GEOTECHNICAL INVESTIGATION REPORT
FOR PORPOSED NEW SUBDIVISION AT 613 HELENA STREET, FORT ERIE, ON

Client

SS Welland Inc.
4080 Confederation Parkway, Unit 605
Mississauga, ON L5B 0G1

Prepared by:

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Project No. 2100394AG

February 16, 2022

HLV2K
ENGINEERING LIMITED

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4080 Confederation Parkway, Unit 605
Mississauga, ON L5B 0G1
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Attention: Hunain Siddiqui
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RE: Geotechnical Investigation Report for Proposed New Subdivision at 613 Helena Street, Fort Erie, ON

Enclosed is a copy of geotechnical investigation report related to the above noted site.

For and on behalf of HLV2K Engineering Limited

Irfan Ahmad Khokhar, Ph.D., P.Eng.
Vice President and Principal

Executive Summary

A geotechnical investigation based on drilling eleven boreholes (BH1 to BH11) was carried out for the proposed new subdivision at 613 Helena Street, Fort Erie, ON. The approximate project site location plan and approximate location of the drilled boreholes are shown on Drawings 1 & 1A.

Based on the information provided by the client, it is our understanding that the project consists of double storey residential dwellings.

HLV2K does not have any architectural or structural information regarding the proposed development.

The purpose of this investigation was to assess the subsurface conditions at the site and provide geotechnical engineering advice and recommendations.

A top layer of topsoil was encountered at all borehole locations except at BH1 and BH3, where asphalt and gravel were encountered as top layer respectively. Topsoil thickness was measured in the range of 150mm to 300mm at borehole locations. It should be noted that asphalt/topsoil quantities should not be calculated from the borehole information, as large variations in depth may exist between and beyond boreholes.

Under the topsoil/asphalt/grave, a layer of fill/disturbed native was encountered at all borehole locations except BH1 and BH3 and extended in general to approximately from 0.2m to 0.6m below the existing ground surface. The disturbed native consisted of silty clay, with inclusions of trace sand and gravel, trace rootlets and organic matter and was typically in loose state. Granular material consisting of silty sand and gravel was found at the location of boreholes BH1 and BH3 and was typically very moist and in loose state. It should be noted that the depth of fill can vary in the area of existing structures or in the area of previous excavations.

Native materials were encountered underlying the fill/disturbed native material in boreholes BH2, BH4 to BH11 and/or granular material at BH1 and BH3. The native materials encountered at most of the borehole locations were quite consistent and were generally cohesive in nature (i.e. firm to very stiff silty clay till) to depths ranging between 3.1m and 4.9m below ground surface followed by a layer of soft to firm silty clay to a maximum explored depth ranging from 4.6 to 6.9m below existing ground surface. Bedrock was encountered at the location of boreholes BH1, BH, BH7 and BH1 at depths 4.6 ranging from 4.6 to 6.9m below existing ground surface.

During drilling and at the completion of drilling, the short-term groundwater levels were observed in boreholes and found dry. Monitoring wells were installed at the borehole locations BH5, BH6, BH7 and BH11. Groundwater level measurements were made at different times to observe water level fluctuations in the monitoring wells and presented in table 3.3 of this report.

It should be noted that groundwater conditions vary depending on factors such as temperature, season, precipitation, construction activity and other situations, which may be different from those encountered at the time of the monitoring. The possibility of groundwater level fluctuations at the site should be considered when designing and developing the construction plans for the project.

Based on the boreholes information, the proposed structures can be supported by conventional spread and strip footings, on undisturbed native deposits predominantly silty clay till for a geotechnical reaction of 100kPa at the Serviceability Limit States (SLS), and for a factored geotechnical resistance of 150kPa at the Ultimate Limit States (ULS). The geotechnical reactions and factored geotechnical resistances including the corresponding highest founding elevations at the borehole locations are summarized on Table 4.1 The recommended founding levels and geotechnical reactions for the proposed structures would need to be confirmed by HLV2K at the time of construction.

Groundwater problems are anticipated during excavation and installation of foundations below the existing ground surface. A positive dewatering system will be required to deal with water problems during the construction. Details of dewatering requirement are provided in a hydrogeological investigation report prepared by HLV2K.

The basement floor slab can be supported on grade, the floor slab can be supported on grade, provided the base is thoroughly proof rolled and any soft and unstable areas detected are sub-excavated and can be replaced with imported Granular A and/or Granular B placed in shallow lifts (each lift not more than 200mm) and compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). The imported granular material must meet the specifications defined in OPSS-1010-13. The perimeter and under floor drainage system shown on Drawing 3 is recommended for the basement walls where open cut excavations will be undertaken.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the on-site fill material and loose to compact native soils can be classified as Type 3 soil. The dense to very dense native soils can be classified as Type 1 to Type 2 soil above the water level and Type 4 below the groundwater table. Wet sandy silt to silty sand seams can also be classified as Type 4 soils. As a general rule, the excavations in Type 1 and 2 soils can be carried out without support using side slopes 1H:1V, while the bottom 1.2m of the excavation can be cut vertically and could retain the wall for a short period of time. The excavation in Type 3 soil can be carried out maintaining the side slopes not steeper than 1H:1V. The excavations in Type 4 soils will require minimum flatter side slopes of 3H to 1V. These slopes should be visually monitored for any movement especially if workers are present within the excavation. These temporary slopes should only be utilized for a short duration. If an excavation contains more than one type of soil, the soil shall be classified as the type with the highest number among the types present.

Underside of the basement floor slab should be placed above the ground water level. Prior to the cut below the groundwater level, positive dewatering system such as well points or eductors and/or deep wells will be required in the portion of basement excavation on the site. Otherwise, it will result in an unstable excavation base and flowing sides. The groundwater table must be lowered one meter below the lowest excavation level. Test pits can be carried out at the site prior to the excavation to further explore the groundwater and seepage conditions. A specialized dewatering contractor should install the dewatering system.

The select inorganic fill and native soils free from topsoil and organics can be used as general construction backfill where it can be compacted with sheep's foot type compactors. Loose lifts of soil, which are to be compacted, should not exceed 200mm. Majority of the on-site inorganic fill is not considered suitable for backfilling, imported fill materials with suitable moisture (preferably granular) must be used to replace the existing fill under the slab-on-grade and in trenches.

Based on the borehole information, the subject site for the proposed new building can be classified as Class ‘D’ for seismic site response according to Table 4.1.8.4.A of OBC 2012 provided the footings will be supported on undisturbed native deposits. Consideration could be given to conduct an earthquake site assessment with the use of in-situ testing of the seismic characteristics (i.e. Geophysical testing – Multi-channel Analysis of Surface Waves-MASW) which can lead to an improved site classification (i.e. from Class D to Class C).

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1 INTRODUCTION

HLV2K Engineering Limited (HLV2K) was retained by SS Fort Erie Inc. (the client) to undertake a geotechnical investigation for the proposed new subdivision at 613 Helena Street, Fort Erie, ON. The approximate project site location plan and approximate location of the boreholes are shown on **Drawings 1 & 1A**.

This work was conducted in accordance with our proposal 2100394AG dated May 25, 2021. Authorization to Proceed (ATP) was issued to HLV2K dated June 14, 2021.

Based on the information provided by the client, it is our understanding that the project will consist of seventeen (17) Residential blocks and one (1) block for stormwater management.

The purpose of this investigation was to assess the subsurface conditions at eleven (11) borehole locations (BH1 to BH11) and from the findings in the boreholes make geotechnical engineering recommendations for the following:

1. Foundations
2. Floor slab and permanent drainage
3. Excavations and backfill
4. Earth pressures
5. Earthquake considerations
6. Underground Utility Trenches
7. Pavement

This report is provided based on the terms of reference presented above and, in the text, and on the assumption that the design will be in accordance with the applicable codes and standards. If there is any change in the design features relevant to the geotechnical analyses, or if any question arises concerning the geotechnical aspects of the codes and standards, HLV2K should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of HLV2K can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for SS Fort Erie Inc. and its designers. Third party use of this report without HLV2K's consent is prohibited. The limitation conditions presented in Appendix A form an integral part of the report and they must be considered in conjunction with this report.

2 FIELD AND LABORATORY WORK

Borehole locations for this investigation were established in and marked on the ground by HLV2K personnel in accordance with the client requirements. Prior to drilling operations, underground utilities were cleared at the borehole locations by the public and private utilities' companies.

For this geotechnical investigation, four boreholes (BH1 to BH11) were drilled to depths varying from 4.6m to 6.9m on September 8 & 9, 2021. The boreholes were advanced by a drilling sub-contractor Landshark Drilling Inc. located at 73 Sinclair Blvd. Brantford, ON, under the supervision of HLV2K personnel. The boreholes were advanced by utilizing continuous flight hollow stem augers. Samples were retrieved at regular intervals with a 50mm O.D. split-barrel sampler driven with a hammer weighing 624 N (63.5 kg) and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method (ASTM D1586). The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 300mm (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or compactness of non-cohesive soils. The results of SPT are shown in the Record of Boreholes. The samples were logged in the field and returned to the HLV2K laboratory for detailed examination by the project engineer and for laboratory testing. The approximate borehole locations are shown on Drawing 1A.

Water level observations were made during drilling and at the completion of the drilling operations. Upon completion of drilling, each borehole was backfilled in accordance with current regulations.

The locations of the boreholes were established in the field by HLV2K accompanied by the client representative based on the plan provided by the client. The borehole elevations and locations were surveyed and established by the HLV2K staff. Note, these elevations are approximate only, for relating borehole soil stratigraphy and should not be used or relied on for other purposes.

As well as visual examination in the laboratory, soil samples were tested for water content determinations. Grain size analyses were carried out on selected soil samples as presented in Table 2.1. The results of the laboratory tests are presented on the borehole logs, and on Drawings 2.

Table 2.1: Sample Details for Grain Size Analyses

Sample No.	Approximate Depth Below the Existing Ground Surface (m)	Approximate Geodetic Elevation (m)	Type of Test	Lab Results
BH1-SS3	1.5 – 2.1	180.6 – 180	MH	Drawing 2
BH2-SS6	4.5 – 5.1	177.0 – 176.5	MH	Drawing 2

Notes: -MH stands for sieve and hydrometer grain size analyses

The results of grain size analyses are presented on subject referenced drawings.

3 RESULTS OF THE INVESTIGATION

The site is located at the west side of Helena Street, south of the intersection of Helena Street and Garrison Road in Fort Erie, Ontario. The site key plan and the borehole locations are presented on Drawings 1 and 1A. Notes on sample descriptions and the general features of fill material and native soils are presented on Drawing 1B. Detailed subsurface conditions are presented on borehole log sheets, attached as Appendix B.

Details of the subsurface conditions encountered at the borehole locations are provided on the borehole logs following the text of this report. The borehole logs indicate the subsurface conditions only at the borehole locations. Note the material boundaries indicated on the attached sheets are approximate and based on visual observations. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should be pointed out that the subsurface conditions will vary across this site. The subsurface soil and groundwater conditions are summarized as follows.

3.1 Subsurface Conditions

In general, below the fill/disturbed native materials (silty clay, trace sand and gravel), the site is underlain by native soils (silty clay till to clayey silt till/silty clay, trace sand and gravel). The subsurface conditions encountered in the boreholes are summarized as follows.

3.1.1 Pavement Structure

Pavement structure is encountered at location of boreholes: BH1. The approximate asphalt concrete thickness is 150 mm underlain by granular base/subbase (sand with gravel with asphalt inclusion). Thickness of granular material is 150 mm to 200 mm.

3.1.2 Fill/Disturbed Native Soil

Under the topsoil/asphalt/grave, a layer of fill/disturbed native was encountered at all borehole locations except BH1 and BH3 and extended in general to approximately from 0.2m to 0.6m below the existing ground surface. The disturbed native consisted of silty clay, with inclusions of trace sand and gravel, trace rootlets and organic matter. SPT N-values recorded within this material generally varied from 4 to 7 blows/300mm indicating loose state.

Based on visual observation in the field and our experience in the area, it appears that these SPT N values are not representative to determine the compactness. It also indicates that the fill did not receive a systematic compaction. It should be noted that the thickness of fill could vary between and beyond boreholes and this should be considered when estimating.

3.1.3 Granular Fill

Granular fill material consisting of silty sand and gravel was found at the location of boreholes BH1 and BH3 and was typically moist and in loose to compact state. It should be noted that the depth of fill can vary in the area of existing structures or in the area of previous excavations.

3.1.4 Native Soils:

Native materials were encountered underlying the fill/disturbed native material in boreholes BH2, BH4 to BH11 and/or granular material at BH1 and BH3. The native materials encountered at most of the borehole locations were quite consistent and were generally cohesive in nature (i.e. firm to very stiff silty clay till) to depths ranging between 3.1m and 4.9m below ground surface followed by a layer of soft to firm silty clay to a maximum explored depth ranging from 4.6 to 6.9m below existing ground surface.

The grain-size distribution of two (2) selected soil samples (BH1-SS3 and BH2-SS6) from native deposit is enclosed in Drawing 2, and results are summarized in Table 3.1.

Table 3.1: Summary of Grain-Size Distribution

Sample No.	Depth Below the Existing Ground Surface (m)	Sieve and Hydrometer Test Results			
		Gravel %	Sand %	Silt %	Clay %
BH1-SS3	1.5 – 2.1	1	7	45	47
BH2-SS6	4.5 – 5.1	1	7	52	40

It should be noted that the thickness of native deposit could vary between and beyond the borehole locations within the depth of investigation, and this should be taken into account when estimating.

3.1.5 Bedrock

Silty clay deposit is underlain by bedrock. Grey, weathered dolomite bedrock was encountered at the location of boreholes BH1, BH, BH7 and BH1 at depths 4.6 ranging from 4.6m to 6.9m below existing ground surface corresponding to geodetic elevations 175.3m to 177.1m.

3.2 Groundwater Conditions

During drilling and at the completion of drilling, the short-term groundwater levels were observed in boreholes. Monitoring wells were installed at the borehole locations BH5 to BH7 and BH11. Groundwater level measurements were made on Oct 21, 2021 to observe water level fluctuations in the monitoring wells and presented in table 3.3

Table 3.3: Summary of Groundwater Level Observations in Installed Monitoring Wells

MW ID	Ground Surface Elevation (m)	Borehole Depth (mbgs)	Groundwater Depth (mbgs)	Elevation (m)
BH5	181.4	5.2	1.6	179.8
BH6	181.2	5.2	1.3	179.9
BH7	181.7	4.6	2.2	179.5
BH11	181.9	6.1	2.05	179.85

Based on the water table readings obtained between on October 21, 2021, the groundwater level varied from 1.3m to 2.2m below the existing ground surface, corresponding to geodetic elevations of 179.5 to 179.9m. For design purpose, the groundwater table can be estimated at an approximate depth of 1.2m corresponding to geodetic elevation of 180.0m.

It should be noted that groundwater conditions vary depending on factors such as temperature, season, precipitation, construction activity and other situations, which may be different from those encountered at the time of the monitoring. The possibility of groundwater level fluctuations at the site should be considered when designing and developing the construction plans for the project.

Note that the groundwater level can vary and is subjected to seasonal fluctuations and in response to major weather events. The depth of groundwater table can also be influenced by the presence of underground features such as utility trenches.

Perched water can be encountered in excavated areas during wet seasons especially at the interface of fill and native soils. A perched water condition can also occur due to the accumulation of surface water in the more permeable fill deposits overlying less permeable clayey soils.

4 DISCUSSION AND RECOMMENDATIONS

Based on the information provided by the client, it is our understanding that the project consists of proposed new subdivision at 613 Helena Street, Fort Erie, ON.

HLV2K does not have any architectural or structural information regarding the proposed development.

The following sections of the report provides our interpretation of the factual geotechnical data obtained during our field evaluation and is intended for the guidance of the design engineer only. Where comments are made on aspects of construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own interpretation of the subsurface information provided as it affects their proposed construction methods, equipment selection, scheduling, safety and the like.

4.1 Foundations

The fill and/or disturbed material are unsuitable to support foundations or floor slabs due to differential settlements that could damage the structures.

4.1.1 Footings founded on Native Soils

Based on the boreholes information, the proposed structures can be supported by conventional spread and strip footings, on undisturbed native deposits predominantly silty clay till for a geotechnical reaction of 100kPa at the Serviceability Limit States (SLS), and for a factored geotechnical resistance of 150kPa at the Ultimate Limit States (ULS). The geotechnical reactions and factored geotechnical resistances including the corresponding highest founding elevations at the borehole locations are summarized on Table 4.1 The recommended founding levels and geotechnical reactions for the proposed structures would need to be confirmed by HLV2K at the time of construction.

Table 4.1: Bearing Values & Founding Levels of Footings on Native Soils

BH No.	Material	Geotechnical Reaction at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Grade (m)	Founding Level at or Below Elevation (m)
BH1	Silty Clay Till	100	150	1.2	181.0
BH2	Silty Clay Till	100	150	1.2	180.4
BH3	Silty Clay Till	100	150	1.2	180.5

BH No.	Material	Geotechnical Reaction at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Grade (m)	Founding Level at or Below Elevation (m)
BH4	Silty Clay Till	100	150	1.2	180.2
BH5	Silty Clay Till	100	150	1.2	180.2
BH6	Silty Clay Till	100	150	1.2	180.0
BH7	Silty Clay Till	100	150	1.2	180.5
BH8	Silty Clay Till	100	150	1.2	180.6
BH9	Silty Clay Till	100	150	1.2	180.6
BH10	Silty Clay Till	100	150	1.2	180.4
BH11	Silty Clay Till	100	150	1.2	180.7

Above geotechnical reactions and founding level are provided here with a condition that basement will not be excavated more than 1.5m below existing ground surface due to presence of a soft clay layer at or below 3.1m bgs. If client decided to excavate below 1.5 for the basements, then HLV2K should be contacted for further recommendations

All base of all foundations must be inspected by this office prior to pouring concrete or placing the mud slab.

4.1.2 Other Comments on Foundations

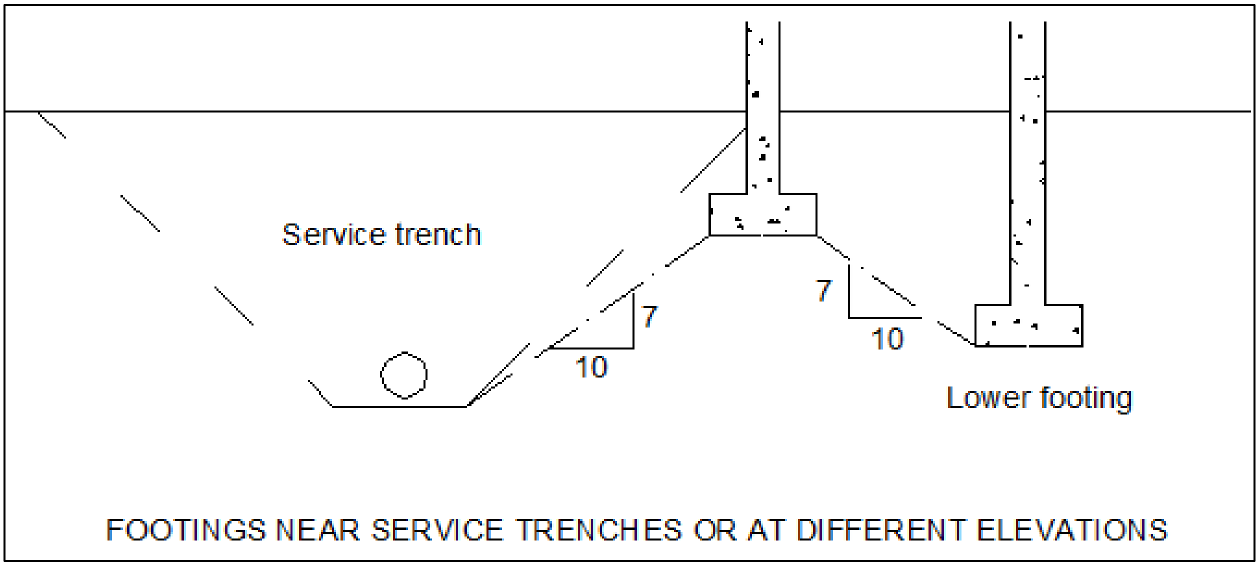
Variations in the soil conditions are expected in between the borehole locations, and during construction, the soil bearing pressures should be confirmed by the Geotechnical Engineer.

The base of all footings must be inspected by this office to ensure of their placement on the competent native soil.

Footings designed to the specified bearing capacity at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

In the vicinity of the existing buried utilities, footings must be lowered to undisturbed native soils, or alternatively the services must be structurally bridged.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing. Footings close to underground services should also be set back from the services based on this slope limitation as shown in the following Figure.



During winter construction, foundations and slab (if applicable) on grade must not be poured on frozen soil. Foundations must be adequately protected at all times from cold weather and freezing conditions.

Design frost protection depth for the general area is 1.2m. Therefore, for frost protection, new footings should have a permanent earth cover of at least 1.2m or be provided with an equivalent thickness of extruded rigid exterior-grade polystyrene insulation. In case of rip-rap (rock fill), only one-half of the rock fill thickness should be assumed to be effective in providing frost protection.

The recommended bearing capacities and the corresponding founding elevations would need to be confirmed by the representative of HLV2K during construction. It should be noted that the recommended bearing capacities have been calculated by HLV2K from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by HLV2K to validate the information for use during the construction stage. In this regard, HLV2K should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, HLV2K will assume no responsibility for interpretation of the recommendations in the report.

4.2 Floor Slab and Permanent Drainage

The basement floor slab can be supported on grade, the floor slab can be supported on grade, provided the base is thoroughly proof rolled and any soft and unstable areas detected are sub-excavated and can be replaced with imported Granular A and/or Granular B placed in shallow lifts (each lift not more than 200mm) and compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). The imported granular material must meet the specifications defined in OPSS-1010-13. The perimeter and under floor drainage system shown on Drawing 3 is recommended for the basement walls where open cut excavations will be undertaken.

A moisture barrier consisting of at least 200 mm thick layer of well compacted 19 mm clear crushed stone is recommended to place directly under the floor slab. The stone bed would act as a barrier and prevent capillary rise of moisture from the subgrade to the floor slab. This moisture barrier has been proven to be effective for conventional floor surfaces such as carpet, vinyl tile and ceramic tile. However, if special floor coverings such as sheet P.V.C. with heat sealed seams, as is used in gymnasiums, is considered, either a high efficiency vapour barrier or venting may be required to prevent moisture accumulating between the concrete floor and the P.V.C. flooring.

The estimated modulus of subgrade reaction (ks) equal to 25 MN/m^3 may be used for the design of slab-on-grade supported on native or structural fill soils, provided that the construction is in accordance with the recommendations provided herein. If structural fill (Granular A or B Type II) having minimum thickness of 300 mm, this value can be increased to 30 MN/m^3. The estimated value provided above may need to be adjusted based on the structure size and locations of detail design.

It should be noted that permanent, failsafe drainage should be designed around any depressed areas such as below grade pits, as well as behind retaining walls (if applicable). Frost Slab or adequate thermal insulation is required for any exterior slab which is sensitive to movement (e.g., sidewalk in front of the doors). The remaining portion of the exterior slab which is not sensitive to movement (e.g., regular sidewalks) does not require thermal insulation subject to placement of adequate granular base (min 200mm to 300mm thick), and positive drainage of the granular base. Differential frost heave should be expected where frost slab (or slab with thermal insulation) abut the slab without any thermal insulation (e.g. away from the doors) or asphalt.

Considering the basement floor slab (where applicable) of proposed building structure below the water table, the perimeter and underfloor drainage must be installed. As soils are exposed below the groundwater table, filter cloth such as Terrafix 270R or equivalent must cover the subgrade, all drains, clear stone and other openings.

The perimeter drainage system shown on **Drawing 3** is recommended for the basement walls where (if any) open cut excavations will be undertaken.

The floor slabs should not be tied to any load-bearing walls or columns unless they have been designed accordingly. Contraction/expansion joints should be provided for the slabs as required by the structural engineer.

4.3 Excavations and Backfill

Excavations can be carried out with a heavy hydraulic backhoe. Considering fill and/or disturbed material removal, it is anticipated that the excavation will be extended below the groundwater level, positive dewatering such as well points can be required to lower the water table to at least 1.0 m below the excavation base. Otherwise, it will result in an unstable base and flowing sides.

Standard borings may not assess dewatering requirements for layered granular soils below the groundwater table. Prior to excavation, we strongly recommend that test pits be carried to further explore the groundwater and seepage conditions and to confirm the need for positive dewatering. A contractor specializing in dewatering should be retained to design the dewatering systems in the area where required. For dewatering details, refer to our hydrogeological report.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the on-site fill material and compact to loose or firm native soils can be classified as Type 3 soil. The dense to very dense native soils can be classified as Type 1 to Type 2 soil above the water level and Type 4 below the groundwater table. Wet sandy silt to silty sand seams can also be classified as Type 4 soils. As a general rule, the excavations in Type 1 and 2 soils can be carried out without support using side slopes 1H:1V, while the bottom 1.2m of the excavation can be cut vertically and could retain the wall for a short period of time. The excavation in Type 3 soil can be carried out maintaining the side slopes not steeper than 1H:1V. The excavations in Type 4 soils will require minimum flatter side slopes of 3H to 1V. These slopes should be visually monitored for any movement especially if workers are present within the excavation. These temporary slopes should only be utilized for a short duration. If an excavation contains more than one type of soil, the soil shall be classified as the type with the highest number among the types present.

Note that till is non-sorted sediment and therefore may contain boulders. Possible large obstructions such as buried concrete pieces may also be encountered in the fill material. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material during construction.

The existing fill (free of topsoil) and native soils can be used as general construction backfill where it can be adequately compacted with suitable type compactors. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. Noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should therefore be compacted at the surface or be covered with tarpaulins to help minimize moisture intake.

Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas. The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular B should be used.

Stockpiles should be placed well away from the edge of excavation and their height should be controlled so that they do not surcharge the sides of the excavation. Surface drainage should be controlled to prevent flow of surface water into the excavations. Excavation safety and stability of temporary construction slopes and lateral support systems are the contractor’s responsibility.

During winter construction, concrete and/or fill must not be placed on frozen fill or soil. Subgrades and foundations must be placed adequately protected at all times from cold weather and freezing conditions.

4.4 Earthquake Considerations

Based on our borehole information and according to the 2012 Ontario Building Code (OBC 2012), the subject site seismic response for the proposed residential can be classified as “Class D” (Table 4.1.8.4.A of OBC 2012). Accordingly, the foundation factors F_a can be obtained from Table 4.1.8.4.B and F_v from Table 4.1.8.4.C for the design of the proposed structure.

Consideration may be given to conduct an earthquake site assessment with the use of in-situ testing of the seismic characteristics (i.e. geophysical testing) which may lead to an improved site classification, if required.

4.5 Underground Utility Trenches

As a part of the site development, a network of utility trenches needs to be constructed.

4.5.1 Trenching

It is expected that in most cases the trenches will be excavated through loose to compact fill/disturbed native and/or firm to very stiff silty clay till soils.

Groundwater is not anticipated to be a major problem for excavating utility trenches to approximate depth of 1m from the existing grades. Any cut below the groundwater level (positive dewatering system such as well points or educators or deep wells will be required. Otherwise, it will result in an unstable excavation base and flowing sides. The groundwater table must be lowered one meter below the lowest excavation level. Test pit should be carried out in this area prior to the excavation to further explore the groundwater and seepage conditions. A specialized dewatering contractor should install the dewatering system. In accordance with OHSA, on-site fill above the groundwater table can be classified as Type 3 soil and the undisturbed native soils as Type 1 to Type 2 soils. Soils below the groundwater table can be classified as Type 4.

4.5.2 Bedding

The undisturbed native deposits or engineered fill will provide adequate support for the utility pipes and allow the use of normal Class B type bedding.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions such are encountered, especially when the soil at the trench base level consists of wet, dilatant silts, sandy silts and soft to firm clayey silt to silty clay. The bedding material should consist of well graded granular material such as Granular ‘A’ or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.5.3 Backfilling of Trenches

The existing fill (free of topsoil) and native soils can be used as general construction backfill where it can be adequately compacted with suitable type compactors.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) of the optimum water content and each layer should be compacted to at least 95% SPMDD to within 1.5 m to final subgrade. In the upper 1 m, the degree of compaction should be minimum 98% SPMDD, except for landscape area. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils should not be used in confined areas (e.g. around catch basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch basins.

4.6 Pavements

The pavement structures presented in Table 4.2 can be used for the design of proposed parking areas and access roadways during construction under ideal or non-ideal subgrade conditions.

The explored fill generally extended not more than 2 m in the boreholes. The subgrade is expected to consist of earth fill materials and/or native soils depending upon the proposed grades of parking structure. The zone of influence of the pavement subgrade is generally estimated within 1 m below the underside of the granular sub-base.

4.6.1 Ideal Conditions

Under ideal conditions, the zone of the pavement subgrade within 1 m below the underside of the granular sub-base must be compacted to at least 95% of its Standard Proctor Maximum Dry Density (SPMDD) with moisture content 2 to 3% drier than its optimum and then the compaction should be increased to 98% of SPMDD in the upper 0.6 m of the subgrade.

4.6.2 Non-Ideal Conditions

If the roads are to be constructed during the wet seasons and if the subgrade is unsuitable then either the top 1m of the subgrade should be replaced with drier, compacted, select subgrade material meeting as OPSS 1010 or the top 0.8 m of the subgrade should be replaced with granular material meeting the specifications defined in OPSS-1010-13. This will be assessed at the time of access roadways construction and parking area.

The existing fill within 1 m from the underside of sub-base must be excavated and assessed its stability and suitability according to ideal/non-ideal conditions criteria stipulated by the local authority having jurisdiction over the project site. Depending upon evaluation either the excavated material will be re-used or if found to be unsuitable replaced with select subgrade /granular materials.

In preparation of the subgrade, prior to placement of the granular sub-base and base materials, the subgrade must be proof-rolled to determine its stability and suitability for access road construction and parking area by a qualified geotechnical professional.

The recommended pavement structures provided in Table 4.2 are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 4.2: Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Light Duty Parking (Cars)	Heavy Duty Parking (Delivery Trucks)
Asphaltic Concrete	92 to 96.5% Maximum Relative Density	40 mm OPSS HL 3 40 mm OPSS HL 8	50 mm OPSS HL 3 75 mm OPSS HL 8
OPSS Granular A Base (or 20mm Crushed Limestone)	100% SPMDD*	150 mm	150 mm
OPSS Granular B	100% SPMDD	200 mm	350 mm

* Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 300 mm unless accepted HLV2K.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Alternatively, consideration should be given to the use of rigid Portland Cement Concrete pavement where there is intense truck use, parking and turning of vehicles. The following Table 4.3 provides the minimum recommended rigid pavement structure.

Table 4.3: Minimum Rigid Concrete Pavement Structure

Pavement Layer	Compaction Requirements	Heavy Duty Pavement
Portland Cement Concrete (CAN3-CSA A23.1) - Class C-2	CAN3-CSA A23.1	225 mm
Base Course: Granular A (OPSS 1010) or 19 mm Crusher Run Limestone	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm

It must be noted that this structure does not provide full protection of the subgrade from frost penetration; therefore, the pavement slabs must be separated from the building structure.

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into respective catch basins to facilitate drainage of the subgrade and granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level. Subdrains should also be provided at all catch basins within the parking area.

Concrete should be proportioned, mixed, placed and cured in accordance with the requirements of CSA Standard CAN/CSA-A23.1-19 for class C-2 exposure, with the following key requirements:

minimum 28-day compressive strength:	32 MPa
air entrainment:	5 to 8 %
maximum water/cementing material ratio:	0.45

Concrete should be placed and spread in a manner which avoids segregation. It should be consolidated with a vibratory screed or internal vibrators. Consolidation close to form edges must be given special consideration.

Concrete should be finished to a thickness tolerance of 0 to plus 10 mm. Concrete must be cured adequately to provide durability and strength. Curing can be accomplished by wet blankets, sprinkling, plastic sheets and curing compounds. Curing should begin immediately after loss of bleed water.

Concrete pavement should be provided with joints to control stresses and prevent the formation of irregular cracks. Recommended joint spacing is 24 to 30 times slab thickness to a maximum dimension of about 4.0m. We would also recommend that load transfer dowels be placed at 50 mm spacing at the joints.

Sawed joints should be cut before random cracking occurs in the slab, usually within 6 to 18 hours after concrete placement. The maximum thickness (aperture) of control joints should 6 mm, while the depth of control joints should be about 1/4th of the slab thickness.

The pavement should be closed to traffic until a minimum flexural strength of 2 MPa is attained or an approximate compressive strength of 20 MPa. This minimum strength is generally reached when the concrete can be saw cut without ravelling.

Additional comments on the construction of parking areas and access roadways are as follows:

1. Removal of all fill for pavement is not necessary. As part of the subgrade preparation, proposed parking areas and access roadways should be stripped fill at least in the upper 0.8 m below subgrade and surficially softened native soils and the base then should be thoroughly proof rolled by using a loaded truck. Unstable areas or areas with excessive organic materials should be further sub-excavated. The fill required to raise the grade can consist of inorganic soil, placed in shallow lifts and compacted to minimum 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

2. The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed lot grading. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by HLV2K.

3. The above pavement structure considers that construction will be carried out during the dry period of the year. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material or placement of geogrids may be required. The need for additional sub-base material and/or placement of geogrids including filter fabric to stabilize the base is best determined during construction. It is recommended that the existing subgrade be heavily proof-rolled prior to placement and any areas showing excessive deflection be replaced prior to placing the granular sub-base material.

4. It is recommended that HLV2K be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations.

4.6.3 Stripping, Sub-excavation and Grading

The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for regarding the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per Region Standards. The compaction of the new fill should be checked by frequent field density tests.

4.6.4 Construction

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.7 Engineered Fill and Sub-Excavation

The elevation of the existing grade varies significantly across the site. Detailed site grading plans for the proposed development were not available to us at the time of preparation of this report. However, based on the existing topography at the site, cut and fill operations are expected to require as part of the proposed development.

In the areas where earth fill is required for site grading purposes, engineered fill can be used and similarly, if the area under consideration need to be raised, engineered fill can be used

Prior to the placement of the engineered fill, all of the existing fill, the loose possible fill/disturbed soil, and surficial softened native soils must be removed, and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The depths of sub-excavation required for the construction of engineered fill will be assessed by a geotechnical professional at the time of excavation.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix C**. A geotechnical reaction of 100 to 150 kPa (2000 to 3000 psf) at the Serviceability Limit States (SLS) and factored geotechnical resistances of 150 to 225 kPa at the Ultimate Limit States (ULS) can be used on engineered fill, provided that all requirements on Appendix "C" are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential. Despite full time supervision, it has been found that contractors frequently bulldoze loose fill into areas and compact only the surface. The inspector, either busy on other portions of the site or absent during "off hours" will be unaware of this condition. For this reason, we cannot guarantee the performance of the engineered fill, and this guarantee must be the responsibility of the contractor. The owner and his representatives must accept the risk involved in the use of engineered fill and offset this risk with the monetary savings of avoiding deep foundations/soil improvement. This potential problem must be recognized and discussed at a pre-construction meeting. Procedures can then be instigated to reduce the risk of settlement resulting from un-compacted fill.

The following is a recommended procedure for engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained, and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages (if applicable), etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that

the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and HLV2K Engineering Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by HLV2K Engineering Limited. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by HLV2K Engineering Limited engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by HLV2K Engineering Limited during placement of engineered fill is required. Work cannot commence or continue without the presence of the HLV2K representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A geotechnical reaction of 100 to 150 kPa (2000 to 3000 psf) may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings should be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by HLV2K to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of HLV2K.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

4.8 Geotechnical Review

It is recommended that the project design drawings be submitted to HLV2K for review for compatibility with site subsurface conditions and the recommendations contained in this report.

5 GENERAL COMMENTS

The recommended bearing capacities (Geotechnical Reaction) and the corresponding founding elevations would need to be confirmed by the representative of HLV2K during construction. It should be noted that the recommended bearing capacities have been calculated by HLV2K from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by HLV2K to validate the information for use during the construction.

In this regard, HLV2K should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, HLV2K will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information in this report in no way reflects on any of the environmental aspects of the soil condition at the site and has not been specifically addressed in this report, since this aspect was beyond the scope and terms of reference.

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

For and on behalf of HLV2K Engineering Limited

LICENSED PROFESSIONAL ENGINEER
M.I.A.KHOKHAR
100197668
16/02/2022
PROVINCE OF ONTARIO

Irfan Khokhar, Ph.D., P.Eng.
Principal Geotechnical Engineer

DRAWINGS

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Legend

□ Approx. Site Boundary

Drawn: MM

Approved: KM

Date: NOV. 2021

Project No.: 2100394AG

Title SITE LOCATION PLAN

Project

GEOTECHNICAL INVESTIGATION
Proposed Residential Development 613
Helena Street, Fort Erie, Ontario

Client SS FORT ERIE INC.

HLV2K ENGINEERING LIMITED

0 125 250 500 Meters

Drawing 1

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

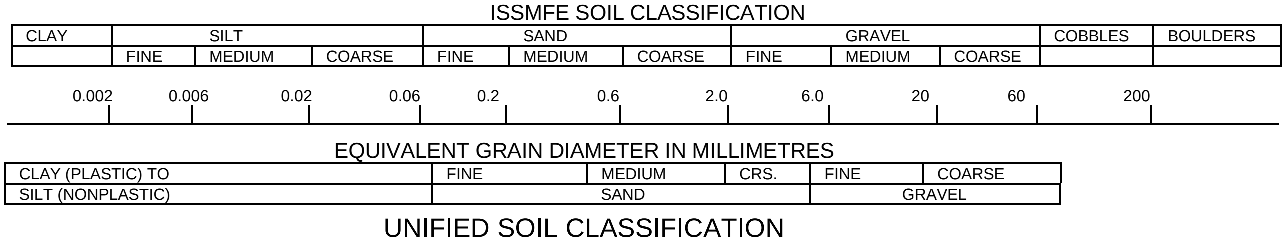
Legend

🟥	Approx. Site Boundary
●	Borehole
⊕	Monitoring Well

Drawn: MM	Title BOREHOLE LOCATION PLAN	
Approved: KM	Project GEOTECHNICAL INVESTIGATION Proposed Residential Development 613 Helena Street, Fort Erie, Ontario	
Date: NOV. 2021		
Project No.: 2100394AG		
	Client SS FORT ERIE INC.	
HLV2K ENGINEERING LIMITED	0 20 40 80 Meters	**Drawing 1A**

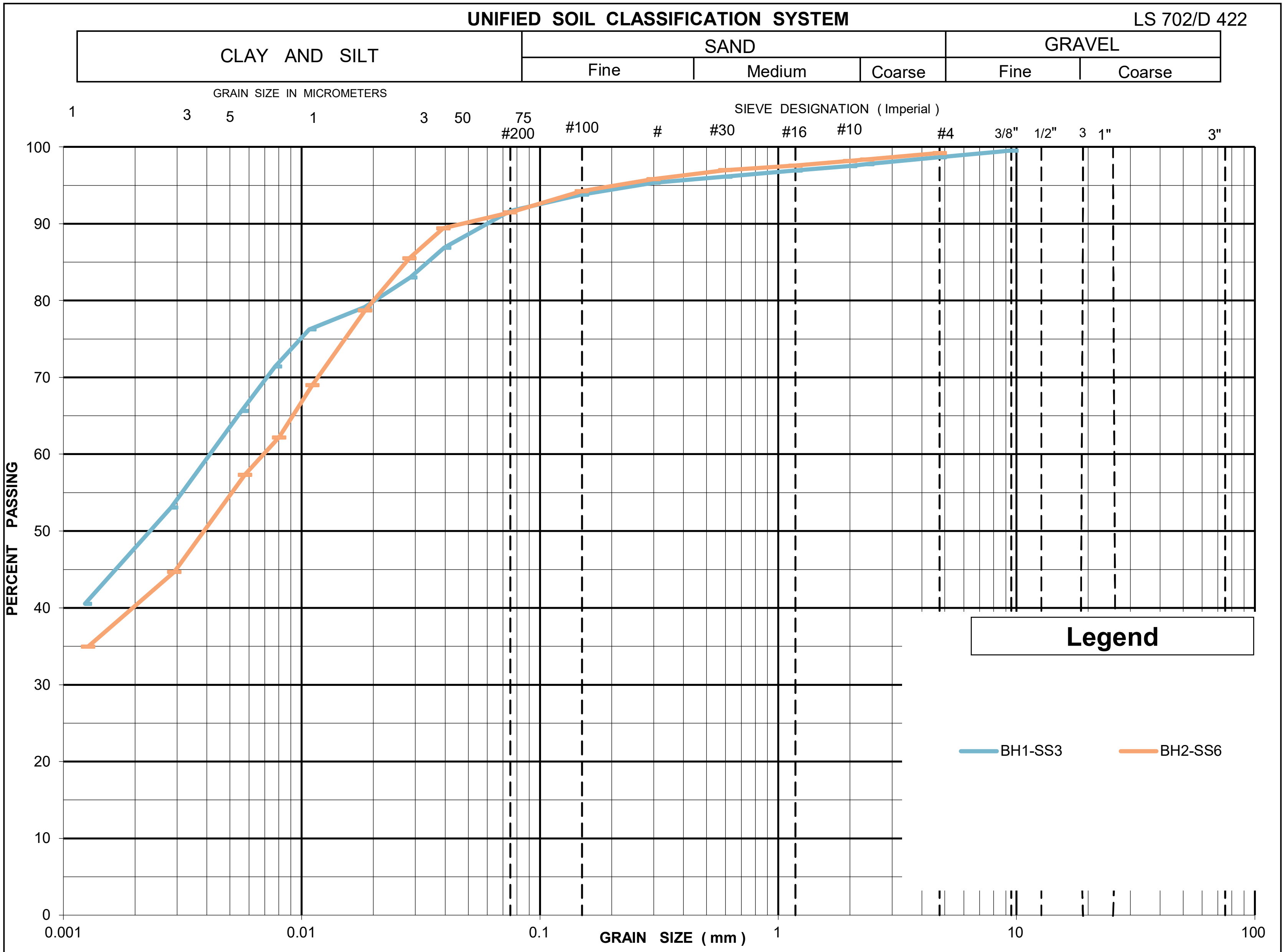
Drawing 1B: Notes on Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by HLV2K Engineering Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advice of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.



HLV2K ENGINEERING LIMITED

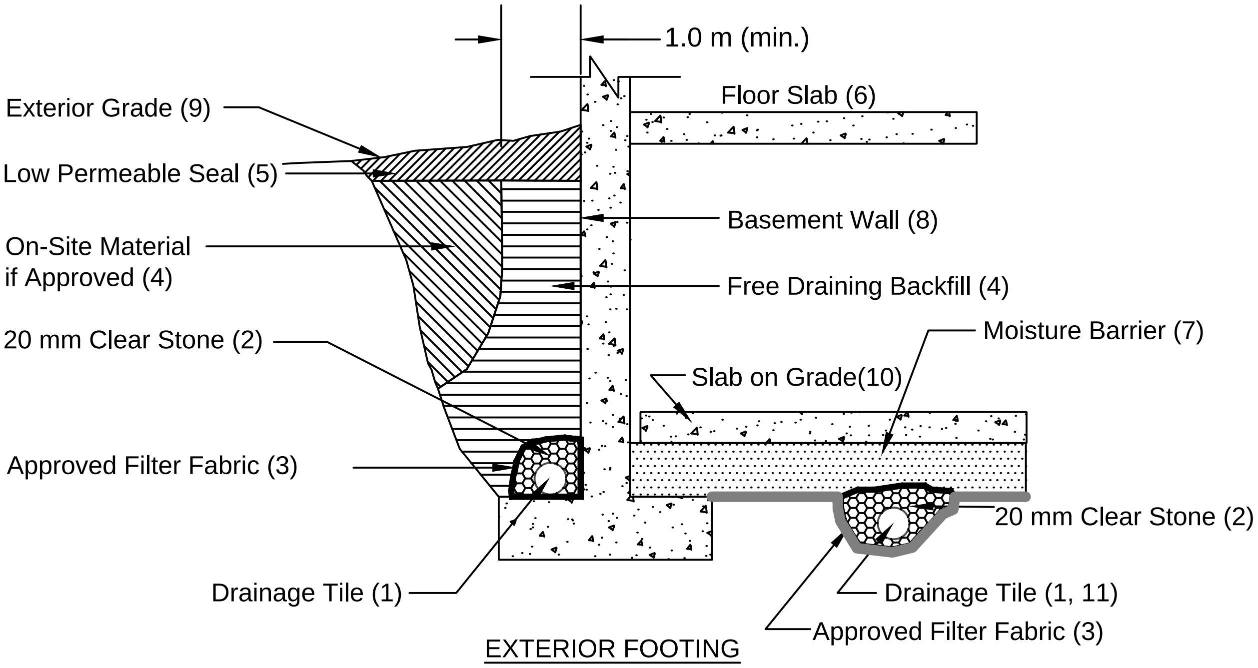
GRAIN SIZE DISTRIBUTION

Drawing No : 2

PROJECT # : 2100394AG

DATE : Sept 16, 2021

Drawing No. 3



Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter fabric (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Low permeable backfill seal - compacted clay, clayey silt or paved with concrete/asphalt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed for parking garage and water proofed for finished basement.
9. Exterior grade to slope away from building.
10. Typically slab on grade is not structurally connected to the wall or footing. However, if it is connected to the wall, it should be designed accordingly.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

APPENDICES

Appendix A:

Limitations of Report

Limitations of Report

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to HLV2K Engineering Limited. at the time of preparation. Unless otherwise agreed in writing by HLV2K Engineering Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environment 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. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations 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.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. 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.

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. HLV2K Engineering Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their officers, agents and employees in excess of the fee paid for professional services.

Appendix B:

Borehole Logs

LOG OF BOREHOLE BH1

PROJECT: Sabrina Homes

CLIENT: Sabrina Homes

PROJECT LOCATION: 613 Helena Street, Fort Erie, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4751014.752 E 668156.609

DRILLING DATA

Method: Hollow Stem Augur

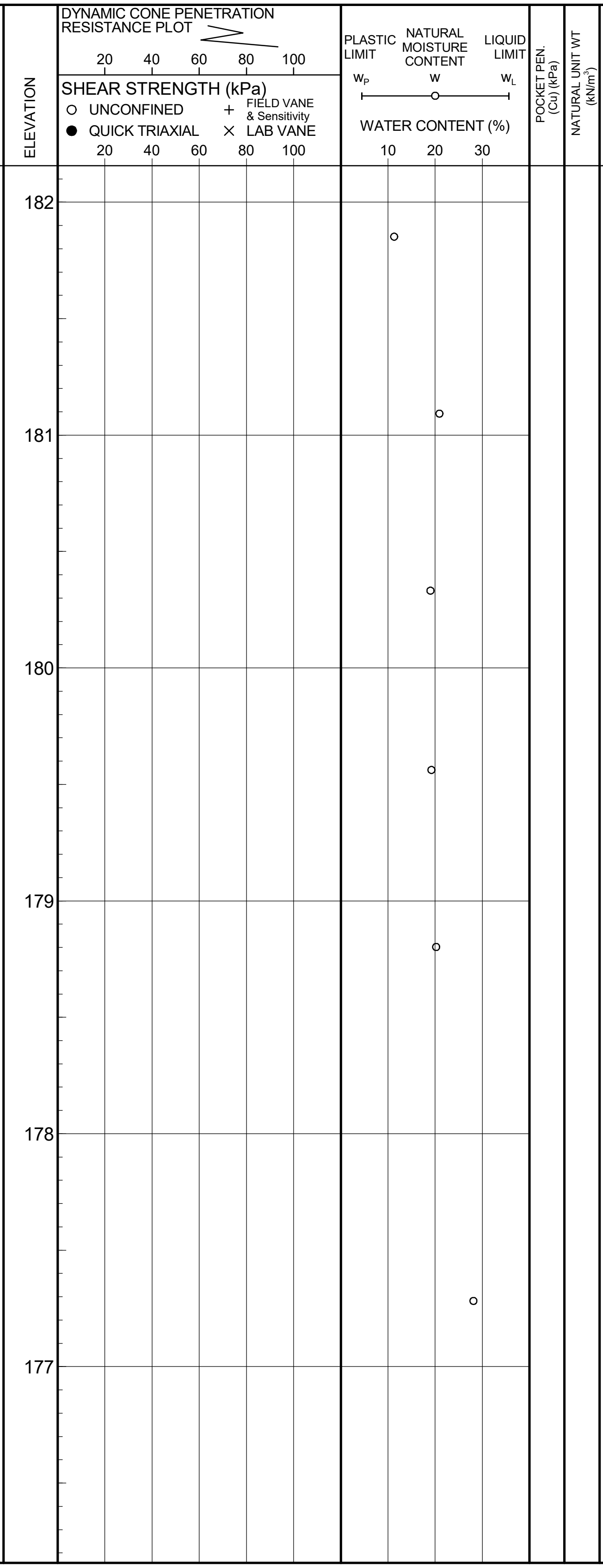
Diameter: 150mm

Date: Sep/08/2021

REF. NO.: 2100394AG

DRAWING NO.: 2

SOIL PROFILE			SAMPLES							
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR	SA	SI	CL
182.2										
182.0 0.0	**Asphalt:** 150mm									
0.2	**Fill:** sand and gravel, trace silt and clay, brown, moist, compact		1	SS	57					
181.4 0.8	**Silty Clay Till:** trace gravel and sand, brown, very moist, firm to very stiff		2	SS	7					
			3	SS	16		1	7	45	47
			4	SS	27					
			5	SS	17					
177.6 4.6	**Silty Clay:** trace sand, brown, moist, firm to very stiff		6	SS	6					



Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH1

PROJECT: Sabrina Homes	**DRILLING DATA**
CLIENT: Sabrina Homes	Method: Hollow Stem Augur
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON	Diameter: 150mm REF. NO.: 2100394AG
DATUM: Geodetic	Date: Sep/08/2021 DRAWING NO.: 2
BH LOCATION: See Borehole Location Plan N 4751014.752 E 668156.609	

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT w LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION					
	Silty Clay: trace sand, brown, moist, firm to very stiff(Continued)		7	SS	8		176		○			
175.3 6.8	**Bedrock:** weathered, black dolomite		8	SS	50/50mm				○			
175.2 6.9	**End of Borehole:** borehole terminated at 6.9m Upon completion: 1) Cave-in: open 2) Water: dry											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH2

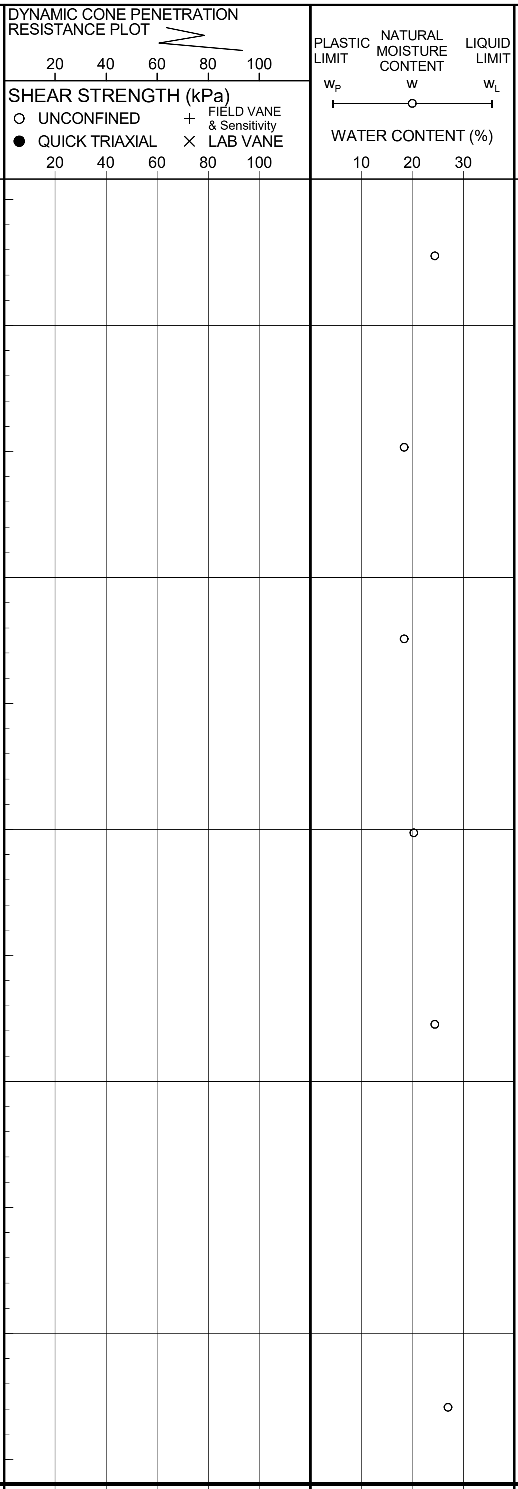
1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750966.835 E 668089.3891

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 3

SOIL PROFILE		SAMPLES			REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	GR	SA	SI	CL
181.6 0.0	**Topsoil:**300mm							
181.3 0.3	**Disturbed Native/Fill:** silty clay, trace sand and gravel, trace rootlets, brown to black, very moist, loose	1	SS	4				
181.0 0.6	**Silty Clay Till:** trace sand, trace gravel, brown to black, very moist, stiff to very stiff	2	SS	16				
		3	SS	20				
		4	SS	15				
		5	SS	8				
177.0 4.6	**Silty Clay:** trace sand, brown, very moist, soft	6	SS	3	1	7	52	40
176.4 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry							



GROUND WATER CONDITIONS | ELEVATION: 181, 180, 179, 178, 177 | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m^3)

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH3

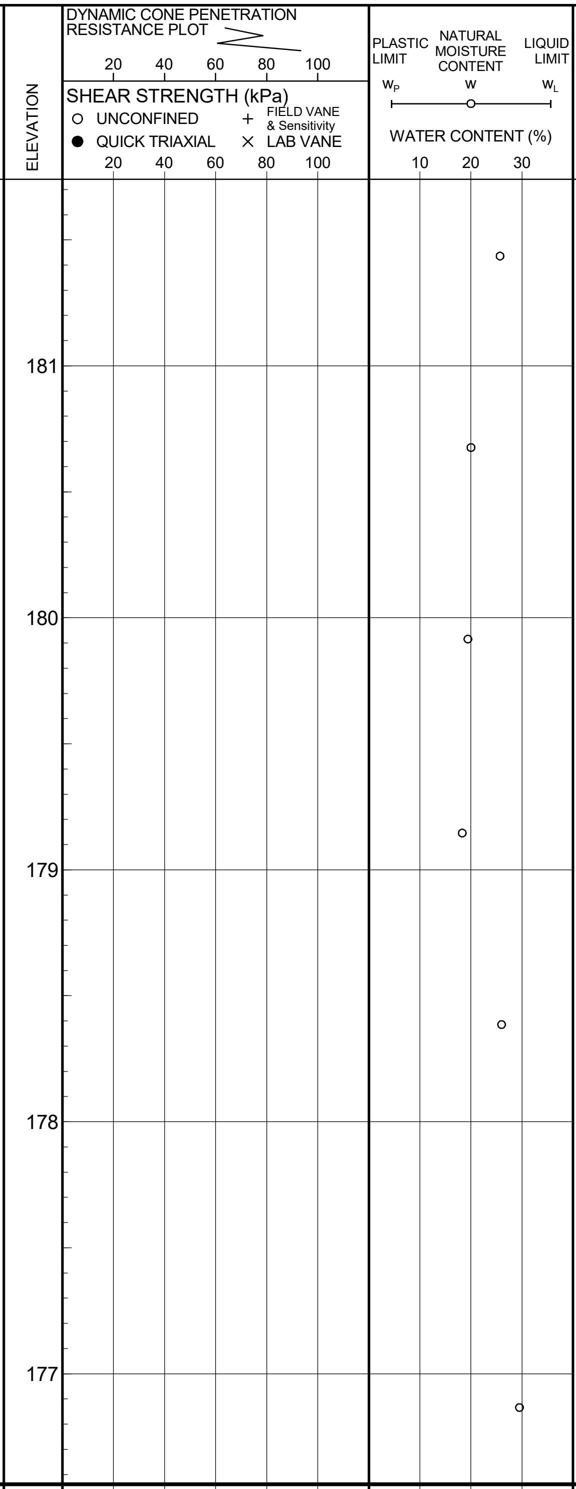
1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750999.13 E 668085.3975

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 4

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.7									
181.6 0.0	**Gravel:** 100mm								
0.1	**Fill:** sandy silt with some gravel, organic inclusions, brown, very moist, loose		1	SS	6				
181.3 0.4	**Silty Clay Till:** trace sand and gravel, trace rootlets, brown, very moist, firm to stiff		2	SS	13				
			3	SS	18				
			4	SS	15				
			5	SS	10				
177.2 4.6	**Silty Clay:** trace sand, brown, very moist, soft		6	SS	4				
176.6 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry								



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH4

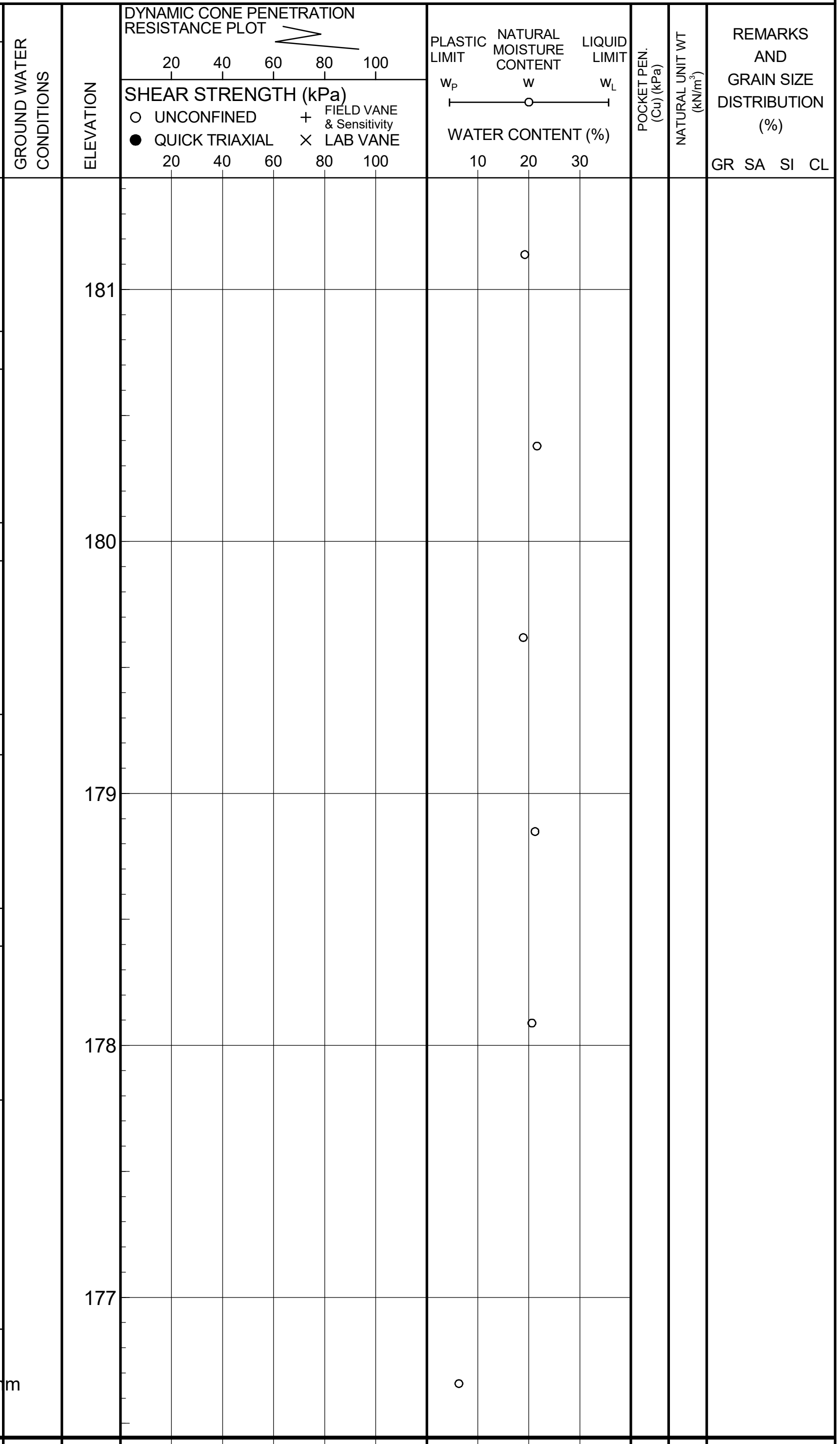
1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750990.884 E 668007.3711

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 5

SOIL PROFILE			SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m
181.4					
0.0	**Topsoil:** 150mm				
181.3 0.2	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown , very moist, loose		1	SS	5
181.0 0.5	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff		2	SS	18
			3	SS	20
			4	SS	14
			5	SS	10
			6	SS	50/130mm
176.6 4.9	**Bedrock:** weathered dolomite				
176.4 5.0	**End of Borehole:** borehole terminated at 5.0m Upon completion: 1) Cave-in: open 2) Water: dry				



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

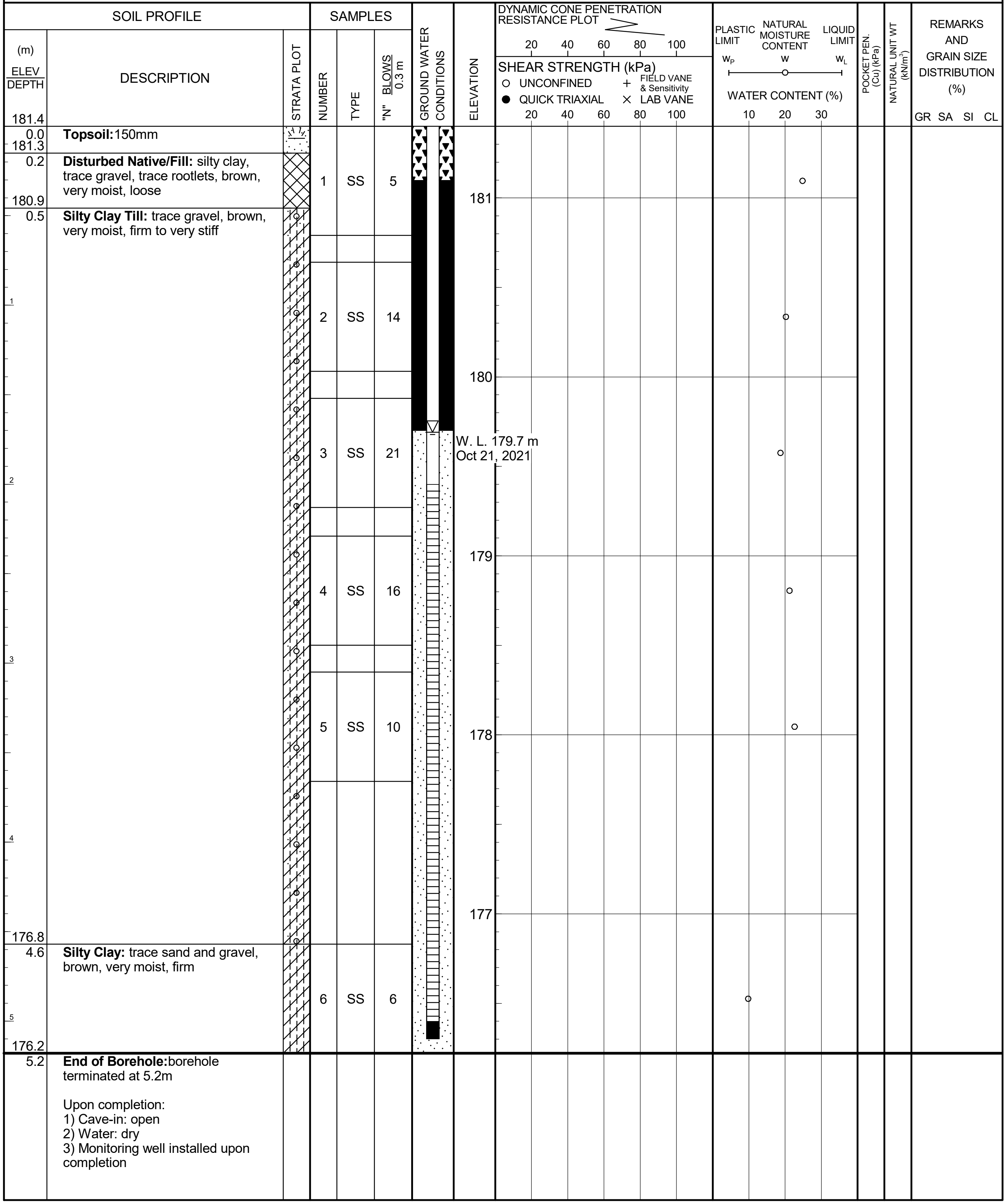
LOG OF BOREHOLE BH5

1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750949.591 E 668062.0856

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 6



(m) ELEV DEPTH	DESCRIPTION
181.4	
0.0	**Topsoil:**150mm
181.3 0.2	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, very moist, loose
180.9 0.5	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff
176.8 4.6	**Silty Clay:** trace sand and gravel, brown, very moist, firm
176.2 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion

NUMBER	TYPE	"N" BLOWS/0.3 m
1	SS	5
2	SS	14
3	SS	21
4	SS	16
5	SS	10
6	SS	6

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

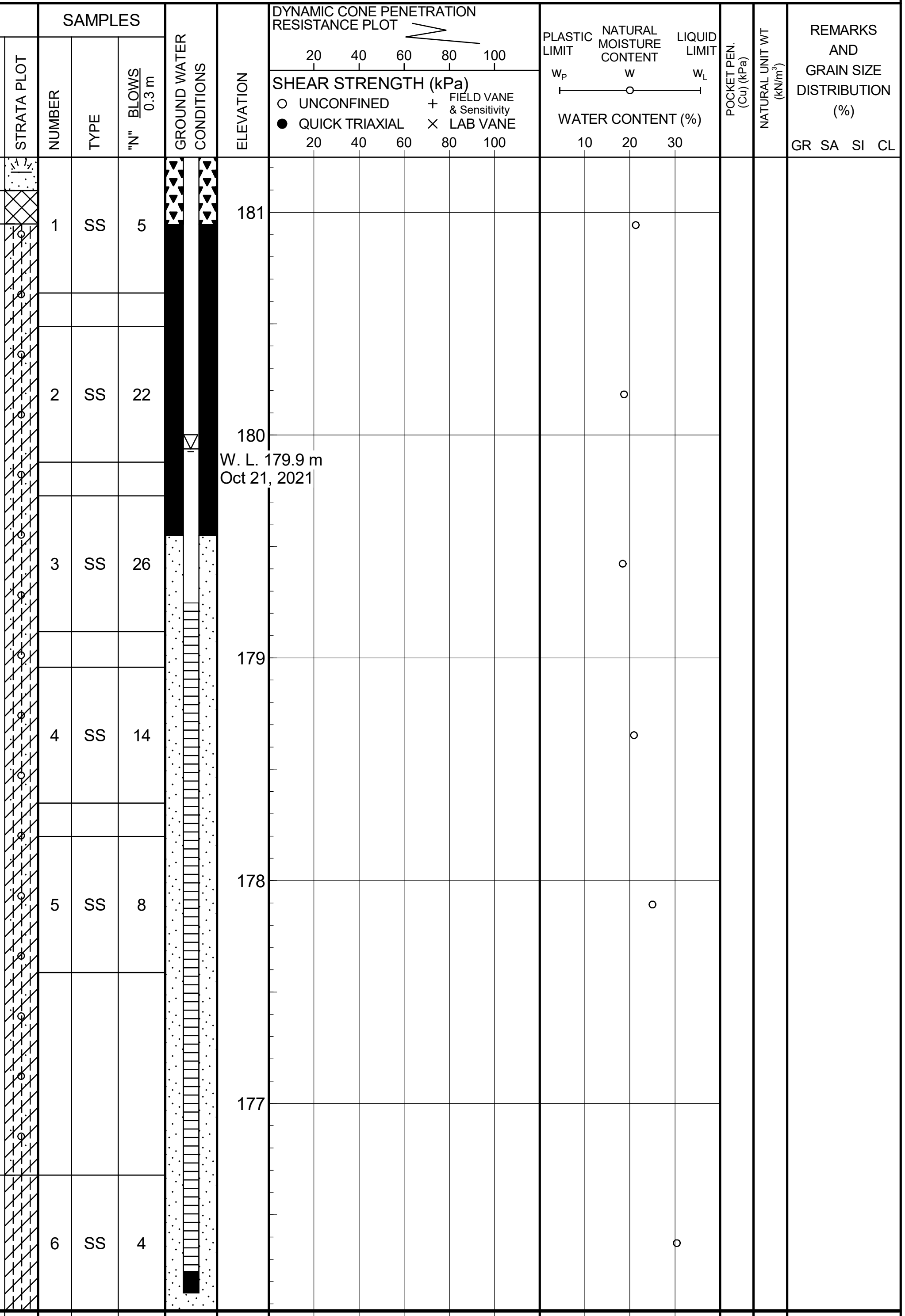
LOG OF BOREHOLE BH6

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750942.554 E 668149.6001

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 7

SOIL PROFILE		SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m
181.2				
0.0 181.1	**Topsoil:**150mm			
0.2 180.9	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, moist, loose	1	SS	5
0.3	**Silty Clay Till:** trace sand and gravel, greyish brown, very moist, firm to very stiff			
		2	SS	22
		3	SS	26
		4	SS	14
		5	SS	8
176.7 4.6	**Silty Clay:** trace sand and gravel, brown, very moist, soft	6	SS	4
176.1 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion			



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3 , × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

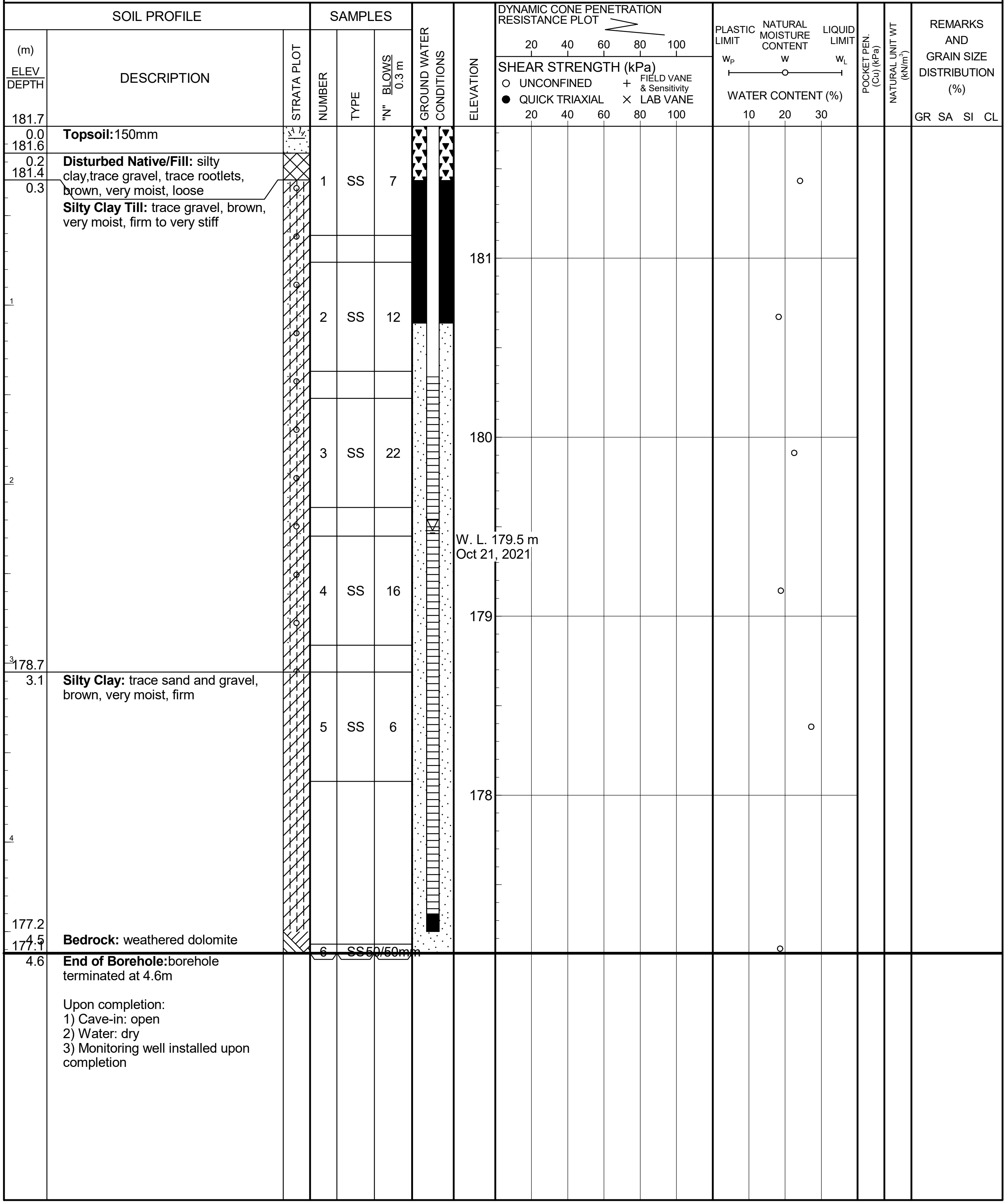
LOG OF BOREHOLE BH7

1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751054.703 E 668018.9953

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 8



(m) ELEV DEPTH	DESCRIPTION
181.7	
0.0	**Topsoil:**150mm
181.6 0.2	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose
181.4 0.3	**Silty Clay Till:** trace gravel, brown, very moist, firm to very stiff
178.7 3.1	**Silty Clay:** trace sand and gravel, brown, very moist, firm
177.2 4.5	**Bedrock:** weathered dolomite
177.1 4.6	**End of Borehole:**borehole terminated at 4.6m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion

NUMBER	TYPE	"N" BLOWS / 0.3 m
1	SS	7
2	SS	12
3	SS	22
4	SS	16
5	SS	6
6	SS	50/50mm

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH8

1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751060.32 E 668093.7114

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 9

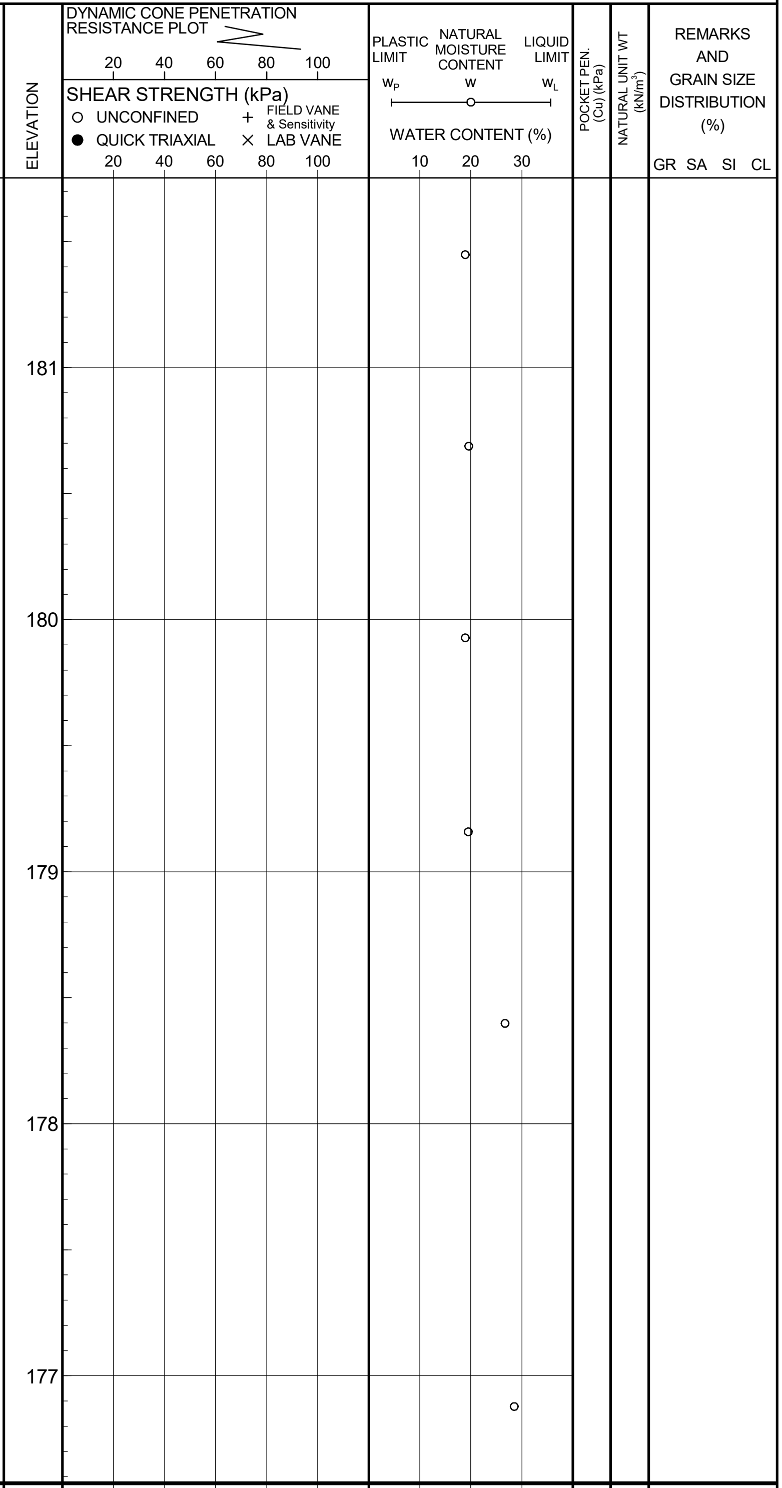
SOIL PROFILE

(m) ELEV / DEPTH	DESCRIPTION
181.8	
0.0	**Topsoil:**230mm
181.5 / 0.2	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose
181.3 / 0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff
178.7 / 3.1	**Silty Clay:** trace sand and gravel, brown, very moist, firm turning soft
176.6 / 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry

SAMPLES

NUMBER	TYPE	"N" BLOWS / 0.3 m
1	SS	5
2	SS	15
3	SS	21
4	SS	18
5	SS	6
6	SS	3

GROUND WATER CONDITIONS



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH9

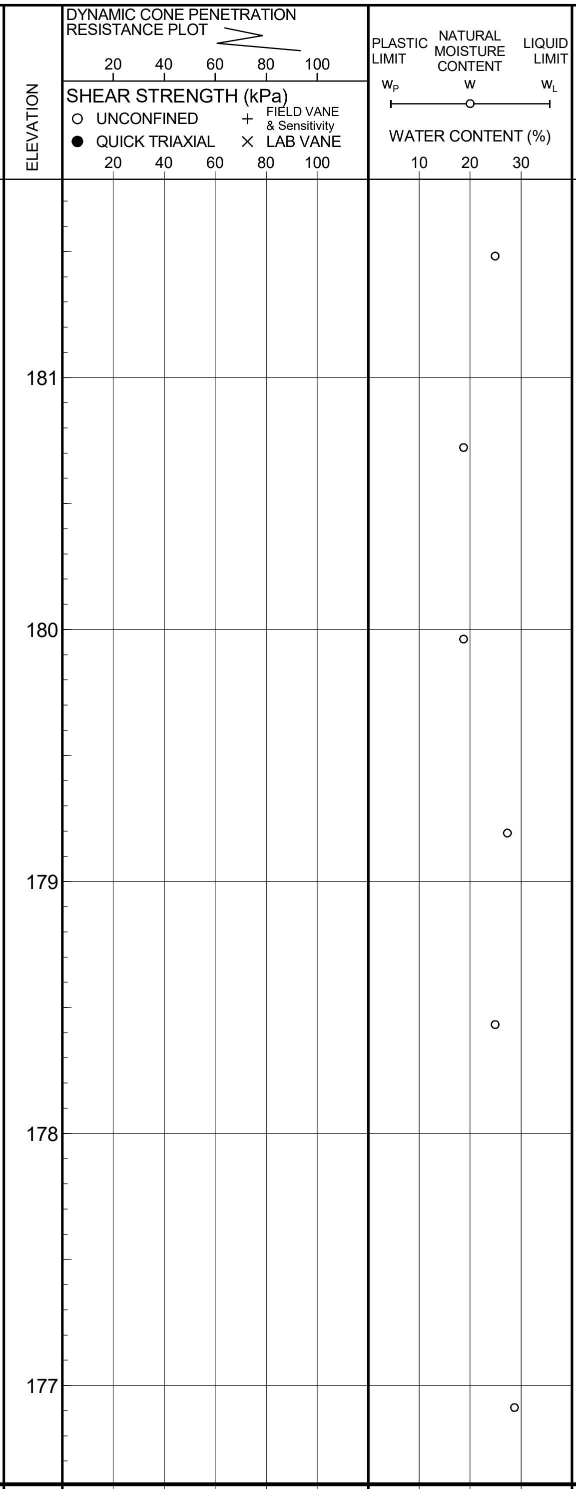
1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751026.281 E 668127.6148

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 10

SOIL PROFILE		SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m
181.8				
0.0	**Topsoil:**230mm			
181.6 0.2	**Disturbed Native/Fill:** silty clay,trace gravel, trace rootlets, brown, very moist, loose	1	SS	6
181.3 0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff	2	SS	16
		3	SS	20
		4	SS	16
178.7 3.1	**Silty Clay:** trace sand, brown, very moist, firm turning soft	5	SS	8
		6	SS	3
176.6 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry			



GROUND WATER CONDITIONS | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

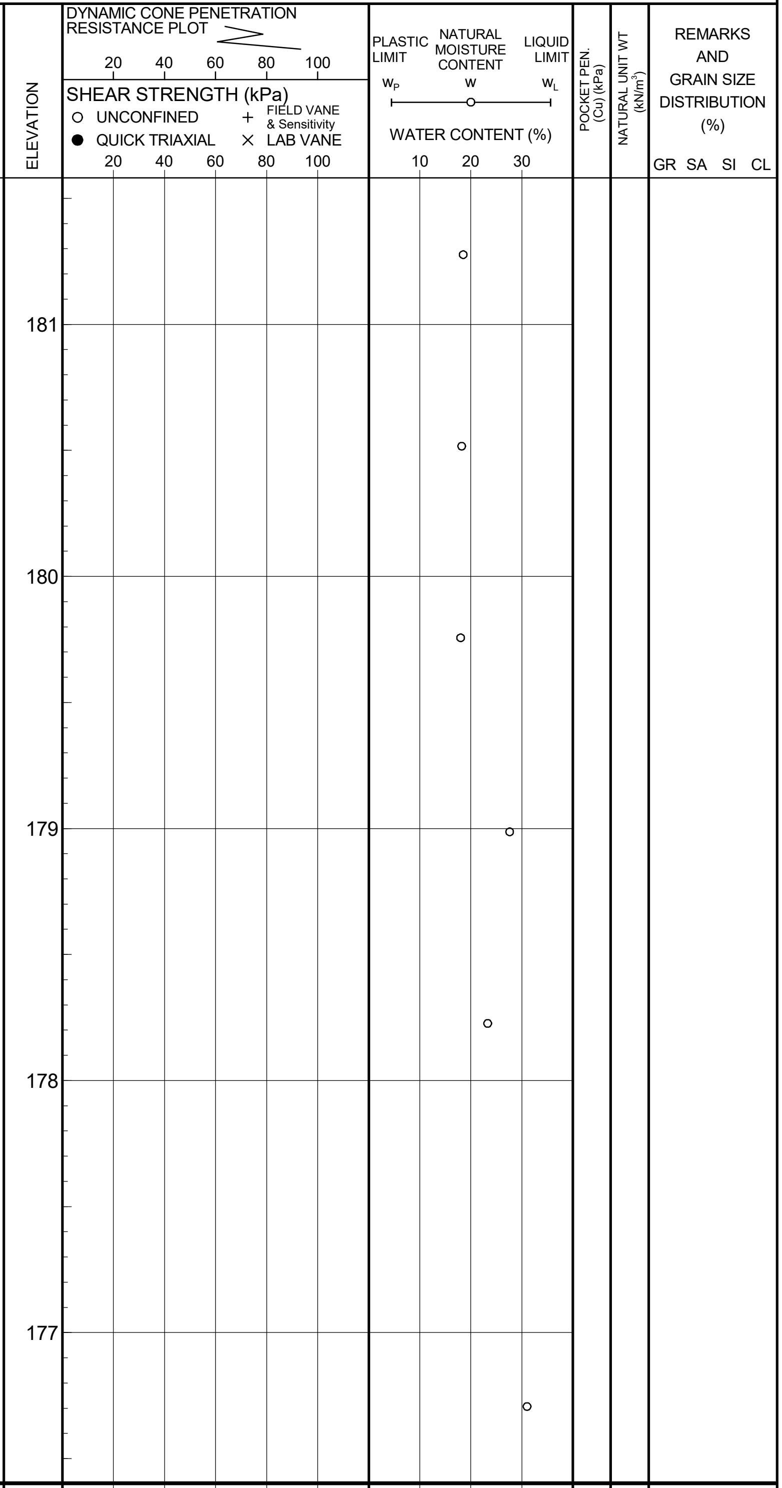
LOG OF BOREHOLE BH10

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4750966.835 E 668089.3891

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/09/2021

REF. NO.: 2100394AG
DRAWING NO.: 11

ELEV (m) DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS
181.6					
0.0	**Topsoil:**150mm				
181.4 0.2	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, very moist, loose	1	SS	5	
181.1 0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff	2	SS	13	
		3	SS	20	
		4	SS	23	
178.5 3.1	**Silty Clay:** trace sand, brown, very moist, firm	5	SS	8	
		6	SS	4	
176.4 5.2	**End of Borehole:**borehole terminated at 5.2m Upon completion: 1) Cave-in: open 2) Water: dry				



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH11

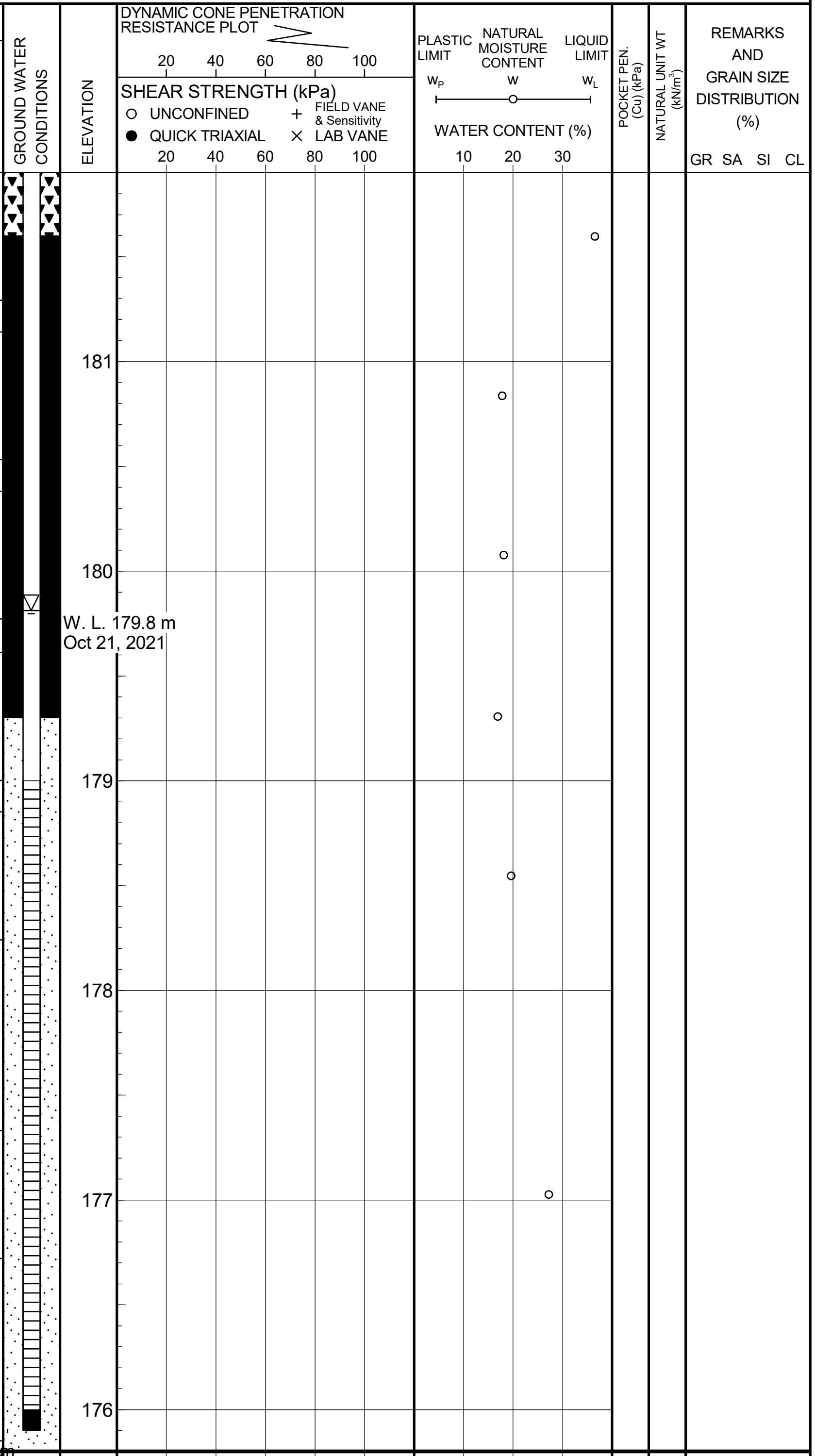
1 OF 1

PROJECT: Sabrina Homes
CLIENT: Sabrina Homes
PROJECT LOCATION: 613 Helena Street, Fort Erie, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4751054.793 E 668166.184

DRILLING DATA
Method: Soild Stem Augur
Diameter: 150mm
Date: Sep/08/2021

REF. NO.: 2100394AG
DRAWING NO.: 12

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m
181.9 0.0	**Topsoil:** 150mm			
181.8 0.2	**Disturbed Native/Fill:** silty clay, trace gravel, trace rootlets, brown, moist, loose	1	SS	5
181.4 0.5	**Silty Clay Till:** trace sand and gravel, brown, very moist, firm to very stiff	2	SS	14
		3	SS	18
		4	SS	20
		5	SS	14
177.3 4.6	**Silty Clay:** trace sand, brown, very moist, firm	6	SS	4
175.9 175.8	**Bedrock:** weathered, dolomite	7	SS	50/50mm
6.1	**End of Borehole:** borehole terminated at 6.1m Upon completion: 1) Cave-in: open 2) Water: dry 3) Monitoring well installed upon completion			



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

Appendix C:

General Requirements for Engineered Fill

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites if suitable. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, HLV2K Engineering Limited (HLV2K) recommends use of OPSS Granular 'B' sand and gravel fill material only.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill should not be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year. If the project demands placement of engineered fill in winter (December 15- April1) it can be placed only under the following conditions:

- All frozen material and or snow must be removed before placement of engineered fill on a daily basis

- Only Granular B Type 2 or Granular A (including crushed concrete or crushed limestone)

- The fill placement must be supervised on a full time basis by a geotechnical consultant

The location of the foundations on the engineered soil pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Foundations placed within the engineered soil pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and HLV2K Engineering Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by HLV2K Engineering Limited. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by an HLV2K engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by HLV2K during placement of engineered fill is required. Work cannot commence or continue without the presence of HLV2K representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. The allowable bearing pressure provided in the accompanying report may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

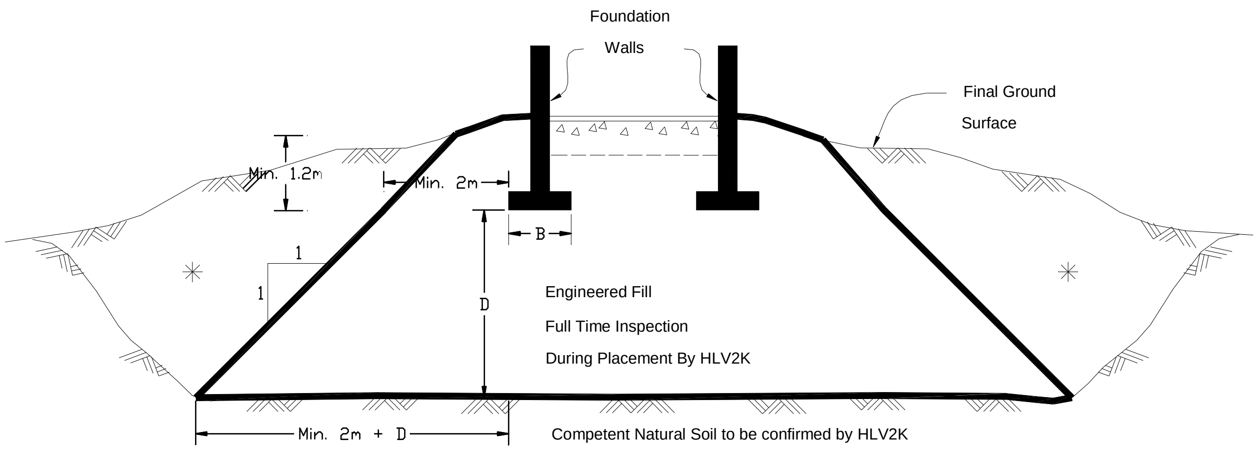
10. After completion of the pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from HLV2K Engineering Limited prior to footing concrete placements. All excavations must be backfilled under full time HLV2K Engineering Limited supervision by HLV2K to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of HLV2K Engineering Limited.

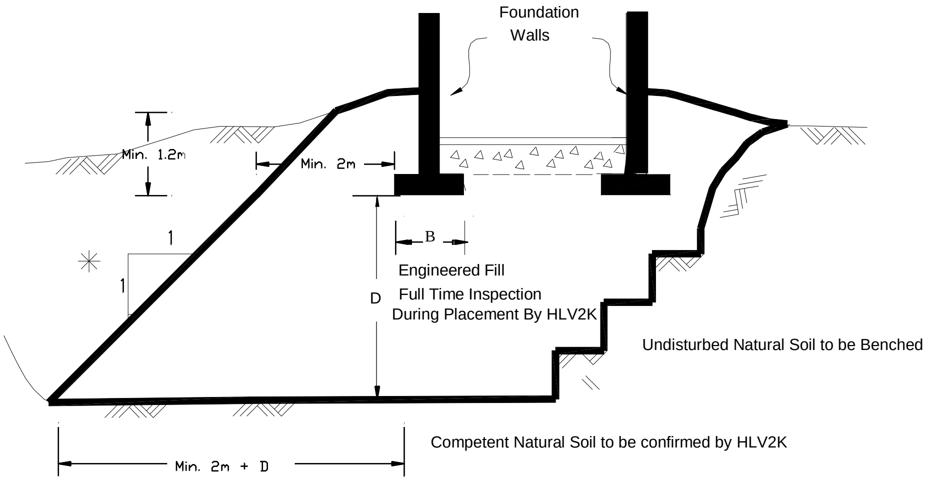
11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with HLV2K Engineering Limited report attached.

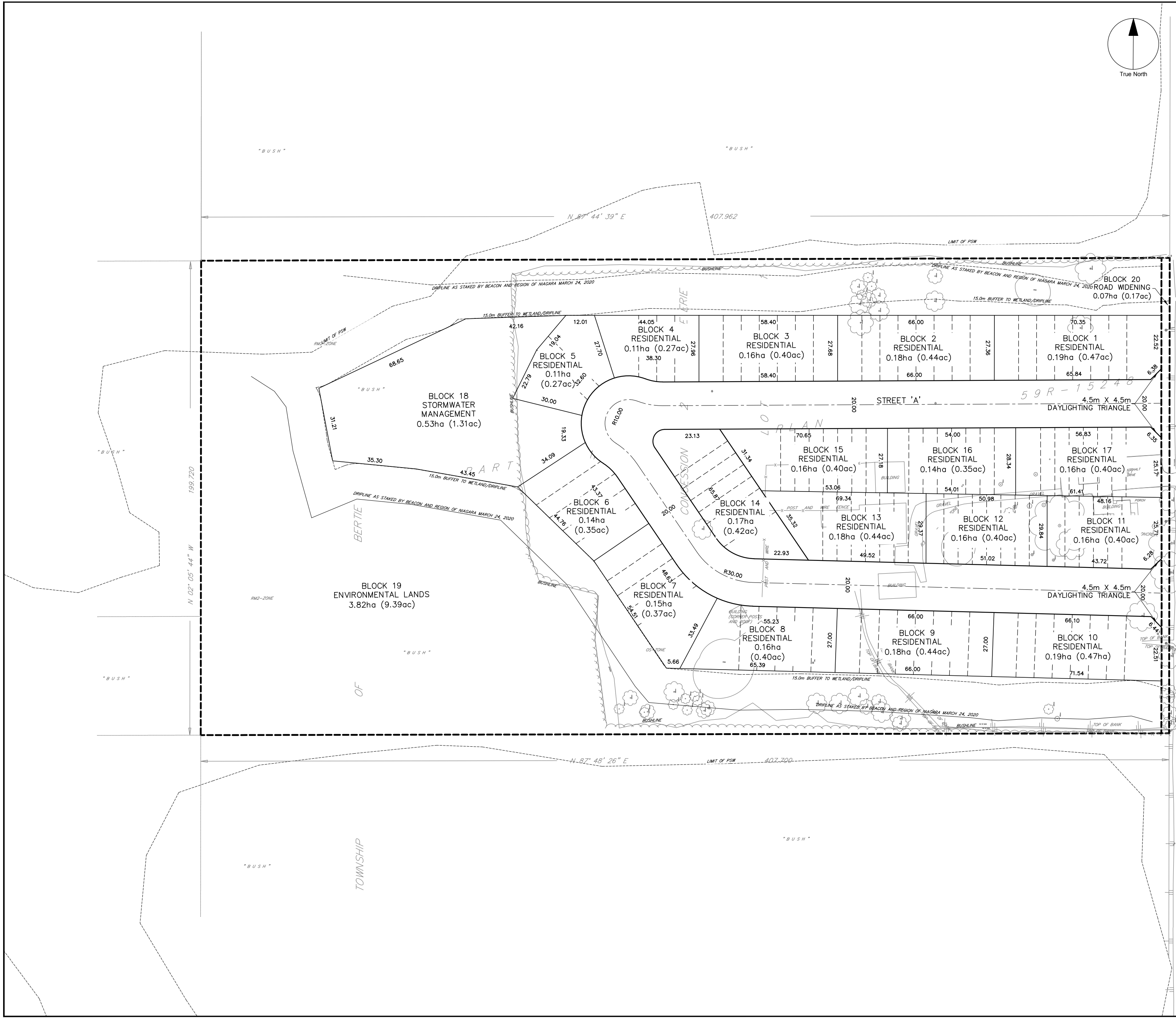




✳ Backfill in this area to be as per the HLV2K report

Appendix D:

Proposed Site Plan Provided by the Client



LAND USE SCHEDULE		
BLOCKS	DESCRIPTION	AREA (ha)
BLOCKS 1-17	RESIDENTIAL	2.70
BLOCK 18	STORMWATER MANAGEMENT	0.53
BLOCK 19	ENVIRONMENTAL LANDS	3.82
BLOCK 20	ROAD WIDENING	0.07
R.O.W.	STREET 'A'	1.02
TOTAL AREA		8.14

DRAFT PLAN
OF SUBDIVISION
613 HELENA STREET

PART OF LOT 1, CONCESSION 2,
LAKE ERIE TOWNSHIP OF BERTIE
IN THE TOWN OF FORT ERIE
REGIONAL MUNICIPALITY OF NIAGARA

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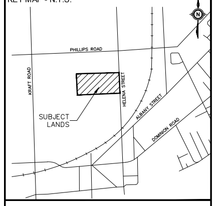
KEY MAP - N.T.S.



INFORMATION REQUIRED

UNDER SECTION 51 (17) OF THE PLANNING ACT, R.S.O. 1990, c.P.13 AS AMENDED
(a) - AS SHOWN
(b) - AS SHOWN
(c) - AS SHOWN
(d) - RESIDENTIAL
(e) - AS SHOWN
(f) - AS SHOWN
(g) - AS SHOWN
(h) - MUNICIPAL (PUBLIC)
(i) - SILTY CLAY
(j) - AS SHOWN
(k) - ALL SERVICES TO BE MADE AVAILABLE
(l) - AS SHOWN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SIGNED ____________________
PHILIP S. SUDA, O.L.S.
SUDA & MALESZYK SURVEYING INC.

DATE ____________

OWNER'S CERTIFICATE

I HEREBY CONSENT TO THE FILING OF THIS PLAN BY IBI GROUP, IN DRAFT FORM.

SIGNED ____________________
MARIO BEVACQUA
1891187 ONTARIO INC.

DATE ____________

#	DATE	BY	DESCRIPTION
1			

DRAWING ISSUE RECORD

APPROVALS

IBI GROUP
Suite 200 - 360 James Street North
Hamilton ON L8L 1H5 Canada
tel 905 546 1010 fax 905 546 1011
ibigroup.com

BENCHMARK

SCALE 10 5 0 10 20 30
1:750 (m)

PROJECT NO:
131951

DRAWN BY: T. NGUYEN	CHECKED BY: T. TUCKER
PROJECT MGR: T.TUCKER	APPROVED BY:

SHEET TITLE
DRAFT PLAN
OF
SUBDIVISION

SHEET NUMBER
DP 1.0

ISSUE
1

File Location: J:\131951_613_Helen\7.0_Production\7.01_Sent-Received\Sent\Client\2021-04-08 - Draft Plan\131951DP 2021-04-08.dwg Last Saved: April 8, 2021, by Tracy.Tucker Plotted: Thursday, April 8, 2021 10:39:00 AM by Tracy Tucker

SCALE CHECK
1 in
10mm