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PROJECT NO.: SM 240605-G

October 11, 2024
Revised October 15, 2024

BRANTHAVEN DEVELOPMENT
720 Oval Court
Burlington, Ontario
L7L 6A9s

Attention: Colin Rauscher
Senior Project Manager

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
DERRY ROAD WEST
MILTON, ONTARIO

Dear Mr. Rauscher,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the report preparation in connection with the above noted project. The scope of work was completed in general accordance with our proposal P240605, dated June 26, 2024. Our comments and recommendations, based on our findings at the eleven [11] borehole locations, are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will involve the construction of a residential development consisting of low-rise buildings [two storey townhouses, back-to-back and three storey rear-lane townhouses] as well as a mid-rise building up to 6 storeys in height with up to 2 basement levels, along with asphalt paved roadways, including associated underground municipal infrastructure, at the currently undeveloped parcel of land located on the northwest quadrant of the intersection of Derry Road West and Fourth Line in Milton, Ontario. The purpose of this geotechnical investigation work is to assess the site subsurface soil and groundwater conditions, and to provide our 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 description, 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, such as additional storeys or basement levels, this office must be consulted to review the new design with respect to the results of this investigation.

2. PROCEDURE

A total of eleven [11] 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 August 9 and 12, 2024 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD., to depths of between approximately 5.2 to 8.2 metres below the existing ground surface.

Upon completion of drilling, a groundwater monitoring wells were installed at Borehole Nos. 1, 2, and 10, to a depth of 6.0 metres below existing grade. The monitoring wells consist of 50-millimetre PVC pipe, screened in the lower 3.0 metres. The monitoring wells were encased in well filter sand up to approximately 0.3 metres above the screened portion, then with bentonite ‘hole plug’ to the surface and fitted with a protective steel ‘stick up’ casing. The remaining boreholes were backfilled in general accordance with Ontario Regulation 903, and the ground surface was reinstated even with the surrounding grade.

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, with hand penetrometer testing conducted on all cohesive samples. Additionally, three [3] selected soil samples were also submitted for laboratory grain size analysis.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The ground surface elevation at the borehole locations was surveyed to a site-specific geodetic benchmark, described as obvert of the culvert located, as illustrated in the Borehole Location Plan. This benchmark was noted to have a geodetic elevation of 199.06 metres, as noted on the topographic survey information 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 11, 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 located at on the north side of the intersection of Derry Road West and Fourth Line in Milton, Ontario, assuming east-west orientation of Derry Road West, and consists of agricultural lands. The site is bounded to the north by Dyane-Adam Elementary School, to the east, south and west by residential properties with Derry Road West on south. The grade of site is relatively even with the adjacent Derry Road West.

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

Topsoil

A surficial veneer of topsoil approximately 200 to 300 millimetres in thickness was encountered in all the borehole locations. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations. 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. Given the current use of the property is for agricultural purposes the upper levels of the soils would be expected to have a reworked nature with a variable topsoil depth based on historical working of the field, ranging from undiscernible to greater depths of topsoil. As such, it is recommended that a conservative approach be taken when estimating topsoil quantities across the site.

Clayey Sandy Silt

Native clayey sandy silt was encountered beneath the topsoil at all borehole locations. The native cohesive soils were reddish brown in colour, contained some gravel and were generally compact to dense in consistency. Native soils were proven to termination in all the borehole locations to depths of approximately between 5.2 and 8.2 metres below the existing ground surface. It is noted that the native soils were reworked in the upper levels as would be expected in agricultural areas where the soils are subjected to tilling as well as repetitive freeze thaw cycles. It is also noted that, while not explicitly encountered in our boreholes, potential fill deposits may be present on site.

As noted above, grain size analyses were conducted on three [3] selected samples of the native soils recovered from the boreholes. The results of this grain size testing can be found appended to the end of this report, and are summarized as follows:

TABLE A - GRAIN SIZE ANALYSES

Sample ID	Depth (m)	% Clay	% Silt	% Sand	% Gravel	Hydraulic Conductivity, k [cm/s]	Estimated Infiltration Rate, [mm/hr]
BH1 SS3	4.9	20	46	23	11	10^{-7}	<10
BH3 SS6	1.8	17	37	22	24	10^{-7}	<10
BH10 SS4	1.8	21	37	19	23	10^{-7}	<10

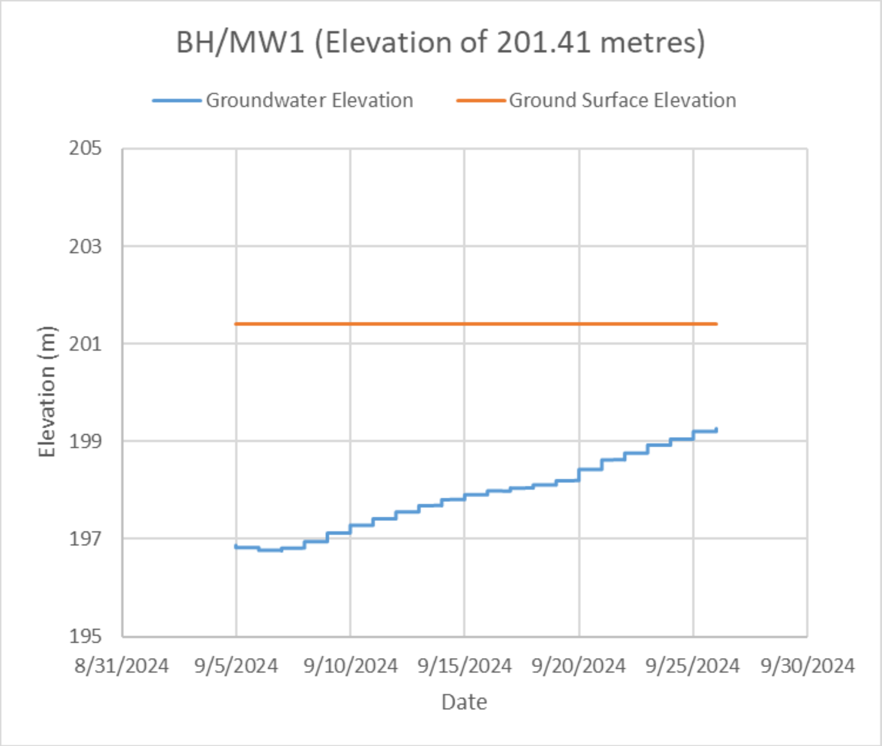
Note: Infiltration rate estimated using Hazen's equation for permeability, and correlation referencing CVC LID Design Guide – Appendix C.

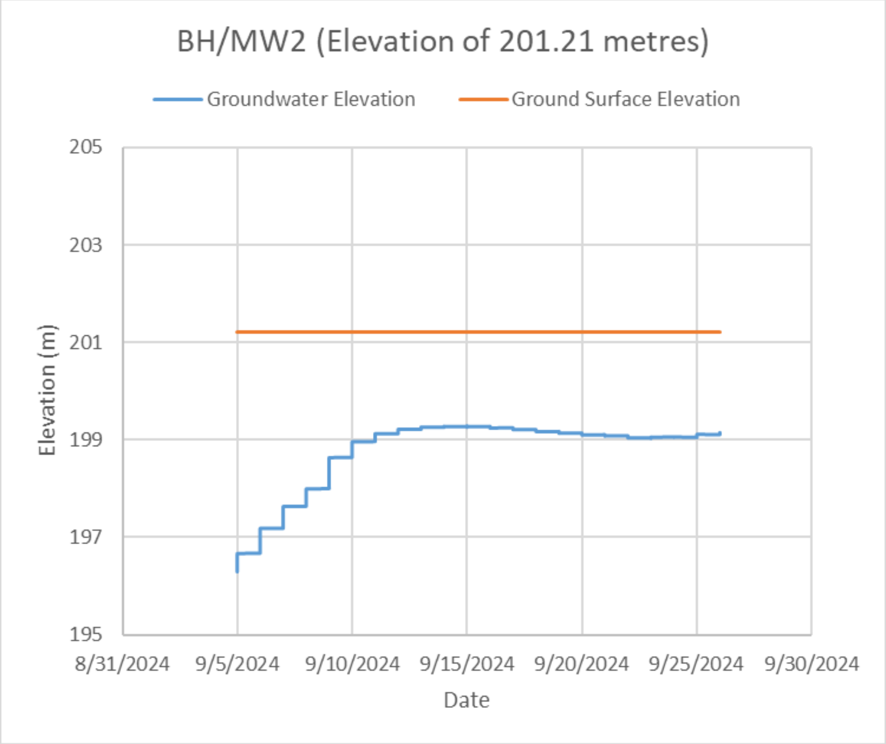
The field and laboratory testing demonstrate the native soils to generally consist of a silty sand/sandy silt with trace clay and gravel in upper levels transitioning to silty clay/clayey silt at depth. According to the Unified Soil Classification System (USCS), the clayey sandy silt soils are classified as M.L. – inorganic silts with very fine sands or clayey silts with slight plasticity to S.M. – silty sands, sand-silt mixtures encountered on site are classified as. The clay and silt soils would generally behave as a cohesive material with slight to medium plasticity, and low hydraulic conductivity, on the order of 10^{-7} cm/sec, and would be of low permeability to effectively impermeable.

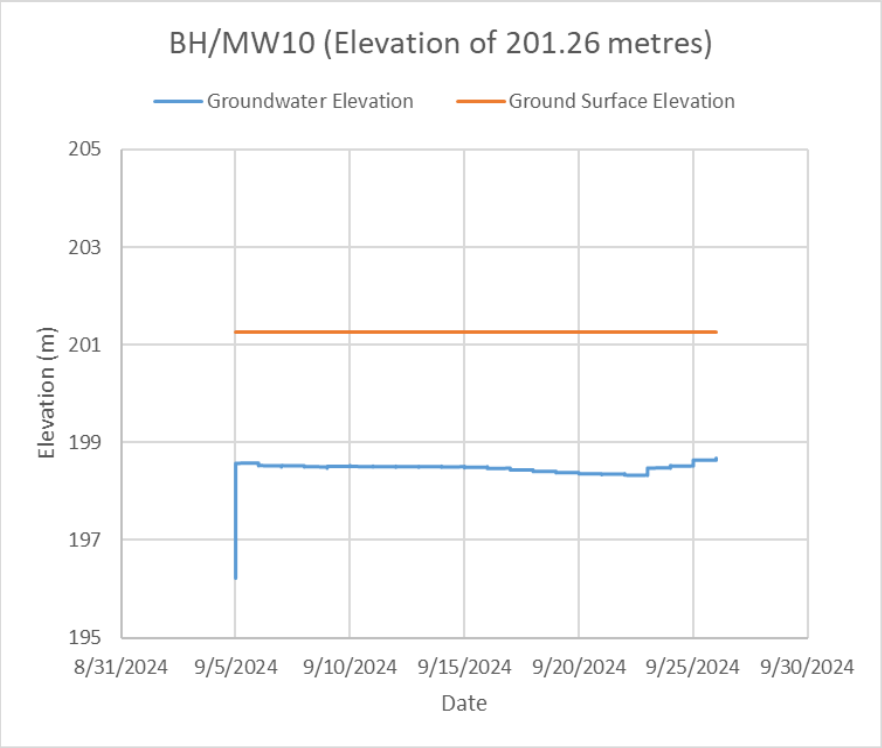
A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subsurface soils in the area are near a boundary of transition between fine-textured glaciolacustrine deposits of silt and clay with minor sand and gravel and alluvial deposits of clay, silt, sand and gravel. These conditions are consistent with our experience in the area, and our observations during drilling.

Groundwater Observations

All boreholes were recorded as 'dry' upon completion of drilling. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. As noted above, monitoring wells were installed at Borehole Nos. 1, 2 and 10, to allow for future measurements of the static groundwater level. These monitoring wells were equipped with data loggers to continuously record the groundwater levels between September 5, 2024 and September 26, 2024. The data obtained from these loggers have been illustrated as follows:


BH/MW1 (Elevation of 201.41 metres)
Groundwater Elevation
Ground Surface Elevation
205
203
201
199
197
195
Elevation (m)
8/31/2024
9/5/2024
9/10/2024
9/15/2024
9/20/2024
9/25/2024
9/30/2024
Date


BH/MW2 (Elevation of 201.21 metres)
Groundwater Elevation
Ground Surface Elevation
205
203
201
199
197
195
Elevation (m)
8/31/2024
9/5/2024
9/10/2024
9/15/2024
9/20/2024
9/25/2024
9/30/2024
Date



Along with the data logger information illustrated above, the following ground water levels were manually measured:

TABLE B - GROUNDWATER MONITORING

MW ID	Depth of Well/Elevation (m)	Surface Elevation (m)	Date	Groundwater Depth (m)	Groundwater Elevation (m)
BH/MW1	6.1/197.54	201.41	September 5, 2024	3.31	198.1
			September 26, 2024	2.14	199.27
BH/MW2	6.1/197.34	201.21	September 5, 2024	1.70	199.51
			September 26, 2024	2.06	199.15
BH/MW10	6.1/196.88	201.26	September 5, 2024	3.87	197.39
			September 26, 2024	2.57	198.67

The available ground water data to date indicates a groundwater level on the order of approximately 1.7 to 3.8 metres below the existing ground surface, varying with the physical topography. This corresponds to groundwater elevations of approximately 197.4 to 199.5 metres. Based on initial readings, ground water monitoring, observations during drilling, etc. the static groundwater level is conservatively estimated at depths of approximately 2 to 4 metres below the existing ground surface, however additional monitoring may allow for a more accurate estimate of the groundwater level. Regardless, shallower 'perched' deposits within permeable seams, etc., should be expected, especially during the 'wet' times of the year. It is noted that the groundwater level would be subject to seasonal fluctuations due to prevailing weather conditions. Depending on the depth of the proposed excavation and timing of construction, it may be prudent to advance a series of test pits to assess first hand the effect groundwater conditions on the proposed excavations during earthworks and servicing.

4. FOUNDATION CONSIDERATIONS

4.1 HOUSE AND TOWNHOUSE CONSTRUCTION

It is anticipated that the design founding level for residential dwellings and townhouse blocks will extend to depths of up to approximately up to 2 metres below the existing grade. The native soils encountered at these depths are considered capable of supporting the loads associated with typical residential dwelling and townhouse structures on conventional spread footings below any fill, organic, or otherwise unsuitable materials, considering a nominal bearing capacity of up to 200 kPa [~4,000 psf] SLS and 300 kPa [~6,000 psf] ULS may be considered in the competent native soils. The founding surfaces must be hand cleaned of any loose or disturbed material, along with any ponded water, immediately prior to placement of foundation concrete.

In the event that site grading work results in engineered fill below founding elevations, the general recommendations presented in the Backfill Considerations above should be strictly adhered to, with compaction to 100 per cent standard Proctor maximum dry density, verified by monitoring and testing by a representative of SOIL-MAT ENGINEERS present on a full time basis. The design bearing capacity for footings within the engineered fill should be limited to 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS, pending a more thorough evaluation of the engineered fill works. 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. Based on the condition of the founding soils at the time of construction, some localised sub-excavation of fill and/or unsuitable materials may be required.

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 foundations elements. As such it is recommended that consideration be given to the provision of nominal reinforcement in the footings and foundation walls to account for variable support and loading conditions. The use of nominal reinforcement is considered good construction practice as it 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 pressures generated against the foundation walls by the backfill. Such nominal reinforcement is an economical approach to the reduction and prevention of costly foundation repairs after completion and later in the life of the buildings. This reinforcement would typically consist of two continuous 15M steel bars placed in the footings [directly below the foundation wall], and similarly two steel bars placed approximately 300 millimetres from the top of the foundation walls at a minimum, depending on ground conditions exposed during construction. These reinforcement bars would 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 transition 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 the above provision for nominal reinforcement would be required.

4.2 MID-RISE BUILDING CONSTRUCTION

It is understood that the proposed mid-rise building will have up to 2 underground levels, with a founding level on the order of approximately 6 to 8 metres below the existing ground surface, into the dense clayey sandy silt soils. These depths are such that it will be below the static groundwater level. The native soils encountered are considered capable of supporting the proposed structure on conventional spread footings considering a bearing capacity of up to 200 kPa [~4,000 psf] SLS and 300 kPa [~6,000 psf] ULS.

In the event that the spread footing coverage exceeds 50 per cent of the building area, a raft slab foundation should be considered, based on a design bearing capacity of 200 kPa [~4,000 psf] SLS and 300 kPa [~6,000 psf] ULS. Alternatively, a raft slab may be designed considering a modulus of subgrade reaction of 50 MN/m^3 [~184 pci] where a flexible design approach is considered.

GENERAL FOUNDATION COMMENTS

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable deflection [settlement] based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect and upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. There is no direct relationship between ULS and SLS; rather they are a function of the soil type and the tolerable deflections for serviceability, respectively. Evidently, the bearing capacity would be lower for very settlement sensitive structures and larger for more flexible buildings.

All footings exposed to the environment must be provided with a minimum of 1.2 meters of earth or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

In areas where it will be necessary to provide adjacent footings at different founding elevations, the lower footing should be constructed before the higher footing is constructed, if possible, and the higher footing should be set below and imaginary line drawn up from the lower footing at 10 horizontal to 7 vertical. This practice will limit stress transfer from the higher footings to lower footings.

With foundations designed as outlined above and as required by the Ontario Building Code, and with careful attention paid to construction detail, total and differential settlements should be well within normally tolerated limits of 25 and 20 millimetres respectively, for the type of building and occupancy expected.

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 outlined in this report, and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the borehole locations.

5. LATERAL EARTH PRESSURE

The lateral earth pressures on basement walls can be estimated on the basis of backfill [free draining granular material] unit weight, [γ], of 22 kN/m^3 [~140 pcf]. The coefficient of lateral earth pressure may be taken as, $k_o = 0.5$ in fill against rigid walls [at rest condition]. Any additional pressures due to surcharge loading, such as parked vehicles, floor slab loading, etc. must be included in the design.

6. EXCAVATIONS AND EXCAVATION SUPPORT CONSIDERATIONS

Excavations for the installation of foundations and underground services are anticipated to extend to depths of up to approximately up to approximately 6 to 8 metres below the existing grade. Excavations through the native clayey sandy silt soils above the groundwater level should be relatively straightforward, with the sides remaining stable for the short construction period at slopes of up to 45 degrees to the horizontal. However, where excavations extend below the static groundwater level, during periods of extended precipitation or during 'wet' times of the year, increased excavation instability should be anticipated, which may cause excavations to 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter, and as such, wider excavations should be anticipated, and the contractor should be prepared to work in the 'wet'. 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 or a trench box must be provided, and a senior geotechnical engineer from this office should monitor the work. With respect to the Act, clayey sandy silt soils would be considered as Type 3 soil.

The base of excavations into the native clayey sandy silt soils should remain firm and stable for the proposed works, however may be prone to localised disturbance from construction traffic when exposed to precipitation and where more 'silty' pockets are encountered. For foundation excavations, consideration may be given to the placement of a thin, lean-mix [~5 MPa] concrete mud slab to protect foundation bases from disturbance. For service trench excavations, base stabilisation, such as the placement of clear coarse stone 'punched' into the softened soils, the use of additional ballast stone and/or additional pipe bedding material may be required. With a firm excavation base, stabilised as required, standard pipe bedding, as typically specified by Region of Halton or Ontario Provincial Standard Specification [OPSS] should be satisfactory, compacted to 95 percent of its standard Proctor maximum dry density. Special attention should be paid to compaction under the pipe haunches.

It is anticipated that all efforts would be made to advance the excavations as open cuts. In the event that site restrictions do not allow for sufficient space for open cuts based on the expected stable slope inclinations, excavation support systems such as shoring systems may be required. A specialty contractor or shoring consultant should be consulted with respect to the design of such a shoring system. For preliminary design purposes the shoring system should be designed on the basis of a retained soil unit weight of γ_{wet} = 19.5 kN/m^3 [~124 pcf], and a lateral earth pressure coefficient of k_o = 0.5 (at rest case) or k_A = 0.3 (active case). Shoring systems such as timber lagging and soldier piles may be supported on caissons extending into the underlying clayey sandy silt, and may be designed for end bearing using the values provided above, however it is recommended that a 50% reduction of this bearing value be used in the shoring design.

The shoring system should be monitored during construction, and the contractor should have a contingency plan in place to be implemented should deflections of the shoring system exceed the tolerable limits. In addition, it is imperative that a pre-construction condition survey be conducted of the adjacent structures, roadways, etc. in order to document the existing conditions prior to the commencement of construction. This will allow for comparison and assessment in the event that disturbance due to construction activities is claimed.

As noted above, the static groundwater level is estimated at a depths of approximately 2 to 4 metres below the existing grade, with excavations likely extending at or below this depths. It is anticipated to adequately control the infiltration of water into the excavations for the construction period using conventional pumping techniques from construction sumps in the base of the excavations, however multiple pumps should be expected to be required, depending on the shoring system utilised. It is anticipated that typical temporary construction dewatering volumes would be below a rate of 50,000 L/day. For greater excavation depths, or lengths, the volume of dewatering may be greater, up to 400,000 L/day, such that an EASR notification may be warranted. The need for a Permit to Take Water [PTTW] is not expected to be required for site servicing. Buildings with basement levels to greater depth may have increased dewatering requirements, however these are best assessed during the design stage on a case by case basis for specific buildings.

We recommend that the invert elevations of any storm sewer pipes for rear yard catch basins be located above the proposed underside of footing elevations of adjacent house structures, or that the trench excavations should be filled with 5 MPa 'lean mix' concrete to the proposed underside of footing level where the excavations extend below an imaginary 10 horizontal to 7 vertical line extending outwards and down from a point 0.3 metres beyond the proposed townhouse foundations.

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, roadways, etc. depending on their proximity to the trench excavations.

7. SEISMIC DESIGN CONSIDERATIONS

Structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 203/24. Based on the subsurface soil conditions encountered in this investigation, the applicable Site Classification for the seismic design is Site Class D – Stiff Soil, based on the average soil characteristics for the site. It is noted that a seismic site class of C may be available, however would need to be confirmed via site specific shear wave velocity testing.

The 2%-in-50-year seismic hazard values for the site from the National Building Code 2020 are as follows:

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.345	0.298	0.172	0.0803	0.0209	0.00648	0.215	0.192

8. PERIMETER DRAINAGE AND WATERPROOFING CONSIDERATIONS

All 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 such as Mirafi 140N/Terrafix 270R or equivalent. Great care should be taken during the installation of the drains, as even a small break in the filtering materials could result in loss of fines into the drains with attendant performance difficulties, including settlements of the ground surface. The perimeter drains should outlet to a sump pit a minimum of 150 millimetres below the underside of the finished floor. 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 exterior grade around the structure should be sloped away from the structure to prevent the ponding of water against the foundation walls. The enclosed Drawing No. 2 shows schematics of the typical requirements for slab-on-grade construction with a basement level.

The provision of two underground levels for the mid-rise structure will result in basement levels well below the static groundwater level. This will require the use of foundation wall drainage systems intended for ‘blind side’ or ‘single face’ application, where excavation shoring is provided, and the installation of perimeter and under-slab weeping tile leading to a sump tank. The system should also incorporate a water-stop component between the footing/raft slab and foundation walls. Under-floor drains may consist of 100-millimetre diameter perforated pipe, with a geofabric sock, placed in the clear stone beneath the floor slabs on nominal 4 to 6 metre centers. It is noted that the under-floor and perimeter drainage systems should have separate piping, i.e. piping from perimeter system does not connect to the under-floor system, in order to prevent surcharging of the under-floor system. They may outlet into a common sump tank, though separate systems would be preferred.

The enclosed Drawing No. 3 shows a schematic of the typical requirements for basement foundation construction with underfloor drainage.

The elevator pit extending below the basement floor level of the proposed mid-rise structure should be designed to be water-tight, and be constructed to resist hydrostatic uplift with the static groundwater level conservatively set at the finished floor level of the basement.

9. BASEMENT FLOOR SLAB CONSIDERATIONS

The basement floor slabs may be constructed using conventional slab-on-grade techniques on a prepared subgrade. Following the removal of any unsuitable material the exposed subgrade surface should be well compacted in the presence of a representative of SOIL-MAT ENGINEERS. Any soft 'spots' delineated during this operation or other site work must be sub-excavated and replaced with quality granular backfill material compacted to a minimum of 98 per cent of its SPMDD. The provision of a layer of compacted Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II (crushed limestone bedrock), as outlined above, would serve to provide a firm and stable sub-grade condition for the support of the basement floor slab.

A moisture barrier will be required under the floor slabs such as the placement of at least 200 millimetres of well-compacted 20-millimetre clear crushed stone. At a minimum the moisture barrier material should contain no more than 10 per cent passing the No. 4 sieve. Where a 'non-damp' floor slab is required, as for instance under sheet vinyl floor coverings, etc., extra efforts will be required to damp proof the floor slab, as with the additional provision of a heavy 'poly' sheet, damp proofing sprays/membranes, drainage board products, etc. Where 'poly' sheets are used care should be taken to prevent puncturing and tearing and/or sufficiently heavy gauge sheeting specified. Alternatively, a proprietary product such as Delta-MS Underslab or WR Meadows membrane may be considered in lieu of the 'poly' sheets.

As with all concrete floor slabs, there is a tendency for the slab to develop cracks. The slab thickness, concrete mix design, the amount of steel and/or fibre reinforcement and/or wire mesh placed into the concrete slab, if any, will therefore be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend to a minimum depth of 1/3 of the thickness of the slab and be cut within 24 hours of being cast.

Curing of the slab must be carefully specified to ensure that slab curl is minimised. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

10. BACKFILL CONSIDERATIONS

The excavated materials will primarily consist of the clayey sandy silt soils encountered in the boreholes, as described above. These soils are generally considered suitable for use as engineered fill, trench backfill, etc., provided they are free of organics, debris, or other deleterious material, and that their moisture contents can be controlled to within 3 per cent of their standard Proctor optimum moisture content. Some selective sorting to remove organics, debris, and other unsuitable materials should be expected.

It is noted that the fine grained soils encountered are not considered to be free draining, and should not be used where this characteristic is required. It is also noted that these soils present difficulties in achieving effective compaction where access with compaction equipment is restricted. The clayey sandy silt soils are generally considered to be near to slightly 'wet' of their standard Proctor Optimum moisture content. Some moisture conditioning may be required depending upon the weather conditions at the time of construction. It is noted that these soils will become nearly impossible to compact when wet of its optimum moisture content. Any material that becomes wet to saturated should be spread out to allow to dry, or removed and discarded, or utilised in non-settlement sensitive areas.

The use of free draining, well-graded granular material, such as OPSS Granular 'B', Type II (crushed limestone bedrock), is recommended for backfill against the 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.

We note that where the 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 therefor impacting 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 fine grained 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, backfill within service trenches, areas to be paved etc. should be compacted to a minimum of 98 per cent of its 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.

11. MANHOLES, CATCH BASINS AND THRUST BLOCKS

Properly prepared bearing surfaces for manholes, valve chambers, etc. in the native competent soils, stabilised where required, 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 98 per cent of its standard Proctor maximum dry density. A geofabric separator should be provided between the free draining material and the on-site fine-grained cohesive soils to prevent the intrusion of fines.

The thrust blocks in the native soils 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.

12. PAVEMENT DESIGN CONSIDERATIONS

All areas to be paved should be stripped of all organic or otherwise unsuitable materials. The exposed subgrade should be proof rolled 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 stabilized by placing coarse crushed stone and 'punching' it into the soft areas. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilization methods, such as the use of coarse aggregate [50-millimetre clear stone, 'rip rap', etc.] 'punched' into the soft areas, or the use of stabilizing geogrid and a geofabric separator. 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 such as telephone, hydro, gas, etc. must also be compacted to 100 per cent of its SPMDD.

Good drainage provisions will optimize 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 may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. This may include restricting certain areas from construction traffic, or 'bulking' up the access roadways with additional granular sub-base layers during import of granular materials, spreading out/reusing the additional granular material once import is complete.

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 OPSS Granular 'B', Type II (crushed limestone bedrock) 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.

Where roads are to be assumed by the Town of Milton the pavement structure should confirm to the appropriate municipal standard. The suggested pavement structures outlined in Table D below may also be considered. These 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 fifteen to twenty 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	Min. 92 % Marshall MRD	40 millimetres	40 millimetres
Binder Course OPSS HL 8	Min. 92 % Marshall MRD	50 millimetres	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

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

Depending on the anticipated traffic, a reduced light duty asphalt structure consisting of 65 millimetres of HL3 surface course may also perform sufficiently. This would be reasonable in areas subjected only to light vehicles such as cars for parking. Such a structure may have a reduced lifespan if subjected to heavier vehicles, and would also not allow for 'mill and pave' type operations for future rehabilitation.

To minimize 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.

13. 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 judgement in light of the information available at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. 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.

Chauhan

Ishan Chauhan, B.Eng., EIT
Junior Engineer

Stephen R. Sears, B. Eng. Mgmt., P. Eng., QP_{ESA}
Senior Engineer

LICENSED PROFESSIONAL ENGINEER
OCT 15/24
S. R. SEARS
PROVINCE OF ONTARIO

Enclosures: Drawing No.1, Borehole Location Plan
Log of Borehole Nos. 1 to 11, inclusive
Grain Size Analysis Nos. 1, 2 and 3
Drawing No. 2, Typical Design Requirements – Drainage and Backfill for Basement Walls
Drawing No. 3, Typical Design Requirements – Drainage and Backfill for Basement Walls With Underfloor Drains

Distribution: Branthaven Development [pdf]

LEGEND

BH# Borehole Location

MW# Monitoring Well Location

BM Benchmark
Obvert of Culvert
Geodetic elevation of 199.06 m.

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 240605-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Residential
Development
Derry Road West
Milton, Ontario

Borehole Location Plan

Project No. SM 240605-G

Date: June 2024

Drawn: IC

Checked: KR

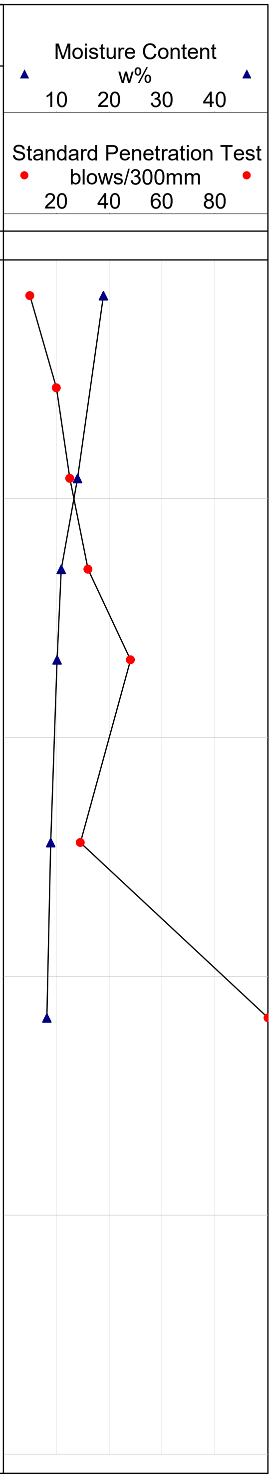
Drawing No. 1

Log of Borehole No. 1

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819976
E: 593592

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	201.41		Ground Surface								
	201.17		**Topsoil** Approximately 200 millimetres of topsoil		SS	1	2,5,5,6	10	■	>4.5	
1			**Clayey Sandy Silt** Reddish brown, some gravel, occasional to frequent cobbles in the lower layers, compact to very dense.		SS	2	6,9,11,13	20	■	>4.5	
2					SS	3	5,10,15,16	25	■	>4.5	
					SS	4	7,12,20,26	32	■	>4.5	
3					SS	5	13,19,29,41	48	■	>4.5	
5					SS	6	11,14,15,19	29	■	>4.5	
6	194.87				SS	7	30,34,50/6"	100	■	>4.5	
			End of Borehole								



End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 8, 2024 to termination at a depth of 6.6 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.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

September 5, 2024 - 3.1 metres

Drill Method: Hollow Stem Auger
Drill Date: August 9, 2024
Hole Size: 200 Millimetres
Drilling Contractor: Elements

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
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www.soil-mat.ca E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

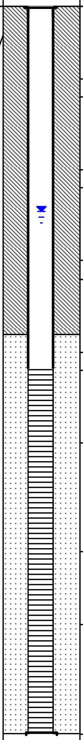
Log of Borehole No. 2

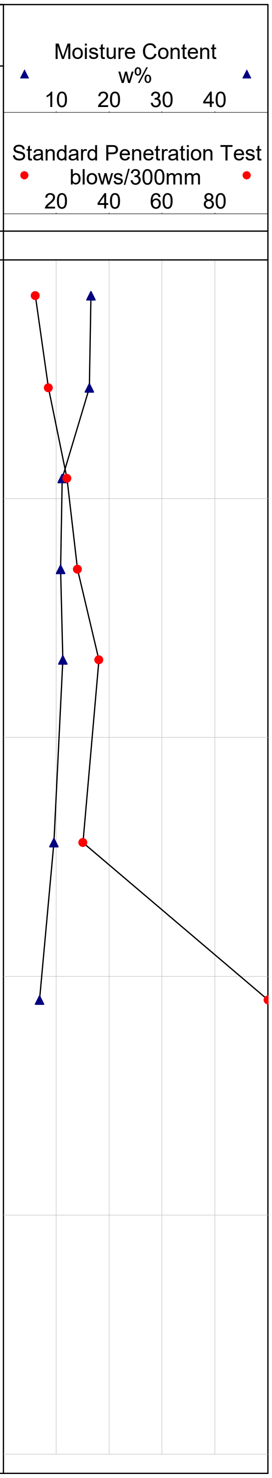
Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819889
E: 593673

Elevation (m)	Description
201.21	Ground Surface
200.97	**Topsoil** Approximately 200 millimetres of topsoil
	Clayey Sandy Silt Reddish brown, trace to some gravel, occasional cobbles, compact to dense.
194.87	End of Borehole

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	5,6,6,7	12		>4.5	
SS	2	5,8,9,10	17		>4.5	
SS	3	5,10,14,13	24		>4.5	
SS	4	7,12,16,24	28		>4.5	
SS	5	8,13,23,31	36		>4.5	
SS	6	7,13,17,15	30		>4.5	
SS	7	33,50/6"	100		>4.5	





NOTES:

1. Borehole was advanced using solid stem auger equipment on August 9, 2024 to termination at a depth of 6.3 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.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

September 5, 2024 - 1.7 metres

Drill Method: Hollow Stem Auger
Drill Date: August 9, 2024
Hole Size: 200 Millimetres
Drilling Contractor: Elements

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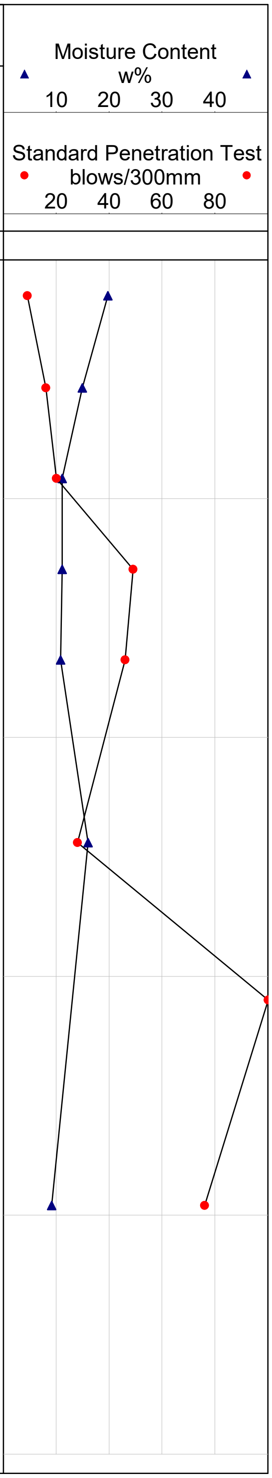
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819872
E: 593604

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	200.91		Ground Surface								
	200.67		**Topsoil** Approximately 200 millimetres of topsoil		SS	1	4,4,5,4	9	▨	>4.5	
			Clayey Sandy Silt Reddish brown, trace to some gravel, occasional to frequent cobbles, reworked appearance in upper levels, compact to very dense.		SS	2	6,8,8,14	16	▨	>4.5	
					SS	3	6,10,10,15	20	▨	>4.5	
					SS	4	13,24,25,20	49	▨	>4.5	
					SS	5	10,19,27,39	46	▨	>4.5	
					SS	6	14,12,16,18	28	▨	>4.5	
					SS	7	50/2"	100			
					SS	8	20,32,44,50	76	▨	>4.5	
	192.67		End of Borehole								



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 9, 2024 to termination at a depth of 8.2 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: Hollow Stem Auger
Drill Date: August 9, 2024
Hole Size: 200 Millimetres
Drilling Contractor: Elements

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Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

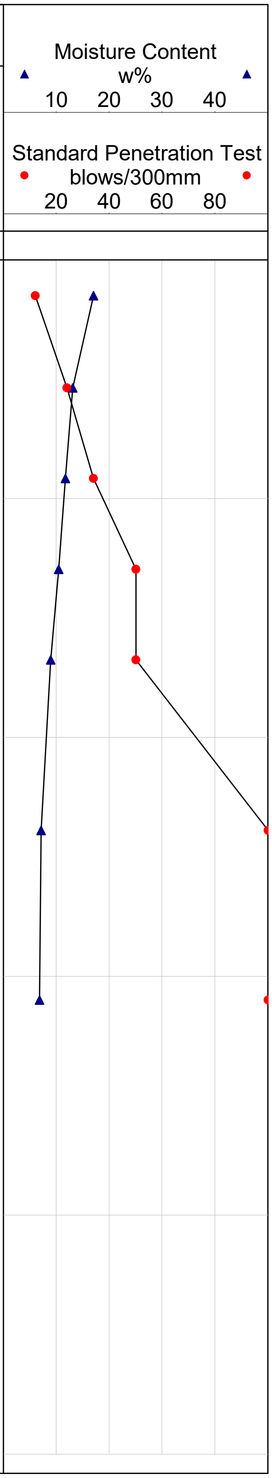
Log of Borehole No. 4

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819811
E: 593596

Depth (ft)	Depth (m)	Elevation (m)	Description
0	0	200.51	Ground Surface
0 – 1	0 – 0.34	200.17	**Topsoil** Approximately 300 millimetres of topsoil
1 – 20.7	0.34 – 6.3	194.17	**Clayey Sandy Silt** Reddish brown, trace to some gravel, occasional to frequent cobbles, reworked appearance in upper levels, compact to very dense.
			End of Borehole

			SAMPLE				
Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	SS	1	5,5,7,9	12	▨	>4.5	
	SS	2	8,11,13,15	24	▨	>4.5	
	SS	3	11,15,19,19	34	▨	>4.5	
	SS	4	10,18,32,24	50	▨	>4.5	
	SS	5	16,20,30,30	50	▨	>4.5	
	SS	6	40,44,50/6"	100		>4.5	
	SS	7	45,50/4"	100	▨	>4.5	



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 9, 2024 to termination at a depth of 6.3 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 Auger
Drill Date: August 9, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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Sheet: 1 of 1

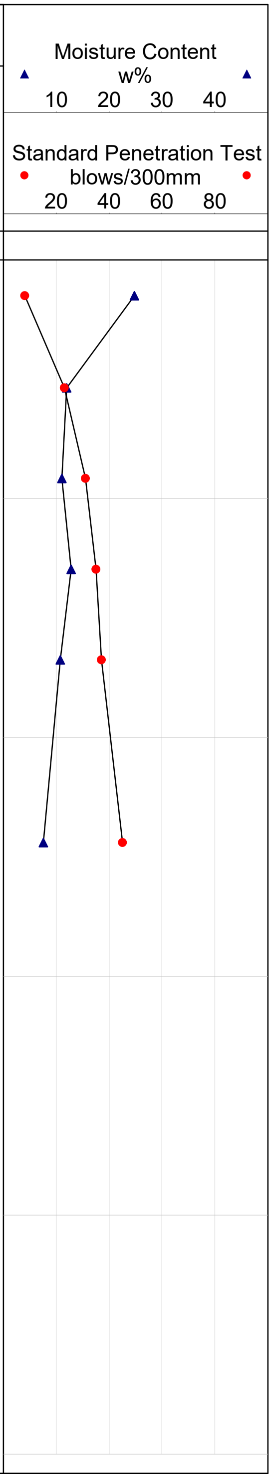
Log of Borehole No. 5

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819862
E: 593591

Depth ft: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
Depth m: 0 1 2 3 4 5 6 7 8 9

Elevation (m)	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
200.68		Ground Surface								
200.47		**Topsoil** Approximately 200 millimetres of topsoil		SS	1	2,3,5,4	8	▨	>4.5	
		Clayey Sandy Silt Reddish brown, trace to some gravel, occasional to frequent cobbles, reworked appearance in upper levels, compact to dense.		SS	2	7,10,13,18	23	▨	>4.5	
				SS	3	7,14,17,26	31	▨	>4.5	
				SS	4	7,13,22,23	35	▨	>4.5	
				SS	5	8,15,22,28	37	▨	>4.5	
				SS	6	14,21,24,32	45	▨	>4.5	
195.47		End of Borehole								



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 9, 2024 to termination at a depth of 5.2 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 Auger
Drill Date: August 9, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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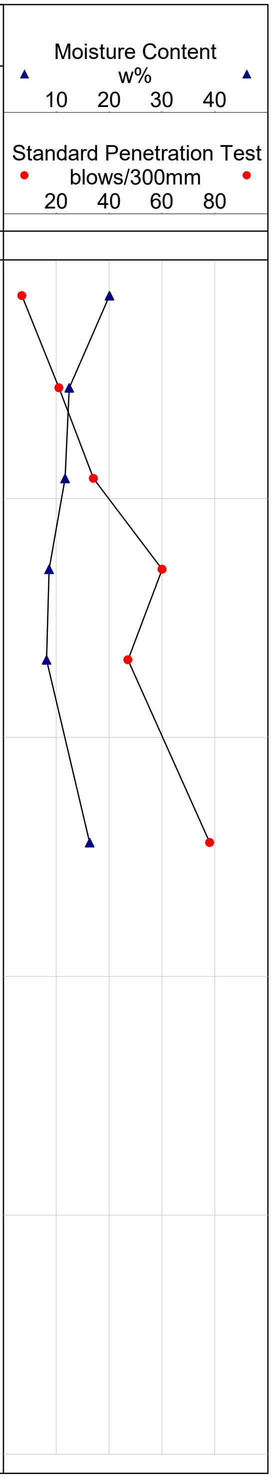
Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819799
E: 593476

Depth	Elevation (m)	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 ft / 0 m	199.23	Ground Surface								
	198.98	**Topsoil** Approximately 200 millimetres of topsoil		SS	1	3,3,4,4	7	■		
		Clayey Sandy Silt Reddish brown, trace to some gravel, reworked apprearance in upper levels, compact to very dense.		SS	2	5,9,12,19	21	■	4.0	
				SS	3	11,14,20,21	34	■	>4.5	
				SS	4	14,28,32,38	60	■	>4.5	
				SS	5	14,20,27,50	47	■	>4.5	
				SS	6	19,36,42,48	78	■	>4.5	
	193.98	End of Borehole								



End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 12, 2024 to termination at a depth of 5.2 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 Auger
Drill Date: August 12, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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Sheet: 1 of 1

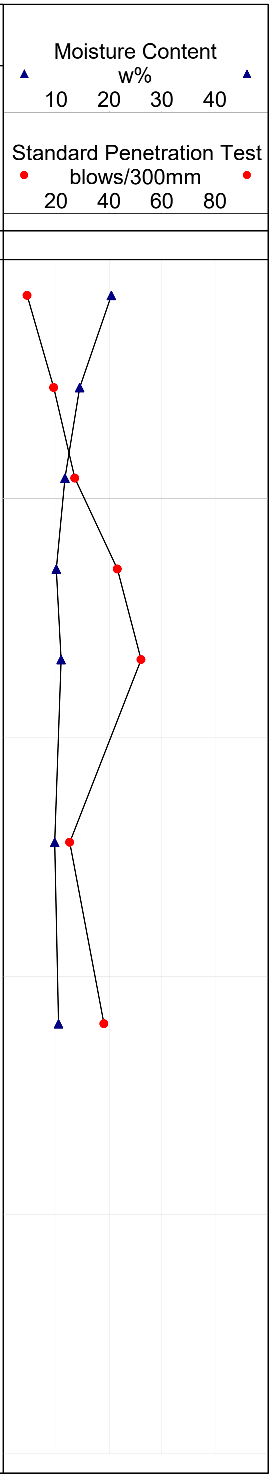
Log of Borehole No. 7

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819738
E: 593524

Depth	Elevation (m)	Symbol	Description	Well Data
ft 0 / m 0	200.65		Ground Surface	
	200.38		**Topsoil** Approximately 300 millimetres of topsoil	
			Clayey Sandy Silt Reddish brown, trace to some gravel, some sand in lower levels, occasional cobbles in lower levels, reworked in appearance in upper levels, compact to dense.	
	193.98		End of Borehole	

SAMPLE						
Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	4,4,5,7	9	▨		
SS	2	4,8,11,14	19	▨	>4.5	
SS	3	9,12,15,18	27	▨	>4.5	
SS	4	19,19,24,30	43	▨	>4.5	
SS	5	10,23,29,38	52	▨	>4.5	
SS	6	4,12,13,13	25	▨	>4.5	
SS	7	14,18,20,19	38	▨		



End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 12, 2024 to termination at a depth of 6.7 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 Auger
Drill Date: August 12, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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Sheet: 1 of 1

Log of Borehole No. 8

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819716
E: 593462

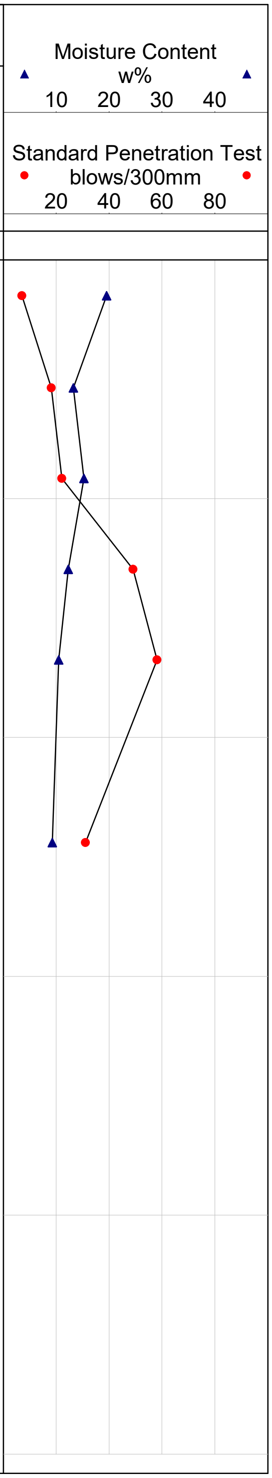
Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	201.06		Ground Surface								
	200.88		**Topsoil** Approximately 200 millimetres of topsoil		SS	1	3,3,4,6	7			
			Clayey Sandy Silt Reddish brown to brown, trace to some gravel, reworked appearance in upper levels, compact to very dense.		SS	2	6,8,10,12	18		>4.5	
					SS	3	4,8,14,25	22		3.5	
					SS	4	11,23,26,32	49		>4.5	
					SS	5	10,23,35,40	58		>4.5	
					SS	6	10,15,16,19	31		>4.5	
5	195.88		End of Borehole								

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 12, 2024 to termination at a depth of 5.2 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 Auger
Drill Date: August 12, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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Datum: Geodetic
Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 9

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819740
E: 593360

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	201.22		Ground Surface								
	200.88		**Topsoil** Approximately 300 millimetres of topsoil		SS	1	3,2,3,5	5	▨		
			Clayey Sandy Silt Reddish brown, trace to some gravel, occasional to frequent cobbles, reworked appearance in upper levels, compact to very dense.		SS	2	8,10,13,19	23	▨	>4.5	
					SS	3	8,12,17,17	29	▨	>4.5	
					SS	4	13,19,27,36	46	▨	>4.5	
					SS	5	15,26,35,41	61	▨	>4.5	
					SS	6	11,23,33,35	56	▨	>4.5	
					SS	7	21,26,33,32	59	▨		
	194.48		End of Borehole								

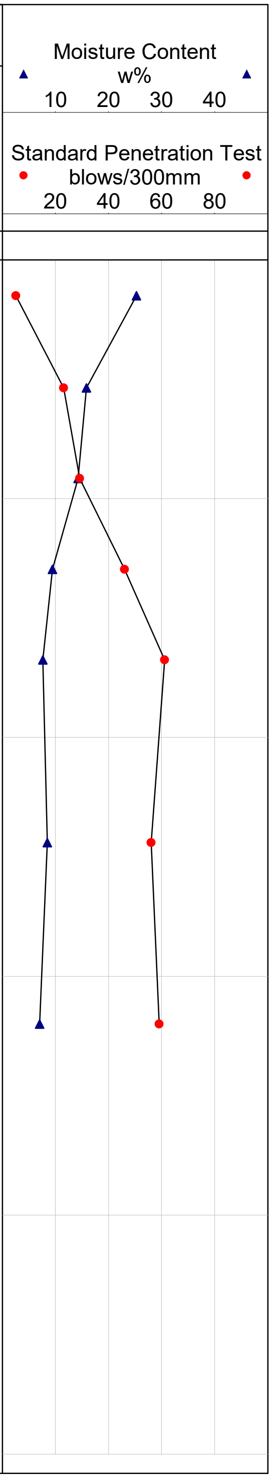
End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 12, 2024 to termination at a depth of 6.7 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 Auger
Drill Date: August 12, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

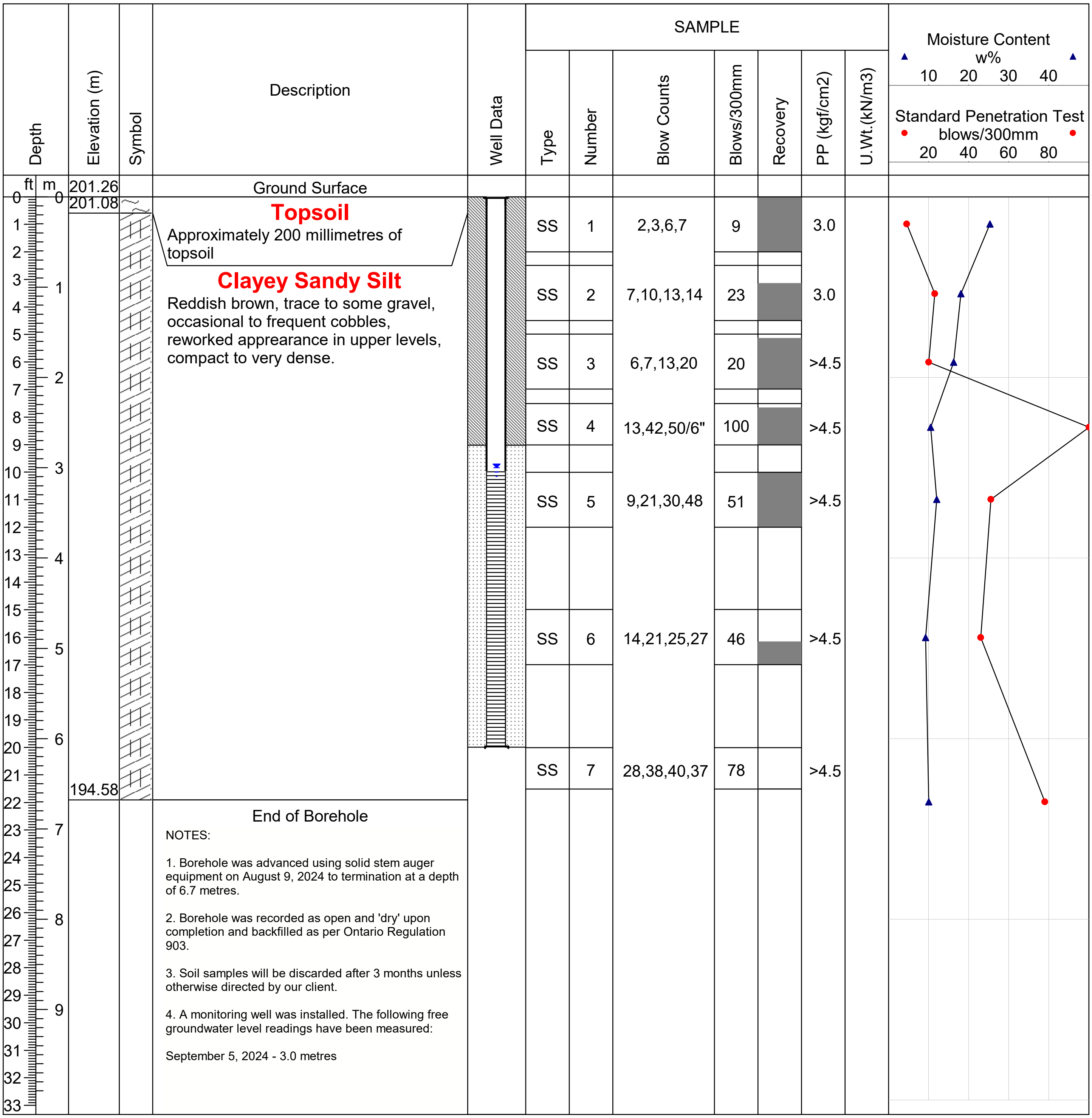
Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
T: 905.318.7440, TF: 800.243.1922, F: 905.318.7455
www.soil-mat.ca E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 10

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819618
E: 593468



Elevation (m)	Description
201.26	Ground Surface
201.08	**Topsoil** Approximately 200 millimetres of topsoil
	Clayey Sandy Silt Reddish brown, trace to some gravel, occasional to frequent cobbles, reworked appearance in upper levels, compact to very dense.
194.58	End of Borehole

SAMPLE						
Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,3,6,7	9	▨	3.0	
SS	2	7,10,13,14	23	▨	3.0	
SS	3	6,7,13,20	20	▨	>4.5	
SS	4	13,42,50/6"	100	▨	>4.5	
SS	5	9,21,30,48	51	▨	>4.5	
SS	6	14,21,25,27	46	▨	>4.5	
SS	7	28,38,40,37	78		>4.5	

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 9, 2024 to termination at a depth of 6.7 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.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

September 5, 2024 - 3.0 metres

Drill Method: Hollow Stem Auger
Drill Date: August 9, 2024
Hole Size: 200 Millimetres
Drilling Contractor: Elements

Soil-Mat Engineers & Consultants Ltd.
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Datum: Geodetic
Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

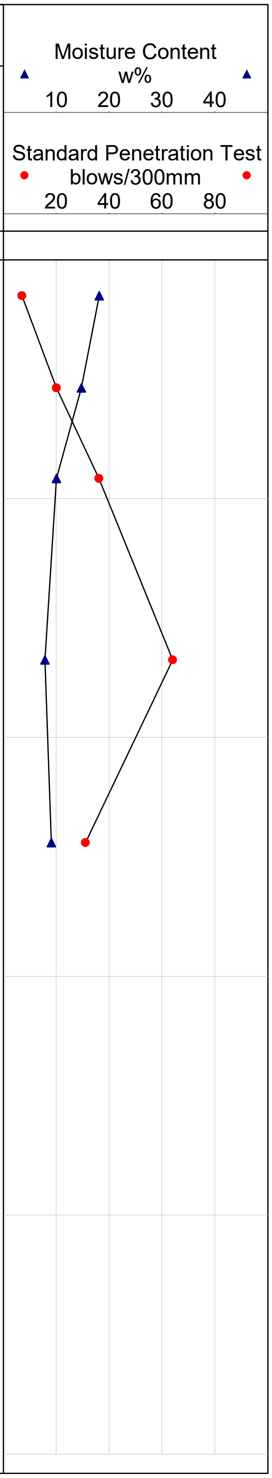
Log of Borehole No. 11

Project No: SM-240605-G
Project: Proposed Residential Development
Location: Derry Road West, Milton
Client: Branthaven Development

Project Manager: Kyle Richardson, P. Eng
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4819691
E: 593392

Depth (m)	Elevation (m)	Description
0	201.12	Ground Surface
	200.88	**Topsoil** Approximately 200 millimetres of topsoil
		Clayey Sandy Silt Reddish brown, trace to some gravel, reworked apprearance in upper levels, compact to very dense.
	195.88	End of Borehole

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	3,3,4,7	7	▨		
SS	2	6,9,11,14	20	▨	3.5	
SS	3	10,12,22,27	34	▨	>4.5	
SS	5	18,23,41,44	64	▨	>4.5	
SS	6	13,15,16,24	31	▨	>4.5	



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 12, 2024 to termination at a depth of 5.2 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 Auger
Drill Date: August 12, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Elements

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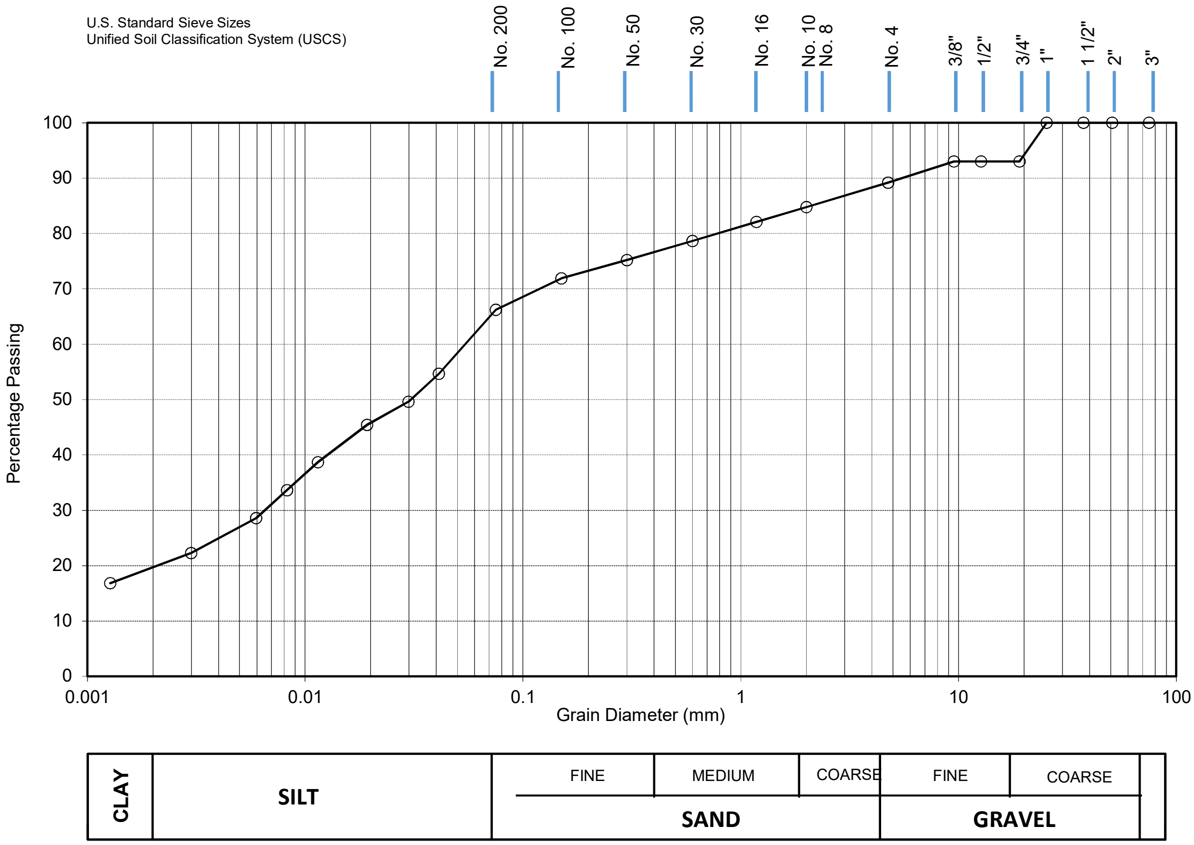
Datum: Geodetic
Field Logged by: AS
Checked by: KR
Sheet: 1 of 1

Mechanical & Hydrometer Analyses



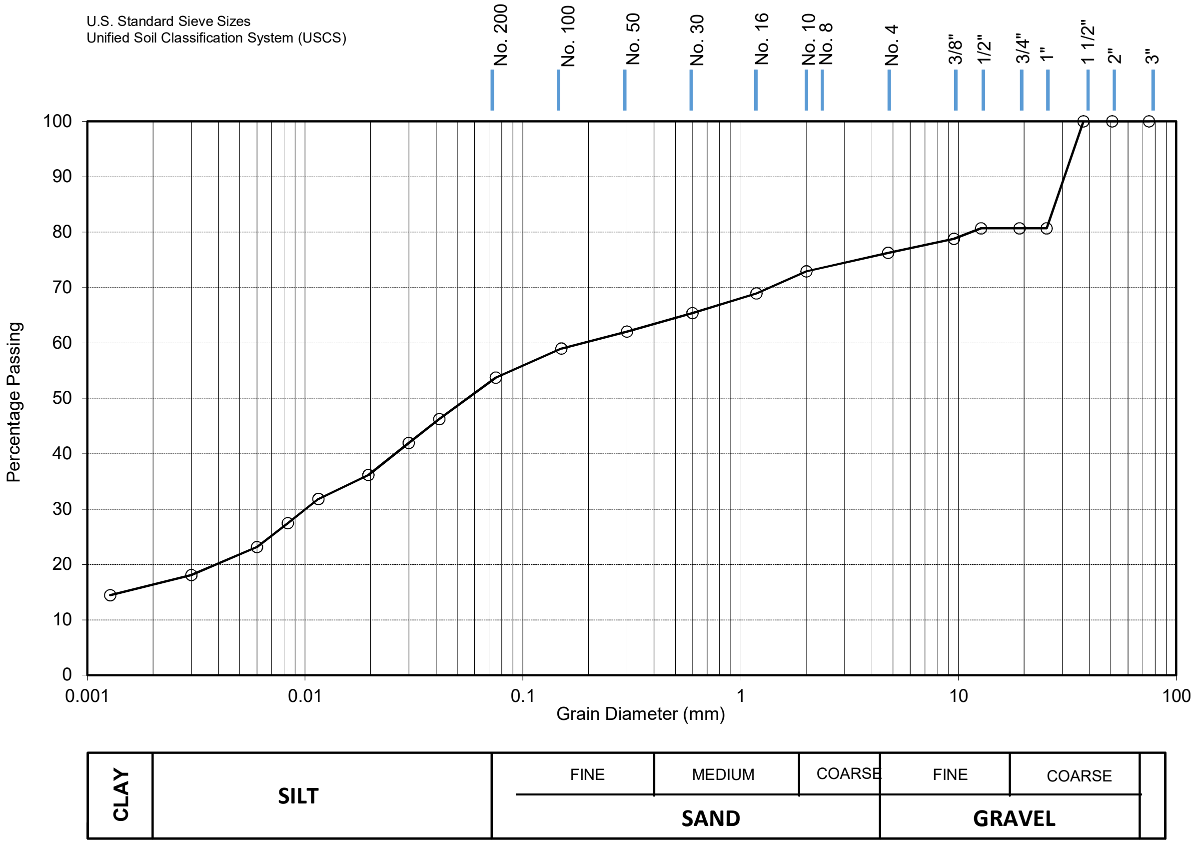
Lab No.:	**24-294**	Notes: Depth: 5'			
Borehole No.:	**1**				
Sample No.:	**3**				
CLAY [%]:	**20**	Soil Description: **Reddish Brown Sandy and Clayey Silt w/ some Gravel**			
SILT [%]:	**46**	**M.L. - Inorganic silts and very fine sands, clayey silts with slight plasticity, clayey fine sands**			
SAND [%]:	**23**	**to G.M. - Gravel-sand-silt mixtures to G.C. - Gravel-sand-clay mixtures**			
GRAVEL [%]:	**11**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0004**	Coefficient of Uniformity C_U:	**135.0**	Coefficient of Curvature C_C:	**2.1**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Derry Road West, Milton ON

August 2024	**Grain Size Analysis No. 1**	**Project No.: SM 240605-G**

Mechanical & Hydrometer Analyses



Lab No.:	**24-295**
Borehole No.:	**3**
Sample No.:	**6**
CLAY [%]:	**17**
SILT [%]:	**37**
SAND [%]:	**22**
GRAVEL [%]:	**24**
D_{10} (Effective Diam. in mm):	**0.0005**

Notes: Depth: 15'

Soil Description: **Reddish Brown Gravelly and Sandy Silt w/ some Clay**
M.L. - Inorganic silts and very fine sands, clayey silts with slight plasticity, clayey fine sands to G.M. - Gravel-sand-silt mixtures to G.C. - Gravel-sand-clay mixtures

Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
Coefficient of Uniformity C_U:	**360.0**	Coefficient of Curvature C_C:	**1.1**

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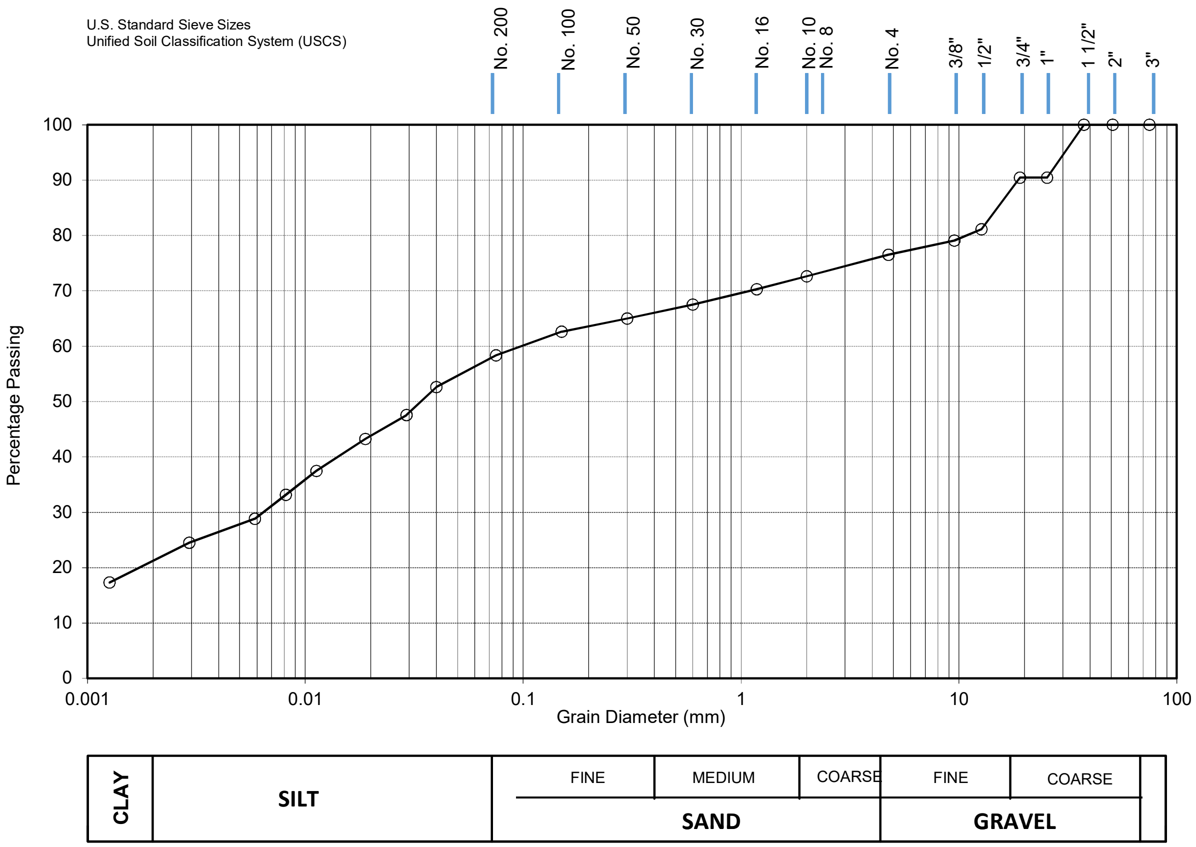
Derry Road West, Milton ON

August 2024	**Grain Size Analysis No. 2**	**Project No.: SM 240605-G**

Mechanical & Hydrometer Analyses



Lab No.:	**24-296**	Notes: Depth: 7.5'			
Borehole No.:	**10**				
Sample No.:	**4**				
CLAY [%]:	**21**	Soil Description: **Reddish Brown Gravelly and Clayey Silt w/ some Sand** **M.L. - Inorganic silts and very fine sands, clayey silts with slight plasticity, clayey and silty fine sands to G.M. - Gravel-sand-silt mixtures to G.C. - Gravel-sand-clay mixtures**			
SILT [%]:	**37**				
SAND [%]:	**19**				
GRAVEL [%]:	**23**	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:	**161.7**	Coefficient of Curvature C_C:	**0.7**

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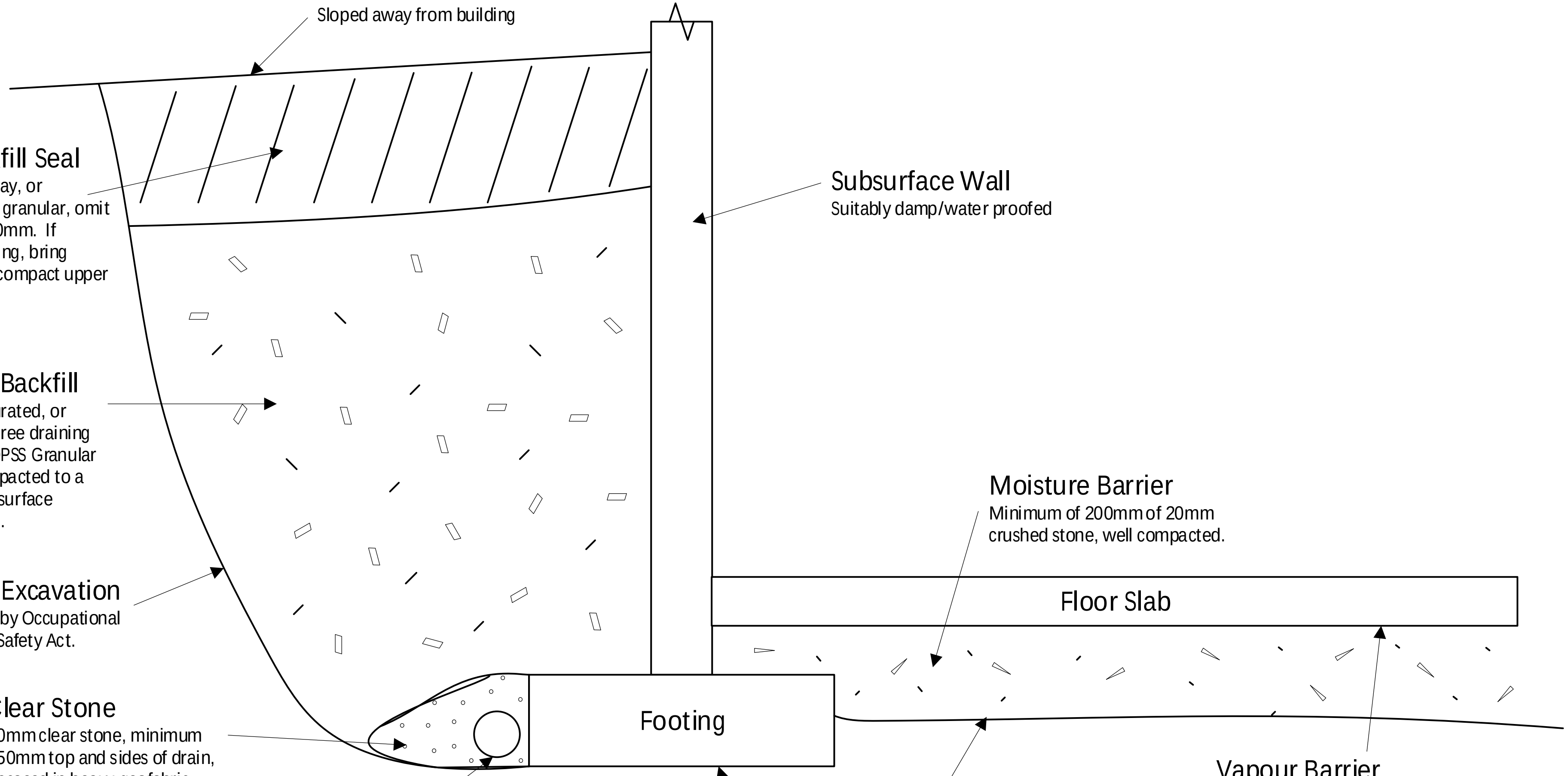
Derry Road West, Milton ON

September 2024 | **Grain Size Analysis No. 3** | **Project No.: SM 240605-G**



Ground Surface
Sloped away from building

Impermeable Backfill Seal
Well compacted clay/silty clay, or equivalent. If original soil is granular, omit seal and compact upper 600mm. If pavement adjacent to building, bring Granular 'B' to surface and compact upper 1 metre to 100% SPMDD.

Select Compacted Backfill
Free of organic, frozen, saturated, or otherwise unsuitable soil. Free draining granular material, such as OPSS Granular 'B' (Type II) preferred. Compacted to a minimum of 95% SPMDD if surface settlement can be tolerated.

Limit of Excavation
As required by Occupational Health and Safety Act.

Clear Stone
20mm clear stone, minimum 150mm top and sides of drain, encased in heavy geofabric.

Perimeter Drain
150mm diameter weeping tile or pipe equivalent, leading to positive sump or outlet. Invert at least 150mm below underside of floor slab.

Pour flush with original undisturbed soil.

Subsurface Wall
Suitably damp/water proofed

Moisture Barrier
Minimum of 200mm of 20mm crushed stone, well compacted.

Subgrade
Competent native soil or well compacted fill.

Vapour Barrier
Where 'non-damp' floors are required, provide heavy poly sheeting over a 'choke' layer of 50mm compact sand.

NOT TO SCALE

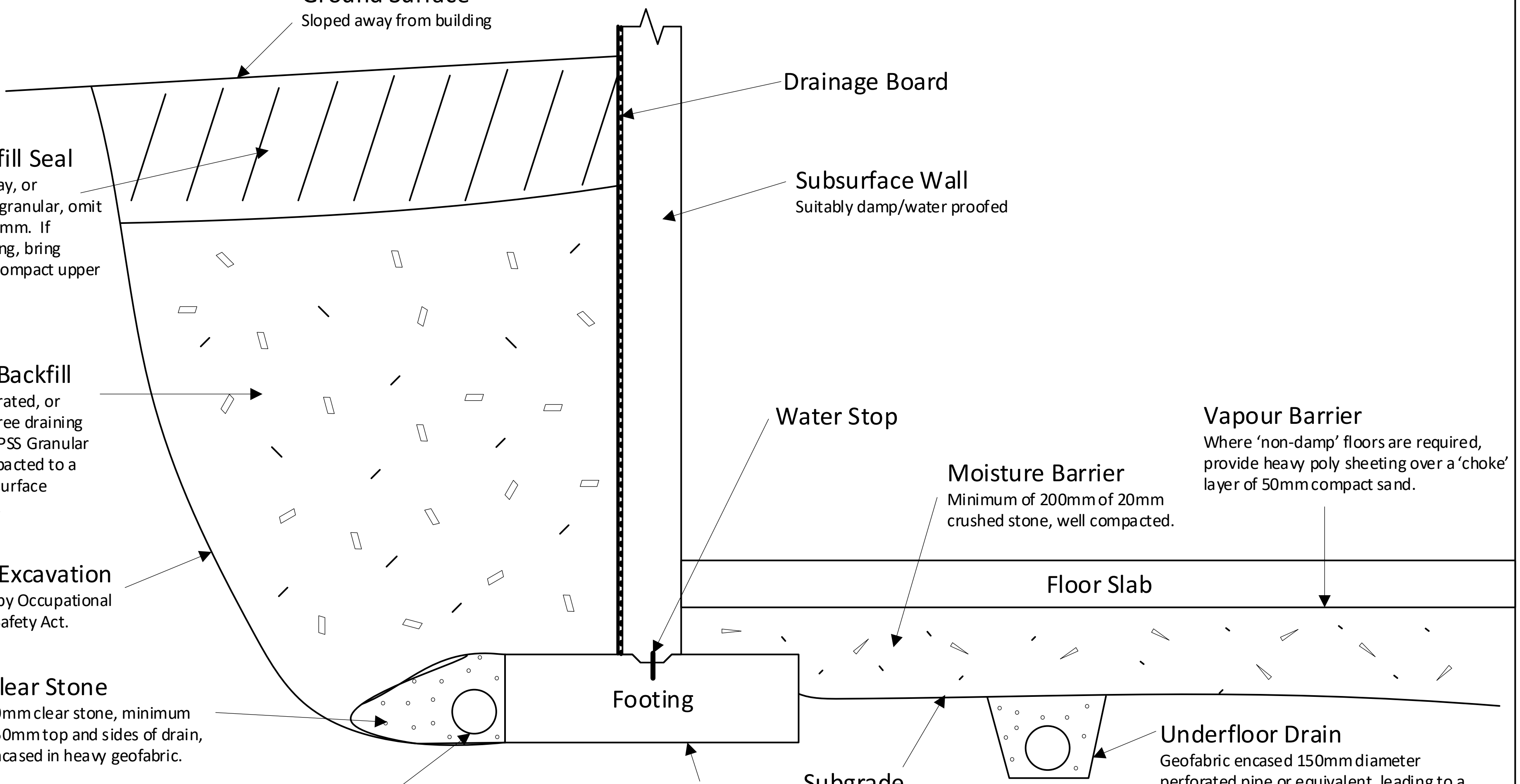
Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 240605-G
Date:	October, 2024

Typical Design Requirements
Drainage and Backfill for Basement Walls

Drawing No. 2



Ground Surface
Sloped away from building

Drainage Board

Impermeable Backfill Seal
Well compacted clay/silty clay, or equivalent. If original soil is granular, omit seal and compact upper 600mm. If pavement adjacent to building, bring Granular 'B' to surface and compact upper 1 metre to 100% SPMDD.

Subsurface Wall
Suitably damp/water proofed

Select Compacted Backfill
Free of organic, frozen, saturated, or otherwise unsuitable soil. Free draining granular material, such as OPSS Granular 'B' (Type II) preferred. Compacted to a minimum of 95% SPMDD if surface settlement can be tolerated.

Water Stop

Vapour Barrier
Where 'non-damp' floors are required, provide heavy poly sheeting over a 'choke' layer of 50mm compact sand.

Moisture Barrier
Minimum of 200mm of 20mm crushed stone, well compacted.

Limit of Excavation
As required by Occupational Health and Safety Act.

Clear Stone
20mm clear stone, minimum 150mm top and sides of drain, encased in heavy geofabric.

Underfloor Drain
Geofabric encased 150mm diameter perforated pipe or equivalent, leading to a positive sump or outlet. Invert at least 300mm below underside of floor slab. Pipe placed in parallel rows on nominal 4-6m centres.

Perimeter Drain
150mm diameter weeping tile or pipe equivalent, leading to positive sump or outlet. Invert at least 150mm below underside of floor slab.

Pour flush with original undisturbed soil.

Subgrade
Competent native soil or well compacted fill.

NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.: SM 240605-G
Date: October 2024

Typical Design Requirements
Drainage and Backfill for Basement Walls With Underfloor Drains

Drawing No. 3