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Geotechnical Investigation
Proposed Wren Subdivision - Phase 3
Wren Drive

Cobden, Ontario

GEMTEC Project: 62658.03

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Submitted to:

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Renfrew, Ontario
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Geotechnical Investigation
Proposed Wren Subdivision - Phase 3
Wren Drive
Cobden, Ontario

December 21, 2022
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experience • knowledge • integrity

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December 21, 2022 File: 62658.03

Bonnechere Excavating Inc.
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Attention: Matt Naismith

Re: Geotechnical Investigation
Proposed Wren Subdivision – Phase 3
Wren Drive
Cobden, Ontario

Please find enclosed our geotechnical investigation report for the above noted project, in accordance with our proposal dated November 30, 2022. This report was prepared by Mr. Alex Meacoe, P.Eng., and reviewed by Mr. Bill Cavers, P.Eng..

W. Alex Meacoe

Alex Meacoe, P.Eng.

Bill

Bill Cavers, P.Eng.

WAM/BC

Enclosures
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1.0 INTRODUCTION

This report presents the results of a geotechnical assessment carried out at proposed Phase 3 of the proposed Wren Subdivision at Wren Drive in Cobden, Ontario. The purpose of the investigation was to identify the general subsurface conditions at Phase 3 of the site based on the previously completed test pits.

This report should be read in conjunction with our previous geotechnical investigation report:

- Report titled "Geotechnical Investigation, Wren Subdivision, Township of Whitewater Region, Cobden, Ontario", dated October 7, 2014 (Project No. 14-327).

2.0 PROJECT DESCRIPTION AND SITE GEOLOGY

Plans are being prepared to develop a parcel of land located west of Morrison Drive and south of Highway 17 in Cobden, Ontario (refer to Key Plan inset, Figure 1).

It is understood that the proposed phase 3 of the development will consist of a residential subdivision with an internal roadway system. It is understood that the residences will be either homes, townhouses, or a combination of both, all of conventional wood frame construction with full depth concrete basements. Water, sanitary and storm services will be part of the proposed development, along with a stormwater management facility at the northwest corner of the site.

Based on our previous local experience and published geology maps of the area, it is expected that the subsurface conditions within the project area are characterized primarily by overburden deposits composed of silty clay and shallow bedrock. Based on nearby Ministry of Environment, Conservation, and Parks (MECP) well records, the overburden thickness is indicated to range from 0 to 15 metres. Bedrock geology maps of the area indicate that the overburden deposits are underlain by Precambrian bedrock.

During the previous investigations, 13 test pits were advanced at the site. The test pits encountered topsoil underlain by deposits of silty clay over glacial till over bedrock.

3.0 SUBSURFACE CONDITIONS

3.1 General

The boreholes and test pits advanced within and adjacent to Phase 3 of the subdivision consist of test pits 2 to 13 from the previous investigations.

Descriptions of the subsurface conditions encountered in the test pits are provided on the Record of Test Pit sheets in Appendix A. The approximate locations of the test pits are shown on the Site Plan, Figure 1. The results of the laboratory classification tests are provided on the Test Pit sheets and in Appendix B. The results of the corrosion testing are provided in Appendix C.

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. Subsurface conditions at other than the test pit and borehole locations may vary from the conditions encountered in the test pits. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site.

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 groundwater conditions described in this report refer only to those observed at the location and date of observation noted in the report and on the test pit logs. Groundwater conditions may vary seasonally, or may be affected by construction activities on or in the vicinity of the site.

3.2 Topsoil

A surficial layer of topsoil was encountered from ground surface at all of the test pits. The topsoil has thicknesses ranging from about 50 to 310 millimetres.

3.3 Silty Clay

Native deposits of silty clay were encountered below the topsoil in test pits 2, 3, 4, 7 to 11, and 13 and below a native deposit of silty sand in test pit 12.

The silty clay is grey brown and weathered. Based on the effort required for excavation and our visual and tactile examination, the weathered silty clay is estimated to have a very stiff consistency. The weathered crust extends to depths ranging from about 0.5 to 4.3 metres below the existing ground surface.

At the locations of test pits 3 and 8, the weathered silty clay is underlain by grey silty clay. The grey silty clay was not fully penetrated in the boreholes, but was proven to depths of about 3.7 and 4.9 metres below the existing ground surface in test pits 3 and 8, respectively.

The results of in situ field vane tests carried out in bucket samples of the grey silty clay deposit in test pit 8 between about 4.5 and 5.0 metres below ground surface gave undrained shear strength values ranging from about 35 to 50 kilopascals, which represents a firm consistency. It is pointed out that the samples tested were likely disturbed during excavating and therefore, the undrained shear strength values should be considered as approximate.

The water contents of samples of the silty clay from test pit 4 range from about 30 to 33 percent.

3.4 Silty Sand

At the locations of test pits 6 and 12, native deposits of brown, silty sand with trace to some gravel were encountered below the topsoil. The thickness of the silty sand deposits are about 0.4 and 0.3 metres at the locations of test pits 6 and 12, respectively.

The results of grain size classification testing carried out on samples of the silty sand deposits are provided in Appendix B. The results of the testing are summarized in the table below.

Table 4.1 – Summary of Grain Size Distribution Test (Silty Sand)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt and Clay(%)
6	2	0.2 – 0.5	13	66	21
12	2	0.2 – 0.5	5	73	22

The water contents of samples of the silty sand from test pit 6 and 12 were about 13 and 10 percent, respectively.

3.5 Glacial Till

Native deposits of glacial till were encountered below the silty clay in test pits 2, 3, 4, 7, and 9 to 12, and below the silty sand in test pit 6.

Glacial till is a heterogeneous mixture of all grain sizes, which at this site can be described as a silty sand with some gravel, cobbles and boulders and trace clay. The glacial till extends to depths ranging from about 0.8 to 4.7 metres below the existing ground surface.

The water content of a sample of the glacial till from test pit 4 was about 13 percent.

3.6 Practical Refusal to Excavation (Inferred Bedrock)

Practical refusal to excavating occurred in test pits 5, 6, 9, 10 and 12 at depths ranging from about 0.3 to 3.9 metres below ground surface. Probable weathered bedrock was encountered at a depth of about 1.2 metres below the existing ground surface.

The operator of the excavation equipment indicated possible bedrock depths at the locations of test pits 7 and 13 at about 3.7 and 3.9 metres below ground surface, respectively. It is possible that these refusals represent the surface of the bedrock, however, refusal can also occur on large boulders within the glacial till deposit.

The following table summarizes the depths and elevations of practical excavator refusal.

Table 4.2 – Summary of Excavator Refusal Depths and Elevations

Test Pit	Ground Surface Elevation (metres)	Depth to Excavator Refusal (metres)	Elevation of Excavator Refusal (metres)
Test Pit 5	147.4	0.3	147.2
Test Pit 6	146.2	1.6	144.6
Test Pit 9	145.4	0.8	144.6
Test Pit 10	148.2	1.7	146.5
Test Pit 12	149.1	1.3	147.8

3.7 Groundwater Levels

The groundwater levels measured in the well screens on August 21, 2014, are summarized in the following table.

Table 4.3 – Groundwater Levels in Well Screens

Test Pit	Groundwater Level (metres below ground surface)	Groundwater Elevation (metres, geodetic datum)
Test Pit 8	1.6	142.5
Test Pit 11	2.1	143.3
Test Pit 13	2.2	141.9

Groundwater infiltration measured for the short time the test pits remained open in test pits 1, 2, 3, 4, 7, 8, and 11, are summarized in the following table. Test pits 5, 6, 9, and 10 were dry upon completion of the excavation.

Table 4.4 – Groundwater Levels in Open Test Pits

Test Pit	Ground Surface Elevation (metres)	Groundwater Infiltration Depth (metres)
Test Pit 2	147.1	3.3
Test Pit 3	147.3	3.2

Test Pit	Ground Surface Elevation (metres)	Groundwater Infiltration Depth (metres)
Test Pit 4	147.2	2.7
Test Pit 7	144.6	2.5
Test Pit 8	144.1	4.6
Test Pit 11	145.4	3.3
Test Pit 13	144.1	3.3

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.

3.8 Groundwater Chemistry Related to Corrosion

The results of chemical testing carried out on a sample of the groundwater obtained from the well screen in test pit 1 on August 21, 2014, are provided in Appendix C and summarized in the following table.

Table 4.5 – Groundwater Chemistry Relating to Corrosion

Parameter	Well Screen, Test Pit 1 August 21, 2014
Conductivity (µS/cm)	506
Hardness (mg/L)	267
pH	7.5
Chloride (mg/L)	5
Sulphate (mg/L)	27

4.0 GEOTECHNICAL GUIDELINES

4.1 General

This section of the report provides preliminary engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the available test pit information, and the project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous uses or activities of this site or adjacent properties, and/or resulting from the introduction onto the site from materials from off site sources are outside the terms of reference for this report and have not been investigated or addressed.

4.2 Grade Raise Restrictions

Portions of the site are underlain by deposits of silty clay, which have an estimated firm to very stiff consistency. The placement of fill material must be controlled so that the stress imposed by the fill material does not result in excessive consolidation of the silty clay deposits. The settlement response of the silty clay deposits due to the increase in stress caused by fill materials is influenced by variables such as the existing effective overburden pressure, the past preconsolidation pressure for the silty clay, the compressibility characteristics of the silty clay, and the presence or absence of drainage paths, etc. It is well established that the settlement response of silty clay deposits can be significant when the stress increase is near or above the preconsolidation pressure.

For preliminary design purposes, the grade raise fill restriction in areas that are underlain by silty clay is 2.5 metres. This represents the thickness of the fill material above the existing grade as required for development of the site. If grade raise fill in excess of 2.5 metres is required on portions of the site underlain by silty clay deposits, additional investigation may be required. The subdivision grading plan should be reviewed by GEMTEC Consulting Engineers and Scientists Limited at the detailed design stage.

4.3 Proposed Houses

4.3.1 Excavation

The excavations for the foundations should be made through any surficial fill, topsoil, or otherwise deleterious material to expose undisturbed soil. 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 shallow native overburden deposits of clay and the sands and till above the groundwater level 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.

Excavation of the native silty clay should not present any constraints. Furthermore, excavation of the native silty sand and glacial till above the groundwater should also not present any excavation constraints. In contrast, excavation in the native silty sand and glacial till below the groundwater level could present constraints. Groundwater inflow from the silty sand and glacial till deposits could cause sloughing of the sides of the excavation and disturbance to the soils at the bottom of the excavation. Flatter side slopes may be required if excavation below the groundwater in silty sands or glacial till is required.

Based on our observations on site during the construction of Phase 1 and 2 of the site, groundwater inflow from the overburden deposits into the excavations should be expected during the excavations for the proposed houses. It is not expected that short term pumping during excavation will have any significant affect on nearby structures and services.

Bedrock excavation may be required for foundations at this site. Guidelines on bedrock excavation are provided below in Section 5.5.1.2.

4.3.2 Placement of Engineered Fill

In areas where the proposed founding level is above the level of the native soil, or where subexcavation of disturbed material is required below proposed founding level (i.e., due to groundwater infiltration), imported granular material (engineered fill) should be used. The engineered fill should consist of granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type I or II and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the material’s standard Proctor maximum dry density. To allow spread of load beneath the footings, the engineered fill should extend horizontally at least 0.3 metres beyond the footings and then down and out from the edges of the footings at 1 horizontal to 1 vertical, or flatter. The excavations should be sized to accommodate this fill placement. The engineered fill should be placed in accordance with the site grade raise restrictions, where applicable.

4.3.3 Spread Footing Design

The proposed houses could be founded on spread footings bearing on or within the native soil or on engineered fill above the native deposits. The topsoil and any fill materials are not considered suitable for the support of the proposed houses or concrete floor slabs and should be removed from the proposed building areas.

To reduce the potential for long term pumping requirements, we recommend that the footings be designed to be at least 0.3 metres above the high groundwater level. Based on the water infiltration into excavations during the construction of Phase 1 and 2 of the development, the proposed underside of footing elevations may need to be increased to accommodate the groundwater level. Where the underside of footing elevations need to be increased, recommendation for the placement of engineered fill are provided in Section 4.3.2, above.

Based on the results of the borehole investigation, the following may be used to size the spread footing foundations:

Table 5.1 – Allowable Bearing Pressures for Foundations

Subgrade Material	Allowable Bearing Pressure for Foundations (kilopascals)
Weathered silty clay	100
Glacial till	150
Bedrock	200
Engineered fill material, over undisturbed native deposits	150

Note: The allowable bearing pressures assume the native soils are in an undisturbed state.

The allowable bearing pressures provided above are based on settlement. The post construction total and differential settlement of footings should be less than 25 and 15 millimetres, respectively, provided that all loose or disturbed soil is removed from the bearing surfaces and provided that any engineered fill material used is compacted to the required density.

4.3.4 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 exterior footings adjacent to surfaces which are cleaned of snow cover during the winter months should be provided with a minimum of 1.8 metres of earth cover. Alternatively, the required frost protection could be provided by means of a combination of earth cover and extruded polystyrene insulation. Further details regarding the insulation of foundations could be provided at the detailed design stage, if necessary.

4.3.5 Basement Foundation Wall Backfill and Drainage

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

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

Where areas of hard surfacing (walkways, driveways, etc.) abut the proposed houses, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible materials to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below ground surface 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.

A perforated plastic foundation drain with a surround of clear crushed stone should be installed on the exterior of the foundation walls, with the exception of garages. To avoid loss of sand backfill into the voids in the clear stone (and possible post construction settlement of the ground around the houses), the perforated drains should be wrapped in a geotextile. The top of the drain should be located below the bottom of the floor slab. The drain should outlet to a sump from which the water is pumped or should drain by gravity to a storm sewer.

4.3.6 Garage Foundation and Pier Backfill

To avoid adfreeze and possible jacking (heaving) of the foundation walls, between the unheated garage foundation walls and the wall backfill, the interior and exterior of the garage foundation walls should be backfilled with free draining, non-frost susceptible sand or sand and gravel such as that meeting OPSS requirements for Granular B Type I or II or 19 millimetre clear stone. The backfill within the garage should be compacted in maximum 300 millimetres thick lifts to at least 95 percent of the material's standard Proctor dry density value using suitable vibratory compaction equipment. Compaction of clear stone is not essential.

The backfill against isolated (unheated) walls or piers should consist of free draining, non-frost susceptible material, such as sand meeting OPSS Granular B Type I or II requirements. Other measures to prevent frost jacking of these foundation elements could be provided, if required.

4.3.7 Basement Concrete Slab Support

To provide predictable settlement performance of the basement slab, all topsoil, fill material, and other deleterious materials should be removed from the slab area.

The base for the floor slab should consist of 19 millimetre clear crushed stone. For preliminary design purposes, allowance should be made for between 150 and 200 millimetres of base material.

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

Underfloor drainage should be provided below the floor slab. If clear crushed stone is used below the floor slab, drains are not considered essential provided that the clear stone can outlet to the sump and drains are installed to link any hydraulically isolated areas in the basement. The drains should outlet by gravity to a sump from which the water is pumped or drained by gravity to a sewer or to a suitable outlet such as a drainage ditch.

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

4.3.8 Effects of Trees on the Foundations

The results of this investigation indicate that silty clay deposits exist at the site. This material is known to be susceptible to shrinkage with a change/reduction in moisture content. Research by the Institute for Research in Construction (formerly the Division of Building Research) of the National Research Council of Canada has shown that trees can cause a reduction of moisture content in the sensitive clays in the Ottawa area, which can result in significant settlement/damage to nearby buildings supported on shallow foundations. Therefore, for houses bearing on or within the silty clay deposits, no deciduous trees should be permitted closer to the houses (or any ground supported structures which may be affected by settlement) than the ultimate height of the trees. For groups of trees or trees in rows, the separation distance should be increased to 1.5 times the ultimate height of the trees.

The effects of existing and future trees on proposed houses, services and other ground supported structures should be considered in the landscaping design.

4.4 Internal Roadways

4.4.1 Subgrade Preparation

In preparation for roadway construction at this site, all surficial topsoil and any soft, wet or deleterious materials should be removed from the proposed roadways. Any subexcavated areas could be filled with compacted earth borrow. Similarly, should it be necessary to raise the roadway grades at this site, material which meets OPSS specifications for Select Subgrade Material or earth borrow 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 material’s standard Proctor maximum dry density value using vibratory compaction equipment. Prior to placing granular material for the roadway, the exposed subgrade should be heavily proof rolled and inspected and approved by geotechnical personnel. Any soft areas evident from the proof rolling should be subexcavated and replaced with suitable earth borrow or rock fill approved by the geotechnical engineer.

The subgrade should be shaped and crowned to promote drainage of the roadway granular materials.

4.4.2 Pavement Design

For internal roadways at this site, the following minimum pavement structure is suggested:

- 80 millimetres of asphaltic concrete (40 millimetres of Superpave 12.5 Traffic Level B over 40 millimetres of Superpave 19.0 or HL8 Traffic Level B), over
- 150 millimetres of OPSS Granular A base, over
- 375 millimetres of OPSS Granular B, Type I or II subbase

The above pavement structure assumes that any trench backfill is adequately compacted and that the roadway subgrade surface is prepared as described in this report. If the roadway subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thickness given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type I or II subbase and/or to incorporate a woven geotextile separator between the roadway subgrade surface and the granular subbase material. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

It is suggested that the placement of the surface course of asphaltic concrete be delayed for at least six months to allow for any settlement of fill material and service trench backfill within the roadway.

4.4.3 Granular Material Compaction

The pavement granular materials should be compacted in maximum 300 millimetre thick lifts to at least 98 percent of material’s standard Proctor maximum dry density using suitable vibratory compaction equipment.

4.4.4 Asphaltic Concrete Types

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

4.4.5 Transition Treatments

In areas where the new pavement structure will abut existing pavements, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter, to match the depths of the granular material(s) exposed in the existing pavement.

4.4.6 Pavement Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. In order to provide drainage of the granular subbase, it is suggested that catch basins be provided with perforated stub drains extending about 3 metres out from the catch basins in two directions parallel to the roadway. These drains should be installed at the bottom of the subbase layer. Where ditches are used, the bottom of the OPSS

Granular B Type I or II should be at least 0.3 metres above the bottom of the ditch and the granular material should extend to the ditch slopes.

revise based on proposed section

4.5 Site Services

4.5.1 Excavation

4.5.1.1 Overburden Excavation

The overburden excavations for the site services will be carried out through topsoil, silty sand, silty clay and glacial till.

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, most of the soils at this site can be classified as Type 3 soils. Therefore, for design purposes, allowance should be made for 1 horizontal to 1 vertical, or flatter, excavation slopes. 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.

4.5.1.2 Bedrock Excavation

In bedrock, the excavation for flexible service pipes should be in accordance with OPSD 802.013 for bedrock. The excavation for rigid service pipes should be in accordance with OPSD 802.033 for bedrock.

Localized removal of competent bedrock at this site could be carried out using (a) drill and blasting, (b) hoe ramming techniques possibly in conjunction with line drilling on close centres or (c) a combination of both. Provided that good bedrock excavation techniques are used, the competent bedrock could be excavated using vertical side walls.

Any blasting should be carried out under the supervision of a blasting specialist engineer. As a guideline for blasting, the suggested peak vibration limits at the nearest structure or service are provided in Table 5.2.

Table 5.2 Peak Vibration Limits

Frequency of Virbration (Hz)	Vibration Limits (millimetres/second)
<10	5
10 to 40	5 to 50 (interpolated)
>40	50

It is pointed out that these criteria, although conservative, were established to prevent damage to existing buildings and services in good condition; more stringent criteria may be required to prevent damage to freshly placed (uncured) concrete or vibration sensitive equipment or utilities. Monitoring of the blasting should be carried out to ensure that the blasting meets the limiting vibration criteria. Pre-construction condition surveys of nearby structures and existing buried services are considered essential. The effects due to vibration from blasting can be controlled by limiting the size and amount of charge, using delayed detonation techniques, and the like. To reduce the effects of vibration on nearby services, we suggest that the separation distance between any blasting and existing underground services be at least 3 metres. Any bedrock removal within these limits could be carried out using hoe ramming techniques in conjunction with line drilling on close centres. It is noted that the cost of bedrock removal generally increases the closer the bedrock removal is to any existing structures or services.

As an alternative to blasting, bedrock removal could be carried out using large hydraulic excavation equipment in combination with hoe ramming. Line drilling on close centres could be used to reduce, not prevent, over break and under break of the bedrock excavation and to define the limit of excavation next to existing structures and services. For the bedrock at this site, it is suggested that allowance be made for line drilling 75 to 100 millimetre diameter holes on 200 to 300 millimetre centres. The vibration effects of hoe ramming are usually minor and localized. Monitoring of the hoe ramming could be carried out, at least initially, to measure the vibrations to ensure that they are below the acceptable threshold value. Provided that good bedrock excavation techniques are used, the bedrock could be excavated using vertical side walls. Any loose rock should be scaled from the side of the excavation.

Depending on the depth of the proposed excavations, a Permit to Take Water (PTTW) may be required for the project in accordance with Ministry of the Environment requirements (MOE). The type of permit (i.e., Category 2 or 3) will depend on the depth of the excavations relative to the groundwater level, type of soil within the anticipated depth of excavation, and project duration. Issuance of the permit by the MOE usually takes about 90 business days.

4.5.2 Bedding and Cover

The bedding and cover for the proposed utilities should consist of OPSS Granular A backfill placed in accordance with the applicable Ontario Standard Drawings (OPSD) for the type of underground utility installed. The use of 19 millimetre clear stone is not recommended as bedding or cover.

Bedding and cover materials should be placed in lifts not exceeding 200 millimetres thick and compacted to at least 95 percent of standard Proctor density.

4.5.3 Trench Backfill

In areas where the service trench will be located below or in close proximity to existing or future areas of hard surfacing (i.e., access roadways and parking), 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.

It is anticipated that most of the inorganic overburden materials encountered during the subsurface investigation will be acceptable for reuse as trench backfill. Any topsoil or organic soil from the trench should be wasted.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the access roadways the trench backfill should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the material’s standard Proctor maximum dry density. The specified density may be reduced to 90 percent of the material’s standard Proctor dry density in areas where the trench backfill is not located below or in close proximity to existing or future roadways and parking areas, provided that some settlement above the trench is acceptable.

The lower portions of the silty clay deposits may have water contents that are too high for adequate compaction. Furthermore, depending on the weather conditions at the time of construction, some wetting of materials could occur. As such, the specified densities may not be possible to achieve and, as a consequence, some settlement of these backfill materials should be expected. We recommend final paving be deferred to allow for some settlement.

4.6 Corrosion of Buried Concrete and Steel

The measured sulphate concentration in samples of the groundwater obtained from test pit 1 is 27 milligrams per Litre. According to Canadian Standards Association (CSA) “Concrete Materials and Methods of Concrete Construction”, the concentration of sulphate in the groundwater can be classified as low. Any concrete that will be in contact with the native soil or groundwater should be batched with General Use (formerly known as Type 10 cement). The effects of freeze thaw in the presence of de-icing chemical (sodium chloride) use on the roadways should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

Based on the conductivity and pH of the groundwater recovered from test pit 1, the groundwater sampled can be classified as non-aggressive towards unprotected steel. The manufacturer of any buried steel elements that will be in contact with the groundwater should be consulted to determine the durability of the product used. It is noted that the corrosivity of the groundwater could vary throughout the year due to the application sodium chloride for de-icing.

5.0 ADDITIONAL CONSIDERATIONS

5.1 Construction Induced Vibration

Some of the construction operations (such as granular material compaction, overburden and bedrock excavation, etc.) will cause ground vibration on the site. The vibrations will attenuate with distance from the source but may be felt at nearby structures. It is suggested therefore that these construction operations be planned to avoid any adverse effects of such vibrations on freshly placed (uncured) concrete and on existing buildings.

Pre-construction surveys should be carried out on existing, nearby structures to assist with any damage related claims.

5.2 Winter Construction

In the event that construction is required during freezing temperatures, the soil below the footings should be protected immediately from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means.

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

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

5.3 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.

5.4 Design Review and Construction Observation

The details for the proposed construction were not available to us at the time of preparation of this report. It is recommended that the 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.

The subgrade surfaces for the proposed structures, utilities and roadways should be inspected by experienced geotechnical personnel to ensure that suitable materials have been reached and properly prepared. The placing and compaction of earth fill and imported granular materials should be inspected to ensure that the materials used conform to the grading and compaction specifications.

6.0 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.

W. Alex Meacoe

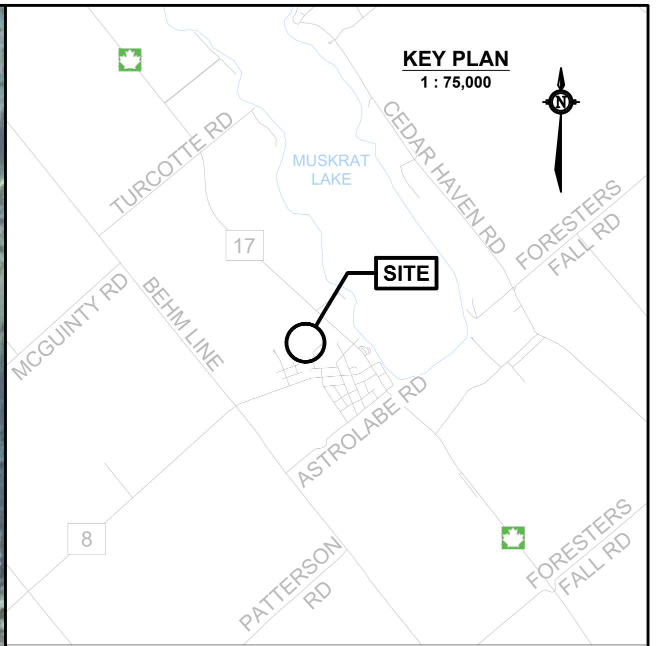
Alex Meacoe, P.Eng.
Senior Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
W. A. MEACOE
100162115
Dec. 21, 2022
PROVINCE OF ONTARIO

Bill Cavers, P.Eng.
Senior Geotechnical Engineer

KEY PLAN

1 : 75,000



LEGEND

TP # ◄— TEST PIT ID

APPROXIMATE TEST PIT LOCATION
(GEMTEC, 2014)

—·—·— **APPROXIMATE SITE BOUNDARY**

- - - - **PHASE 3 BOUNDARY**

GENERAL NOTE(S)

1. Coordinate system: NAD83, UTM ZONE 18N.

SCALE

1:3000

0 100 200m

DRAWING

SITE PLAN

CLIENT

BONNECHERE EXCAVATING INC.

PROJECT

PROPOSED DEVELOPMENT
WREN SUBDIVISION
PHASE 3
COBDEN, ONTARIO

DRAWN BY	CHECKED BY
S.L.	W.A.M.
PROJECT NO.	REVISION NO.
62658.03	0
DATE	FIGURE NO.
DECEMBER 2022	**FIGURE 1**

GEMTEC
Consulting Engineers and Scientists

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

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APPENDIX A

Record of Test Pit Sheets
List of Abbreviations and Symbols
Test Pits 2 to 13

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

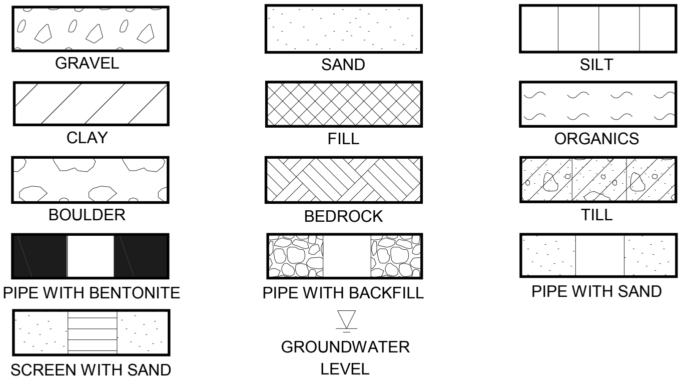
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

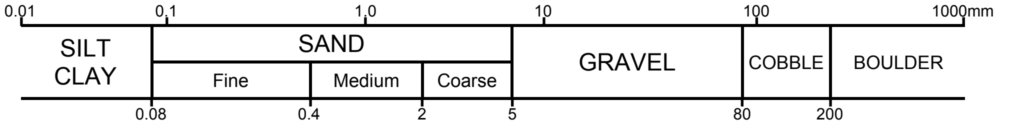
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	Description	Cu, kPa	Description
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)

0 10 20 35

TRACE	SOME	ADJECTIVE	noun > 35% and main fraction
trace clay, etc	some gravel, etc.	silty, etc.	sand and gravel, etc.

GEMTEC

RECORD OF TEST PIT 2

PROJECT: 14-327
LOCATION: See Test Pit Location Plan, Figure 2
DATE OF EXCAVATION: August 14, 2014

SHEET 1 OF 1
DATUM: Geodetic
TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ├──○W──┤ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	Ground Surface		147.13					
0	Dark brown silty clay, trace organic material (TOPSOIL)		146.88 0.25	1				Native Backfill
1 2 3	Very stiff, grey brown SILTY CLAY (Weathered Crust)		143.93 3.20	2 3				
	Grey brown silty sand, some gravel, cobbles, and boulders, trace clay (GLACIAL TILL)		143.47 3.66	4				
4 5 6	End of Test Pit Notes: - Groundwater inflow observed at about 3.3 metres below ground surface							

DEPTH SCALE
1 to 30

Houle Chevrier Engineering

LOGGED: A.N.
CHECKED:

RECORD OF TEST PIT 3

PROJECT: 14-327
LOCATION: See Test Pit Location Plan, Figure 2
DATE OF EXCAVATION: August 14, 2014

SHEET 1 OF 1
DATUM: Geodetic
TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	147.30					
	Dark brown silty clay, trace organic material (TOPSOIL)	147.07 0.23	1				Native Backfill
	Very stiff, grey brown SILTY CLAY (Weathered Crust)		2 3				
		143.82 3.48					
	Firm, grey SILTY CLAY	143.64 3.66	4				
	Grey silty sand, some gravel, cobbles and boulders, trace to some clay (GLACIAL TILL)	142.60 4.70	5				
	End of Test Pit						

Notes:

- Groundwater inflow observed at about 3.2 metres below ground surface

DEPTH SCALE
1 to 30

Houle Chevrier Engineering

LOGGED: A.N.
CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 4

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ⊢—○ W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	147.15					
	Dark brown silty clay, trace organic material (TOPSOIL)	146.92 0.23	1				Native Backfill
	Very stiff, grey brown SILTY CLAY (Weathered Crust)	144.81 2.34	2 3				
	Grey brown silty sand, some gravel, cobbles, and boulders (GLACIAL TILL)	143.49 3.66	4				
	End of Test Pit						

Notes:

- Groundwater inflow observed at about 2.7 metres below ground surface

Depth scale: 0, 1, 2, 3, 4, 5, 6

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 5

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
0	Ground Surface		147.42					
	Dark brown silty sand, trace organic material (TOPSOIL)		147.17 0.25	1				Native Backfill ▨
	Practical Excavator Refusal on Inferred Bedrock End of Test Pit Notes: - No groundwater observed upon completion of test pit							
1								
2								
3								
4								
5								
6								

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

RECORD OF TEST PIT 6

PROJECT: 14-327

LOCATION: See Test Pit Location Plan, Figure 2

DATE OF EXCAVATION: August 14, 2014

SHEET 1 OF 1

DATUM: Geodetic

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	146.18			Native Backfill
	Dark brown silty sand, trace organic material (TOPSOIL)	145.98 0.20	1		
	Brown, SILTY SAND, some gravel	145.57 0.61	2	Sieve (see Fig. A1)	
1	Grey brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)	144.96 1.22	3		
	Possible Weathered Bedrock	144.60 1.58	4		
	Practical Excavator Refusal on Inferred Bedrock End of Test Pit				
2	Notes: - No groundwater inflow observed upon completion of test pit				
3					
4					
5					
6					

SHEAR STRENGTH, Cu (kPa)
Natural. V - +
Remoulded. V - ⊕
20 40 60 80

WATER CONTENT (PERCENT)
Wp ├──○ W──┤ Wl
20 40 60 80

DEPTH SCALE
1 to 30

Houle Chevrier Engineering

LOGGED: A.N.
CHECKED:

TESTPIT RECORD 2012 14-327 TEST PIT LOGS AUGUST 2014.GPJ HCE DATA TEMPLATE.GDT 9-29-14

PROJECT: 14-327

RECORD OF TEST PIT 7

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ⊢—○ W —⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		144.56					
	Dark brown silty clay, trace organic material (TOPSOIL)		144.33 0.23					Native Backfill
1 2	Very stiff, grey brown SILTY CLAY (Weathered Crust)		141.99 2.57					
3	Grey brown silty sand, some gravel, cobbles, and boulders, trace clay (GLACIAL TILL)		140.85 3.71					
4 5 6	End of Test Pit Notes: - Groundwater inflow observed at about 2.5 metres below ground surface - Possible bedrock at about 3.7 metres below ground surface							

TESTPIT RECORD 2012 14-327 TEST PIT LOGS AUGUST 2014.GPJ HCE DATA TEMPLATE.GDT 9-29-14

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 8

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

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

SHEAR STRENGTH, Cu (kPa)
Natural. V - +
Remoulded. V - ⊕
20 40 60 80

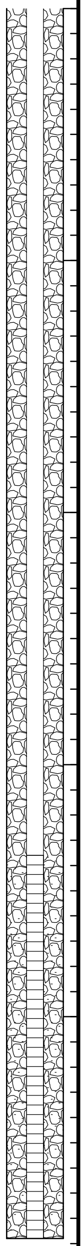
WATER CONTENT (PERCENT)
Wp ⊢—○ W—⊣ Wl
20 40 60 80

ADDITIONAL LAB. TESTING

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
Ground Surface	144.12		
Dark brown silty clay, trace organic material (TOPSOIL)	143.89 0.23		Native Backfill
Very stiff, grey brown SILTY CLAY (Weathered Crust)	139.80 4.32		25mm diameter, 1.52m long slotted PVC pipe
Firm, Grey SILTY CLAY	139.24 4.88	1	
End of Test Pit			Water level in standpipe at about 1.6 metres below ground surface (elevation 142.5 metres geodetic) on August 21, 2014.

Notes:

- Groundwater inflow observed at about 4.6 metres below ground surface



DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 9

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		145.37					
	Dark brown silty clay, trace organic material (TOPSOIL)		145.12 0.25	1				Native Backfill
	Very stiff, grey brown SILTY CLAY (Weathered Crust)	▨	144.86 0.51	2				
	Grey brown silty sand, some gravel, cobbles, and boulders (GLACIAL TILL)		144.61 0.76	3				
1	Practical Excavator Refusal on Inferred Bedrock End of Test Pit Notes: - No groundwater inflow observed upon completion of test pit							
2								
3								
4								
5								
6								

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 10

SHEET 1 OF 1

LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ├──○W──┤ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		148.22					
	Dark brown silty sand, trace organic material (TOPSOIL)	▨	147.91 0.31	1				Native Backfill ▨
	Very stiff, grey brown SILTY CLAY (Weathered Crust)	▨	147.41 0.81	2				
1	Grey brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)	▨	146.52 1.70	3				
2	Practical Excavator Refusal on Inferred Bedrock End of Test Pit Notes - No groundwater inflow observed upon completion of test pit							
3								
4								
5								
6								

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

PROJECT: 14-327

RECORD OF TEST PIT 11

SHEET 1 OF 1

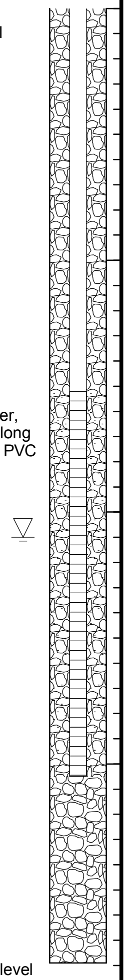
LOCATION: See Test Pit Location Plan, Figure 2

DATUM: Geodetic

DATE OF EXCAVATION: August 14, 2014

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ├──⊖ W──┤ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		145.44					
	Dark brown silty clay, trace organic material (TOPSOIL)		145.39 0.05	1				Native Backfill
	Very stiff, grey brown SILTY CLAY (Weathered Crust)			2				
1								
				3				25mm diameter, 1.52m long slotted PVC pipe
2								
3								
	Grey silty sand, trace to some clay, some gravel, cobbles, and boulders (GLACIAL TILL)		142.29 3.15	4				
	End of Test Pit Notes: - Groundwater inflow noted at 3.3 metres below ground surface		141.65 3.79					Water level in standpipe at about 2.1 metres below ground surface (elevation 143.3 metres geodetic) on August 21, 2014.
4								
5								
6								



DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

RECORD OF TEST PIT 12

PROJECT: 14-327

LOCATION: See Test Pit Location Plan, Figure 2

DATE OF EXCAVATION: August 14, 2014

SHEET 1 OF 1

DATUM: Geodetic

TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SHEAR STRENGTH, Cu (kPa) Natural. V - + Remoulded. V - ⊕ 20 40 60 80	WATER CONTENT (PERCENT) Wp ├──○ W──┤ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		149.05					
	Dark brown silty sand, trace organic material (TOPSOIL)		148.85 0.20	1				Native Backfill
	Brown, SILTY SAND, trace gravel		148.57 0.48	2			Sieve (See Fig. A1)	
	Very stiff, grey brown SILTY CLAY (Weathered Crust)		147.98 1.07	3				
1	Grey brown silty sand, some gravel, cobbles and boulders (GLACIAL TILL)		147.75 1.30	4				
	Practical Excavator Refusal on Inferred Bedrock End of Test Pit Notes: - No groundwater inflow observed upon completion of test pit							
2								
3								
4								
5								
6								

DEPTH SCALE

1 to 30

Houle Chevrier Engineering

LOGGED: A.N.

CHECKED:

RECORD OF TEST PIT 13

PROJECT: 14-327
LOCATION: See Test Pit Location Plan, Figure 2
DATE OF EXCAVATION: August 14, 2014

SHEET 1 OF 1
DATUM: Geodetic
TYPE OF EXCAVATOR: CAT 330C

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER
0	Ground Surface	144.12	
	Dark brown silty sand, trace organic material (TOPSOIL)	144.02 0.10	1
	Very stiff, grey brown SILTY CLAY (Weathered Crust)		2 3 4
3	Grey brown silty sand, trace clay, some gravel, cobbles, and boulders (GLACIAL TILL)	140.84 3.28	
4	End of Test Pit	140.21 3.91	

SHEAR STRENGTH, Cu (kPa)
Natural. V - +
Remoulded. V - ⊕
20 40 60 80

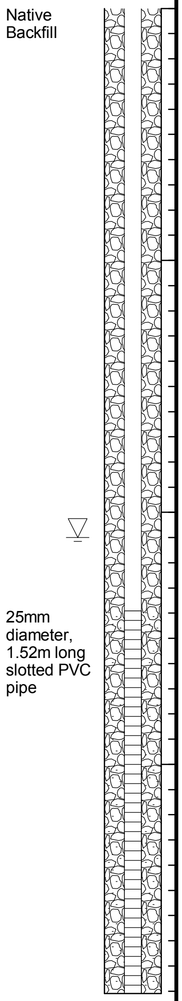
WATER CONTENT (PERCENT)
Wp ⊢—○W—⊣ Wl
20 40 60 80

ADDITIONAL LAB. TESTING

WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION

Notes:

- Groundwater inflow observed at about 3.3 metres below ground surface
- Possible bedrock at about 3.9 metres below ground surface



Water level in standpipe at about 2.2 metres below ground surface (elevation 141.9 metres geodetic) on August 21, 2014.

DEPTH SCALE
1 to 30

Houle Chevrier Engineering

LOGGED: A.N.
CHECKED:

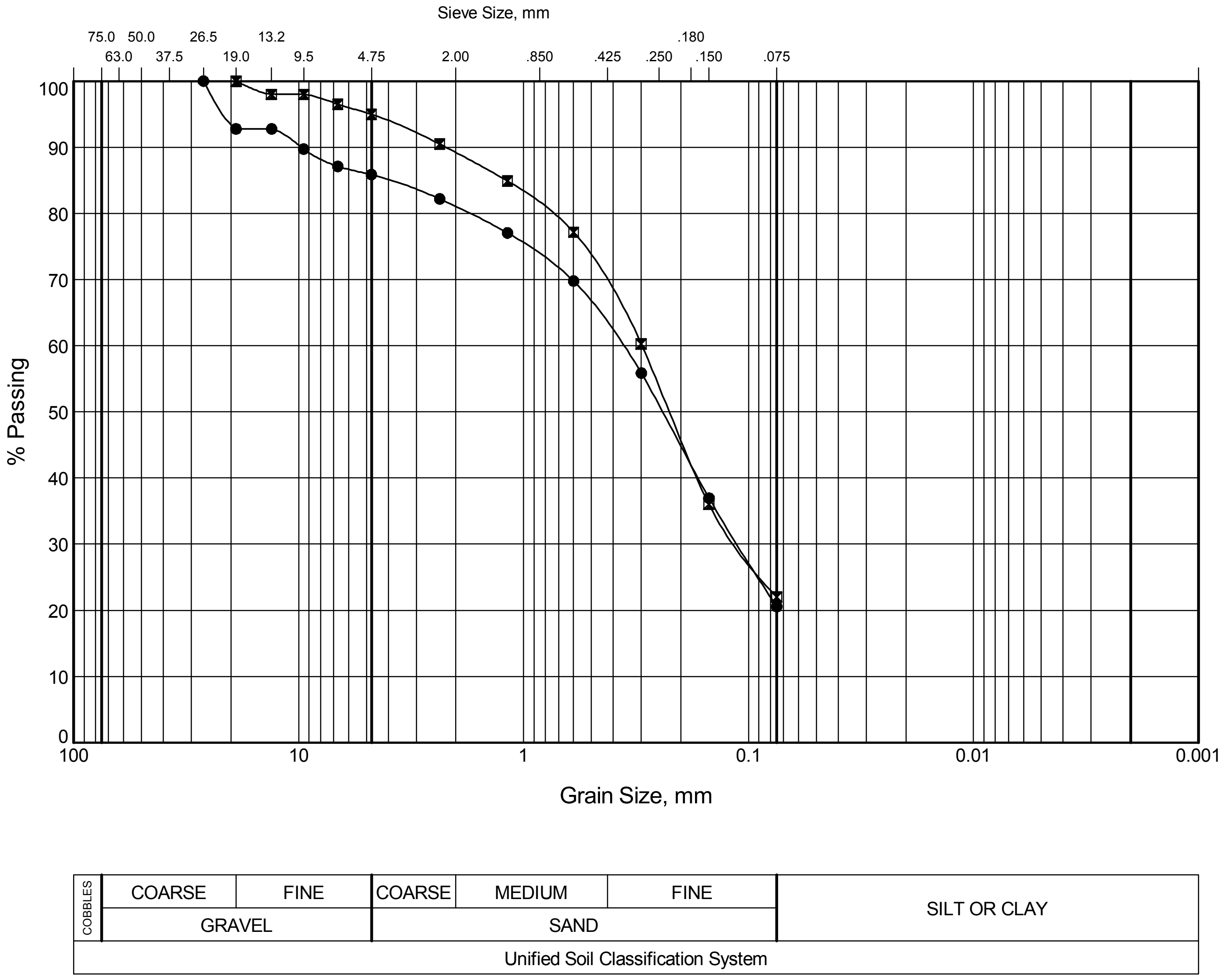
APPENDIX B

Laboratory Test Results
Grain Size Distribution Testing

Report to: Bonnechere Excavating Inc.
GEMTEC Project: 62658.03 (December 21, 2022)

GRAIN SIZE DISTRIBUTION

FIGURE A1



Test pit	Sample	Depth (m)	Legend
6	2	0.2 - 0.5	●
12	2	0.2 - 0.5	☒

Houle Chevrier Engineering

Date: October 2014

Project: 14-327

APPENDIX C

Chemical Analysis of Soil Samples
Sample Relating to Corrosion
(Paracel Laboratories Ltd. Order No. 1434268)

Certificate of Analysis

Report Date: 27-Aug-2014
Order Date:21-Aug-2014

Client: **Houle Chevrier**
Client PO:
Project Description: 14-327

	Client ID:	TP1	-	-	-
	Sample Date:	21-Aug-14	-	-	-
	Sample ID:	1434268-01	-	-	-
	MDL/Units	Water	-	-	-

General Inorganics

Conductivity	5 uS/cm	506	-	-	-
Hardness	1.0 mg/L	267	-	-	-
pH	0.1 pH Units	7.5	-	-	-

Anions

Chloride	1 mg/L	5	-	-	-
Sulphate	1 mg/L	27	-	-	-

P: 1-800-749-1947
E: PARACEL@PARACELLABS.COM

WWW.PARACELLABS.COM

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300-2319 St. Laurent Blvd.
Ottawa, ON K1G 4J8

OTTAWA-WEST
104-195 Stafford Rd. W.
Nepean, ON K2H 9C1

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6645 Kitimat Rd. Unit #27
Mississauga, ON L5N 6J3

SARNIA
218-704 Mara St.
Point Edward, ON N7V 1X4

NIAGARA
360 York Rd. Unit 16B
Niagara-on-the-Lake, ON L0S 1J0

KINGSTON
1058 Gardiners Rd.
Kingston, ON K7P 1R7

Page 3 of 7

experience • knowledge • integrity

civil	civil
geotechnical	géotechnique
environmental	environnement
structural	structures
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité