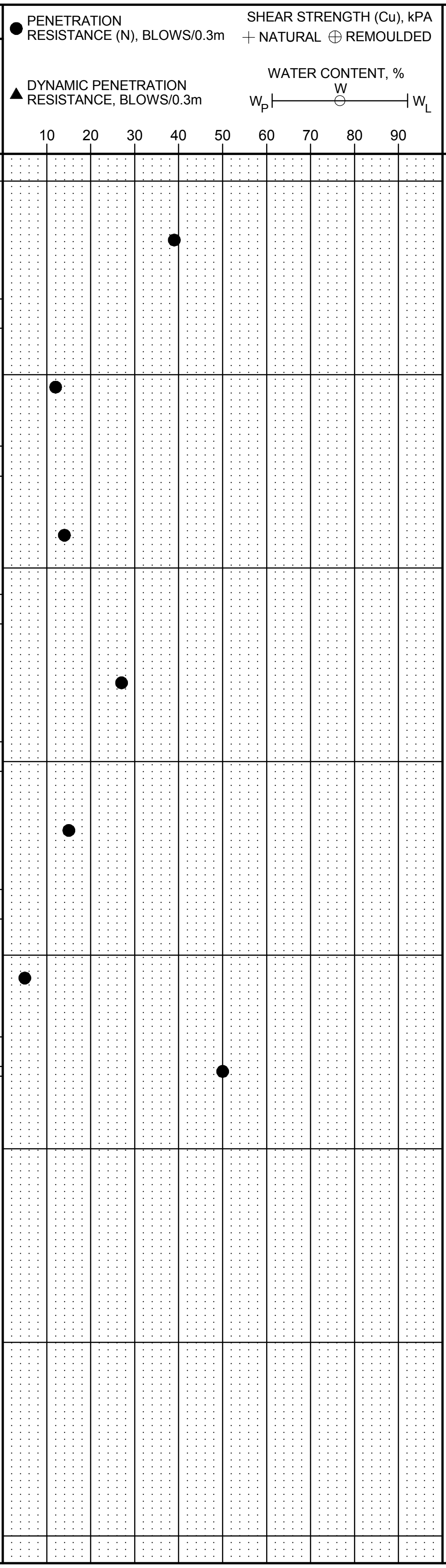
RECORD OF BOREHOLE 20-2

CLIENT: Novatech
PROJECT: Geotechnical Investigation
JOB#: 65080.01
LOCATION: See Borehole Location Plan, Figure 1

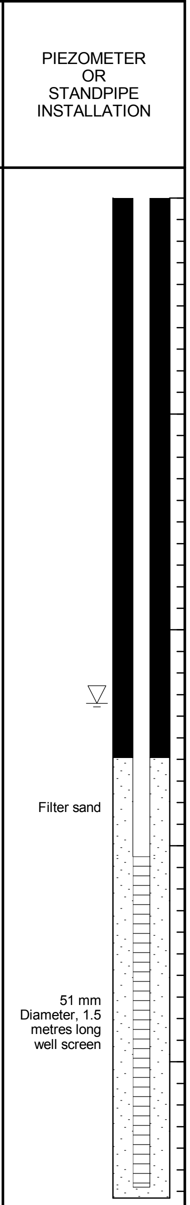
SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 19 2020

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

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0	Ground Surface	91.49				
	TOPSOIL FILL	91.36 0.13				
	Brown silty sand, some gravel and organic material, trace cobbles, brick, debris and asphalt (FILL MATERIAL)		1	SS	500	39
1			2	SS	380	12
2			3	SS	380	14
			4	SS	450	27
3			5	SS	500	15
	Grey, clayey sand, some silt and gravel (GLACIAL TILL)	87.96 3.53				
4			6	SS	350	5
			7	SS	50	50
	Auger Refusal on Inferred Bedrock End of Borehole	86.86 4.63				
5						
6						
7						



ADDITIONAL LAB. TESTING



GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
20-05-25	2.3 ∇	89.2

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LOGGED: A.N.
CHECKED: L.B.

RECORD OF BOREHOLE 20-3

CLIENT: Novatech
PROJECT: Geotechnical Investigation
JOB#: 65080.01
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 19 2020

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

DESCRIPTION	ELEV. / DEPTH (m)
Ground Surface	91.60
TOPSOIL FILL	91.47 0.13
Brown and black, silty sand, some gravel, concrete, and asphalt (FILL MATERIAL)	87.71 3.89
Grey, silty sand and gravel, trace organic material (GLACIAL TILL)	87.48 4.12
Auger Refusal on Inferred Bedrock End of Borehole	

NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
1	SS	430	10
2	SS	430	32
3	SS	480	8
4	SS	350	72
5	SS	380	24
6	SS	230	57

● 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

PIEZOMETER OR STANDPIPE INSTALLATION: Backfilled with Auger Cuttings

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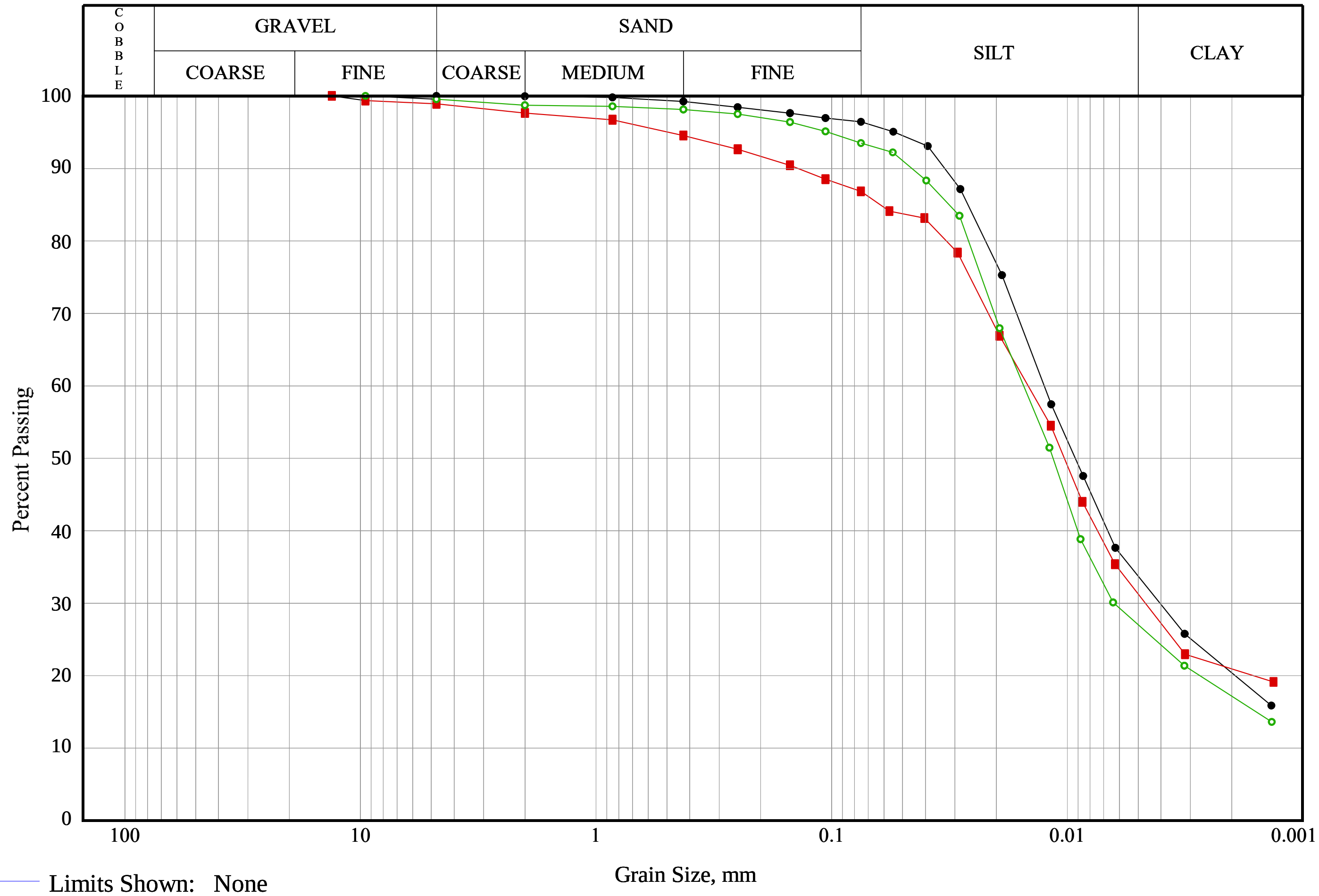
LOGGED: A.N.
CHECKED: L.B.

APPENDIX C

Soil Classification Testing Results

GEMTEC Consulting Engineers and Scientists	Client: Novatech Project: Geotechnical Investigation - 300 Somme Street, Ottawa Project #: 6508001	# Soils Grading Chart



Limits Shown: None

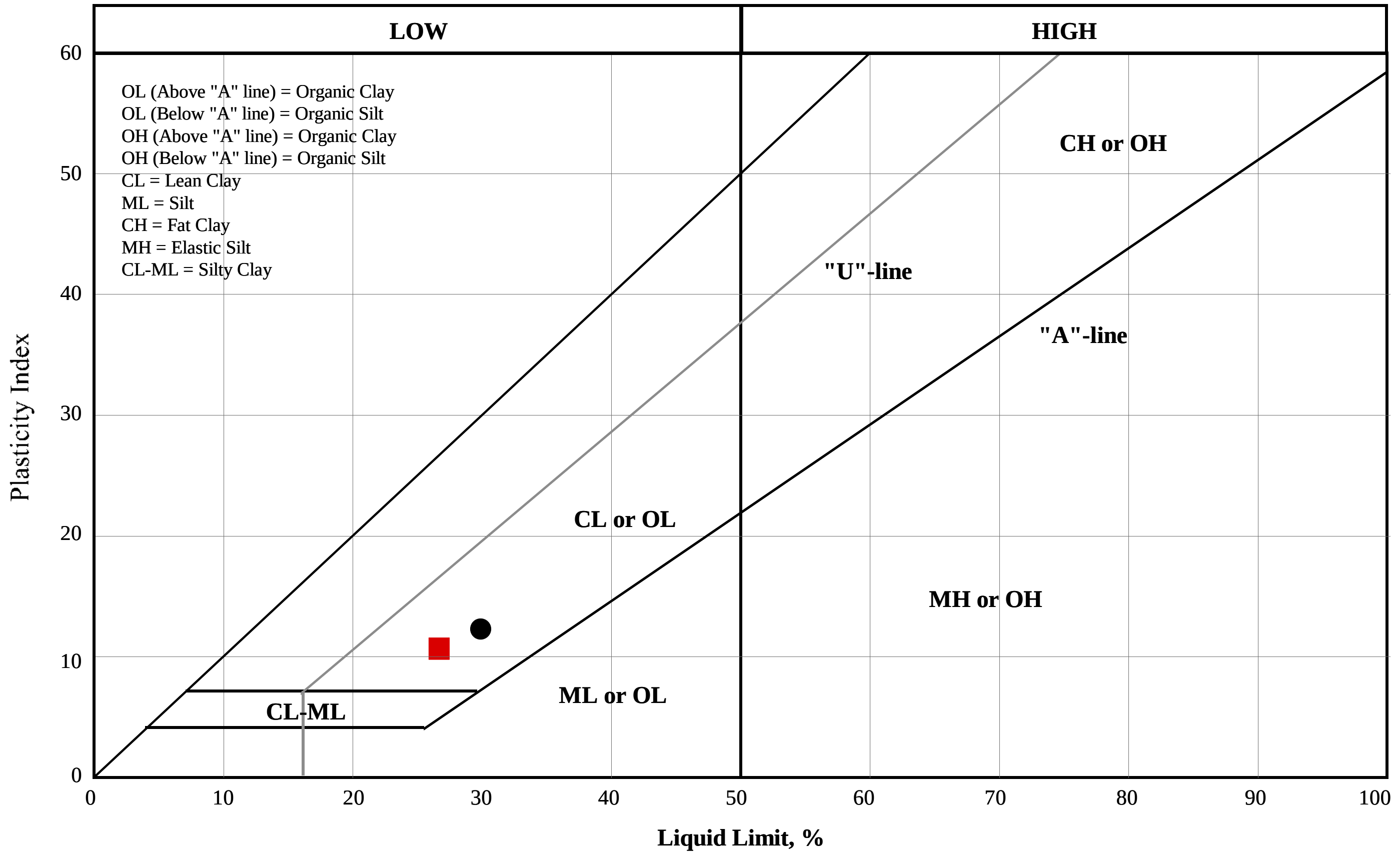
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●		20-1	11	7.62-8.23	0.0	3.6	62.7	33.7
■		20-1	13	9.14-9.75	1.1	12.1	55.5	31.3
○		20-1	15	10.67-11.28	0.4	6.1	66.5	27.0

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●	Clayey silt , trace sand	CL	---	---	0.00	0.01	0.01	0.03	62.7
■	Clayey silt , some sand , trace gravel	CL	---	---	0.00	0.01	0.01	0.06	55.5
○	Clayey silt , trace gravel, trace sand	N/A	---	0.00	0.01	0.01	0.02	0.03	66.5

GEMTEC
Consulting Engineers and Scientists

Client:	Novatech
Project:	Geotechnical Investigation - 300 Somme Street, Ottawa
Project #:	6508001

Plasticity Chart



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	20-1	11	7.62-8.23	29.9	17.6	12.3	☐	23.03
🟥	20-1	13	9.14-9.75	26.7	16.0	10.6	☐	21.33

APPENDIX D

Paracel Laboratories Test Results
Sample Relating to Corrosion - Groundwater

Certificate of Analysis

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

Client PO:

Report Date: 28-May-2020

Order Date: 25-May-2020

Project Description: 65080.01

	Client ID:	MW20-2	-	-	-
	Sample Date:	25-May-20 06:50	-	-	-
	Sample ID:	2022002-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
General Inorganics					
Conductivity	5 uS/cm	1250	-	-	-
pH	0.1 pH Units	7.8	-	-	-
Anions					
Chloride	1 mg/L	10	-	-	-
Sulphate	1 mg/L	314	-	-	-

experience • knowledge • integrity

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

expérience • connaissance • intégrité