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REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
121 BRAE CRESCENT
CITY OF OTTAWA, ONTARIO

Project # 220338

Submitted to:

Bryden Gibson Architects Inc.
1066 Somerset St. West, Suite 200
Ottawa, ON
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February 22, 2023

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February 22, 2023 220338

Bryden Gibson Architects Inc.
1066 Somerset St. West, Suite 200
Ottawa, ON
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RE: GEOTECHNICAL INVESTIGATION
PROPOSED RESDENTIAL DEVELOPMENT
121 BRAE CRESCENT
CITY OF OTTAWA, ONTARIO

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the proposed residential development at 121 Brae Crescent, City of Ottawa, Ontario (See Key Plan, Figure 1).

The purpose of the investigation was to:

- Identify the subsurface conditions at the site by means of a limited number of boreholes;
- Based on the factual information obtained, provide recommendations and guidelines on the geotechnical engineering aspects of the project design; including bearing capacity and other construction considerations, which could influence design decisions.

2.0 BACKGROUND INFORMATION AND SITE GEOLOGY

2.1 Existing Conditions and Site Geology

The subject site for this assessment consists of about a 0.06 hectare (0.15 acres) irregular shaped property located at 121 Brae Crescent, City of Ottawa, Ontario (see Key Plan, Figure 1).

For the purposes of this assessment, project north lies in a direction perpendicular to Brae Crescent, located north of the site.

Surrounding land use is mostly residential development and one commercial development. The site is bordered on the north by Brae Crescent followed by residential and one commercial development, to the west by Norway Spruce Street followed by residential development, and to the south and east by residential developments. The site is currently vacant.

The ground surface at the site is currently graded such that surface water drains to the west.

Based on a review of the surficial geology map for the site area, it is expected that the site is underlain by sand and/or gravel. Bedrock geology maps indicate that the bedrock underlying the site consists of limestone of the Ottawa Formation.

2.2 Proposed Development

It is understood that preliminary plans are being prepared for the construction of a 3-storey residential building. The building will be serviced by a parking lot. It is understood that the building will be wood framed with some brick veneer with conventional concrete spread footing foundations and a cast in place ground floor slab-on-grade (no basement). The proposed building will be serviced by municipal water and sanitary services.

Surface drainage for the proposed building will be by means of swales, nearby catch basins and storm sewers.

3.0 PROCEDURE

The field work for this investigation was carried out on February 14, 2023, at which time two boreholes, numbered BH1 and BH2 were put down at the site using a track mounted drill rig equipped with a hollow stem auger owned and operated by CCC Geotechnical & Environmental Drilling of Ottawa, Ontario. The boreholes were put down in the vicinity of the proposed building.

The subsurface soil conditions encountered at the boreholes were classified based on visual and tactile examination of the samples recovered (ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), standard penetration tests (ASTM D-1586) as well as laboratory test results on select samples. Groundwater conditions at the boreholes were noted at the time of drilling and at a later date. The boreholes were loosely backfilled with the auger cuttings upon completion of drilling.

Sampling of the overburden materials encountered at the borehole location was carried out at regular 0.75 metre depth intervals using a 50 millimetre diameter drive open conventional split spoon sampler in conjunction with standard penetration testing. All of the boreholes were put down to bedrock at the site. The soils were classified using the Unified Soil Classification System.

One soil sample (BH1 – SS10 – 6.9 – 7.5 m) was submitted for Particle Size Analysis (ASTM D422). One soil sample (BH1 – SS4 – 2.3 – 2.9 m) was submitted for sieve analysis (ASTM C136). The samples were selected based on depth and tactile examination to be representative of the various soil conditions encountered at the site. The soils were classified using the Unified Soil Classification System.

A total of nineteen soil samples recovered from the boreholes were also tested for moisture content (ASTM D2216).

One soil sample (BH2 – SS2 – 0.8 – 1.4 m) was delivered to a chemical laboratory for testing for any indication of potential soil sulphate attack on concrete and corrosivity to buried steel.

The field work was supervised throughout by members of our engineering staff who located the boreholes in the field, logged the boreholes and cared for the samples obtained. A description of the subsurface conditions encountered at the boreholes is given in the attached Record of Borehole Sheets. The results of the laboratory testing of the soil samples are presented in the Laboratory Test Results section and Attachment A following the text in this report. The approximate locations of the boreholes are shown on the attached Site Plan, Figure 2.

4.0 SUBSURFACE CONDITIONS

4.1 General

As previously indicated, a description of the subsurface conditions encountered at the boreholes is provided in the attached Record of Borehole Sheets following the text of this report. The borehole logs indicate the subsurface conditions at the specific drill locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at locations other than borehole locations may vary from the conditions encountered at the boreholes.

Classification and identification of soil involves judgement and Kollaard Associates Inc. 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 on the date the observations were noted in the report and on the borehole logs. Groundwater conditions may vary seasonally, or may be affected by construction activities on or in the vicinity of the site.

The following is a brief overview of the subsurface conditions encountered at the boreholes.

4.2 Topsoil

From the surface, a layer of topsoil measuring about 0.15 to 0.25 metres in thickness was encountered in boreholes BH1 and BH2. The material was classified as topsoil based on the colour and the presence of organic materials. The identification of the topsoil layer is for geotechnical purposes only and does not constitute a statement as to the suitability of this layer for cultivation and sustainable plant growth.

4.4 Sand

Yellow brown or red brown to grey brown to grey sand consisting of interlayered silty sand and fine to medium sand was encountered beneath the topsoil in all boreholes. Blow counts within the sand ranged between 5 to 33 blows per 0.3 metres, which indicates a loose to dense state of packing. The sand ranged in thickness between about 4.3 to 6.6 metres and was fully penetrated where encountered.

The results of one sieve analysis (ASTM C136) on a sample of soil (BH1-SS4 – 2.3 – 2.9 m) indicates the sample has a gravel content of 0.4 percent, a sand content of 34 percent, and a silt and clay content of 65.6 percent. The results are located in Attachment A.

4.4 Glacial Till

Glacial till was encountered beneath the silty clay in boreholes BH1 and BH2, at depths between about 4.6 to 6.7 metres below the existing ground surface. The glacial till consisted of grey silty sand, with some gravel, cobbles and boulders and traces of clay. The results of the standard penetration testing carried out in the glacial till material were about 9 to 52 blows per 0.3 metres, indicating a loose to very dense state of packing. Boreholes BH1 and BH2 were terminated with practical refusal on bedrock or large boulders at depths of about 7.3 and 6.6 metres, respectively, below the existing ground surface.

The results of a hydrometer test (ASTM D422 and D2216) on one sample of soil (BH1 – SS10 – 6.8 – 7.4 m) indicates the sample has the following:

Sample	Depth(metres)	% Gravel	% Sand	% Silt	% Clay
BH1 – SS10	6.8 – 7.4	8.8	49.3	25.9	16.0

The results of the laboratory testing are located in Attachment A.

4.8 Moisture Contents

A total of eighteen soil samples recovered from the boreholes were tested for moisture content (ASTM D2216). The measured moisture contents of the sand ranged from 5 to 25 percent. The moisture content of the glacial till ranged from 9 to 12 percent. The results of the moisture content analysis are located on the Record of Borehole sheets following the text of this report.

4.5 Groundwater

Some groundwater was encountered in boreholes BH1 and BH2 at depths of about 5.0 and 4.3 metres, respectively, below the existing ground surface at the time of drilling, February 14, 2023. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

4.6 Corrosivity on Reinforcement and Sulphate Attack on Portland Cement

The results of the laboratory testing of a soil sample (BH2 – SS2 – 0.8 – 1.4 m) for submitted for chemistry testing related to corrosivity is summarized in the following table.

Item	Threshold of Concern	Test Result	Comment
Chlorides (Cl)	Cl > 0.04 %	<0.0005	Negligible concern
pH	5.5 > pH	7.40	Basic Negligible concern
Resistivity	R < 20,000 ohm-cm	16600	Mildly corrosive
Sulphates (SO_4)	SO_4 > 0.1%	<0.0020	Negligible concern

The results of the laboratory testing of a soil sample for sulphate gave a percent sulphate of less than 0.0020. The National Research Council of Canada (NRC) recognizes four categories of potential sulphate attack of buried concrete based on percent sulphate in soil. From 0 to 0.10 percent the potential is negligible, from 0.10 to 0.20 percent the potential is mild but positive, from 0.20 to 0.50 percent the potential is considerable and 0.50 percent and greater the potential is severe. Based on the above, the soils are considered to have a negligible potential for sulphate attack on buried concrete materials and accordingly, conventional GU or MS Portland cement may be used in the construction of the proposed concrete elements.

The pH value for the soil sample was reported to be at 7.40, indicating a durable condition against corrosion. This value was evaluated using Table 2 of Building Research Establishment (BRE) Digest 362 (July 1991).The pH is greater than 5.5 indicating the concrete will not be exposed to attack from acids.

The chloride content of the sample was also compared with the threshold level and presents negligible concrete corrosion potential.

Corrosivity Rating for soils ranges from extremely corrosive to non-corrosive as follows:

Soil Resistivity (ohm-cm)	Corrosivity Rating
> 20,000	non- corrosive
10,000 to 20,000	mildly corrosive
5,000 to 10,000	moderately corrosive

3,000 to 5,000	corrosive
1,000 to 3,000	highly corrosive
< 1,000	extremely corrosive

The soil resistivity was found to be 16600 ohm-cm for the sample analyzed making the soil mildly corrosive for buried steel within below grade concrete walls.

Consideration to increasing the specified strength and/or adding air entrainment into any reinforced concrete in contact with the soil should be given. Consideration should also be given to increasing the minimum concrete cover over reinforcing steel.

5.0 GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS

5.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the information from the test holes 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 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 at this site or adjacent properties, and/or resulting from the introduction onto the site of materials from offsite sources are outside the terms of reference for this report.

5.2 Foundation for Proposed Residential Building

With the exception of the topsoil and loose sand, the subsurface conditions encountered within the test holes are suitable for the support of the proposed residential building on conventional spread footing foundations. Excavations for the proposed foundations should be taken through the topsoil to expose the native sand subgrade.

5.3 Foundation Design and Bearing Capacity

It is expected that the proposed footing will bear between 1.0 and 1.5 metres below the existing ground surface. Based on the relative density of the sand at that level is is recommended that the excavation be extended to 0.3 metres below the proposed USF. The exposed subgrade should be proof-rolled, then brought up to the USF using engineered fill.

The foundation of the proposed residential building may be placed on conventional pad and strip footings. A maximum allowable bearing pressure of 100 kilopascals using serviceability limit states design and a factored ultimate bearing resistance of 200 kilopascals using ultimate limit states design may be used for the design of conventional strip or pad footings, a minimum of 0.6 metres in width, founded on an engineered pad founded on the silty or fine to medium sand.

The above allowable bearing pressure is subject to a maximum grade raise of 1.5 metres above the existing ground surface. Total and differential settlement of the footings for the residential building designed and founded based on the above guidelines should be less than 25 millimetres and 20 millimetres, respectively.

The subgrade surfaces should be inspected and approved by geotechnical personnel prior to placement of any engineered fill or concrete.

5.4 Engineered Fill

It is recommended that the building be founded on engineered fill placed on silty sand or fine to medium sand. It is not recommended that the footings be placed on both native soil and engineered fill at different locations in the building.

Any fill required to raise the footings for the proposed building to founding level should consist of imported granular material (engineered fill). The engineered fill should consist of granular material meeting Ontario Provincial Standards Specifications (OPSS) requirements for Granular A or Granular B Type II and should be compacted in maximum 300 millimetre thick loose lifts to at least 98 percent of the standard Proctor maximum dry density. It is considered that the engineered fill should be compacted using dynamic compaction with a large diameter vibratory steel drum roller or diesel plate compactor. If a diesel plate compactor is used, the lift thickness may need to be restricted to less than 300 mm to achieve proper compaction. Compaction should be verified by a suitable field compaction test method.

To allow the spread of load beneath the footings, the engineered fill should extend out 0.5 metres horizontally from the edges of the footing then down and out at 1 horizontal to 1 vertical, or flatter. The excavations for the proposed residential building should be sized to accommodate this fill placement.

5.5 Excavation Considerations

5.5.1 Foundation Excavation

Any excavation for the proposed structure will likely be carried out through topsoil to bear upon the native sand materials. The sides of the excavations should be sloped in accordance with the requirements of Ontario Regulation 213/91, s. 226 under the Occupational Health and Safety Act. According to the Act, the native soils at the site can be classified as Type 3 soil, however this classification should be confirmed by qualified individuals as the site is excavated and if necessary, adjusted.

It is expected that the side slopes of the excavation will be stable in the short term provided the walls are sloped at 1H:1V through the fill materials to 1.2 metres or less from the bottom of the excavation and provided no excavated materials are stockpiled within 3 metres of the top of the excavations.

5.5.2 Effect of Foundation Excavation on Adjacent Structures and City of Ottawa Services

As previously indicated, the proposed foundation excavations will be carried out through topsoil, silty sand and fine to medium sand. There will be no bedrock excavation or removal. As such, there will be no excavation processes which could contribute to vibration which could potentially damage adjacent municipal services.

5.5.3 Ground Water in Excavation and Construction Dewatering

Groundwater inflow from the native soils into the excavations during construction, if any should be handled by pumping from sumps within the excavation.

Groundwater was observed in boreholes BH1 and BH2 at depths of about 5.0 and 4.3 metres, respectively, below the existing ground surface. Based on the water levels observed within the native soils onsite, it is considered unlikely that a permit to take water will be required prior to excavation. It is considered however that registration under the Environmental Activity and Sector Registry may be required.

5.5.4 Effect of Dewatering of Foundation or Site Services Excavations on Adjacent Structures

Since the existing normal groundwater level at the site will be below the expected underside of footing elevations, dewatering of the excavation will not remove water from historically saturated soils. As such dewatering of the foundations or site services excavations, if required, will not have a detrimental impact on any adjacent structures.

5.6 Frost Protection Requirements for Spread Footing Foundations

In general, all exterior foundation elements and those in any unheated parts of the proposed building should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated, unheated foundation elements adjacent to surfaces, which are cleared of snow cover during winter months should be provided with a minimum 1.8 metres of earth cover for frost protection purposes.

Where less than the required depth of soil cover can be provided, the foundation elements should be protected from frost by using a combination of earth cover and extruded polystyrene rigid insulation. A typical frost protection insulation detail could be provided upon request, if required.

5.7 Foundation Wall Backfill and Drainage

Provided the proposed finished floor surfaces are above the exterior finished grade at all locations, the granular materials beneath the proposed floor slab are properly compacted and provided the exterior grade is adequately sloped away from the proposed building, no perimeter foundation drainage system is required.

The native soils encountered at this site are considered to be slightly frost susceptible. As such, to prevent possible foundation frost jacking, the backfill against any unheated or insulated walls or isolated walls or piers should consist of free draining, non-frost susceptible material. If imported material is required, it should consist of sand or sand and gravel meeting OPSS Granular B Type I grading requirements.

Alternatively, foundations could be backfilled on the exterior with native material in conjunction with the use of an approved proprietary drainage layer system (such as Platon System Membrane) against the foundation wall. There is potential for possible frost jacking of the upper portion of some types of these drainage layer systems if frost susceptible material is used as backfill. To mitigate this potential, the upper approximately 0.6 metres of the foundation should be backfilled with non-frost susceptible granular material.

Where the granular backfill will ultimately support a pavement structure or walkway, it is suggested that the wall backfill material be compacted in 250 millimetre thick lifts to 95 percent of the standard Proctor dry density value. In that case any native material proposed for foundation backfill should be inspected and approved by the geotechnical engineer.

5.8 Building Floor Slab

As stated above, it is expected that the proposed building will be founded on an engineered pad placed on the sand. For predictable performance of the proposed concrete basement floor slab all topsoil, and any otherwise deleterious material should be removed from below the proposed floor slab areas. The exposed native sand subgrade surface should then be inspected and approved by geotechnical personnel.

The fill materials beneath the proposed concrete basement floor slab on grades should consist of a minimum of 150 millimetre thickness of crushed stone meeting OPSS Granular A immediately beneath the concrete floor slab followed by sand, or sand and gravel meeting the OPSS for Granular B Type I, or crushed stone meeting OPSS grading requirements for Granular B Type II, or other material approved by the Geotechnical Engineer. The fill materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density.

The slab should be structurally independent from walls and columns, which are supported by the foundations. This is to reduce any structural distress that may occur as a result of differential soil movement. If it is intended to place any internal non-load bearing partitions directly on the slab-on-grade, such walls should also be structurally independent from other elements of the building founded on the conventional foundation system so that some relative vertical movement between the floor slab and foundation can occur freely.

The concrete floor slab should be saw-cut at regular intervals to minimize random cracking of the slab due to shrinkage of the concrete. The saw cut depth should be about one quarter of the thickness of the slab. The crack control cuts should be placed at a grid spacing not exceeding the lesser of 25 times the slab thickness or 4.5 metres. The slab should be cut as soon as it is possible to work on the slab without damaging the surface of the slab. Under slab drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level. If any areas of the proposed building are to remain unheated during the winter period or under slab insulation is to be used, thermal protection of the foundation may be required. Further details on the insulation requirements could be provided, if necessary.

5.9 Seismic Design for the Proposed Residential Building

5.9.1 Seismic Site Classification

Based on the limited information from the boreholes, for seismic design purposes, in accordance with the 2012 OBC Section 4.1.8.4, Table 4.1.8.4.A., the site classification for seismic site response is Site Class D.

5.9.2 National Building Code Seismic Hazard Calculation

The design Peak Ground Acceleration (PGA) for the site was calculated as 0.248 with a 2% probability of exceedance in 50 years based on the interpolation of the 2015 National Building Code Seismic Hazard calculation. The results of the test are attached following the text of this report.

5.9.3 Potential for Soil Liquefaction

Consideration for the potential for soil liquefaction was determined by considering the ratio between the cyclic resistance ratio (CRR) and the cyclic stress ratio (CSR) for the soils between the proposed underside of footing level and the depth at which refusal to further advancement using standard penetration testing was attained. The CRR value was determined from a mathematical expression as determined by Rauch (1997) of the base curve obtained from Robertson and Fear (1996). The CSR was determined from Seed and Idriss (1971). It is considered that a soil with a normalized SPT of greater than 30 is non-liquefiable. It is also considered that a soil with a CRR/CSR ratio of greater than one is not liquefiable. The average CRR / CSR ratio for the materials encountered to the depth explored excluding the normalized SPT values above 30 is 22.4. As such the underlying soils below the proposed foundation are not considered to be liquefiable.

6.0 SITE SERVICES

6.1 Excavation

The excavations for the site services will be carried out through topsoil silty sand and/or fine to medium sand. For the purposes of Ontario Regulation 213/91 the soils at the site can be considered to be Type 3 soil. The sides of the excavations in overburden materials should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Ontario Occupational Health and Safety Act. That is, open cut excavations with overburden deposits should be carried out with side slopes of 1 horizontal to 1 vertical, or flatter. Where space constraints dictate, the excavation and backfilling operations should be carried out within a tightly fitting, braced steel trench box.

Based on the depths at which groundwater was measured within the boreholes, significant groundwater flow into any excavation is unlikely. Any groundwater inflow into the service trenches should be handled by pumping from sumps from within the excavations.

6.2 Pipe Bedding and Cover Materials

It is suggested that the service pipe bedding material consist of at least 150 millimetres of granular material meeting OPSS requirements for Granular A. A provisional allowance should, however, be made for sub-excavation of any existing fill or disturbed material encountered at sub-grade level. Granular material meeting OPSS specifications for Granular A could be used as a sub-bedding material. The use of clear crushed stone as bedding or sub-bedding material should not be permitted.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of OPSS Granular A.

The sub-bedding, bedding and cover materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

6.3 Trench Backfill

The general backfilling procedures should be carried out in a manner that is compatible with the future use of the area above the service trenches.

In areas where the service trench will be located below or in close proximity to existing or future roadway areas, native material should be used as backfill between the roadway sub-grade level and the depth of seasonal frost penetrations (i.e. 1.8 metres below finished grade) in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent section of roadway.

Where native backfill is used, it should match the native materials exposed on the trench walls. Some of the native materials from the lower part of the trench excavations may be wet of optimum for compaction. Depending on the weather conditions encountered during construction, some drying of materials and/or recompaction may be required. Any wet materials that cannot be compacted to the required density should either be wasted from the site or should be used outside of existing or future roadway areas. Any boulders larger than 300 millimetres in size should not be used as service trench backfill. 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. If the native material is not suitable for backfill, imported granular material may have to be used. If imported granular materials are used, suitable frost tapers should be used OPSD 802.013.

To minimize future settlement of the backfill and achieve an acceptable sub-grade for the roadways, sidewalks, etc., the trench should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. The specified density may be reduced where the trench backfill is not located or in close proximity to existing or future roadways, driveways, sidewalks, or any other type of permanent structure.

7.0 PARKING LOT PAVEMENTS

7.1 Subgrade Preparation

Based on the results of the boreholes, the subsurface conditions in the proposed and parking lot areas are expected to consist of topsoil followed by loose silty sand and/or fine to medium sand.

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

Where the subgrade surface consists of loose sand, it should compacted using a large vibratory steel drum roller. The compacted silty sand and/or fine to medium sand subgrade should be inspected and approved by geotechnical personnel. Any soft or unacceptable areas evident should be subexcavated and replaced with suitable earth borrow material. The subgrade should be shaped and crowned to promote drainage of the access roadway and parking lot area granulars. Following approval of the preparation of the subgrade, the pavement granulars may be placed.

For any areas of the site that require the subgrade to be raised to proposed parking lot area subgrade level, the material used should consist of OPSS select subgrade material or OPSS Granular B Type I or Type II. Materials used for raising the subgrade to proposed access roadway and parking lot areas subgrade level should be placed in maximum 300 millimetre thick loose lifts and be compacted to at least 95 percent of the standard Proctor maximum dry density using suitable compaction equipment.

The proposed parking lot pavement should consist of:

40 millimetres of Superpave 12.5 asphaltic concrete over

50 millimetres of Superpave 19 asphaltic concrete over

150 millimetres of OPSS Granular A base over
300 millimetres of OPSS Granular B, Type II subbase over
(50 or 100 millimetre minus crushed stone)

Performance grade PG 58-34 asphaltic concrete should be specified. Compaction of the granular pavement materials should be carried out in maximum 300 millimetre thick loose lifts to 100 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

The above pavement structures will be adequate on an acceptable sub-grade, that is, one where any parking lot backfill has been adequately compacted. If the parking lot sub-grade 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 and/or incorporate a non-woven geotextile separator between the roadway sub-grade surface and the granular subbase material. The adequacy of the design of the pavement thickness should be assessed by the geotechnical personnel at the time of construction.

8.0 CONSTRUCTION CONSIDERATIONS

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed development do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design.

All foundation areas and any engineered fill areas for the proposed residential building should be inspected by Kollaard Associates Inc. to ensure that a suitable sub-grade has been reached and properly prepared. The placing and compaction of any granular materials beneath the foundations should be inspected to ensure that the materials used conform to the grading and compaction specifications.

The subgrade for the site services should be inspected and approved by geotechnical personnel. In situ density testing should be carried out on the service pipe bedding and backfill and the pavement granular materials to ensure the materials meet the specifications from a compaction point of view.

The native sand and glacial till at this site will be sensitive to disturbance from construction operations, from rainwater or snow melt, and frost. In order to minimize disturbance, construction traffic operating directly on the subgrade should be kept to an absolute minimum and the subgrade should be protected from below freezing temperatures.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we may be of further services to you, please do not hesitate to contact our office.

Regards,
Kollaard Associates Inc.

LICENSED PROFESSIONAL ENGINEER
Feb 22, 2023
S.E. deWit
100079612
PROVINCE OF ONTARIO

Dean Tataryn, B.E.S., EP.

Steve DeWit, P.Eng.

BOREHOLE BH1

PROJECT: Proposed Residential Development
CLIENT: Bryden Gibson
LOCATION: 121 Brae Crescent
PENETRATION TEST HAMMER: 63.5 kg, Drop, 0.76 mm

PROJECT NUMBER: 220338
DATE OF BORING: 2023-02-14
SHEET: 1 of 1
DATUM: GEODETIC

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	DEPTH (m)	STRATA PLOT	ELEV. (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	UNDIST SHEAR STRENGTH x Cu. kPa x / REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100)	DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100)	MOISTURE CONTENT (%)	PIEZOMETER OR STANDPIPE INSTALLATION
	TOPSOIL	0.00		122.36							
	Yellow brown fine to medium SAND	0.15		122.21	1	SS	4			51	
1.0					2	SS	8			7	
	Grey brown fine to medium SAND	1.07		121.29							
	Grey brown SILTY SAND	1.52		120.84	3	SS	9			21	
2.0											
	Grey SILTY SAND	2.13		120.23	4	SS	30			16	
3.0											
	Grey fine to medium SAND	3.05		119.31	5	SS	32			5	
4.0					6	SS	33			5	
5.0					7	SS	20			16	∇
					8	SS	12			22	Groundwater encountered at about 5.0 metres below the existing ground surface at the time of drilling, February 14, 2023.
6.0					9	SS	5			11	
7.0	Grey silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)	6.71		115.65	10	SS	23			9	
	Practical refusal on bedrock or large boulder	7.32		115.04							

DEPTH SCALE: 1 to 50
LOGGED: CI

BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

BOREHOLE BH2

PROJECT: Proposed Residential Development
CLIENT: Bryden Gibson
LOCATION: 121 Brae Crescent
PENETRATION TEST HAMMER: 63.5 kg, Drop, 0.76 mm

PROJECT NUMBER: 220338
DATE OF BORING: 2023-02-14
SHEET: 1 of 1
DATUM: GEODETIC

DESCRIPTION	DEPTH (m)	ELEV. (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	MOISTURE CONTENT (%)	PIEZOMETER OR STANDPIPE INSTALLATION
TOPSOIL	0.00	122.20					
Red brown SILTY SAND	0.25	121.95	1	SS	5	16	
Grey brown SILTY SAND	1.07	121.13	2	SS	6	14	
Grey brown fine to medium SAND	1.52	120.68	3	SS	8	13	
Grey fine to medium SAND	2.13	120.07	4	SS	18	5	
			5	SS	24	5	
			6	SS	10	25	∇
Grey silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)	4.57	117.63	7	SS	9	12	
			8	SS	39	8	Groundwater encountered at about 4.3 metres below the existing ground surface at the time of drilling, February 14, 2023.
			9	SS	52	9	
Practical refusal on bedrock or large boulder	6.58	115.62					

UNDIST SHEAR STRENGTH x Cu. kPa x; REM SHEAR STRENGTH o Cu. kPa o (0 20 40 60 80 100)

DYNAMIC CONE PENETRATION TEST blows/300 mm (0 20 40 60 80 100)

DEPTH SCALE (meters): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0

DEPTH SCALE: 1 to 50
LOGGED: CI
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS auger sample
CS chunk 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 millimeter 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° 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 remolded shear strength

SOIL DESCRIPTIONS

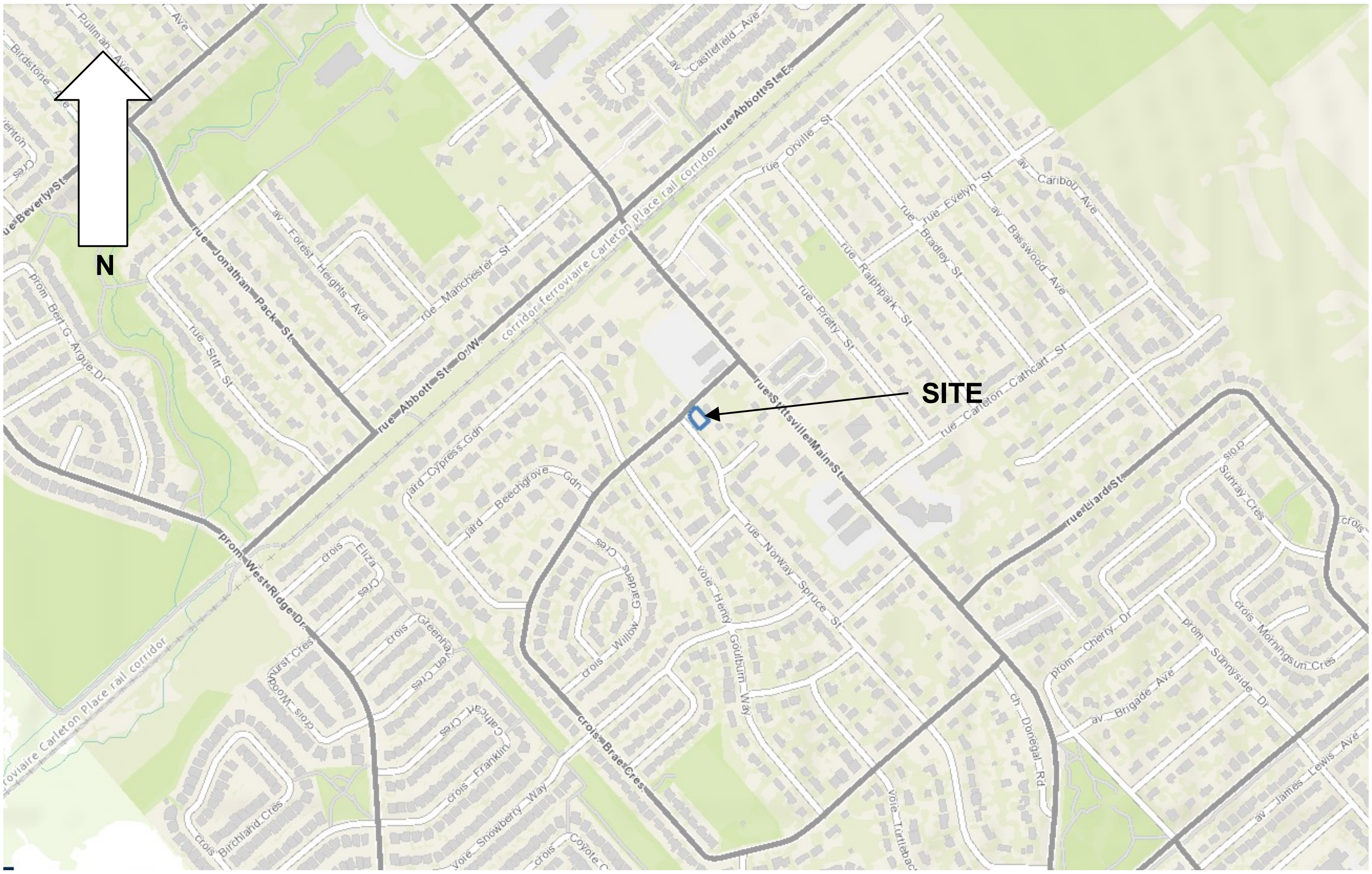
Relative Density	'N' Value
Very Loose	0 to 4
Loose	4 to10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to100
Very Stiff	over100

LIST OF COMMON SYMBOLS

Cu undrained shear strength
e void ratio
Cc compression index
Cv coefficient of consolidation
k coefficient of permeability
Ip plasticity index
n porosity
u pore pressure
w moisture content
wL liquid limit
Wp plastic limit
$1 effective angle of friction
r unit weight of soil
y^1 unit weight of submerged soil
cr normal stress

KEY PLAN	FIGURE 1



NOT TO SCALE

Kollaard Associates
Engineers

Project No. 220338
Date January 2022

DRAWING NUMBER:
SITE PLAN, FIGURE 2

LEGEND:

APPROXIMATE BOREHOLE LOCATION

REFERENCE: PLAN SUPPLIED BY
CITY OF OTTAWA EMAPS

SPECIAL NOTE: THIS DRAWING TO
BE READ IN CONJUNCTION WITH
THE ACCOMPANYING REPORT.

REV.	NAME	DATE	DESCRIPTION

Kollaard Associates
Engineers

P.O. BOX 189, 210 PRESCOTT ST
KEMPTVILLE ONTARIO
K0G 1J0 FAX (613) 258–0475
http://www.kollaard.ca
(613) 860–0923
info@kollaard.ca

CLIENT:
BRYDEN GIBSON ARCHITECTS INC.

PROJECT:
GEOTECHNICAL INVESTIGATION
FOR
PROPOSED RESIDENTIAL
DEVELOPMENT

LOCATION:
121 BRAE CRESCENT, STITTSVILLE
CITY OF OTTAWA, ON

DESIGNED BY: ––	*DATE:* JANUARY 6, 2023
DRAWN BY: DT	*SCALE:* N.T.S

KOLLAARD FILE NUMBER:
220338

ATTACHMENT A

Laboratory Test Results for Physical Properties

Moisture Content

LS - 701 / ASTM D 2216

PROJECT NO.: 220338	DATE SAMPLED: February 14, 2023	DATE TESTED: February 15, 2023
CLIENT: Bryden Gibosn Architects Inc.	DATE RECEIVED:	TESTED BY: CI
LOCATION: 121 Brae Crescent	DATE REQUESTED:	FILE NO.:

METHOD A ■ METHOD B □

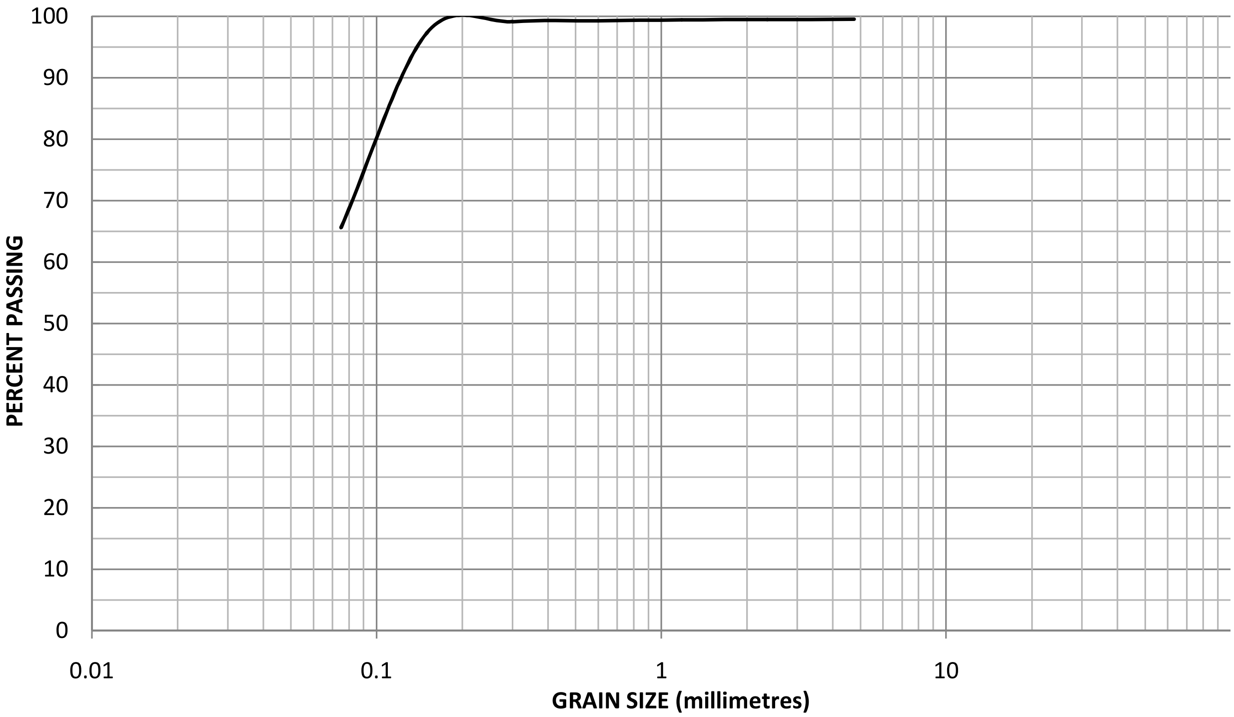
Water Content Recorded to +/- 1%			Water Content Recorded to +/- 0.1%		
Sieve Size, mm	Specimen Mass	Balance Readability, g	Sieve Size, mm	Specimen Mass	Balance Readability, g
75.0	5 kg	10	75.0	5 kg	10
37.5	1 kg	10	37.5	1 kg	10
19	250 g	0.1	19	250 g	0.1
9.5	50 g	0.1	9.5	50 g	0.1
4.75	20 g	0.1	4.75	20 g	0.1
2.00	20 g	0.1	2.00	20 g	0.1

ASTM D 2216 TABLE 1

Bore Hole:	BH1	BH1	BH1	BH1	BH1	BH1	BH1	BH1	BH1
Sample No.:	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10
Depth:	0.8-1.4	1.5-2.1	2.3-2.9	3.0-3.6	3.8-4.4	4.5-5.2	5.3-5.9	6.1-6.7	6.9-7.5
Tare No.:	2	3	4	5	6	7	8	9	10
Tare +Wet Soil (gms)	75.30	95.26	75.71	68.99	65.46	82.71	103.78	87.85	78.44
Tare + Dry Soil (gms)	71.71	82.47	68.06	66.91	63.20	74.31	88.89	81.41	73.96
Mass of Water (gms)	3.59	12.79	7.65	2.08	2.26	8.40	14.89	6.44	4.48
Mass of Tare (gms)	21.06	21.94	21.35	21.26	21.33	21.48	21.28	21.41	21.77
Mass of Solids (gms)	50.65	60.53	46.71	45.65	41.87	52.83	67.61	60.00	52.19
WATER CONTENT (%)	7	21	16	5	5	16	22	11	9
Drying Tempterature (ºC), if other than 110 ±5ºC									

Bore Hole:	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2
Sample No.:	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9
Depth:	0-0.6	0.8-1.4	1.5-2.1	2.3-2.9	3.0-3.6	3.8-4.4	4.5-5.2	5.3-5.9	6.1-6.7
Tare No.:	11	12	13	14	15	16	17	18	19
Tare +Wet Soil (gms)	73.10	70.73	75.00	76.46	72.40	111.25	101.65	77.33	86.07
Tare + Dry Soil (gms)	65.95	64.58	68.92	73.59	69.99	92.99	93.16	73.05	80.94
Mass of Water (gms)	7.15	6.15	6.08	2.87	2.41	18.26	8.49	4.28	5.13
Mass of Tare (gms)	21.30	21.09	21.22	21.06	21.41	21.17	20.95	21.24	21.19
Mass of Solids (gms)	44.65	43.49	47.70	52.53	48.58	71.82	72.21	51.81	59.75
WATER CONTENT (%)	16	14	13	5	5	25	12	8	9
Drying Tempterature (ºC), if other than 110 ±5ºC									

GRAIN SIZE DISTRIBUTION ANALYSIS	FIGURE 1



SIEVE SIZE (mm)	76.2	53	26.5	19.0	16	13.2	9.5	4.75	2.36	1.180	0.600	0.300	0.15	0.075
SAMPLE PASSING			100.0	100.0	100.0	100.0	99.9	99.6	99.5	99.4	99.3	99.2	97.3	65.6

CLIENT: Bryden Gibson Architects Inc

PROJECT: 121 Brae Crescent

OUR REF.: 220338

TYPE OF MATERIAL: Silty Sand

INTENDED USE: N/A

DATE SAMPLED: June 8, 2022

DATE TESTED: February 21, 2023

SOURCE: Native Soil

SAMPLE NO: 1

REMARKS:

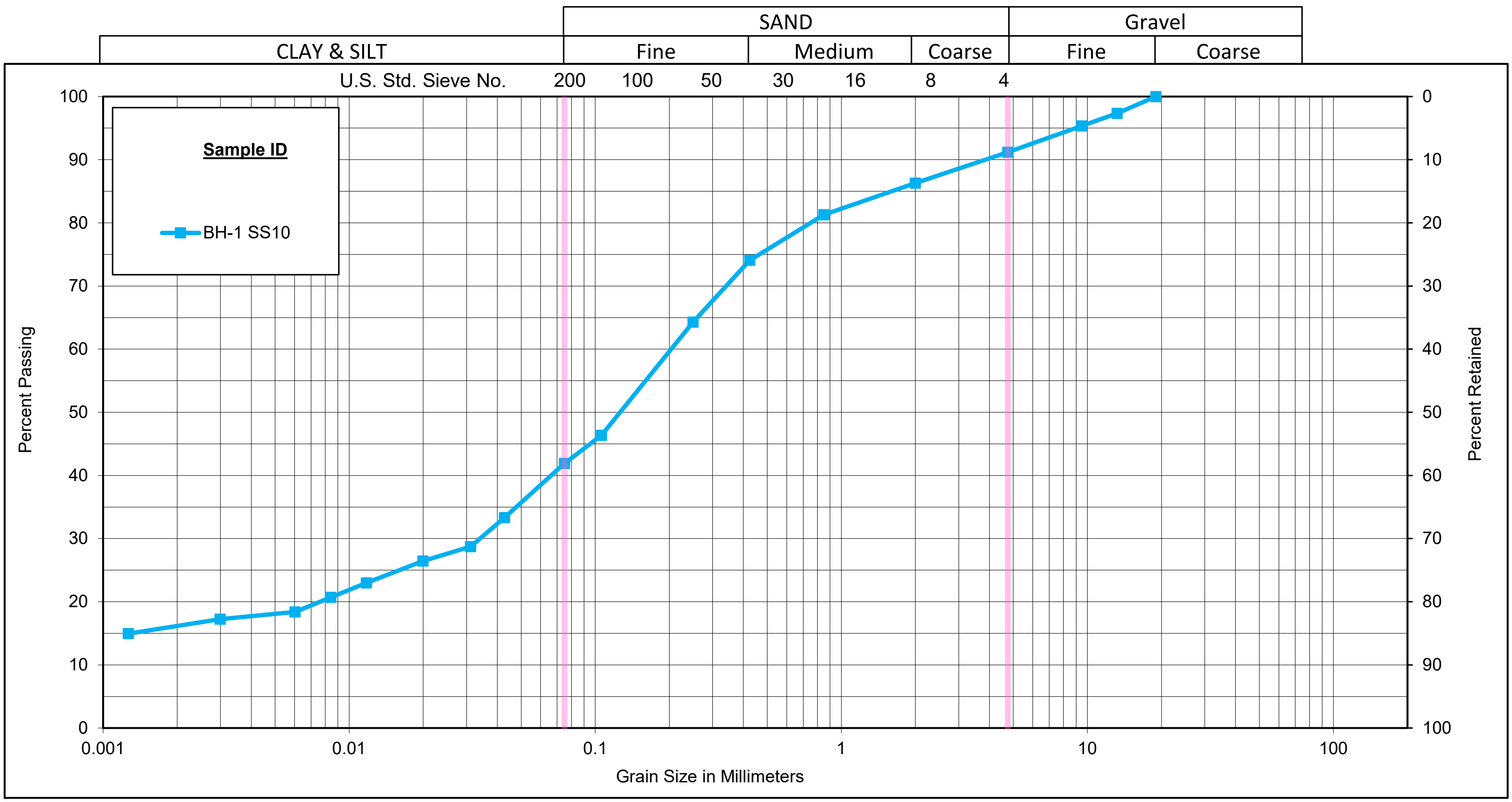
Kollaard Associates
Engineers
210 Prescott Street
Box 189
Kemptville, ON K0G 1J0
(613) 860-0923, www.kollaard.ca

Tested by: Connor Ibach

Issued by: Dean Tataryn, B.E.S., EP

Date: February 21, 2023

Unified Soil Classification System



Sample ID	Depth	% Gravel	% Sand	% Silt	% Clay
BH-1 SS10	22'6"-24'6"	8.8	49.3	25.9	16.0

Stantec

GRAIN SIZE DISTRIBUTION

Kollaard Associates Engineers, File #220338

121 Brae Crescent

Figure No.

Project No. 122410003

Stantec

Particle-Size Analysis of Soils
LS702
AASHTO T88

PROJECT DETAILS

Client:	Kollaard Associates Engineers, File #220338	Project No.:	122410003
Project:	121 Brae Crescent	Test Method:	LS702
Material Type:	Soil	Sampled By:	Kollaard Associates Engineers
Source:	BH-1	Date Sampled:	February 14, 2023
Sample No.:	SS10	Tested By:	Brian Prevost
Sample Depth	22'6"-24'6"	Date Tested:	February 23, 2023

WASH TEST DATA

Oven Dry Mass In Hydrometer Analysis (g)	73.43
Sample Weight after Hydrometer and Wash (g)	38.09
Percent Passing No. 200 Sieve (%)	48.1
Percent Passing Corrected (%)	41.52

PERCENT LOSS IN SIEVE

Sample Weight Before Sieve (g)	772.40
Sample Weight After Sieve (g)	771.30
Percent Loss in Sieve (%)	0.14

SOIL INFORMATION

Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	40	g

CALCULATION OF DRY SOIL MASS

Oven Dried Mass (W_o), (g)	76.98
Air Dried Mass (W_a), (g)	77.33
Hygroscopic Corr. Factor ($F=W_o/W_a$)	0.9955
Air Dried Mass in Analysis (M_a), (g)	73.76
Oven Dried Mass in Analysis (M_o), (g)	73.43
Percent Passing 2.0 mm Sieve (P_{10}), (%)	86.28
Sample Represented (W), (g)	85.11

SIEVE ANALYSIS

Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5		100.0
26.5		100.0
19.0	0.0	100.0
13.2	20.5	97.3
9.5	35.9	95.4
4.75	68.0	91.2
2.00	106.0	86.3
Total (C + F)[1]	771.30	0.1
0.850	4.26	81.27
0.425	10.38	74.08
0.250	18.73	64.27
0.106	33.98	46.35
0.075	37.76	41.91
PAN	37.90	

Note 1: (C + F) = Coarse + Fine

HYDROMETER DETAILS

Volume of Bulb (V_B), (cm^3)	63.0
Length of Bulb (L_2), (cm)	14.47
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.29
Scale Dimension (h_s), (cm/Div)	0.155
Cross-Sectional Area of Cylinder (A), (cm^2)	27.25
Meniscus Correction (H_m), (g/L)	1.0

START TIME 9:31 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c 21	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
23-Feb-23	9:32 AM	1	36.0	7.0	21.0	29.0	33.34	10.63404	9.84835	0.013126	0.04280
23-Feb-23	9:33 AM	2	32.0	7.0	21.0	25.0	28.74	11.25404	9.84835	0.013126	0.03114
23-Feb-23	9:36 AM	5	30.0	7.0	21.0	23.0	26.44	11.56404	9.84835	0.013126	0.01996
23-Feb-23	9:46 AM	15	27.0	7.0	21.0	20.0	22.99	12.02904	9.84835	0.013126	0.01175
23-Feb-23	10:01 AM	30	25.0	7.0	21.0	18.0	20.69	12.33904	9.84835	0.013126	0.00842
23-Feb-23	10:31 AM	60	23.0	7.0	21.0	16.0	18.39	12.64904	9.84835	0.013126	0.00603
23-Feb-23	1:41 PM	250	22.0	7.0	20.5	15.0	17.2440	12.80404	9.96839	0.013205	0.00299
24-Feb-23	9:31 AM	1440	20.0	7.0	20.0	13.0	14.9448	13.11404	10.09098	0.013286	0.00127

Remarks:

Reviewed By: Brian Prevost
Date: February 24, 2023

V:\01216\active\laboratory_standing_offers\2023-Laboratory Standing Offers\122410003 Kollaard Associates\February 15, Hyd._MC, Kollaard #220338\Hydrometer-Lab Standing Offers.xlsx

ATTACHMENT B

Laboratory Test Results for Chemical Properties

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **WT2304674**	Page	: 1 of 3
Client	: **Kollaard Associates Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Dean Tataryn	Account Manager	: Costas Farassoglou
Address	: 210 Prescott Street Unit 1 Kemptville ON Canada K0G1J0	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 613 860 0923	Telephone	: 613 225 8279
Project	: 220338	Date Samples Received	: 24-Feb-2023 10:15
PO	: ----	Date Analysis Commenced	: 27-Feb-2023
C-O-C number	: ----	Issue Date	: 03-Mar-2023 15:37
Sampler	: ----		
Site	: ----		
Quote number	: SOA 2022		
No. of samples received	: 1		
No. of samples analysed	: 1		

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Soil**

(Matrix: **Soil/Solid)**

					Client sample ID	BH2-SS2	----	----	----	----
					Client sampling date / time	14-Feb-2023 10:00	----	----	----	----
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		WT2304674-001	--------	--------	--------	--------
						Result	----	----	----	----
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm		60.1	----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units		7.40	----	----	----	----
Resistivity	----	EC100R	100	ohm cm		16600	----	----	----	----
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg		<5.0	----	----	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg		<20	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Environmental Division
Waterloo
Work Order Reference
WT2304674

Telephone : + 1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	Kollaard Associates (27196)
Contact:	Dean Tataryn
Phone:	613.860.0923, ext.225
	Company address below will appear on the final report
Street:	210 Prescott Street, Unit 1 P.O. Box 189
City/Province:	Kemptville, Ontario
Postal Code:	K0G 1J0
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Project Information

ALS Account # / Quote #:	Q71021
Job #:	220338
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax dean@kollaard.ca
Email 2
Email 3

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax mary@kollaard.ca
Email 2

Oil and Gas Required Fields (client use)

AFE/Cost Center:		PO#	
Major/Minor Code:		Routing Code:	
Requisitioner:			
Location:			
ALS Contact:	Melanie M.	Sampler:	

Select Service Level Below - Contact your

Regular [R] ☒ Standard TAT if received

PRIORITY (Business Days)		EMERGENCY	
4 day [P4-20%]	☐	1 Bu	
3 day [P3-25%]	☐	Same	
2 day [P2-50%]	☐	(Labc	

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service

Ana

Indicate Filtered (F), Preserved (P) or Fil

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Corrosivity (KOLLAARD-CORR-WT)	VOC, F1-F4 (VOC-R511 F1-F4-WT)	Metals & Inorganics (R511 Inorganics)	PAH (PAH-511-WT)	BTEX / F1-F4	PICK-UP FEE	SAMPLES ON HOLD	Sample is hazardous (please provide further detail
	BH2-SS2	Feb14/23	10:00	SOIL	X					X		

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
3.4	8.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: Feb16, 2023	Time: 8:00	Received by: [signature]	Date: 2/24/23	Time: 10:15	Received by: [signature]	Date: 02/25/23	Time: 12pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

SOL-877

ATTACHMENT C

National Building Code Seismic Hazard Calculation

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.256N 75.919W **User File Reference:** 121 Brae Crescent 2023-02-23 18:25 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.389	0.208	0.123	0.037
Sa (0.1)	0.460	0.257	0.159	0.052
Sa (0.2)	0.387	0.222	0.140	0.049
Sa (0.3)	0.295	0.172	0.110	0.039
Sa (0.5)	0.211	0.124	0.080	0.028
Sa (1.0)	0.107	0.064	0.041	0.014
Sa (2.0)	0.052	0.030	0.019	0.006
Sa (5.0)	0.014	0.008	0.004	0.001
Sa (10.0)	0.005	0.003	0.002	0.001
PGA (g)	0.248	0.141	0.087	0.028
PGV (m/s)	0.176	0.100	0.061	0.019

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information