PRELIMINARY GEOTECHNICAL INVESTIGATION

1062 and 1074 Cooke Boulevard
Burlington, Ontario

Client

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Project Number

BIGC-ENV-462A

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1 Introduction

B.I.G. Consulting Inc. (BIG) has been retained by Camarro Developments Inc. (the Client) to conduct a preliminary geotechnical investigation for the proposed development on the property located at 1062 and 1074 Cooke Boulevard, Burlington, Ontario (the Site). The Site location plan is shown on Figure 1 in Appendix A.

The investigation was authorized by Mr. Kyle Camarro on behalf of the Client.

It is our understanding that the proposed development will comprise of 2-High Rise Towers with 3 to 5-Levels of underground parking structure.

The field work for this investigation was carried out in conjunction with Phase Two Environmental Site Assessment (ESA) and Hydrogeological Investigation (HG). This report addresses the geotechnical aspects of the proposed development only and the reports for the ESA I, HG and RSC will be issued under separate covers.

The purpose of this investigation was to obtain the information on the subsurface soil and groundwater conditions at the Site by means of advancing a limited number of boreholes, in-situ tests as well as laboratory tests of selected soil samples and based on this information to prepare an engineering report on geotechnical perspective pertaining to the preliminary design and construction of the proposed development. Final design drawings of the proposed development were not available to BIG at the time of preparation of this report. Therefore, once the existing buildings are demolished and final design drawings are available, additional investigation and analysis will be necessary and further recommendations will be provided as appropriate.

The recommendations and comments made in this report are based on factual information and are intended only to use for the design engineers. The number of boreholes, depths, tests data and their interpretation presented in this report may not be sufficient to determine all the factors that may have effects on the design and construction of the proposed development.

The report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. On-going liaison with BIG during the final design and construction phase of the project is recommended to ensure that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed development should be directed to BIG for further elaboration and/or clarification.

The attached 'Report Limitations' is an integral part of this report.

2 Site Description

The municipal address of the Site is 1062 and 1074 Cooke Boulevard which is located at the southwest corner of Cooke Boulevard and Masonry Court in Burlington, Ontario. The Site is bound to the north by Masonry Court followed by residential properties, to the east by Cooke Boulevard followed by an industrial property, to the south by industrial properties and to the west by commercial and residential properties. For the simplicity of the description in this report, Cooke Boulevard and Masonry Court have been considered running north-south and east-west respectively.

The Site is irregular in shape and measures approximately 7,100 m² in size. The Site is currently occupied by 2-Single storey slab-on-grade industrial/commercial buildings (the Site buildings). The Site buildings have combined footprint area of approximately 2,300 m² and occupy approximately 33 % of the Site area. The areas surrounding the Site buildings are covered with asphalt pavement and landscaping.

The topography of the site was generally gently sloping down from north to south.

3 Field Investigation Procedures

Prior to initiating the subsurface investigation activities, the borehole locations were marked at the Site by BIG personnel and all applicable public utility services (Gas, Bell, Rogers, Hydro, Network cables, etc.) were cleared with the assistance of Ontario-One-Call. A Private Utility Locator was also retained to locate underground private utility lines adjacent to the borehole locations to ensure the lines will not be damaged and safety of the worker during the investigation work.

The fieldwork for this investigation was carried out between May 26 and June 9, 2021 and consisted of advancing a total of 8-Boreholes BH/MW1 to BH/MW8 to depths varying between 6.7 and 25.3 m below the existing ground surface (BGS) including rock coring in 2-Boreholes. The approximate borehole/core-hole locations established and drilled/cored at the Site are shown on Figure 2 in Appendix A.

The boreholes were advanced by using power operated solid and hollow stem continuous flight augers (truck-mounted drill rig), supplied and operated by a specialist drilling contractor, working under the full-time supervision of an experienced BIG geotechnical personnel. Soil samples of the overburden were generally taken at 0.76 m or 1.5 m intervals while performing the Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg hammer for a vertical distance of 0.76m to drive a 51 mm outer diameter split-barrel (split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the ground by a vertical distance of 0.30 m was recorded as SPT 'N' value of the soil which indicates the consistency of cohesive soils or the relative density of non-cohesive soils.

The BIG's drilling supervisor examined and logged the overburden soil samples as they were obtained from the boreholes. The recovered samples were sealed in clean, airtight plastic bags and transferred to the BIG's Mississauga laboratory for further examination and laboratory testing.

Groundwater observations were made in all boreholes during and immediately upon completion of drilling. In order to obtain the information on stabilized groundwater levels, all boreholes were equipped with monitoring wells, one in each borehole, upon completion of drilling. Monitoring Wells installation details are shown on the Record of Borehole logs, and the details of the groundwater observation are presented on Section 4.8.

The ground surface elevation at the borehole locations were surveyed by BIG personnel with reference to the top of Water Valve located in front of 1026 Cooke Boulevard with a Geodetic Elevation of 100.37 mASL as shown on Topographical Survey Plan of Part of Lot 6, Concession 1; prepared by Rady-Pentek & Edward Surveying Ltd., dated January 26, 2017.

It should be noted that the ground surface elevations at the borehole locations are approximate and should not be used for design and construction purpose. Contractors performing the work should confirm the elevations prior to construction. The borehole locations plotted on Borehole/Monitoring Well Location Plan are based on the measurements of the Site features and should be considered to be approximate.

4 Subsurface Conditions

The following summary is to assist the designers of the project with an understanding of the anticipated subsurface conditions across the Site. However, it should be noted that the subsurface soil and groundwater conditions between and beyond the drilled borehole locations may differ from those encountered at the borehole locations, and conditions may become apparent during the construction, which could not be detected or anticipated at the time of the Site investigation. The boundaries between the various strata as shown on the Record of Boreholes are based on the non-continuous sampling and

represent an inferred transition between the various strata and their lateral continuation, rather than a precise plane of geological change.

Based on the subsurface conditions encountered at the borehole locations, the soil profile generally consisted of asphalt pavement overlying existing fills, which in turn was underlain by native silty sand till, clayey silt till, cohesionless sand and Shale bedrock, respectively.

A brief description of the subsurface stratigraphy and groundwater conditions encountered at the borehole locations are summarized, in order of depth, in the following sections and more information are provided in the Record of Boreholes presented in the Appendix B.

4.1 Asphalt Pavement

All boreholes were advanced through existing asphalt pavement consisting of approximately 50-100 mm thick asphalt concrete over 200 to 250 mm thick granular bases.

4.2 Existing Fill

Below the asphalt pavement in all boreholes, existing fill generally consisting of clayey silt/silty clay, silty sand, and sand with gravel was encountered in all boreholes that extended to depths varying between 0.3 and 6.1 mBGS. Fill also contained occasional cobble and boulders, pieces of concrete and bricks, etc. A 0.6 m thick layer of light weight concrete was also encountered from 4.6 to 5.2 mBGS in BH/MW2.

The SPT 'N' values recorded were generally varied from 1 to over 50 blows per 300 mm of penetration indicating very loose/very soft to very dense/hard consistencies. The moisture content measurement of the recovered samples generally varied between 8 and 39 % by weight, indicating moist to wet conditions.

4.3 Silty Sand Till

Below existing fill in boreholes BH/MW1 and BH/MW3, a glacial deposit of native silty sand till was encountered that extended to the depths varying between 6.1 to 7.6 mBGS. Silty sand till also contained trace clay to some clay, and trace gravel.

The SPT 'N' values recorded in this layer varied from 12 to over 50 blows per 300 mm of penetration indicating compact to very dense relative density. The moisture content measurement of the recovered samples was between 9 and 22 % by weight, indicating moist to wet conditions.

Due to the nature of till formation, cobbles and boulders should be anticipated within the glacial till deposits.

4.4 Upper Clayey Silt/Silty Clay Till

Below existing fill in boreholes BH/MW2, BH/MW4, BH/MW5, BH/MW6, BH/MW7 and BH/MW8; below Sandy Silt Till in borehole BH/MW3; another native deposit of upper clayey silt/silty clay till was encountered that extended to depths varying between 4.6 to 10.7 mBGS. Clayey silt till deposit also contained trace sand and trace gravel.

The SPT 'N' values recorded in this till deposit varied from 0 to 22 blows per 300 mm of penetration indicating very soft to very stiff consistencies. The moisture content measurement of the recovered samples was between 9 and 24 % by weight, indicating moist to very moist conditions.

4.5 Sand

Below silty sand till in borehole BH/MW1 and below upper clayey silt/silty clay till in boreholes BH/MW2 to BH/MW8, a cohesionless deposit of sand was encountered that extended to depths varying between 6.7 and 12.5 mBGS. Sand deposit also contained trace silt and trace gravel. Borehole BH/MW1 was terminated within this deposit.

The SPT 'N' values recorded in this deposit varied from 11 to over 50 blows per 300 mm of penetration, indicating compact to very dense relative density. The moisture content measurement of the recovered samples varied between 3 and 19 % by weight, indicating moist to wet conditions.

4.6 Lower Clayey Silt/Silty Clay Till

Below sand deposit in BH/MW2 to BH/MW8, another glacial deposit of native clayey silt/silty clay till was encountered that extended to depths varying between 15.5 and 18.3 mBGS. This lower deposit also contained trace to some sand and trace gravel. Occasional fragments of Shale were also encountered within this deposit. Boreholes BH/MW3, BH/MW5, BH/MW6, and BH/MW8 were terminated within this deposit.

The SPT 'N' values recorded in this till deposit varied from 11 to over 50 blows per 300 mm of penetration indicating stiff to hard consistencies. The moisture content measurement of the recovered samples was between 8 and 20 % by weight, indicating a moist condition.

Geotechnical laboratory test consisting of Particle Size Analysis (Hydrometer) and Atterberg Limit tests were conducted on selected soil samples from this deposit as summarized below:

Particle Size Analysis Test Results:

Borehole No.	Sample No.	Approx. Sample Depth (m)	% Gravel	% Sand	% Silt	% Clay
BH/MW5	SS13	15.5	10	20	47	22
BH/MW8	SS13	15.5	4	19	52	25

Atterberg Limits Test Results:

Borehole No.	Sample No.	Approx. Sample Depth (m)	W (%)	LL (%)	PL (%)	PI (%)
BH/MW8	SS13	15.5	14	28	15	13

Based on the above noted information, the on-Site native soil may be classified as clayey silt till with some sand and trace gravel.

Summary of test results are also included in the respective Record of Boreholes in Appendix B and Lab Test Reports are included in Appendix C.

Due to the nature of till formation, cobbles and boulders should be anticipated within the glacial till deposit.

4.7 Shale Bedrock

Below clayey silt till, a highly weathered reddish brown and/or grey Shale bedrock was encountered in BH/MW2, BH/MW4 and BH/MW7 that extended to the borehole termination depths varying between 19.8 to 25.3 mBGS.

The SPT 'N' values recorded were generally over 50 blows per 300 mm of penetration, indicating a hard consistency. The laboratory moisture content measurements of the recovered samples were between 10 and 16 % by weight, indicating a moist condition.

Further, from the depths of 18.3 mBGS in borehole BH/MW4 and 16.8 mBGS in borehole BH/MW7, HQ size samples of Shale bedrock were cored to the depth of 24.9 and 25.3 mBGS, respectively. The percentage of recoveries of rock core samples were between 83% and 100%, and the Rock Quality Designation (R.Q.D.) values were found between 72% and 100%, indicating fair to excellent quality of rock mass. Within the Shale bedrock core samples, occasional interbedded Limestone layers were also present. Pictures of Rock Core Samples are included in Appendix D.

4.8 Groundwater Observation

Groundwater observations were made in all boreholes during and immediately upon completion of drilling. It should be noted that the sufficient time was not available for the groundwater to stabilize within open boreholes/monitoring wells immediately upon completion of drilling and sampling operations. In order to obtain information on the stabilized groundwater level in conjunction with hydrogeological investigation, all boreholes were equipped with Monitoring Wells, one in each borehole, upon completion of drilling.

Groundwater observation made in open boreholes during Site exploration as well as the groundwater level recorded in the installed monitoring wells on June 10, 2021 are tabulated below:

Groundwater Observation:

Borehole No.	Ground Elevation (m)	Borehole Depth (mBGS)	MW Depth (mBGS)	Screen Length (m)	Groundwater Depth (mBGS)/Elevation (mASL)	
					Upon Completion of Drilling	June10, 2021
BH/MW1	103.48	6.7	6.1	3	Dry	Dry
BH/MW2	104.11	19.8	12.2	3	Dry	10.91 / 93.20
BH/MW3	104.41	15.8	15.2	3	12.19	11.89 / 92.52
BH/MW4	103.72	24.9	21.3	3	*	9.97 / 93.75
BH/MW5	102.64	15.5	13.7	3	12.19	10.13 / 92.51
BH/MW6	101.22	15.9	12.2	3	12.19	8.71 / 92.51
BH/MW7	101.41	25.3	22.9	3	*	9.19 / 92.22
BH/MW8	102.42	15.9	13.7	3	10.66	9.95 / 92.47

mBGS: Meter Below Ground Surface
mASL: Meter Above Sea Level
**: Not measured due to Drilling Water Introduced for Rock Coring.*

Records of groundwater observation are also shown on the respective Record of Boreholes. It should be noted that the groundwater levels at the Site may fluctuate seasonally and may be expected to be somewhat higher during the spring months and in response to major weather events.

5 Engineering Discussion and Recommendation

It is our understanding that the proposed development will comprise of 2-High Rise Towers with 3 to 5-Levels of underground parking structure.

Final design drawings of the proposed development were not available to BIG at the time of preparation of this report. Therefore, once the existing buildings are demolished and final design drawings are available, additional investigation and analysis will be necessary and further recommendations will be provided as appropriate.

Considering the presence of moist to wet conditions of cohesionless sand layer between elevations 97.6 and 89.0 mASLs and the measurements of stabilized groundwater levels in the monitoring wells varying between elevations of 93.75 and 92.22 mASLs, an appropriate temporary groundwater control system should be designed, installed and operated by an experienced dewatering contractor, prior to excavation and duration of below grade construction works, in order to preserve the structural integrity of the sidewalls and base of excavation. The hydrogeological investigation report provides details of the anticipated construction dewatering quantities and permit requirements.

It should be noted that, in the event, if long-term groundwater discharge option from the building foundation has to be considered, subject to water quality, an appropriate discharge location (storm or sanitary sewer) should be agreed with the City of Burlington and/or Region of Halton.

The recommendations and comments provided in this report are based on factual information obtained from this preliminary investigation and are intended only to use for the design engineers. The number of boreholes, tests data and their interpretation presented in this report may not be sufficient to determine all the factors that may have effects on the design and construction of the proposed development.

The following preliminary discussion and recommendations should be revised or supplemented where necessary, when the conditions of the proposed development are different from the noted conditions/assumptions.

5.1 Grading and Site Preparation

As parts of effective and efficient design and construction of the proposed development, following items highlight the fundamental geotechnical requirements to be considered during Grading and Site Preparation. Detailed recommendations are provided in the following sections:

a) All ground surface cover (asphalt pavement, topsoil, existing fill, construction debris, soft/loose/wet materials containing organics, etc.) should be stripped and removed from the area of the proposed development.

b) It is our understanding that all existing buildings at the Site will be demolished, and the floor slabs, foundations, and underground infrastructure of the demolished buildings will be removed completely.

c) Any existing infrastructures (e.g., manholes, catch basins, buried structures, construction debris, etc.) should be sub-excavated and removed from the area of the proposed development, if they are located in the zone of influence of foundations of the proposed building. The zone of influence of the foundation is defined as an area laterally extending 1 m beyond the bottom edge of the foundation with downward slope of 1H:1V. Furthermore, any existing underground services, outside of the foundation influence, should be either removed or abandoned by injecting with non-shrinkable grout.

d) Care must be taken during excavation near any existing structures and underground services/utilities located within or adjacent to the excavation. Foundations of heavily loaded settlement sensitive structures and utilities located within the close proximity to the proposed excavation should be accurately located and supported adequately with the suitable temporary or permanent support system where required, prior to excavation, to preserve the integrity of these structures. Similarly, the excavation near the vicinity of any existing structure should be carried out without disturbing and/or undermining their foundations.

e) Where open excavation is not feasible, a properly designed perimeter shoring system should be installed prior to the mass excavation for the proposed development. For the drilling and installation of shoring system (e.g., caissons, etc.), travel path and working platform areas of the Site for drill rig must be properly prepared, inspected and approved by a geotechnical engineer from BIG prior to starting the installation of shoring system.

f) An appropriate temporary groundwater control system should be designed, installed and operated by an experienced dewatering contractor prior to excavation and keep the base of excavation dry all the times for the duration of below grade construction works, in order to preserve the structural integrity of the founding soils. The groundwater level should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation). In no case should the footing be placed on dilated or disturbed subgrade level.

g) The base of excavation at design subgrade level should be inspected and approved by a geotechnical engineer from BIG. During inspection, any soft/loose and wet spots identified, should be sub-excavated and replaced with compacted approved material as directed by the geotechnical engineer.

h) Any fill, required to be used, should be used as an engineered fill. Materials used for engineered fill may consist of portion of the approved on-site soils and/or imported soils (OPSS Granular B, OPSS Select Sub-grade) which do not contain organics and deleterious materials. Some reconditioning (i.e., drying) prior to reuse may require, if the materials are found to be too wet. However, any imported soils to the Site for engineered fill must meet the requirements of O. Reg. 153/04 as determined by BIG.

i) To reduce the post-construction settlements, all new fills should be placed in thin lifts, not exceeding 200 mm thick loose lifts, within ±2 % of its optimum moisture content, and thoroughly compacted with suitable heavy compactors to at least 98% of Standard Proctor Maximum Dry Density (SPMDD) of the fill material, before placing the next lift.

j) Surface water runoff from the neighboring properties should not be permitted to enter and/or pond within the construction area. Consideration should be given to redirecting the surface water runoff from the neighboring properties (temporary and/or permanent) if there would be a down gradient and grade difference between site grades and existing neighboring property grades. This is especially important to the success of the planned construction.

k) The existing on-site soils are susceptible to disturbance when exposed to weather and construction traffics. Construction traffic over exposed subgrade materials should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, adequately reinforced haul roads (e.g., increased thickness of granular sub-base, geo-fabrics, etc.) should be constructed to reduce disturbance to the subgrade soils. Similarly, if the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional subbase material is best determined during construction.

5.2 Foundation Options and Design Parameters

Based on the preliminary information obtained from the investigation, the Site is considered suitable for the construction of the proposed development from geotechnical viewpoint. Following two foundation options are recommended for the design and construction of the proposed developments. The selection of the option would predominantly depend on the estimated cost, project schedule, ease of construction, etc.

OPTION-1: Conventional Spread/Strip Footings

Considering the existing subsoil and groundwater conditions, the proposed tower buildings may be supported by conventional spread/strip footings founded on the competent native soils with the following preliminary geotechnical bearing resistances at Serviceability Limits State (SLS) and factored geotechnical bearing resistance at Ultimate Limit State (ULS) as shown below, subject to inspection and adequate groundwater control during construction:

Preliminary Geotechnical Resistances:

Underground Parking Structure	Anticipated Foundation Elevations mASL	Anticipated Sub-soil conditions	Preliminary Geotechnical Bearing Resistances (SLS/ULS) kPa
3 to 4 Levels	Between 88 to 91	Stiff to hard silty clay/clayey silt till, and/or compact sandy silt till	400 / 600
5 Levels	Below 87	hard silty clay/clayey silt till	600 / 900

Higher bearing capacities may be available subject to final design drawings and additional investigation and analysis.

It should be noted that, in the areas, if the footing excavation has to be extended deeper than the design depth/elevation to the competent soil level, then consideration may be given placing the footing on competent soil level or raise the grade to the design footing level using the un-shrinkable lean concrete (minimum 1.0 MPa) avoiding compaction effort.

The minimum footing sizes, footing thickness, excavations and other footing requirements should be designed in accordance with the latest edition of the Ontario Building Code. However, a minimum width of 600 mm is recommended for the strip footings.

The groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation), and the base of excavation should be dry in order to preserve the structural integrity of the founding soils. In no case should the footing be placed on dilated or disturbed subgrade soils.

The footing subgrade should be protected, immediately after excavation and inspection, with a 50 mm thick concrete mud-slab, if water seepage is encountered and/or the excavation is to remain open for more than a day.

Where it is necessary to place foundations at different levels, the upper foundation must be founded below an imaginary 10 horizontal to 7 vertical lines drawn up from the base of the lower foundation. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

Total and differential settlements of footings founded on the competent native soils and designed as outlined above should not exceed 25 and 19 mm respectively, provided that the founding subgrade is not loosened or softened by construction activities or prolonged exposure to the weather.

Prior to the placement of concrete, all footing subgrades must be inspected and approved by a geotechnical engineer from BIG to ensure that the founding soils are similar to those identified in the boreholes and are capable of supporting the design bearing resistance.

OPTION-2: Tanked Raft Foundation

In the event that the long-term foundation drainage for Option 1 above is not allowed to discharge into the City's sewer systems and/or if the bearing resistance provided above is not sufficient, the proposed buildings may also be designed and supported by "tanked" water-proofed continuous raft foundation system avoiding permanent dewatering (i.e., avoiding permanent perimeter and under-floor drainage system) using the following geotechnical bearing resistances subject to inspection and adequate groundwater control during construction:

Preliminary Geotechnical Resistances:

Underground Parking Structure	Anticipated Foundation Elevations mASL	Anticipated Sub-soil conditions	Preliminary Geotechnical Bearing Resistances (SLS/ULS) kPa
3 to 4 Levels	Between 88 to 91	Stiff to hard silty clay/clayey silt till, and/or compact sandy silt till	600 / 900
5 Levels	Below 87	hard silty clay/clayey silt till	950 / 1400

Higher bearing capacities may be available subject to final design drawings and additional investigation and analysis.

The advantage of raft foundation is that the wall and column loads are distributed over the entire area of the raft slab, thereby greatly reducing the bearing pressures and the differential settlements. The

thickness and reinforcement of the raft foundation should be designed by a structural engineer to account for differential settlements.

The groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation), and the base of excavation should be dry in order to preserve the structural integrity of the founding soils. In no case should the footing be placed on dilated or disturbed subgrade soils.

Provided the subgrade will be prepared to a uniform high density and subsequent inspection and approval by the geotechnical engineer as per Section 5.1 above, a layer of minimum 200 mm thick Granular A (OPSS 1010) or its approved equivalent, compacted to at least 98 % of its SPMDD, is recommended below the raft slab foundation. A modulus of subgrade reaction of 25,000 kN/m^3 and 30,000 kN/m^3 may be used for the design of the raft slabs at 3-4 levels and 5 level respectively.

The foundation subgrade should be protected, immediately after excavation and inspection, with a 50 mm thick concrete mud-slab, if water seepage is encountered and/or the excavation is to remain open for more than a day.

A gap of approximately 600 mm service space should be kept between the top of the raft slab and the parking level floor slab to allow for the installation and maintenance of drainpipes, sewers and any other underground utilities. The service space between the utilities may be filled with clear stone up to the underside of parking floor slab.

Waterproofing of the perimeter basement wall and floor slab is recommended. The perimeter walls may be dampproofed above the raft foundation levels to at least 0.6 m below the proposed ground surface level. The manufacturer of the selected product should be consulted for application details for damp proofing.

Total and differential settlements of raft foundation founded on the competent native soils and designed as outlined above should not exceed 50 and 20 mm respectively, provided that the founding subgrade is not loosened or softened by construction activities or prolonged exposure to the weather.

Prior to the placement of concrete, foundation subgrade must be inspected and approved by a geotechnical engineer from BIG to ensure that the founding soils are similar to those identified in the borehole/core-hole and are capable of supporting the design bearing resistance.

5.3 Floor Slab Construction

Considering the Option 1 above, the subsoils immediately below 3 to 4 levels of underground parking garage slabs and 5 level of parking garage slab are anticipated to be form to hard clayey silt/silty clay till and/or compact sand deposits, and hard clayey silt/silty clay till deposit respectively. The floor-slab on these materials can be designed and constructed as a conventional slab-on-grade method provided that the proper dewatering measures are in place.

Provided the subgrade will be prepared to a uniform high density and subsequent inspection and approval by the geotechnical engineer as per Section 5.1 above, a floor slab bedding consisting of at least 200 mm thick Granular A (OPSS 1010) or its approved equivalent, is recommended to improve the support and work as a moisture barrier. The bedding should be compacted to at least 98% of SPMDD. A polyethylene vapor barrier or equivalent may be placed on the granular bedding if a moisture sensitive finish is to be placed on the floor. A modulus of subgrade reaction of 25,000 kN/m^3 and 30,000 kN/m^3 may be used for the design of the floor slabs at 3-4 levels and 5 level respectively, provided that the construction is in accordance with the recommendations provided herein.

The thickness of the concrete slab and the reinforcement (if any) should be designed by a structural engineer. The floor slab should not be tied to any load-bearing walls or columns unless they have been

designed accordingly. Contraction and expansion joints should be provided for the slabs as required by the structural engineer.

5.4 Permanent Perimeter and Under-floor Drainage

If the basement is designed as a "drained" structure (Option 1), permanent perimeter drainage system should be provided around the perimeter walls of the underground parking structure. Where adequate space is not available for open-cut excavation with slopes, then properly designed vertical shoring system should be installed to support the sides of excavation. In this case, a permanent perimeter drainage system consisting of pre-fabricated continuous vertical blanket, Miradrain 6000 or its equivalent, should be used at and along the shoring location, just outside of the perimeter walls of the underground parking structure. Several collection pipes, installed through the perimeter walls, connect the pre-fabricated perimeter vertical drains with the solid collector pipe installed in a positive grade leading to a frost-free sump. The installation and connections of pre-fabricated perimeter vertical drains should be carried out as per the manufacturer's specifications.

The walls of the underground parking structure should be waterproofed/damp proofed suitably and wrapped with a continuous drainage blanket connecting to the permanent perimeter drainage system.

Considering the subsurface soils and the groundwater measurements in the installed monitoring wells, underfloor drainage system may be required at this site. However, the need for vertical and underfloor drainage systems and the anticipated volumes of water to be pumped during and post construction should be based on the findings of the hydrogeological investigation report. The underfloor drainage system, if needed, should be kept separate from the perimeter drainage system.

A provision of additional groundwater control measures, consisting of underfloor sump pumps connected to an emergency power grid, should be installed below the lowest floor level of the parking for the consequence arising from a failure of the regular system.

A conceptual design of Permanent Perimeter & Under-floor Drainage System with Shoring is shown in Appendix E.

5.5 Lateral Pressure

The lateral earth pressures acting on retaining structures (perimeter basement walls, cantilever walls, etc.) may be calculated from the following expression:

$$P = K(\gamma H + q)$$

Where,

P	= Lateral earth pressure at depth H (m)		kPa
K_a	= Lateral earth pressure coefficient	0.4	
γ	= Bulk unit weight of the soil	21	kN/m^3
H	= Depth of the wall below outer finish grade		m
q	= Equivalent value of all surcharge loads on the ground surface		kPa

The above equation assumes an effective drainage system to prevent the build-up of hydrostatic pressure behind the buried retaining structures. If a drainage system is not provided, the buried portion of retaining structures must be designed to withstand the full hydrostatic pressure.

5.6 Frost Protection

The design frost penetration depth for the general Site area is 1.2 m as per OPSD 3090.101. Therefore, any structural foundation (perimeter and other footings) and buried underground utilities exposed to seasonal freezing conditions should be provided with frost protection comprising at least 1.2 m of earth

cover or its equivalent thermal insulation. As a general guidance, a 25 mm of insulation provides the same thermal equivalency as 600 mm of soil cover.

During winter time construction, exposed subgrades to support foundations must be temporarily protected against freezing by means of loose straw, tarpaulins, heating, etc.

5.7 Earthquake Consideration

In conformance to the criteria in Table 4.1.8.4.A, Division B - Part 4 of the Ontario Building Code OBC 2012, the project site may be classified as Site Class "C-Very dense Soil and Soft Rock". The four values of the Spectral response acceleration Sa (T) for different periods and the Peak Ground Acceleration (PGA) can be obtained from Table C-2 in Appendix C, Division B. The design values of F_a and F_v for the project site should be calculated in accordance to Table 4.1.8.4.B and C.

5.8 Excavation and Temporary Groundwater Control

The excavation for 3 to 5-Levels of underground parking structure depths is expected through the existing fills, glacial tills, sand and highly weathered Shale bedrock, and can be handled by conventional mechanical excavation equipment. Allowance should be made for cobbles and boulders that may occur randomly in the fills, glacial tills and remnants of demolished buildings during excavation.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulation 213/1991 for Construction Projects to ensure the protection of workers from on-Site contaminants of concerned impacted soil and groundwater. Under the Act, the soils to be excavated can be classified as follows:

Fill soils	Type 3	When submerged/saturated	Type 4
Sand (compact)	Type 3	When submerged	Type 4
Sand (dense to very dense)	Type 2	When submerged	Type 3
Clayey silt till (stiff to firm)	Type 3	When saturated and/or fissured	Type 4
Clayey silt till (very stiff)	Type 2	when saturated and/or fissured	Type 3
Clayey Silt Till (hard)	Type 1	when saturated and/or fissured	Type 2
Weathered Shale	Type 1	when saturated and/or fissured	Type 2

For Type 3 soils, a bank slope of 1H:1V is required. For Type 2 soils, a 1.2 m high vertical cut at the bottom of excavation may generally be used. Near the ground surface, occasional 3H:1V slopes may be required due to disturbed surficial soils. If an excavation contains more than one soil types, the excavation slope geometry shall be governed by the highest soil type number. In general, above the water table, side slopes of trenches deeper than 1.2 m should be cut to a gradient no steeper than 1V:1H upon the inspection of a qualified geotechnical engineer.

Stockpiles of excavated materials should be kept at a horizontal distance of at least the excavation depth away from the edge of any excavation to avoid the slope instability, subject to confirmation by the geotechnical engineer. Care should also be taken to avoid overloading of any underground services/structures by stockpiles

In areas where an open excavation slope cannot be maintained due to the close proximity of the existing structures on the adjacent properties (e.g., buildings, roads, etc.), the excavation within the overburden should be supported by using a shoring system (e.g., tight wooden bracing, sheet pile, trench box, strutted soldier pile & lagging wall etc.), designed by a shoring consultant. Further, the depths of shoring walls should be extended sufficiently below the base of the excavation to ensure that toe resistance is maintained when the soil is excavated.

Perched water may be encountered during excavation in the earth fill and/or water bearing seams/pockets present in the glacial till deposits above the groundwater level. The amount of free water from this source is anticipated to be minor and the water accumulated in the excavation can readily be handled by using temporary filtered sumps and pumps. However, based on the water levels measured in the observation wells, it is anticipated that the excavation extending deeper than the elevation of 93.7 mASL may encounter groundwater during excavation. A temporary groundwater control system should, therefore, be in place prior to excavation and groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation), before the excavation deepens. The base of excavation should be kept dry all the time for the duration of below grade construction works, in order to preserve the structural integrity of the founding soils. In this case, a temporary groundwater control measure, e.g., use of well-points or eductors, will be required to lower the groundwater level sufficiently in order to reduce the potential for instability of the sidewalls and base of the excavation. The magnitude of groundwater ingress will also depend upon the dimensions of an excavation, thickness of water bearing strata and composite hydraulic conductivity of the soil deposits. The hydrogeological investigation report provides details of the anticipated construction dewatering quantities and permit requirements.

Consideration should be given to carrying out the construction during the drier seasons of the year to reduce the need for dewatering and disturbances to the founding soils caused by the excavation below prevailing groundwater table.

5.9 Reuse of On-Site Soils

Based on the conditions encountered in the boreholes, portions of on-site excavated soils which do not contain organics and deleterious materials can be re-used for backfill as an engineered fill. However, depending upon the weather condition, the excavated soils may require some reconditioning prior to reuse, i.e., maintain the moisture contents of these materials within ±2% of SPMDD values (i.e., Proctor values) to obtain the required compaction. For reuse as an engineered fill for foundation support, a uniform material must be used. Significant variations in fill type will require thinner lifts, more compaction effort and more field and laboratory testing. Less stringent requirements may be considered for fills placement below slab-on-grade, above footing levels and pavement areas. Special care should be exercised to ensure compaction around columns and adjacent to foundation walls.

Unsuitable material such as organic rich pockets, frozen soils, cobbles, boulders, remnants of demolished structures, etc., should be wasted. Ideally, dissimilar materials should be stockpiled separately during excavation.

Portion of the existing soils are considered as frost susceptible (e.g., fine sand, silt) and should not be reused where a volume change in the presence of freezing conditions would have an adverse effect on the serviceability of the proposed infrastructure.

5.10 Underground Services

It is considered that the sewer depths will not exceed 4.0 m below grades. Trench excavation should be carried out in accordance with the most recent version of the Ontario Occupational Health and Safety Act & Regulations for Construction Projects. The boreholes show that the trenches, generally, will be dug through existing fill and glacial till deposits. Normal conventional excavation equipment will be suitable for excavating trenches in the fill and native soil deposits.

Within these soils, above the groundwater table, the side-slopes of excavations are expected to be temporarily stable at 1V:1H. Flatter slopes will be required for the soils located below groundwater table, if encountered as noted on Section 5.8.

In areas where an open excavation slopes cannot be maintained, the excavation within the overburden should be supported using a temporary shoring system (e.g., tight wooden bracing, etc.), designed by a

shoring consultant. Excavations can also be carried out at steeper side slopes by using trench box, designed in accordance with the Safety Regulations, for the protection of the workers.

Groundwater seepage into the excavations may occur from perched groundwater, surface water flow or wet seams within glacial till deposits. Dewatering should be achievable by properly filtered sumps and pumps. The groundwater level in the trench should be kept below the bottom of the excavation by dewatering. Ideally, to prevent disturbance of the soil at the bedding level, the groundwater table must be lowered to at least 0.6 m below the base of the trench. In no case should the pipes be placed on disturbed subsoil.

The boreholes show, the anticipated subgrade soils at the base of trench for pipe bedding at their current state comprise of existing fill, dense to very dense silty sand till, and firm to very stiff silty clay/clayey silt till. The native soils, in their undisturbed state, are considered to be suitable for supporting the pipes, provided the integrity of the base of the trench is maintained during construction. However, the suitability of the existing fill materials should be further assessed by qualified geotechnical personnel from BIG during construction. This assessment consists of inspection and recommendation as required.

Pipe bedding should be in accordance with the pipe manufacturer's recommendations, appropriate local municipality requirements and standards (e.g., OPS). As a guideline, normal Class 'B' Type bedding (OPSD-802) may be considered. In general, a minimum of 150 mm thick base bedding and 300 mm above & adjacent to the pipes of OPSS Granular A is recommended for pipes 450 mm diameter or less; for large diameter pipes, the thickness of the base bedding should be increased to 200 mm. The bedding and cover materials should be compacted to a minimum of 95% of their SPMDD to provide support and protection to the pipes.

The thickness of the bedding material, however, may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. Similarly, where moist to wet conditions are encountered, the use of 'clear stone' bedding (such as 19mm clear stone, OPSS 1004) may be considered, only in conjunction with a suitable geotextile filter (e.g., Terrafix 270R or equivalent). Without proper filtering, there may be loss of fines from native soils and/or trench backfill materials into or through the bedding materials. This loss of fines could result in loss of support to the pipes and possible surface settlements.

Based on visual and tactile examination of the soil samples, portion of the on-site excavated soils can be re-used to backfill the service trenches subject to the conditions noted in Sections 5.1 and 5.9.

The fills should be placed in thin lifts not exceeding 200 mm thick loose lifts, within ±2 % of its optimum moisture content, and thoroughly compacted with suitable heavy rollers to at least 95% of SPMDD, before placing the next lift. This value should be increased to at least 98 % within 0.6 m of the final subgrade of trench for the road pavement.

5.11 Loading Dock Retaining Walls and Concrete Pavement

Loading docks are anticipated for the proposed development. Loading dock typically contains a ramp, which extends below the Finished Floor Elevation. The grade difference between the ramp and the building floor slab will be supported by the foundation wall of the building. These portions of the foundation wall should be designed as reinforced concrete retaining walls, which support the floor subgrades and surcharge on the slab-on-grade. Further, the grade change between the ramp and surrounding exterior grades would also require construction of a retaining structure. The typical design is the use of reinforced concrete retaining wall.

Where the lateral movement of the retaining walls is restricted, the walls should be designed for the at-rest earth pressure condition calculated in accordance with the Canadian Foundation Engineering Manual, 4th Edition. The following parameters may be adopted:

- Coefficient of lateral earth pressure = 0.45
- Bulk unit weight of retained soils = 21 kN/m^3

The floor slab load and any other surcharges would increase the applied lateral load to the retaining walls and should therefore be considered in the analysis and design of the walls.

Based on subsoil and groundwater conditions in boreholes, the foundation component of the retaining wall is anticipated to be founded on the engineered fill and/or native soil deposits at the conventional frost depth. The foundation of the retaining wall, therefore, may be designed and constructed with a bearing capacity of 150 kPa at SLS.

The retaining walls should be backfilled with granular soil (OPSS Granular A or Granular B Type I) placed along the walls in 150 mm thick loose lifts that can be compacted with light equipment without over-compacting and damaging the walls. Drainage should be provided behind the retaining wall.

The backfill and subgrade soils, located immediately behind the foundation wall of the building, should be protected against the ambient freezing temperature by providing sufficient insulation in order to prevent the effects of frost heave/thaw on the slab-on-grade.

The coefficient of friction between concrete and native soil and between concrete and granular backfill is 0.35 and 0.50, respectively. It is recommended a minimum factor of safety of 1.5 be used to assess the stability of the retaining walls against sliding.

Similarly, concrete pavement is generally used in the ramp and apron of the loading docks. The concrete pavement should be constructed as jointed concrete slab with a minimum thickness of 200 mm and maximum joint spacing of 4.5 m.

5.12 Shoring Considerations

In areas where an open excavation slope cannot be maintained, the excavation within the overburden should be supported by using a shoring system. Where settlement sensitive structures are located at the close proximity of the proposed excavation, a series of caisson walls embedded sufficiently below the bottom of the excavation, will have to be used to prevent any movement in the adjacent properties. Shoring system consisting of soldier piles and timber laggings can be used, on the other sides, where slight movement in the ground surface can be tolerated, i.e., where non-sensitive structures exist.

The shoring system should be designed by an experienced shoring consultant in accordance with the guidelines provided in the latest edition of the Canadian Foundation Engineering Manual (Manual). Similarly, the construction of the shoring system should also be carried out by a contractor, experienced in this type of construction.

The depth of pile penetration in the low to medium plasticity very stiff clayey silt deposit should be calculated from the following expressions:

$$R = 9\, C_u\, D\, (L - 1.5D)$$

Where,	R	= Ultimate load to be restrained	kN
	D	= Diameter of concrete filled hole	m
	C_u	= Undrained shear strength of the soil	150 kPa
	L	= Embedment Depth of the pile	m

The soldier piles should be installed in pre-augured holes which should be filled up to excavation level with 20 MPa (3000 psi) concrete and above that with 1-1/2 bag mix.

The following thicknesses of lagging boards have been recommended in the Manual:

Thickness of lagging	Maximum Spacing of Soldier Piles
50 mm (2 in)	2.0 m (6.5 ft)
75 mm (3 in)	2.5 m (8.0 ft)
100 mm (4 in)	3.0 m (10 ft)

Local experience has indicated that the lagging thickness of 75 mm has been adequate for soldier pile spacing of 3 m for soil conditions similar to those encountered at the subject site. However, it is important to consider all local conditions, such as the duration of excavation, the weather likely to be encountered, seasonal variations in the ground water and ice lensing causing frost heave in determining the lagging thickness.

All spaces behind the lagging must be filled with free draining granular fill. If wet conditions are encountered the space between boards should be packed with geotextile filter fabric or straw to prevent loss of ground.

5.13 Pavement Construction

Pavement design and pavement thicknesses are highly dependent on the subgrade conditions. The pavement subgrade should, therefore, be adequately prepared to receive the granular bases for the pavement construction noted in Section 5.1.

Prior to the placement of granular bases, the exposed subgrade for pavement construction should be thoroughly and consistently compacted with a suitable heavy compactors followed by a proof-roll operation in the presence of the qualified geotechnical personnel from BIG. Any wet/soft areas of subgrade, revealed by this process, should be sub-excavated and replaced with an approved on-site or imported fill material compatible to the existing subgrade condition. Similarly, if the grade beneath the proposed pavement areas is required to be raised, approved on-site or imported fill can be used.

All new fills should be placed in a maximum of 200 mm loose lifts, within ±2 % of its optimum moisture content, and each lift should be compacted by a suitable heavy equipment to minimum 95% of SPMDD before placing the next lift. The uppermost 600 mm of the pavement subgrade should be compacted to a minimum 98% of SPMDD.

Construction traffic over exposed subgrade should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, hauling roads should be adequately reinforced with increased thickness of granular materials and/or geo-grids, etc. to reduce the disturbance to the subgrade soils.

Considering the proposed pavement usage, frost susceptibility and assuming adequate drainage provided, the following minimum pavement structure thicknesses are recommended for the long-term satisfactory performance of the pavement:

Recommended Minimum Pavement Structure Thickness:

Particulars	Heavy Duty Driveway (mm)	Standard Duty Driveway (mm)
Asphaltic Concrete: OPSS HL3	40	50
Asphaltic Concrete: OPSS HL8	70	50
Base Course - OPSS Granular A or equivalent	150	150
Sub-base Course - OPSS Granular B or equivalent	350	250

The recommended pavement structure may have to be adjusted according to the local regulations and/or respective city/town/region standards.

The granular base and subbase materials should conform to the OPSS 1010 and should be compacted to 98% of the ASTM D698 SPMDD within ±2% of the optimum moisture content.

Hot mix asphalt concrete should conform to OPSS 1150 and OPSS 310 and be placed and compacted to at least 92 to 96.5 % of the Marshall Maximum Relative Density (MMRD). It is recommended that the asphalt mix design be reviewed by BIG prior to the start of the paving.

The pavement thickness considers that construction will be carried out during the drier time of the year and that the subgrade is competent. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional subbase material is best determined during construction.

6 Construction Monitoring

Qualified Geotechnical personnel should monitor the foundation excavation, subgrade inspection, in-situ density tests and material testing services in all stages of the proposed development, to ensure that the materials and conditions comply with this geotechnical report and project requirements. Should the condition that encountered vary from those described in this report, our office should be informed immediately so that the proper measures are undertaken. The on-Site review of the condition of the foundation soil is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code.

All backfilling should be supervised to ensure that proper materials are used, and that adequate compaction is achieved. Strict quality control guidelines should be followed during the placement of fill materials.

7 Closure

The subsoil information and recommendations contained in this report was prepared solely for the purpose to use at the specific project as described in this report and should not be used to any other project or site location. The information contained in this report is for the sole benefit of the Client and his/her consultants. *In order to properly understand the contents of the report, reference must be made to the whole of the report. BIG cannot be held responsible for the use of portions of the report without reference to the entire report.*

We recommend that BIG be retained to review the recommendations for this specific applicability, once the details of the proposed development are finalized and prior to the final design stage of the project.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

B.I.G. Consulting Inc.



Subir Shrestha, M.Eng., P.Eng.
Principal Geotechnical Engineer

Darko Strajin, P.Eng.
Managing Partner

8 Report Limitations

The conclusions and recommendations given in this report are based on information determined at the test hole (borehole, test pit, probe hole, etc.) locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations and opinions given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance to the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. Construction methods discussed, however, express BIG's opinion only and are not intended to direct the contractors on how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all the factors that may have an effect upon the construction. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably at the site. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. BIG accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix A - Figures



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LEGEND

SITE BOUNDARY

SCALE

10m 10 20 30 40

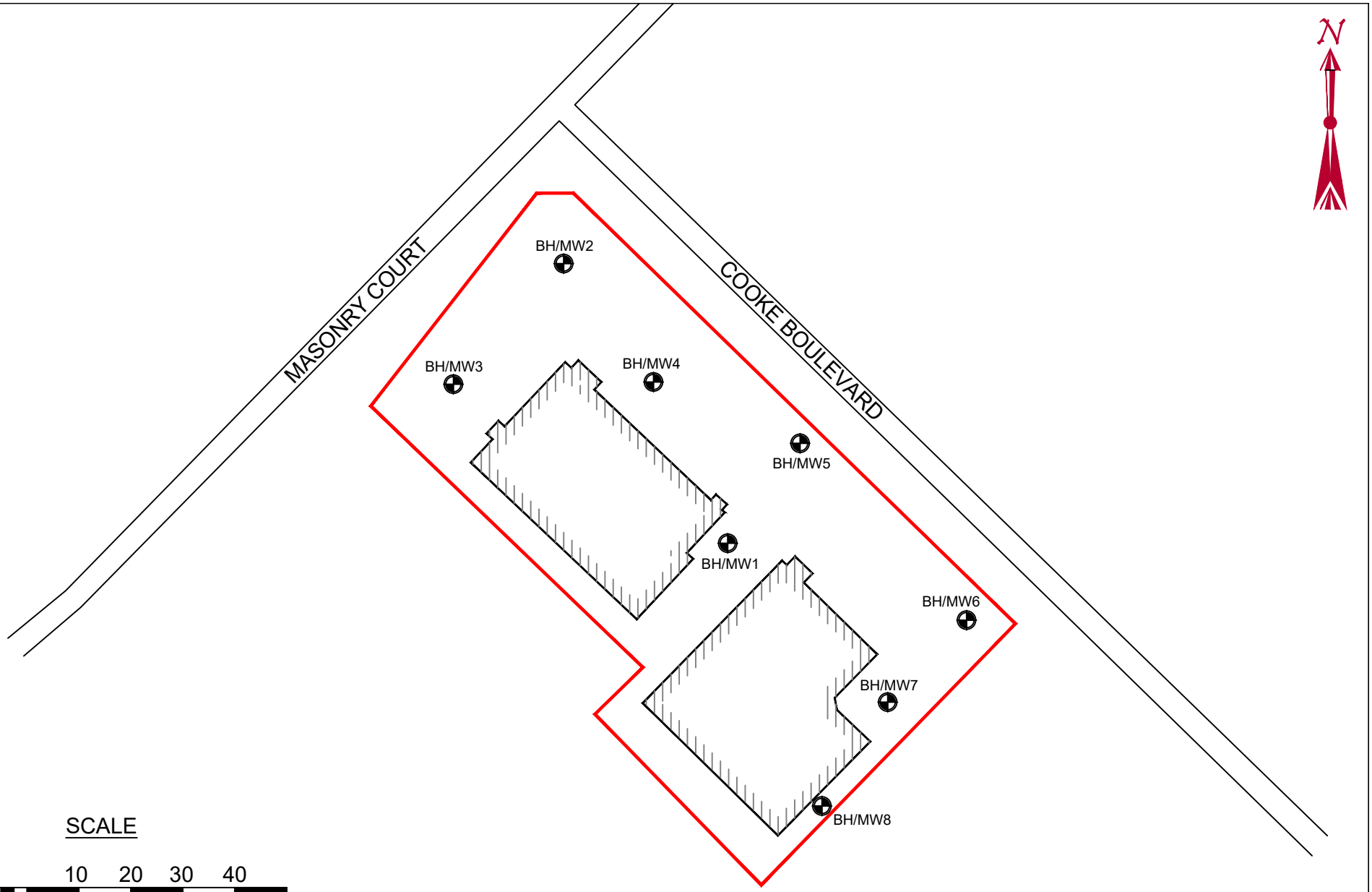
0m 50m

IMAGERY OBTAINED FROM GOOGLE MAPS, DATED 2021

TITLE AND LOCATION

SITE LOCATION PLAN
PRELIMINARY GEOTECHNICAL INVESTIGATION
1062 AND 1074 COOKE BOULEVARD, BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-462A	O.A.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JUNE 2021	1



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LEGEND

SITE BOUNDARY

BUILDING FOOTPRINT

LOCATION OF BOREHOLE/MONITORING WELL (BIG, 2021)

TITLE AND LOCATION

BH/MW LOCATION PLAN
PRELIMINARY GEOTECHNICAL INVESTIGATION
1062 AND 1074 COOKE BOULEVARD,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-462A	O.A.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JUNE 2021	2

Appendix B – Records of Boreholes

NOTES TO RECORD OF BOREHOLES

DRILLING METHOD		SAMPLE TYPE		LABORATORT DATA	
SSA	Solid Stem Auger	SS	Split Spoon	W	Water Content
HSA	Hollow Stem Auger	AS	Auger Flight Sample	W_p	Plastic Limit
WB	Wash Boring	TW	Thin Wall Open	W_l	Liquid Limit
RM	Rotary Mud Drilling	TP	Thin Wall Piston	γ	Natural Unit Weight (kN/m^3)
		WS	Washed Sample	C_u	Undrained Shear Strength (kPa)
		VT	Vane Test	PP	Pocket Penetrometer
		GS	Grab Sample	UC	Unconfined Compression
		RC	Rock Core	UU	Unconsolidated Undrained
		PH	Sample Advanced Hydraulically	CU	Consolidated Undrained
		PM	Sample Advanced Manually	CD	Consolidated Drained
		CC	Continuous Core	TOV	Total Organic Vapors

STANDARD PENETRATION TEST (SPT 'N'): The number of blows required to advance a standard 51 mm outer diameter split spoon sampler to penetrate 0.3 m distance into the undisturbed ground in a borehole driven by means of a 63.5 kg hammer falling freely from a distance of 0.76m.

DYNAMIC CONE PENETRATION TEST (DCPT): The number of blows required to advance a 51 mm diameter – 60 degree cone fitted to the end of the drill rods to penetrate 0.3 m distance into the undisturbed ground driven by 475 Joules driving energy per blow.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR RELATIVE DENSITY

CONSISTENCY: Cohesive soils are described on the basis of their undrained shear strength (Cu) or 'N' values as follows:

N (blows/0.3m)	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	>30
Consistency	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
Cu (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200

RELATIVE DENSITY: Cohesionless soils are described on the basis of their relative density as indicated by 'N' values as follows:

N (blows/0.3m)	0 - 4	4 - 10	10 - 30	30 - 50	>50
Relative Density	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

RECOVERY: Sum of the lengths of all recovered rock core pieces divided by the total length of the core run (expressed as a percent).

ROCK QUALITY DESIGNATION (RQD): Sum of the lengths of intact rock core pieces, 100 mm or more in lengths, divided by the total length of the core run (expressed as a percent). Classifications of a rock based on the RQD value are as follows:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
Quality	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50 Millimeters	50 - 300 Millimeters	0.3 – 1.0 Metres	1.0 – 3.0 Metres	> 3.0 Metres
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

RECORD OF BOREHOLE No. BH/MW1

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Truck Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	26 May 21	Date Completed: 26 May 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 103.48 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT ○ / DCPT ●); MTO Vane* (Intact △ / Remould ▲); Nilcon Vane* (Intact ◇ / Remould ◆); * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 50 mm asphalt over 250 mm granular bases — 103.18 / 0.3	SS	1	67	19	0	103	○	10		
	FILL: silty sand, trace clay, trace gravel, trace rootlets, brown, moist, compact - rock	SS	2	70	20	1	102	○	12		
	- very moist, loose — 101.19	SS	3	67	8	2		○	9		
	SILTY SAND TILL: trace to some clay, trace gravel, fragments of shale, reddish brown, moist to very moist, dense to very dense — 2.3	SS	4	62	34	3	101	○	9		
		SS	5	84	53	4	100	○	9		
	- compact — 97.39	SS	6	84	18	5	99	○	9		
	SAND: trace silt, trace gravel, brown, very moist, compact — 6.1 / 96.78	SS	7	84	19	6	98	○	4		
	End of Borehole — 6.7						97				

Notes:
1. Borehole open and dry upon completion of drilling.
2. Borehole dry on June 10,2021.

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▽ Groundwater depth on completion of drilling: Dry m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: Dry m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH/MW2

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Truck Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	26 May 21	Date Completed: 27 May 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 104.11 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT ○ / DCPT ●); MTO Vane* (Intact △ / Remould ▲); Nilcon Vane* (Intact ◇ / Remould ◆); * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L; Plastic 20 40 60 80 Liquid	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 50 mm asphalt over 250 mm granular bases 103.81 / 0.3	SS	1	46	11	0	104		9		
	FILL: silty clay, trace sand, trace gravel, reddish brown, moist, stiff to hard	SS	2	79	15	1	103		11		
		SS	3	89	79	2	102		11		
		SS	4	0	50/3			50/3			
	- rubble					3	101				
	- silty sand, trace clay, trace gravel, reddish brown, very moist to wet, loose	SS	5	70	9				39		
	- sand and gravel, wet, grey, very dense	SS	6	62	42	4	100		20		
	- light weight concrete	SS	7	87	12	5	99				
	98.02					6	98				
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, fragments of shale, reddish brown, moist, stiff to very stiff 6.1	SS	8	100	14				18		
		SS	9	100	13	7	97		21		
		SS	10	62	22	8	96				
	93.45					9	95		24		
	SAND: trace clay, trace silt, trace gravel, reddish brown, moist, compact 10.7	SS	11	62	23	10	94				
	91.92					11	93		9		
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, fragments of shale, reddish brown, moist, stiff to hard 12.2	SS	12	95	13	12	92		20		
	----- grey	SS	13	95	47	13	91		15		
		SS	14	95	55	14	90		8		
	----- reddish brown	SS	15	65	50/8	15	89	50/8	12		
	85.83					16	88				
	BEDROCK: Shale, highly weathered, reddish brown, moist, hard 18.3	SS	16	60	50/5	17	87	50/5	10		
	84.27					18	86				
	End of Borehole 19.8	SS	17	100	50/3	19	85	50/3	16		

Notes:
1. Borehole open and dry upon completion of drilling.
3. Groundwater level reading at 10.91 m bgs on June 10, 2021.

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▽ Groundwater depth on completion of drilling: Dry m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 10.91 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH/MW3

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Truck Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	31 May 21	Date Completed: 31 May 21	Revision No.: 0, 29/6/21

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 104.41 m)		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 100 mm asphalt over 200 mm granular bases	104.11 0.3	SS	1	38	12	0	104	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80		
	FILL: silty sand, trace clay, trace gravel, occasional fragments of Asphalt, reddish brown, moist, very loose to compact		SS	2	41	4	1	103				
	- 150 mm thick layer of Asphalt		SS	3	67	16	2	102				
			SS	4	5	2	3	101				
	- clayey silt, trace to some sand, trace gravel, fragments of Asphalt, grey, firm		SS	5	8	5	4	100				
	- possible rock/boulder		SS	6	23	50/13	5	99				
		98.32					6	98				
	SILTY SAND TILL: trace gravel, reddish brown, wet, compact	6.1	SS	7	33	12	7	97				
		96.79					8	96				
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist, stiff	7.6	SS	8	87	17	9	95				
		95.27					10	94				
	SAND: trace silt, trace gravel, reddish brown, moist, dense	9.1	SS	9	70	31	11	93				
		91.91	SS	10	54	35	12	92				
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, very moist, stiff to hard	12.5	SS	11	75	12	13	91				
	------- grey		SS	12	67	49	14	90				
		88.57	SS	13	95	50	15	89				
	End of Borehole	15.8										

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level reading at 12.19 m bgs upon completion of drilling.
3. Groundwater level reading at 11.89 m bgs on June 10, 2021.

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▽ Groundwater depth on completion of drilling: 12.19 m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 11.89 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying 'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW4

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Truck Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	31 May 21	Date Completed: 1 Jun 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 103.72 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)
	ASPHALT PAVEMENT: 50 mm asphalt over 200 mm granular bases (0.3)	SS	1	8	7	0	103.47
	FILL: sand and gravel, trace clay, brown, moist, loose	SS	2	62	12	1	103
	- silty sand, trace clay, trace gravel, occassional fragments of brick and concrete, reddish brown, compact	SS	3	75	18	2	102
	------- silty clay,trace sand, trace gravel, reddish brown, moist, very stiff to hard	SS	4	87	43	3	101
	occasional pieces of concrete and brick, grey	SS	5	79	23	4	100
	- wood pieces (99.15)						
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist, firm (4.6) (97.63)	SS	6	87	7	5	99
	SAND: some gravel, trace silt, grey, moist, compact to dense (6.1)	SS	7	51	29	6	98
		SS	8	62	41	7	97
		SS	9	62	37	8	96
		SS	10	62	50	9	95
	(91.53)					10	94
	SILTY CLAY/ CLAYEY SILT TILL: trace to some sand, trace gravel, reddish brown, moist to wet, stiff to hard (12.2)	SS	11	54	11	11	93
	------- grey	SS	12	20	50	12	92
		SS	13	100	82	13	91
	(85.44)	SS	14	81	58	14	90
	BEDROCK: Shale, highly weathered to excellent quality, occasional limestone layers, reddish brown to grey, damp to moist (18.3)	SS	15	63	50	15	89
	ROCK CORE BEGINS					16	88
	- Fair Quality	RC	1	97	72	17	87
	- Excellent Quality	RC	2	100	92	18	86
						19	85
						20	84
						21	83
						22	82

FIELD TESTING: Penetration Testing — ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80

LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L; Plastic 20 40 60 80 Liquid

DEPTH (m)	Lower Explosive Limit (LEL)
1	7
2	12
3	14
4	11
5	10
6	21
7	3
8	10
9	6
10	4
11	20
12	16
13	18
14	12

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▽ No freestanding groundwater measured in open borehole on completion of drilling.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 9.97 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW4

Project Number: **BIGC-ENV-462A** Drilling Location: **See Borehole Location Plan** Logged by: **KK**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	BEDROCK: Shale, highly weathered to excellent quality, occasional limestone layers, reddish brown to grey, damp to moist - Excellent Quality	RC	3	99	98	23	81	○			
	- Excellent Quality	RC	4	94	91	24	80	○			
	78.87 24.9 **End of Borehole**						79				

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 9.97 m bgs on June 10, 2021.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW5

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Track Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	2 Jun 21	Date Completed: 2 Jun 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 102.64 m

DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT ○ / DCPT ●); MTO Vane* (Intact △ / Remould ▲); Nilcon Vane* (Intact ◇ / Remould ◆); * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L; Plastic 20 40 60 80 Liquid	INSTRUMENTATION INSTALLATION	COMMENTS
ASPHALT PAVEMENT: 50 mm asphalt over 200 mm granular bases (102.39 / 0.3)	SS	1	70	11	0	102	○ 11	▲ 11		
FILL: silty clay/ clayey silt, trace sand, trace gravel, reddish brown, moist, stiff to hard	SS	2	33	37	1		○	▲ 11		
	SS	3	87	49	2	101	○	▲ 9		
- sand and gravel, grey, moist, very dense	SS	4	74	50/15	3	100	○ 50/15	▲ 9		
	SS	5	95	11	4	99	○	▲ 10		
- NO RECOVERY	SS	6	0	1	5	98	○			
(96.55)					6	97				
SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist to wet, very soft to soft (6.1 / 91.98)	SS	7	95	2	7	96	○	▲ 18		
	SS	8	95	5	8	95	○	▲ 16		
	SS	9	95	4	9	94	○	▲ 15		
					10 ▼	93				
SAND: some gravel, trace clay, trace silt, reddish brown, wet, compact (10.7 / 90.45)	SS	10	67	16	11	92	○	▲ 17		
SILTY CLAY/ CLAYEY SILT TILL: trace to some sand, trace gravel, grey, very moist to wet, very stiff to hard (12.2 / 87.10)	SS	11	95	25	12 ▽	91	○	▲ 16		
	SS	12	95	40	13	90	○	▲ 15		
	SS	13	83	50	14	89	○	▲ 16		Gr-10%; Sa-20%; Si-47%; Cl-22%
					15	88				

End of Borehole 15.5

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level reading at 12.19 m bgs upon completion of drilling.
3. Groundwater level reading at 10.13 m bgs on June 10, 2021.

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▽ Groundwater depth on completion of drilling: 12.19 m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 10.13 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW6

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Track Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	3 Jun 21	Date Completed: 3 Jun 21	Revision No.: 0, 29/6/21

Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 101.22 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING ★ Rinse pH Values 2 4 6 8 10 12 Soil Vapour Reading △ parts per million (ppm) 100 200 300 400 ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 50 mm asphalt over 200 mm granular bases	100.97 0.3	SS	1	62	35		101		8		
	FILL: silty clay/ clayey silt, trace sand, trace gravel, reddish brown, moist, stiff to hard		SS	2	54	9	1	100		11		
	-------		SS	3	84	30	2			11		
	-silty sand, trace clay, trace gravel, occasional fragments of brick pieces, reddish brown, moist, dense		SS	4	84	38	3	99		9		
	-------		SS	5	95	18		98		10		
							4	97				
	- firm		SS	6	41	5	5	96		11		
		95.13					6					
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist to wet, very soft to soft	6.1	SS	7	67	3		95		22		
							7	94				
			SS	8	79	0	8	93		17		
		92.08					9					
	SAND: trace to some gravel, trace clay, trace silt, brown, wet, compact	9.1	SS	9	33	15		92		11		
							10	91				
			SS	10	51	18	11	90		19		
		89.03					12					
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, grey, wet, hard	12.2	SS	11	75	31		89		16		
							13	88				
			SS	12	67	46	14	87		12		
							15					
	- moist	85.37	SS	13	84	54		86		11		
	End of Borehole	15.9										

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level reading at 12.19 m bgs upon completion of drilling.
3. Groundwater level reading at 8.71 m bgs on June 10, 2021.

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▽ Groundwater depth on completion of drilling: 12.19 m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 8.71 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

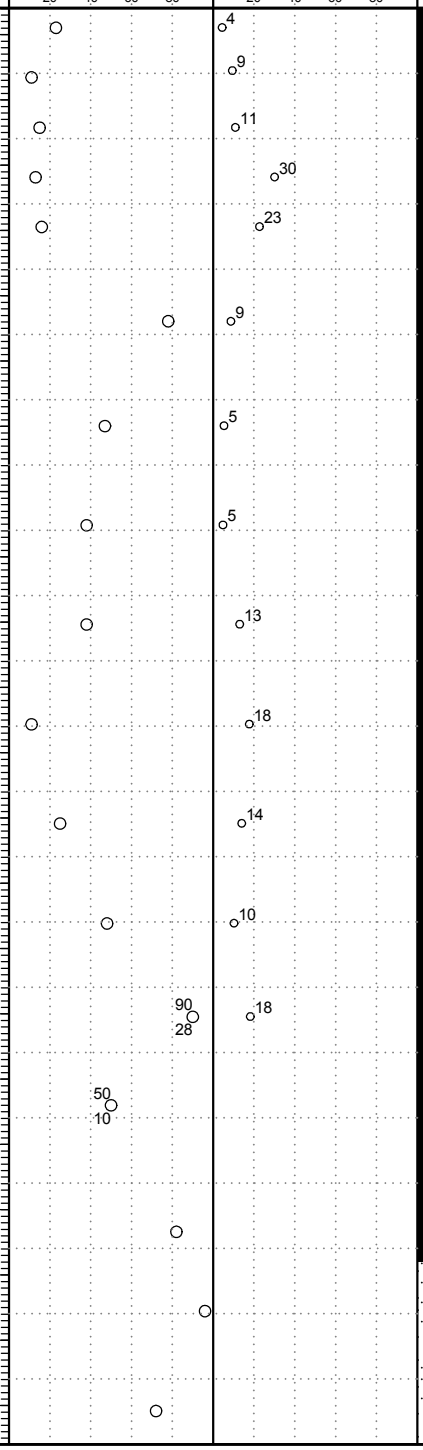
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RECORD OF BOREHOLE No. BH/MW7

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Track Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	8 Jun 21	Date Completed: 9 Jun 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 101.41 m

Lithology Plot	DESCRIPTION	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	Depth (m)
	ASPHALT PAVEMENT: 100 mm asphalt over 200 mm granular bases	101.11 / 0.3	SS	1	59	23	0
	FILL: silty claey, trace sand, trace gravel, occasional fragments of concrete, reddish brown, damp, very stiff to stiff	99.12	SS	2	59	11	1
			SS	3	92	15	2
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist, stiff	2.3 / 96.81	SS	4	95	13	3
			SS	5	75	16	4
	SAND: trace to some gravel, trace silt, greyish brown, moist, very dense to compact	4.6	SS	6	67	78	5
			SS	7	67	47	7
			SS	8	62	38	8
			SS	9	67	38	9 ▼
			SS	10	95	11	11
		89.22					12
	SILTY CLAY/ CLAYEY SILT TILL: trace to some sand, trace gravel, grey, moist, very stiff to hard	12.2	SS	11	70	25	13
			SS	12	95	48	14
			SS	13	77	90/28	15
		84.65	SS	14	30	50/10	16
	BEDROCK: Shale, highly weathered to excellent quality, occasional limestone layers, reddish brown to grey, damp to moist	16.8					17
	ROCK CORE BEGINS		RC	1	83	82	18
	- Good Quality						19
	- Excellent Quality		RC	2	100	96	20
	- Fair Quality		RC	3	100	72	21
							22



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▽ No freestanding groundwater measured in open borehole on completion of drilling.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 9.19 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW7

Project Number: **BIGC-ENV-462A** Drilling Location: **See Borehole Location Plan** Logged by: **KK**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS
	BEDROCK: Shale, highly weathered to excellent quality, occasional limestone layers, reddish brown to grey, damp to moist							Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80		
	- Excellent Quality	RC	4	100	100	23	79				
						24	78				
	- Excellent Quality	RC	5	100	100	25	77				
	76.11										
	End of Borehole 25.3										

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 9.19 m bgs on June 10, 2021.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

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RECORD OF BOREHOLE No. BH/MW8

Project Number:	BIGC-ENV-462A	Drilling Location:	See Borehole Location Plan	Logged by:	KK
Project Client:	Camarro Developments Inc.	Drilling Method:	150 mm SSA+HSA	Compiled by:	KK
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	Track Mounted Drill	Reviewed by:	SS
Project Location:	1062 & 1074 Cooke Boulevard, Burlington, Ontario	Date Started:	3 Jun 21	Date Completed: 3 Jun 21	Revision No.: 0, 29/6/21

Geodetic Ground Surface Elevation: 102.42 m

Depth (m)	Description	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	Field Testing (Penetration Testing: SPT ○ DCPT ●; MTO Vane* Intact △ Remould ▲; Nilcon Vane* Intact ◇ Remould ◆; * Undrained Shear Strength (kPa) 20 40 60 80)	Lab Testing (★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L; Plastic 20 40 60 80 Liquid)	Instrumentation Installation	Comments
0	**ASPHALT PAVEMENT:** 50 mm asphalt over 200 mm granular bases (0.3)	102.17	SS	1	8	6	○	3		
1	**FILL:** sand and gravel, trace clay, trace silt, occasional fragments of Asphalt, brown, moist, loose		SS	2	54	9	○	12		
	------- clayey silt, trace sand, trace gravel, brown, moist, stiff		SS	3	75	9	○	11		
2			SS	4	95	20	○	10		
3	- sand, trace to some gravel, trace clay, moist, brown, compact (3.0)	99.38	SS	5	79	6	○	28		
4	**SILTY CLAY/ CLAYEY SILT TILL:** trace sand, reddish brown, wet, firm to very stiff	97.55	SS	6	67	16	○	10		
5	**SAND:** trace to some gravel, trace silt, brown, moist, compact to very dense (4.9)		SS	7	62	29	○	4		
6			SS	8	33	50	○	3		
7			SS	9	51	75	○	5		
8	- wet									
9			SS	10	62	23	○	13		
10		90.23								
11	**SILTY SAND:** trace clay, trace gravel, reddish brown, wet, compact (12.2)		SS	11	70	14	○	21		
12		88.71								
13	**SILTY CLAY/ CLAYEY SILT TILL:** trace to some sand, trace gravel, grey, moist, hard (13.7)		SS	12	95	45	○	13		
14										
15		86.57	SS	13	95	67	○	14		Gr-4%; Sa-19%; Si-52%; Cl-25%
	End of Borehole (15.9)									

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level reading at 10.66 m bgs upon completion of drilling.
3. Groundwater level reading at 9.95 m bgs on June 10, 2021.

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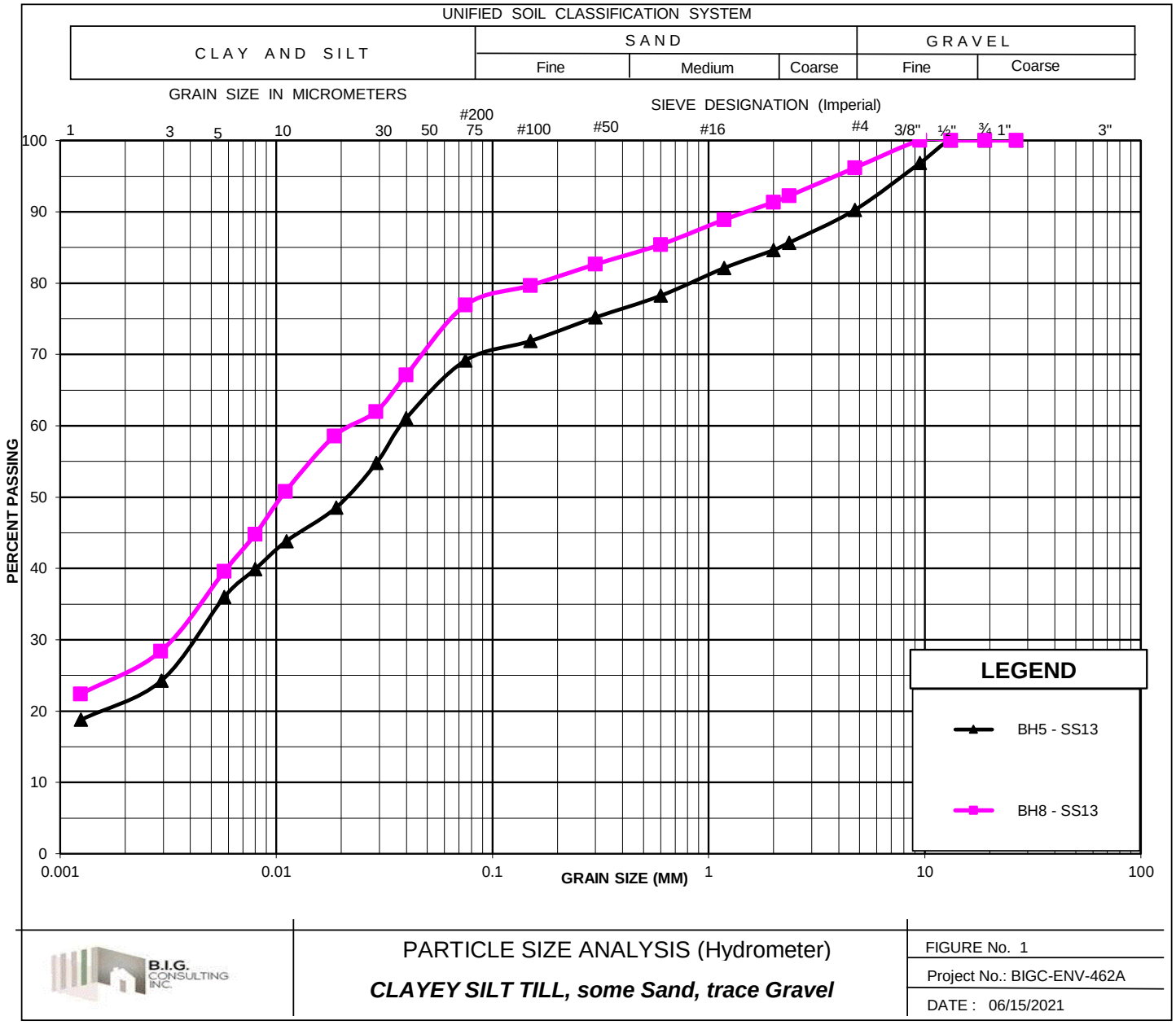
▽ Groundwater depth on completion of drilling: 10.66 m.

▼ Groundwater depth observed on 10/06/2021 at a depth of: 9.95 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

Scale: 1 : 116

Appendix C – Geotechnical Laboratory Test Results



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PARTICLE SIZE ANALYSIS (Hydrometer)

CLAYEY SILT TILL, some Sand, trace Gravel

FIGURE No. 1

Project No.: BIGC-ENV-462A

DATE : 06/15/2021

B.I.G CONSULTING INC.

PLASTICITY CHART

Job # :	BIGC-ENV-462A	**Lab # :**	
Project Client:		**Technician :**	KK
Project :	Preliminary Geotechnical Investigation	**Supervisor :**	SS
Location :	Cooke Boulevard, Burlington, Ontario	**Date :**	12/06/21

TEST RESULTS

Specimen #	Sample #	Depth (m)	LL%	PL%	PI	Fines%	W%	Classification	Remarks
BH8	SS13	15.5	28	15	13	77	14	CI	Native

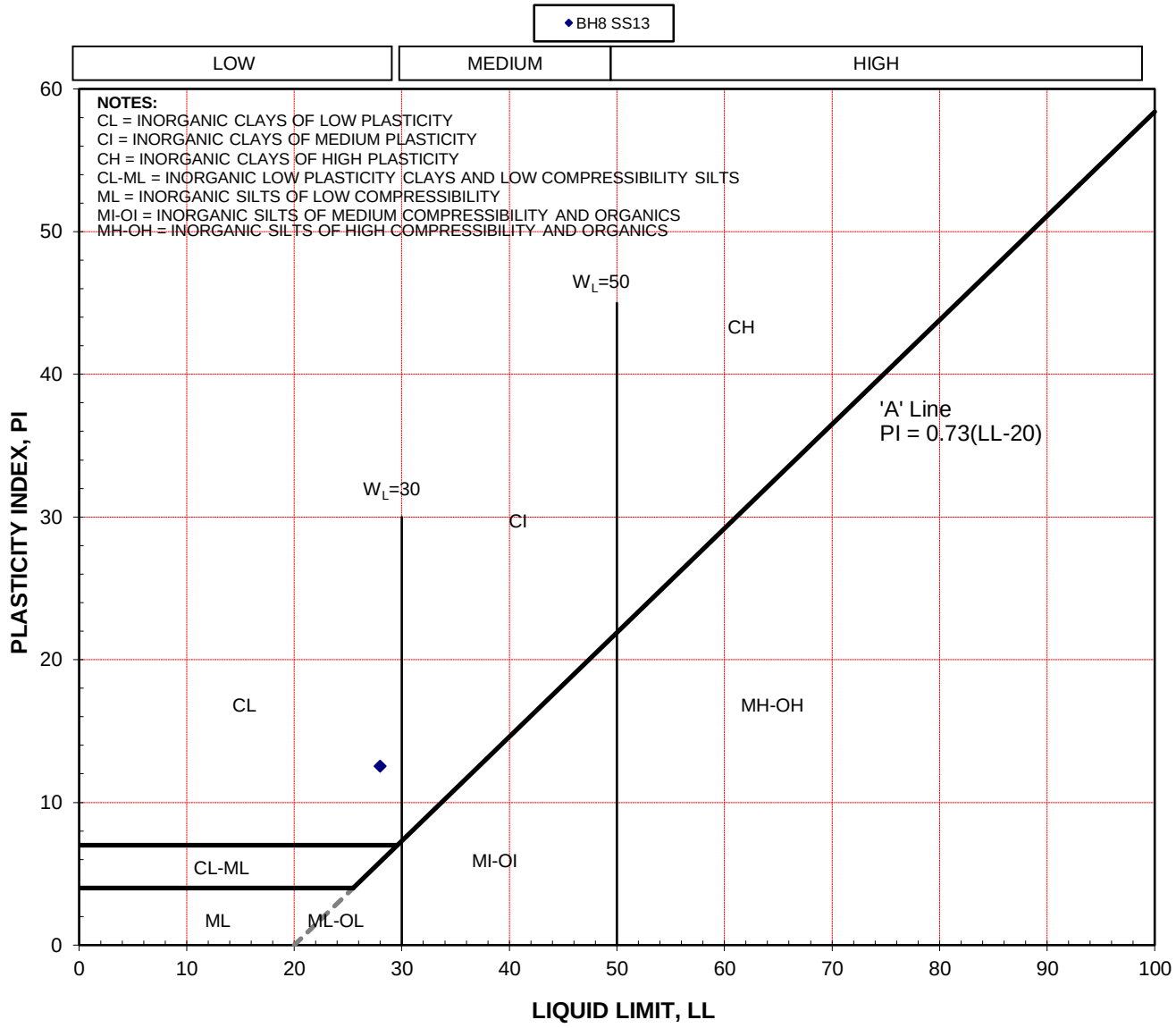


FIGURE - 2

Appendix D - Pictures of Rock Core Samples

ROCK CORE PICTURES
BH/MW4

B.I.G. Consulting Inc.
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Project No.:	BIGC-ENV-462A	**Prepared By:**	KK
Project:	Preliminary Geotechnical Investigation	**Checked By:**	SS
Location:	1062 & 1074 Cooke Blvd., Burlington	**Date:**	June 06'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	19.51	0.91	96	72
RC-2	20.42	1.52	93	93
RC-3	21.95	1.52	100	99
RC-4	23.47	1.52	94	91

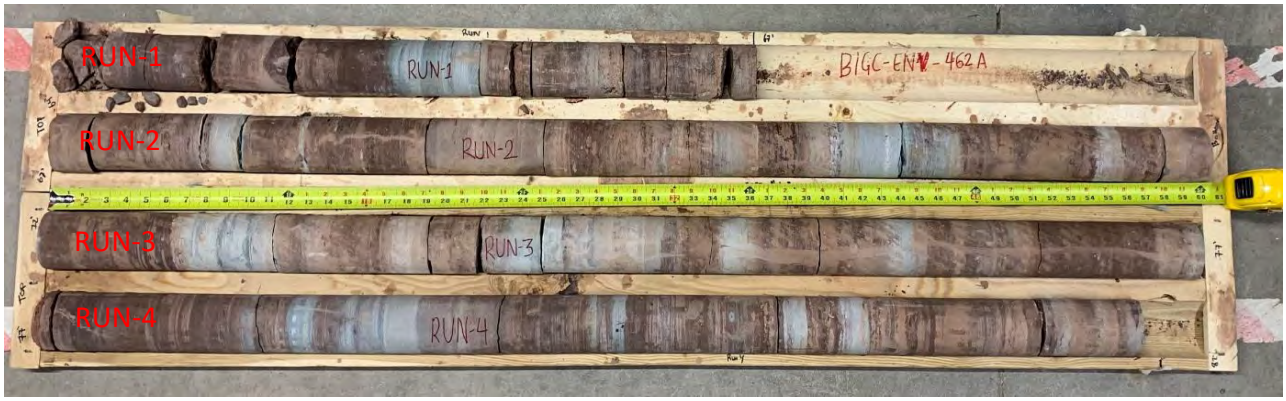


FIGURE- D1

ROCK CORE PICTURES
BH/MW7

B.I.G. Consulting Inc.
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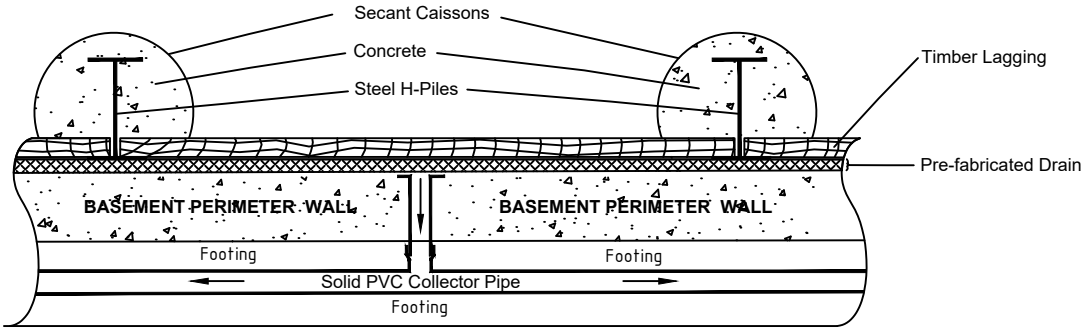
Project No.:	BIGC-ENV-462A	**Prepared By:**	KK
Project:	Preliminary Geotechnical Investigation	**Checked By:**	SS
Location:	1062 & 1074 Cooke Blvd., Burlington	**Date:**	June 11'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	18.29	0.91	83	82
RC-2	19.20	1.52	100	96
RC-3	20.73	1.52	100	72
RC-4	22.25	1.52	100	100
RC-5	23.01	1.52	100	100

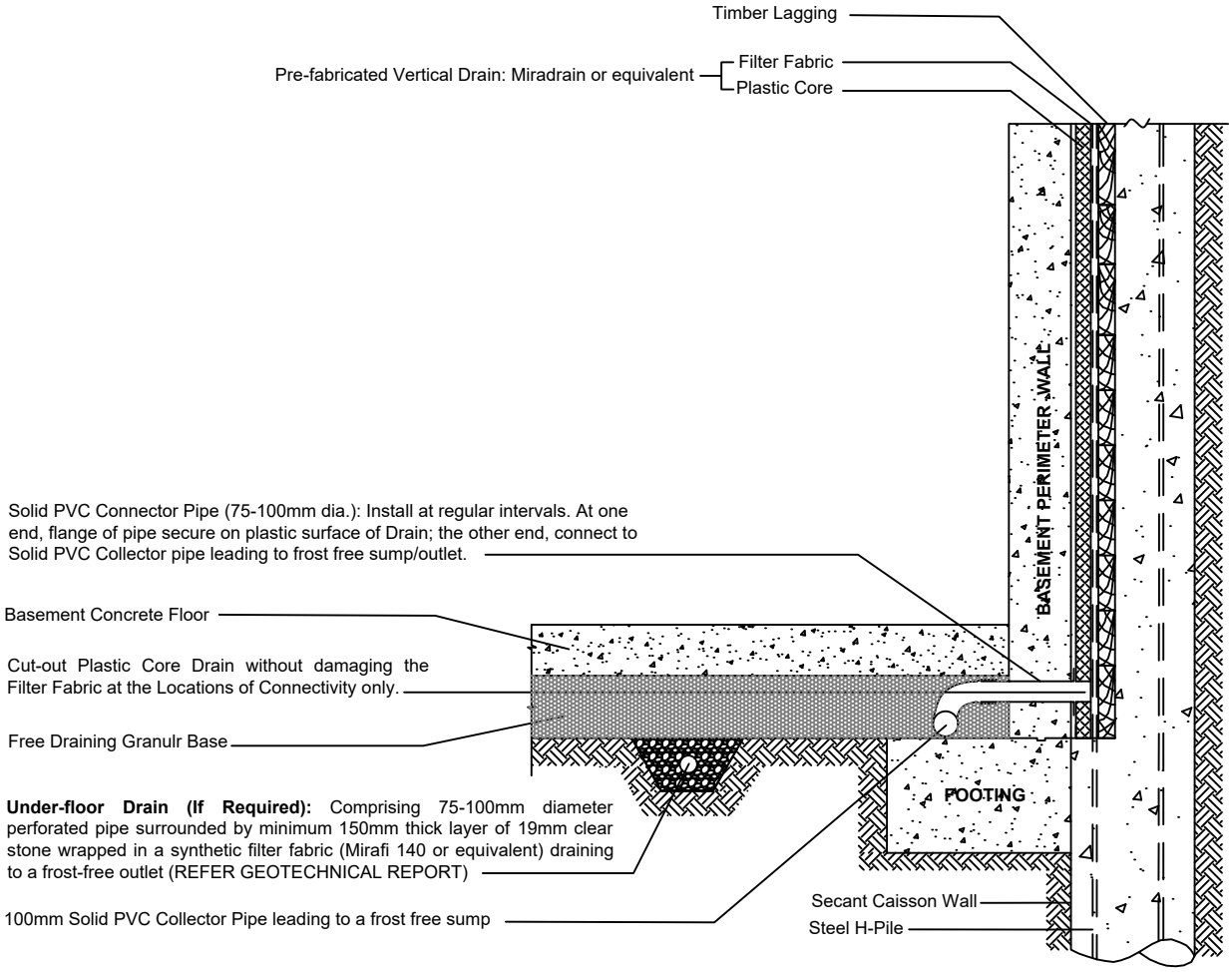


FIGURE- D2

Appendix E - Conceptual Permanent Perimeter and Underfloor Drainage Systems with Shoring



PLAN



TYPICAL SECTION

Note:

1. A continuous blanket of prefabricated drainage system, Miradrain 6000 or equivalent, should extend continuously from the top of footings to approximately 1.2m below the ground surface.
2. All terminal end openings (top, bottom & sides) of drain must be covered with terminal fabic flaps and fasten to prevent intrusion of concrete and soils into the drainage core.
3. All surface joints of the Miradrain should be sealed with tape.
3. The backfill materials behind the lagging should be free draining. If wet conditions are encountered, geotextile flter fabric or straw should be used to prevent loss of ground.
4. Subfloor drainage system (if required) should keep/treat separate from the perimeter drainage system.

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LEGEND

TITLE AND LOCATION

PERMANENT PERIMETER & UNDER-FLOOR DRAINAGE SYSTEM
(CONCEPTUAL-FOR SHORING)
PRELIMINARY GEOTECHNICAL INVESTIGATION
1062 AND 1074 COOKE BOULEVARD,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-462A	O.A.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JUNE 2021	E