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PROJECT NO.: SM 301944-G

October 22, 2021
Revised March 15, 2023

BRUNO CARRERA
281 CHIPPAWA ROAD
PORT COLBORNE, ONTARIO
L3K 1T8

Attention: Bruno Carrera

GEOTECHNICAL CONSIDERATIONS
PROPOSED RESIDENTIAL DEVELOPMENT
281 CHIPPAWA ROAD
PORT COLBORNE, ONTARIO

Dear Mr. Carrera,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The scope of work was completed in general accordance with our proposal P301944, dated June 30, 2021. Our comments and recommendations based on our findings at the twelve [12] borehole locations are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will involve the construction of a new residential development consisting of single family dwellings, semi-detached dwellings, and townhouse blocks along asphalt paved roadways, including the installation of associated municipal underground services, and a stormwater management [SWM] pond at the property located at 281 Chippawa Road in Port Colborne, Ontario. The purpose of this geotechnical investigation work was to assess the subsurface soil conditions and to provide comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed

design, this office must be consulted to review the new design with respect to the results of this investigation. It is noted that this report is not intended to address the environmental aspects of the site.

2. PROCEDURE

A total of twelve [12] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment on September 27, 2021 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD., to auger refusal at depths of approximately 0.15 to 0.5 metres below the existing ground surface.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings. Grain size analyses and Atterberg Limits Testing was conducted on two [2] selected samples of the recovered soils, the results of which are attached to the end of this report.

Groundwater observations were made during the drilling operations. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903, and the ground surface was reinstated flush with the surrounding grade. It is noted that monitoring wells were not installed on the site due to the shallow bedrock encountered.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., based on clearance of existing underground services, and accessibility over the site. The ground surface elevation at the borehole locations was referenced to a site specific geodetic benchmark, described as the Cut Cross, as illustrated in the Borehole Location Plan. This benchmark was noted to have a geodetic elevation of 184.05 metres as per the topographic sketch prepared by Matthews, Cameron, Heywood – Kerry T. Howe Surveying Ltd. [LLN: 58174 File:2006-208 Rev No. 1 dated December 20, 2006], provided to our office.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 12, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed at the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is noted to consist of an agricultural field with a single family dwelling at the north end of the site, at the property located at 281 Chippawa Road in Port Colborne, Ontario. The subject site is bounded to the north by Chippawa Road, by Highway 140 to the east and by vacant forested land and residential development to the south and west. The site is relatively flat and even with a gradual relief of approximately 3 metres from north to south.

The subsurface conditions encountered at the borehole locations have been summarised as follows:

Topsoil

A surficial veneer of topsoil approximately 100 to 200 millimetres in thickness encountered at all borehole locations. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations, and that a conservative approach should be taken in estimating topsoil quantities. It is also noted that the term ‘topsoil’ has been used from a geotechnical point of view, and does not necessarily reflect the materials nutrient content or ability to support plant life.

Clayey Silt/Silty Clay

Native clayey silt/silty clay was encountered below the topsoil at Borehole No. 1, 2, 3, 6, 9, 11, and 12. The native cohesive soil was brown in colour, contained some sand and trace gravel, and was generally firm to very stiff in consistency. The native clayey silt/silty clay was proven to auger refusal on assumed bedrock at depths of approximately 0.15 to 0.5 metres below the surrounding ground surface at all borehole locations.

Limestone/Dolostone Bedrock

Limestone/dolostone bedrock was inferred from auger refusal at depths of approximately 0.15 to 0.5 metres below the existing ground surface at all borehole locations. Based on a review of available published information, geology mapping, etc., the bedrock is comprised is limestone and dolostone of the Bois Blanc formation. The bedrock is generally weathered and fractured in the upper levels becoming more sound with depth, however very competent in terms of foundation and excavation requirements for the project. The depths and elevations at which bedrock was encountered has been summarized as follows:

TABLE A
ASSUMED BEDROCK DEPTHS AND ELEVATIONS

Borehole No.	Surface Elevation [m]	Assumed Bedrock Depth [m]	Assumed Bedrock Elevation [m]
1	180.43	0.45	179.98
2	180.69	0.25	180.44
3	180.75	0.43	180.32
4	181.01	0.15	180.86
5	181.83	0.15	181.68
6	182.51	0.35	182.16
7	181.90	0.15	181.75
8	181.31	0.13	181.18
9	180.96	0.5	180.46
10	181.99	0.1	181.90
11	182.81	0.22	182.60
12	183.82	0.25	183.57

GENERAL DISCUSSION OF SOIL CONDITIONS

In general, the soil conditions encountered were found to consist of a thin deposit of cohesive clayey silt/silty clay with some sand and trace gravel, with limestone/dolostone bedrock at shallow depths across the site. A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subsurface soils to consist of bedrock at near surface depths. These conditions are consistent with our experience in the area and observations during our investigation.

As noted above, grain size analyses and Atterberg Limits Testing was conducted on two [2] selected samples of the overburden soils. The results of this testing can be found appended to the end of this report, and are summarized as follows:

TABLE B
GRAIN SIZE ANALYSES

Sample ID	Depth	% Clay	% Silt	% Sand	% Gravel	Hydraulic Conductivity, k [cm/s]	Estimated Infiltration Rate [mm/hr]
BH1 SS1	0 to 0.45 m	22	41	28	9	10^{-7}	<10
BH2 SS1	0 to 0.25 m	33	49	14	4	10^{-8}	<10

TABLE C
ATTERBERG LIMITS

Sample ID	Depth	Liquid Limit, w_L [% Moisture]	Plastic Limit, w_P [% Moisture]	Plasticity Index, I_p	Natural Moisture Content
BH1 SS1	0 to 0.45 m	28.2	15.4	12.8	21%
BH2 SS1	0 to 0.25 m	40.6	22.6	18.0	26%

The results of this analysis confirm relatively consistent silt and clay soils of low plasticity and very low permeability.

These tests indicate the material to consist predominately of silt and clay with varying sand from some sand to sandy, with trace gravel, consistent with our observations during fieldwork and experience in the area. According to the Unified Soil Classification System the soil samples are generally classified as M.L. – Clayey silts with slight plasticity, inorganic silts and very fine sands to C.L. – Inorganic clays of low to medium plasticity. The subsurface soils encountered have an estimated infiltration rate of less than 10 mm/hr and are considered to be effectively impermeable based on the grain size analyses conducted and summarised above, however more permeable seams may be encountered.

Groundwater Observations

All of the boreholes were recorded as 'dry' upon completion with the exception of Borehole Nos. 2, 6, and 9, which were recorded as 'wet' at depths of 0.15 to 0.3 metres below grade. It is noted that the observed wet conditions are likely due to recent precipitation perched above the bedrock, and are not indicative of the static groundwater level, which would have not had time to stabilize in the open boreholes. Based on our observations during drilling, experience in the area, and available published information, the static groundwater level is estimated to be on the order of 2 to 4 metres below the existing grade, within the limestone bedrock, and would be expected to fluctuate seasonally. If a more accurate estimate of the groundwater level is required, it would need to be confirmed via the installation of monitoring wells into the bedrock.

4. EXCAVATIONS

Excavations for the installation of foundations and underground services are generally expected to extend to depths of up to about 1 to 3 metres below the existing grade. Excavations through the native overburden soils may be expected to remain stable for the short construction period at inclinations of up to 45 to 60 degrees to the horizontal while excavations through any engineered fill may be expected to remain stable for the short construction period at inclinations of 45 degrees to the horizontal. Where wet seams are encountered or during periods of extended precipitation, excavations may have a tendency to 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter. Where excavations extend into the limestone bedrock, the use of mechanical 'rock splitting' equipment will be required, and the rate of excavation should be expected to slow significantly. Excavations in the bedrock would remain stable at near vertical excavations, though the sides should be thoroughly scaled of any loose fragments prior to entry by any worker.

Given the shallow depth of bedrock encountered, depending on the extent that the grade is proposed to be raised, whether the proposed units have basements, and the proposed depths of municipal services, as well as the proposed base elevation of the SWM pond it may be necessary to remove or 'chip out' some depth of limestone bedrock. As such the proposed founding level should be confirmed relative to the depth of bedrock. In the event that foundations extending well into the bedrock are considered, further evaluation of the bedrock condition including coring, as well as assessment of the groundwater level, may be warranted. Alternatively, it may be preferable to raise the structures and provide supplemental frost protection to foundations to limit removal of limestone bedrock.

Nevertheless, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper than those required in the Safety Act must be supported, and a senior geotechnical engineer from this office should monitor the work. With respect to OHSA the native clayey silt/silty clay would be considered as a Type 2 soil, while engineered fill would typically be considered a Type 2 to 3 soil.

As noted above the static groundwater level is estimated to be within the bedrock, likely below the anticipated depths of construction. Regardless, infiltration of groundwater through permeable seams in the overburden soils and limestone bedrock, as well as surface runoff into open excavations, should still be anticipated. The rate of infiltration is anticipated to be relatively low, such that it should be possible to adequately control groundwater infiltration for the short construction period using conventional construction dewatering methods, such as pumping from sumps in the base of the excavation. More groundwater control should be anticipated when connections are made to existing services, and where excavations extend below the groundwater level and in the event that excavations are proposed to extend below the static groundwater level. As noted above, in the event that excavations well into the bedrock are proposed, additional investigations including coring of the bedrock and installation of monitoring wells to further assess the groundwater condition would be warranted. Surface water should be directed away from the excavations.

The base of the excavations in the native clayey silt/silty clays or limestone/dolostone bedrock encountered in the boreholes should generally remain firm and stable. Therefore, standard pipe bedding, as typically specified by the Ontario Provincial Standard Specification will be satisfactory, compacted to 95 per cent of its standard Proctor maximum dry density [SPMDD], should suffice.

Any utility poles, light poles, etc. located within 3 metres of the top of an excavation slope should be braced to ensure their stability. Likewise, temporary support might be required for other existing above and below ground structures, including existing underground services, depending on their proximity to the trench excavations and the existing support conditions.

5. BACKFILL CONSIDERATIONS

The excavated material will consist primarily of the native clayey silt/silty clay as well as limestone bedrock, encountered in the boreholes, as described above. The clayey silt/silty clay soils, would be generally suitable for use as engineered fill, service trench backfill, etc., provided that they are free of organics, debris, or other deleterious material,

and that their moisture content can be controlled to within 3 per cent of their respective standard Proctor optimum moisture content. Any excavated bedrock may be reused as engineered fill provided it is sufficiently crushed down to a useable granular material. It would be possible to crush the excavated bedrock to a suitable gradation such as an Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II or Granular 'A' for use as granular materials such as road base. In such an event, the crushed material must be tested and approved for use by our office.

The use of a free draining, well-graded granular material, such as an OPSS Granular 'B', Type II (crushed limestone bedrock), is recommended for backfill against foundation walls or to raise the interior grade to the design subgrade level. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for interior floor slabs and exterior concrete sidewalks. As noted above it should be possible to adequately crush any limestone bedrock excavated from the site for the use in such areas. The crushed bedrock material should be assessed by our office prior to its use.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of the 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic and therefore impacting roadway construction. If the soil is well dry of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition.

The clayey silt/silty clay soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to its standard Proctor optimum value. It is therefore very important that the placement moisture content of the backfill soils be within 3 per cent of their standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

A representative of SOIL-MAT should be present on-site during the backfilling and compaction operations to confirm the uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. All structural fill should be compacted to 100 per cent of its standard Proctor maximum dry density [SPMDD]. Backfill within service trenches, areas to be paved,

etc., should be compacted to a minimum of 98 per cent of SPMDD. The appropriate compaction equipment should be employed based on soil type, i.e. pad-toe for cohesive soils and smooth drum/vibratory plate for granular soils. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

6. MANHOLES, CATCH BASINS AND THRUST BLOCKS

Properly prepared bearing surfaces for manholes, valve chambers, etc. in the native competent soils or engineered fill, stabilised where required, or limestone/dolostone bedrock, will be practically non-yielding under the anticipated loads. Proper preparation of the founding soils will tend to accentuate the protrusion of these structures above the pavement surface if compaction of the fill around these structures is not adequate, causing settlement of the surrounding paved surfaces. Conversely, the pavement surfaces may rise above the valve chambers and around manholes under frost action. To alleviate the potential for these types of differential movements, free-draining, non-frost susceptible material should be employed as backfill around the structures located within the paved roadway limits, and compacted to 100 per cent of its standard Proctor maximum dry density.

The thrust blocks in the native soils or engineered fill placed as described above, may be conservatively sized as recommended by the applicable Ontario Provincial Standard Specification conservatively using a horizontal allowable bearing pressure of up to 150 kPa [~3,000 psf]. Any backfill required behind the blocks should be a well-graded granular product and should be compacted to 100 per cent of its standard Proctor maximum dry density.

7. PAVEMENT CONSIDERATIONS

All areas to be paved should be stripped of all organic or otherwise unsuitable materials. The exposed subgrade should be proofrolled with 3 to 4 passes of a loaded tandem truck in the presence of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means must be sub-excavated and replaced with suitable backfill material. Alternatively, the soft areas may be stabilised by placing coarse crushed stone and ‘punching’ it into the soft areas. The need for the treatment of softened subgrade will be reduced if construction is undertaken during the dry summer months and careful attention is paid to the compaction operations. The fill over shallow

utilities cut into or across paved areas must also be compacted to 100 per cent of its standard Proctor maximum dry density.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and mitigate softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction. Therefore, precautionary measures should be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimising the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as during the Fall and Spring months, or during colder winter weather, it should be anticipated that additional subgrade preparation will be required, such as additional depth of Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II sub-base material. It is also important that the sub-base and base granular layers of the pavement structure be placed as soon as possible after exposure, preparation, and approval of the exposed subgrade.

The proposed roadways within the residential subdivision would be required to adequately support cars, trucks, and intermittent delivery and garbage trucks. The pavement structure should be consistent with the applicable City of Port Colborne standards where the roadways are to be assumed by the Town. A typical suggested pavement structure for local residential roads would consist of 300 millimetres of Granular 'B' Type II (crushed limestone bedrock) sub-base, 150 millimetres of Granular 'A' base material, with 50 millimetres of HL8 binder course and 40 millimetres of HL3 surface course asphalt. It is our opinion that this design is suitable for use on a residential roadway section, provided that the subgrade has been prepared as specified and is good and firm before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. Where the pavement structure is to be placed directly on the limestone bedrock, a reduced pavement structure may be considered. The granular sub-base and base courses and asphaltic concrete layers should be compacted to OPSS or Town of Port Colborne requirements. A program of in-place density testing must be carried out to monitor that compaction requirements are

being met. We note that this pavement structure may not necessarily be considered suitable for use as a construction roadway.

Asphalt paving of driveways should be consistent with the general recommendations provided above. Proper preparation of the subgrade soils is essential to good long-term performance of the pavement. Likewise, sufficient depth and compaction of granular base materials and adequate drainage will be important in achieving good long-term performance, i.e. preventing/limiting premature cracking, subgrade failure, rutting, etc. A recommended light duty pavement structure for residential driveways would consist of a minimum of 200 millimetres of OPSS Granular 'A' base course, compacted to 100 percent standard Proctor maximum dry density, followed by a minimum of 50 millimetres of HL3 or HL3F asphaltic concrete, compacted to a minimum of 92 per cent of their Marshall maximum relative density [MRD].

For paved area not to be assumed by the City, the suggested pavement structures outlined in Table A below may be considered and are based on subgrade parameters estimated on the basis of visual and tactile examinations of the on-site soils and past experience. The outlined pavement structure may be expected to have an approximate ten to fifteen-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

TABLE D
TYPICAL SUGGESTED PAVEMENT STRUCTURES

LAYER DESCRIPTION	COMPACTION REQUIREMENTS	LIGHT DUTY SECTIONS	HEAVY DUTY [TRUCK ROUTE]
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	92 per cent Marshall	65 millimetres	40 millimetres
Binder Course OPSS HL 8	92 per cent Marshall		65 millimetres
Base Course OPSS Granular A	100% SPMDD	150 millimetres	150 millimetres
Sub-base Course OPSS Granular B Type II	100% SPMDD	300 millimetres	450 millimetres

* SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

Based on the proposed construction the parking lots would be anticipated to be designed predominately for light duty use. However, where the arrangement of light duty and heavy duty pavement sections are included, the transition between sections may present some difficulty for contractors. In this regard, consideration might be given to a slightly increased light duty pavement structure consisting of 50 millimetres of HL8 binder course and 40 millimetres of HL3 surface course asphaltic concrete. This structure will provide for a continuous depth of surface course asphalt allowing for ease of construction. As well such a structure would have an improved performance over an increased design life. Such an arrangement of asphalt layers would also allow for future rehabilitation with a 'mill and pave' type operation. Where a pavement structure is to be placed directly on the limestone bedrock, the light duty granular base makeup would suffice for both light and heavy duty areas.

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often, significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honeycomb surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the course particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

8. RESIDENTIAL CONSTRUCTION

The native soils, suitable engineered fill, or limestone bedrock are considered suitable for support the loads associated with typical single family dwellings [~75 kPa] on conventional spread footings founded below any organic, disturbed or otherwise unsuitable material that may be encountered. Should the site grading works require engineered fill below founding elevations, the general recommendations presented in the Backfill Considerations above should be strictly adhered to, with compaction to 100 percent SPMDD, and monitoring and testing by a representative of SOIL-MAT ENGINEERS present on a full time basis. Footings within quality engineered fill should be designed considering an allowable bearing capacity of no more than 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS, pending a more detailed assessment of the engineered fill operations. If there is a short fall in the volume of fill required, then the source of imported fill should be checked for gradation, Proctor value, and compatibility with existing fill and approved by this office.

The support conditions afforded by the native soils and/or engineered fill are generally not uniform across the building footprint, nor are the loads on the various foundation elements. As such, the provision of nominal steel reinforcement should be considered in the concrete foundations. Such reinforcement will act to reduce the potential for cracking in the foundation walls due to minor settlements, heaving, shrinkage, etc. and will assist in resisting the earth pressures generated against the foundation walls by the backfill. This nominal reinforcement is an economical approach to the reduction or prevention of costly foundation repairs after completion and later in the life of the buildings. Such nominal reinforcement would typically consist of two continuous 15M steel bars placed in the footings [directly below the foundation wall] and a similar two continuous 15M steel bars placed approximately 300 millimetres from the top of the foundation walls. The reinforcing bars should be bent to reinforce all corners and under basement windows, and be provided with sufficient overlap at staggered splice locations. At 'steps' in the foundations and at window locations, the reinforcing steel should be bent to follow the step diagonally, rather than at 90 degrees, to maintain the continuous tensile capacity of the reinforcement. Where footings are founded on or partially on engineered fill, or a combination of native soils and bedrock, the above provision for nominal reinforcement would be a requirement.

All footings exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost penetration. This frost protection, or equivalent, would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Building Code. Given the shallow depth of bedrock, it may be preferable to accommodate such shallower founding depths. In such an event supplemental frost protection such as rigid foam insulation should be provided.

All residential dwelling basement walls should be suitably damp-proofed, including a 'dimple type' drainage boarding leading to a perimeter drainage tile system. The perimeter weeping tile should consist of a perforated plastic pipe with a geofabric sock, surrounded with a minimum of 200 millimetres [top and sides] of 20-millimetre clear stone, in turn encased in a heavy geofabric. The perimeter drainage system should ideally outlet to a gravity storm sewer connection, fitted with a suitable back-flow prevention valve. In the event that sump pit systems are required, consideration should be given to constructing the sump pump system with an 'oversized' reservoir so that the sump pump will not cycle repeatedly within short time periods. The enclosed Drawing Nos. 2 and 3 show schematics of the typical requirements for foundation construction with a basement level and for slab on grade construction respectively.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this geotechnical investigation report, and to allow changes to the made in the event that subsurface conditions differ from the conditions identified at the borehole locations.

9. STORMWATER MANAGEMENT (SWM) POND DESIGN CONSIDERATIONS

It is understood that the storm water management plan for the site will include the installation of a Storm Water Management [SWM] pond, in the southwest corner of the subject site near the area of Borehole Nos. 1 and 2. The conditions encountered at the borehole locations and characterized in the laboratory testing, demonstrate a very thin layer of clayey silt/silty clay overburden soils of low to medium plasticity over limestone/dolostone bedrock at relatively shallow depths on the order of 0.2 to 0.5 metres below the existing grade. Given the relatively shallow depth of bedrock given the existing grade. It is anticipated that the pond would require removal of considerable volumes of limestone bedrock.

It is anticipated that a 'wet' pond would be utilized, given the relatively low permeability of the overburden soils and underlying bedrock It is anticipated that the pond would have a permanent pool elevation above the static groundwater level, such that it would be necessary to provide an impermeable liner over the base of the SWM pond to resist the exfiltration of water out of the pond. This could be accomplished through the use of a compacted clay liner, or with a weighed down proprietary liner system, etc. Based on the groundwater levels estimated to be below the anticipated depths of the SWM pond, it is anticipated that a clay liner thickness on the order of 0.5 metres would be sufficient, however this should be reviewed and confirmed as part of the detailed design of the SWM pond.

An impermeable compacted clay liner would consist of a sufficiently plastic clay soil, with a recommended minimum clay content of 20 per cent and plasticity index of 7. Based on the laboratory testing, the on site soils are generally considered to be suitable for use as a clay liner, however depending on the volume of material available relative to the volume required for the impermeable liner, it may be necessary to import a sufficiently clayey material for use as the liner. The clay liner material should be placed in nominal lifts of 300 millimetres, sufficiently worked to destroy any natural layering or soil structure, moisture conditioned to -2 to +4 per cent of its optimum moisture content, and nominally compacted to 95 per cent SPMDD.

Alternatively, weighed down proprietary liners could be considered, however the material suppliers of such materials (such as Layfield, Terrafix, Suprema) would have to be consulted for recommendations on the appropriate product and installation methods for the site conditions. Such artificial liners would not require compaction efforts and could be weighed down with practically any available soil or granular material.

The final design interior pond slopes in the native overburden or constructed using the on-site excavated soils should be at 4 horizontal to 1 vertical, or flatter, and the exterior slopes of any berms, where required, at 3 horizontal to 1 vertical, or flatter. Should steeper slopes be required it will be necessary to provide some form of stabilisation, such as with the placement of coarse 'rip-rap' stone, or proprietary product such as Turfstone or Cable-Crete. In fact, it is recommended that all interior pond slopes be provided with at least some form of nominal stabilisation/protection to control erosion/loss of ground. It is anticipated that topsoil will be placed within the SWM pond area and 'seeded' to provide stabilisation and erosion protection.

Material utilised in construction of pond slopes must be free of significant organic deposits, construction debris, or any other deleterious materials which would affect stability of the pond walls or impermeability of the liner. Our office should be retained to review any imported material to the site for suitability of material for such a use, as well as to provide quality control services during construction.

It is also noted that appropriate care and effort will be required by the contractor around inlet and outlet structures to ensure the impermeable liner is continuous and avoid the potential of 'piping'. In this regard the clay liner should be completely constructed prior to the installation of inlet/outlet structures. A bentonite clay material could be utilised within the fill around any structures to provide a continuous impermeable seal.

As noted above, no monitoring wells or rock coring was conducted as part of this geotechnical investigation at this time. In the event that construction of the SWM pond required significant excavation of the bedrock, it may be prudent to further assess both the condition of the limestone bedrock via coring, and installation of monitoring wells to more accurately estimate the static groundwater level, to aid in estimating the cost of pond construction, and its design.

10. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgment in light of the information available to it at the time of preparation. The information presented concerning subsurface soil and groundwater conditions are descriptive of conditions at the borehole locations only. There may be conditions in the study area which are not represented by these investigations. 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. SOIL-MAT ENGINEERS 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 trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Malcolm Craig, B.Eng., EIT

Kyle Richardson, P. Eng.
Project Engineer

LICENSED PROFESSIONAL ENGINEER
Mar 5/13
S.K. RICHARDSON
100179716
PROVINCE OF ONTARIO

Enclosures: Drawing No.1, Borehole Location Plan
Log of Borehole Nos. 1 to 12
Grain Size Analyses
Plasticity Chart
Drawing No. 2, Basement Perimeter Drainage
Drawing No. 3, Slab on Grade Perimeter Drainage

Distribution: Bruno Carrera [1, plus pdf]

LEGEND

BH# Borehole Location

BM Benchmark
Cut Cross Elevation,
Elevation of 184.05 m

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 301944-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Proposed Mixed-Use Development
281 Chippawa Road
Port Colborne, Ontario

Borehole Location Plan

Project No. SM 301944-G

Date: July 2021

Drawn: KJR | Checked:KR

SM 301944-G Borehole Location Plan

Drawing No. 1

Log of Borehole No. 1

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751608
E: 644056

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		180.43		Ground Surface									
0	0	180.43		**Topsoil** Approximately 200 millimetres of topsoil.									
		180.23		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance, firm. Auger refusal on assumed bedrock.		SS	1	3,3,4,50/2"	7				● ▲
		179.90		End of Borehole									
1													
2													
3	1												
4													
5													
6													

NOTES:

1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.5 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

Soil-Mat Engineers & Consultants Ltd.
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Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751666
E: 644034

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		180.69		Ground Surface									
0	0	180.49		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	4,50/4"	100				▲ ●
		180.40		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance.									
1				End of Borehole Auger refusal on assumed bedrock.									
2				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to spoon refusal on assumed bedrock at a depth of 0.3 metres. 2. Borehole was recorded as open and 'wet' at a depth of 0.2 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751697
E: 643966

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		180.75		Ground Surface									
0	0	180.75		**Topsoil** Approximately 200 millimetres of topsoil.									
		180.55		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance.		SS	1	3,3,50/5"	100		<1.0		▲ 35 • 80
1		180.30		End of Borehole Auger refusal on assumed bedrock.									
2				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.5 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751756
E: 643962

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		181.01		Ground Surface									
0	0			**Topsoil** Approximately 175 millimetres of topsoil.		SS	1	2,50/1"	100				▲ 30 • 80
		180.84		End of Borehole Auger refusal on assumed bedrock.									
1				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.17 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
2													
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Sheet: 1 of 1

Log of Borehole No. 5

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751883
E: 643954

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		181.83		Ground Surface									
0	0	181.71		**Topsoil** Approximately 125 millimetres of topsoil.		SS	1	50/5"	100				▲ ●
				End of Borehole Auger refusal on assumed bedrock.									
1													
2													
3	1												
4													
5													
6													

NOTES:

1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.12 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Log of Borehole No. 6

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751979
E: 643951

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		182.51		Ground Surface									
0	0	182.51		**Topsoil** Approximately 200 millimetres of topsoil.									
		182.31		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance.		SS	1	3,6,50/2"	100				▲ •
1		182.16		End of Borehole Auger refusal on assumed bedrock.									
2				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.35 metres.									
3	1			2. Borehole was recorded as open and 'wet' at a depth of 0.3 metres upon completion and backfilled as per Ontario Regulation 903.									
4				3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Sheet: 1 of 1

Log of Borehole No. 7

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751890
E: 644000

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		181.90		Ground Surface									
0	0	181.78		**Topsoil** Approximately 125 millimetres of topsoil.		SS	1	50/5"	100				▲ ●
				End of Borehole Auger refusal on assumed bedrock.									
1													
2													
3	1												
4													
5													
6													

NOTES:

1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.15 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Sheet: 1 of 1

Log of Borehole No. 8

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751790
E: 644000

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		181.31		Ground Surface									
0	0	181.18		**Topsoil** Approximately 125 millimetres of topsoil.		SS	1	50/5"	100				▲ ●
				End of Borehole Auger refusal on assumed bedrock.									
1				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.13 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
2													
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Datum: Geodetic
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Log of Borehole No. 9

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751745
E: 644045

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		180.96		Ground Surface									
0	0	180.96		**Topsoil** Approximately 150 millimetres of topsoil.									
		180.81		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance, some fractured rock in the lower levels.		SS	1	3,5,24,50/3"	29				▲ ●
1		180.50		End of Borehole Auger refusal on assumed bedrock. NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.5 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
2													
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Datum: Geodetic
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Sheet: 1 of 1

Log of Borehole No. 10

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751827
E: 644052

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		181.99		Ground Surface									
0	0	181.90		**Topsoil** Approximately 100 millimetres of topsoil.		SS	1	50/4"	100				
				End of Borehole Auger refusal on assumed bedrock.									
1				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.1 metres. 2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
2													
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

Soil-Mat Engineers & Consultants Ltd.
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Datum: Geodetic
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Sheet: 1 of 1

Log of Borehole No. 11

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4751991
E: 644036

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		182.81		Ground Surface									
0	0	182.66		**Topsoil** Approximately 150 millimetres of topsoil.		SS	1	2,50/3"	100				▲ ●
		182.60		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel reworked in appearance.									
1				End of Borehole Auger refusal on assumed bedrock.									
2				NOTES: 1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.2 metres. 2. Borehole was recorded as open and 'wet' at a depth of 0.15 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
3	1												
4													
5													
6													

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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Log of Borehole No. 12

Project No: SM 301944-G
Project: Proposed Mixed-Use Development
Location: 281 Chippawa Road, Port Colborne
Client: Bruno Carrera

Project Manager: Kyle Richardson, P.Eng
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4752095
E: 644027

Depth (ft)	Depth (m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
		183.82		Ground Surface									
0	0	183.67		**Topsoil** Approximately 150 millimetres of topsoil.		SS	1	7,50/4"	100				▲ 10 20 30 40 ▲ / • 20 40 60 80 •
		183.57		**Clayey Silt/Silty Clay** Brown, some sand, trace gravel, reworked in appearance.									
1				End of Borehole Auger refusal on assumed bedrock.									
2													
3	1												
4													
5													
6													

NOTES:

1. Borehole was advanced using solid stem auger equipment on September 24, 2021 to auger refusal on assumed bedrock at a depth of 0.25 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: September 24, 2021
Hole Size: 150 Millimetres
Drilling Contractor: Elements Geo

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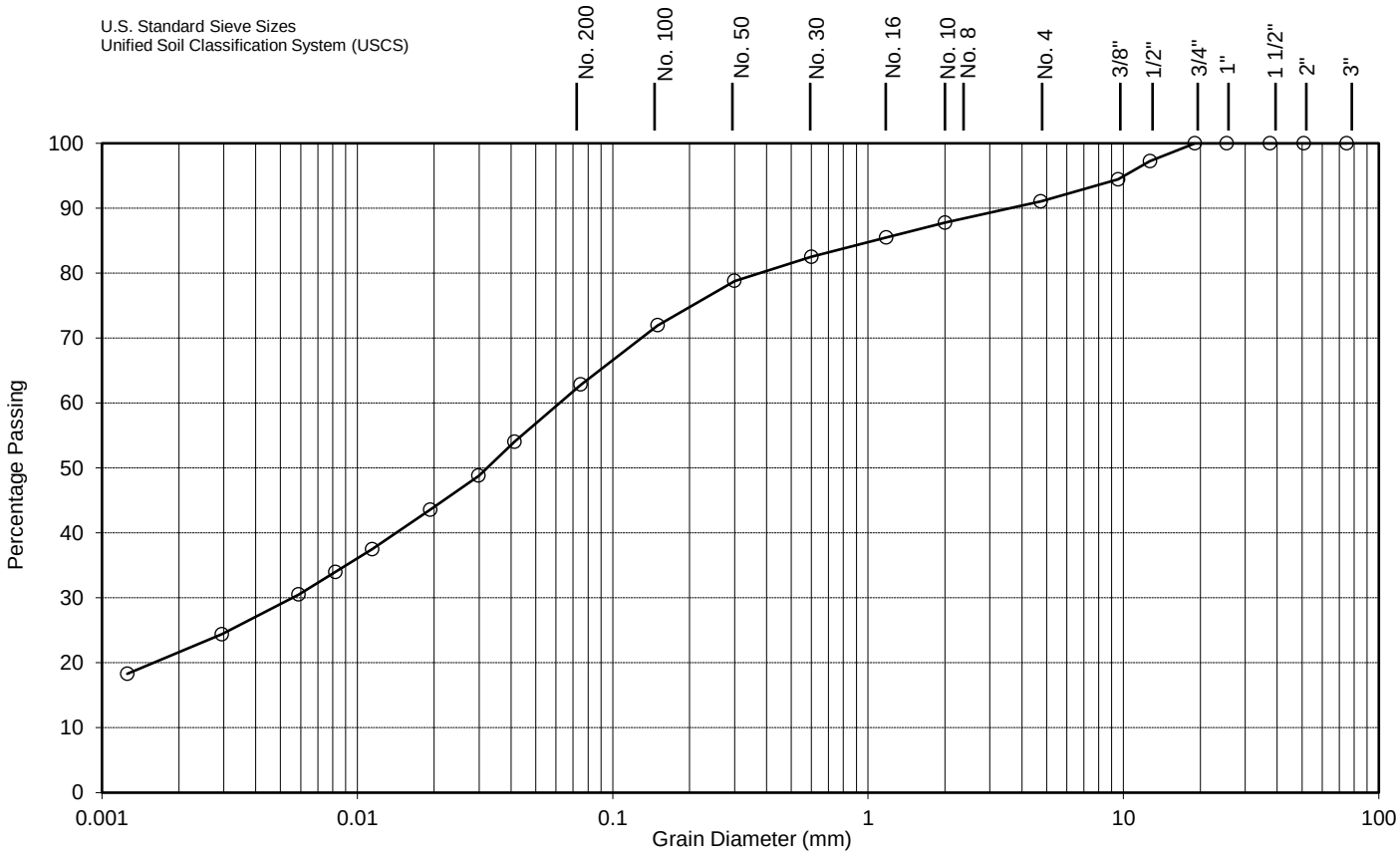
Sheet: 1 of 1

Mechanical & Hydrometer Analyses



CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

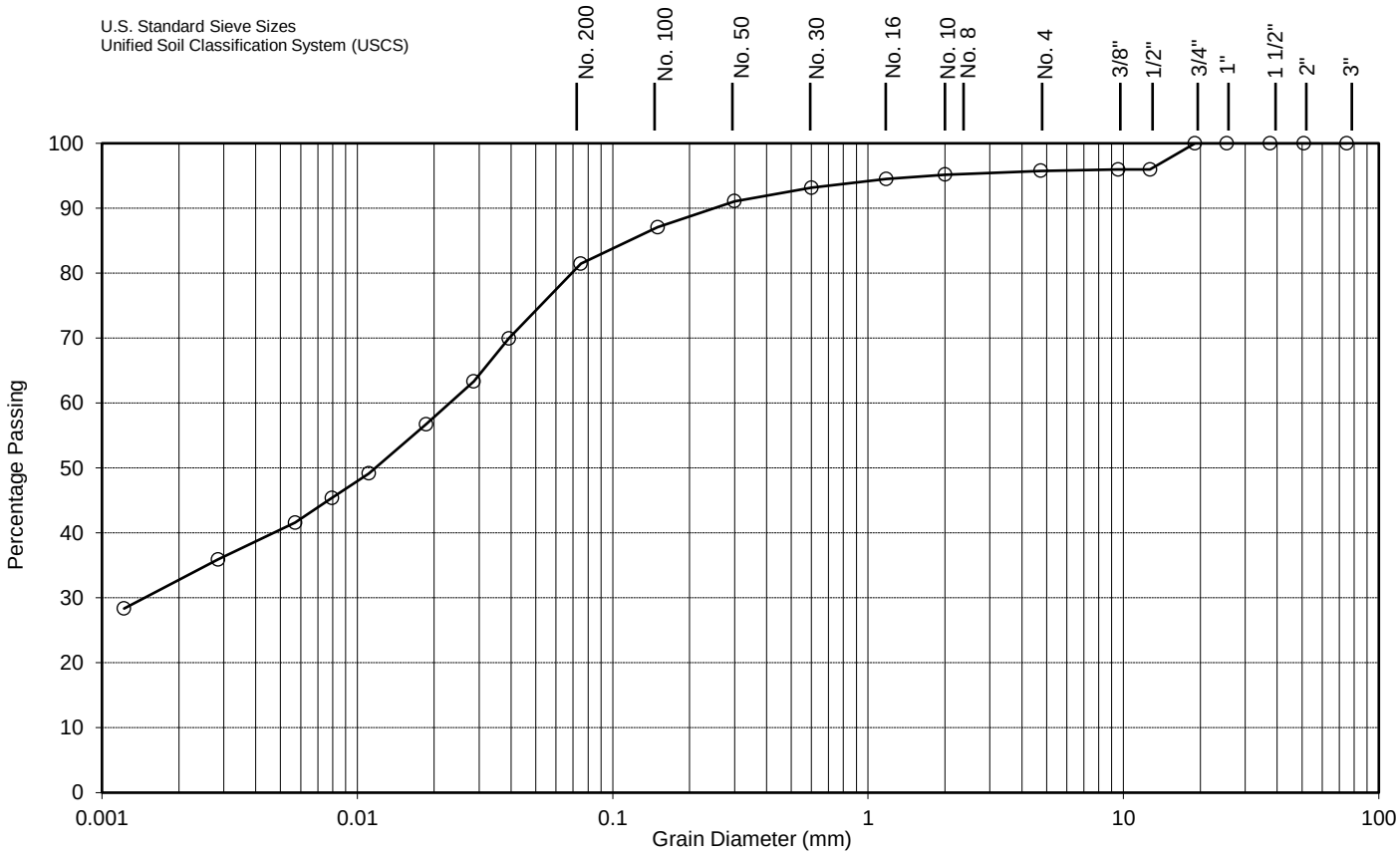
Lab No.:	**21-392**	Notes: Depth: 0 m			
Borehole No.:	**1**				
Sample No.:	**1**				
CLAY [%]:	**22**	Soil Description:	**Brown Sandy Clayey Silt w/ a trace of Gravel**		
SILT [%]:	**41**		**M.L. - Clayey silts with slight plasticity, Inorganic silts and very fine sands,**		
SAND [%]:	**28**		**silty or clayey fine sands**		
GRAVEL [%]:	**9**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0006**	Coefficient of Uniformity C_U:	**101.7**	Coefficient of Curvature C_C:	**0.9**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

281 Chippawa Road, Port Colborne ON

October 2021	**Grain Size Analysis No. 1**	**Project No.: SM 301944-T**

Mechanical & Hydrometer Analyses



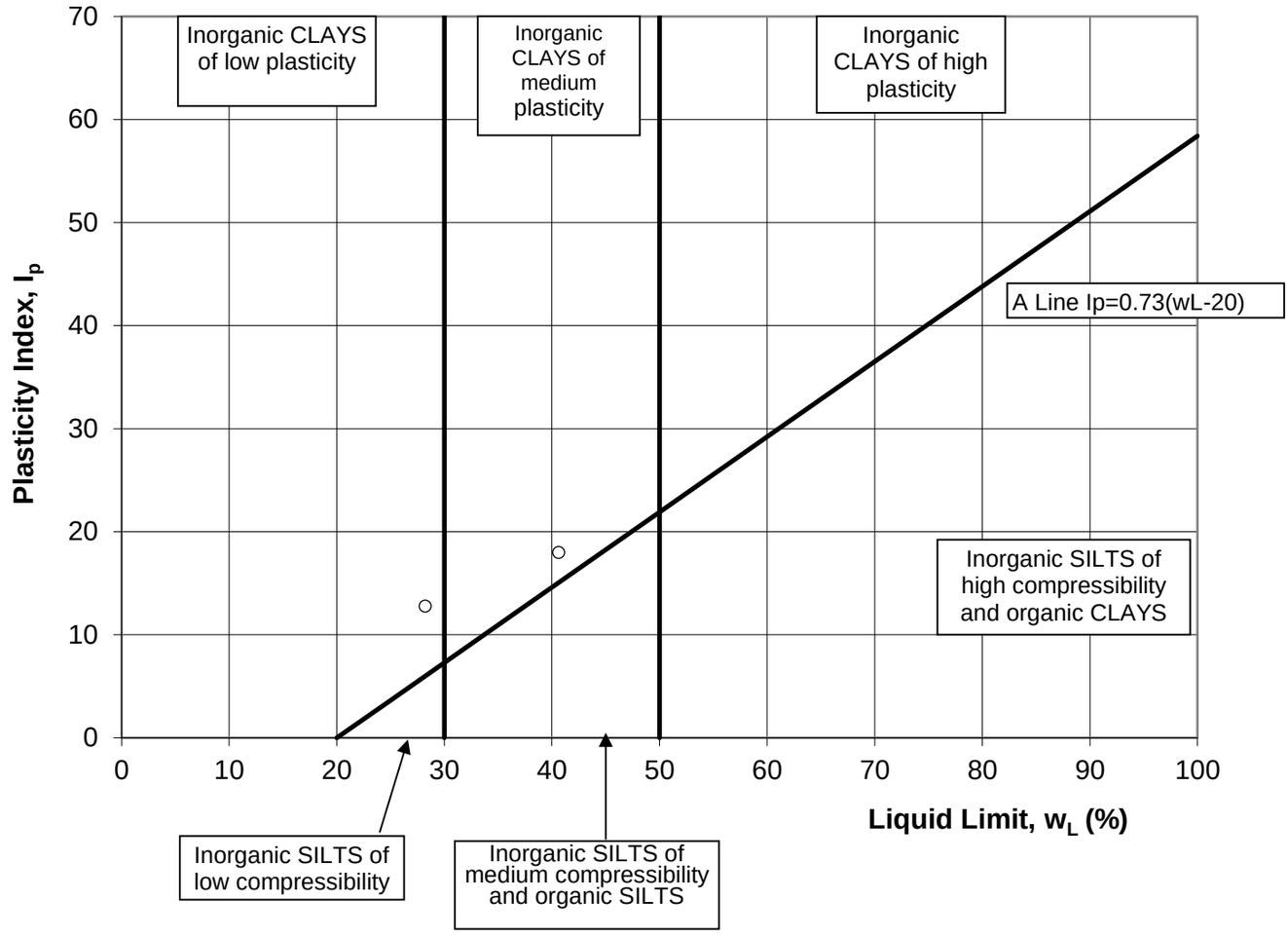
CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

Lab No.:	**21-393**	Notes: Depth: 0 m			
Borehole No.:	**2**				
Sample No.:	**1**				
CLAY [%]:	**33**	Soil Description:	**Brown Clayey Silt w/ some Sand and a trace of Gravel**		
SILT [%]:	**49**		**M.L. - Clayey silts with slight plasticity, Inorganic silts and very fine sands to**		
SAND [%]:	**14**		**C.L. - Inorganic clays of low to medium plasticity**		
GRAVEL [%]:	**4**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-8}**
D_{10} (Effective Diam. in mm):	**0.0003**	Coefficient of Uniformity C_U:	**76.7**	Coefficient of Curvature C_C:	**0.4**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

281 Chippawa Road, Port Colborne ON

October 2021	**Grain Size Analysis No. 2**	**Project No.: SM 301944-T**



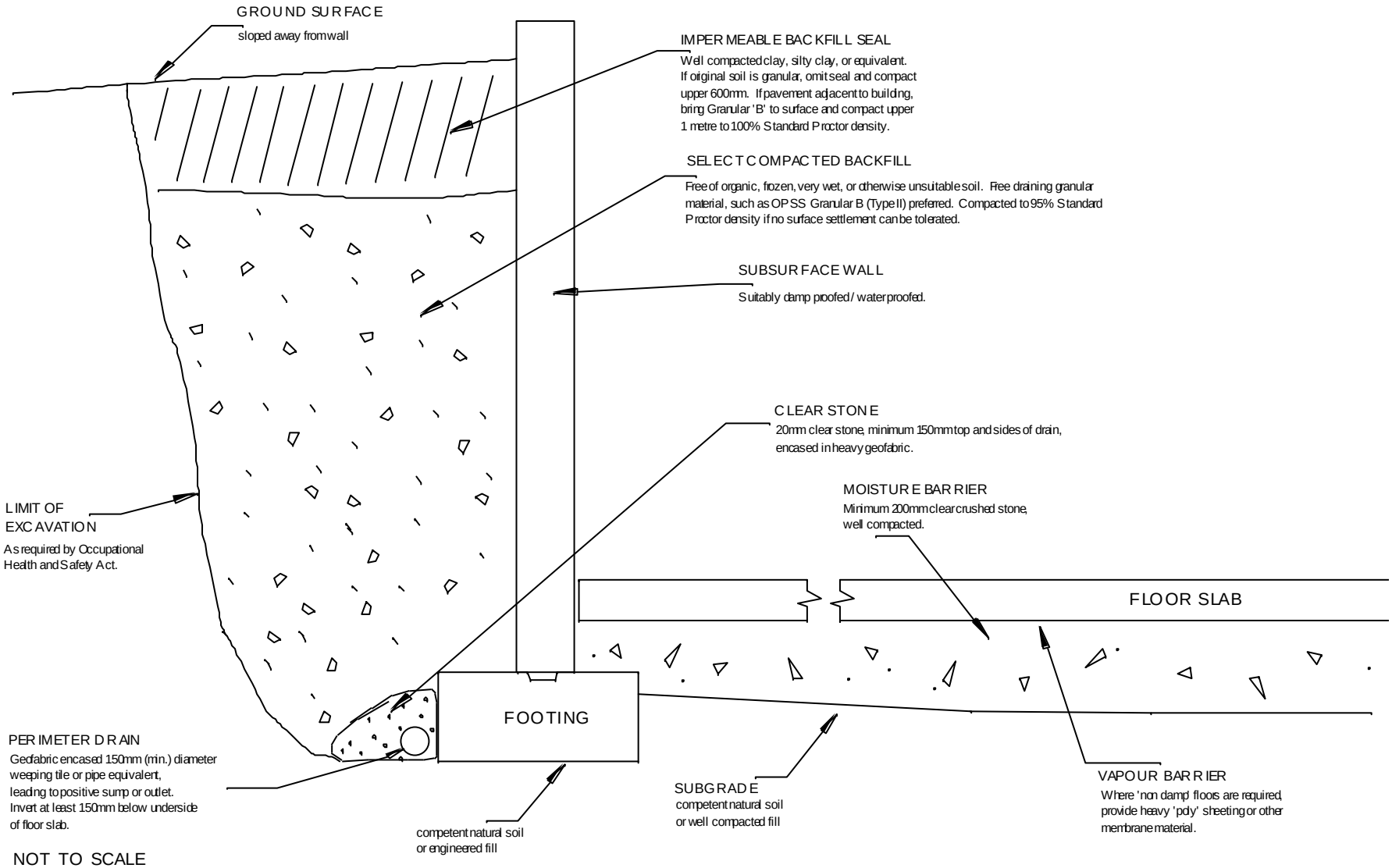
Atterberg Limits				
Sample No.	Sample Location	Liquid Limit wL	Plastic Limit wp	Plasticity Index Ip
BH1 SS1	Depth 0'	28.2	15.4	12.8
BH2 SS1	Depth 0'	40.6	22.6	18.0

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

281 Chippawa Road, Port Colborne ON

Atterberg Limits

Client:	**Bruno Carrera**		
Project No.:	**SM 301944-G**	**October 2021**	**Plasticity Chart**



NOT TO SCALE

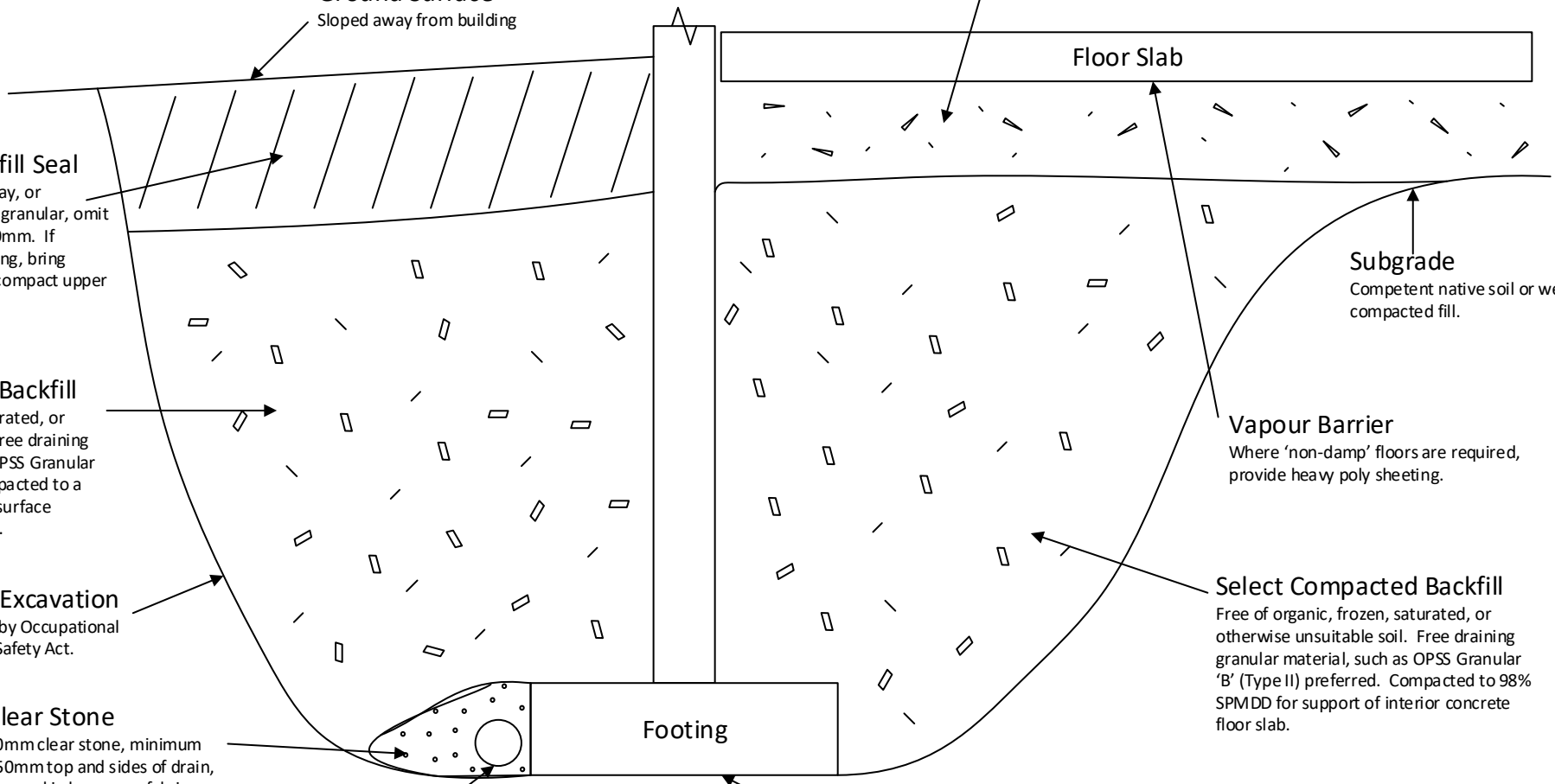
Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 301944-G
Date:	October 2021

Typical Design Requirements
Drainage and Backfill for Basement Walls

Drawing No. 2



Note:
Drainage system not required if final exterior grade is at least 0.3 metres below finished floor.

NOT TO SCALE

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Typical Design Requirements
Slab-on-Grade with Perimeter Drainage

Drawing No. 3