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PROJECT NO.: SM 230581-EG

June 4, 2024
Revised: November 25, 2024

LOSANI HOMES
430 McNeilly Road, Suite 203
Stoney Creek, Ontario
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Attention: Daniel Borrelli
Planner and Project Coordinator

GEOTECHNICAL INVESTIGATION
PROPOSED 24-STOREY BUILDING
127 PLAINS ROAD WEST
BURLINGTON, ONTARIO

Dear Mr. Borrelli,

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 P230581 r1, dated July 11, 2023, and revised on February 14, 2024. Our comments and recommendations, based on our findings at the eight borehole locations, are presented herein.

1. INTRODUCTION

We understand that the proposed project will involve the construction of a 24-storey structure with three basement levels for underground parking at the property, upon demolition of the existing structure located at 127 Plains Road West in Burlington, Ontario. The purpose of this geotechnical investigation work is to assess the 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 eight [8] 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 as well as HQ diamond barrel coring equipment, under the direction of a representative of SOIL-MAT ENGINEERS. The boreholes were advanced to depths of approximately 14.0 to 32.1 metres below the existing grade on April 29 & 30, and May 1, 2, 3, 6, & 7, 2024. Upon completion of drilling all boreholes were outfitted with groundwater monitoring wells. The wells installed consisted of 50-millimetre diameter PVC pipe, screened in the lower 3 metres. The monitoring wells were backfilled with 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 'flushmount' casing.

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 the 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. Pocket penetrometer testing was performed on all cohesive samples recovered from the borings, routine moisture content tests were performed on all soil samples, and grain size analyses were performed on six [6] selected samples.

As noted above the boreholes were advanced with HQ diamond coring equipment where the power auger equipment encountered refusal on Queenston shale bedrock. Rock Quality Designation [RQD] was calculated for the recovered core samples, and 8 [eight] selected samples of the recovered cores were subjected to unconfined compressive strength testing at our laboratory. The detailed results of these tests can be found appended to the end of this report.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., based on accessibility over the site and clearance of underground services. The ground surface elevation at the borehole locations was referenced to a geodetic benchmark, described as the top of catch basin, located east of the tenant parking spaces, as illustrated on Drawing No. 1, Borehole Location Plan. This benchmark was noted to have a geodetic elevation of 102.89 metres on the survey provided to our office (A.T. McLaren Ltd. Drawing No. 30012-T, dated April 10, 2024).

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. 1A to 6, 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 as the exact depths of geological change.

It is understood that TerraDynamics Consulting Inc. have been retained to complete the Hydrogeological Assessment on the property based on the wells installed as part of this investigation. Their office was contacted for the completed static groundwater readings to allow for the relevant discussions in this report.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is currently occupied by commercial properties Ye Olde Squire Pub and Benjamin Moore Paints on the ground floor, with residential apartments above. The subject site beyond the footprint of the mixed-use building primarily consists of concrete and asphalt paved entryways and parking spaces, with a landscaped area and sidewalk bordering the adjacent roadways. The site is bounded to the north by a commercial wholesaler, to the east by Howard Road, to the south by Plains Road West, and to the west by commercial properties. The site has relatively flat and even topography with the surrounding landscape.

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

Pavement Structure

All the boreholes were advanced through the existing pavement structure, which was found to consist of approximately 125 millimetres of asphaltic concrete overlying approximately 300 to 450 millimetres of granular base material. The pavement structure encountered at the borehole locations has been summarized as follows:

Table A – Pavement Structure

Borehole No.	Asphaltic Concrete (mm)	Granular Base (mm)
1A / 1B	125	450
2	125	450
3	125	450
4	125	300
5A / 5B	125	450
6	125	450

Sand and Gravel Fill

Sand and gravel fill material was encountered below the pavement structure at Borehole Nos. 2, 3, 4, and 6. The granular fill material was brown in colour, typically containing trace to some silt, occasional to moderate cobbles, occasionally exhibited clayey seams in the lower levels, and was generally found to be in a very loose to dense state. The granular fill encountered was proven to depths of between approximately 2.3 to 4.7 metres below the existing ground surface. Given the granular nature of the fill, the transition from fill materials to native sand and gravel was somewhat indistinct. As such, material identified as sand and gravel fill material may in fact be native sand and gravel.

Sand Fill

Sand fill was encountered below the pavement structure and in Borehole Nos. 1A/1B & 5A/5B. The granular fill material was brown in colour, contained traces of, to some, silt and gravel, and was noted to be in a very loose to compact state. The granular fill encountered was proven to depths of between approximately 2.1 to 2.2 metres below the existing ground surface.

Sand and Gravel

Native sand and gravel material was encountered immediately beneath the fill material at all borehole locations. The granular material was brown in colour, with varying gravel content throughout, typically containing traces of silt and clay, occasional to frequent cobbles, contained a seam of reddish-brown silty clay/clayey silt in Borehole Nos. 1A/1B, and was generally found to be in a compact to very dense state. The native material was proven to depths of between approximately 4.1 to 10.3 metres below the existing ground surface. As noted above, given the granular nature of the fill overburden, the transition from fill materials to native sand and gravel was somewhat indistinct. As such, material identified as native sand and gravel may in fact be fill material.

Sand

Native sand material was encountered immediately beneath the native silty clay/clayey silt in Borehole No. 4, and beneath the native sand and gravel at all remaining Borehole locations. The granular material was brown in colour, typically containing trace to some silt and gravel, occasionally exhibiting silty layers in the lower levels, and was generally found to be in a compact to very dense state. The native material was proven to depths of between approximately 14.0 to 17.9 metres below the existing ground surface.

Silty Clay/Clayey Silt

Native silty clay/clayey silt soil was beneath the native sand and gravel in Borehole No. 6, and beneath the native sand in Borehole Nos. 1A and 5A. The silty clay/clayey silt was reddish-brown in colour in Borehole No. 6, and grey in Borehole No. 1A and 5A, contained traces of, to some, sand, trace gravel in the upper levels, and was generally in a very soft state in Borehole No. 6, while exhibiting a stiff to very stiff state in Borehole Nos. 1A and 5A. The fine-grained native soil was proven to depths of between approximately 7.1 to 22.4 metres below the existing ground surface.

Sandy and Silty Gravel

Native sandy and silty gravel material was encountered beneath the silty clay/clayey silt in Borehole Nos. 1A and 5A. The native material was red to reddish grey in colour, with some gravel in the upper levels, containing traces of clay increasing with depth, and was generally in a very dense state. The cohesive material was proven to depths of between approximately 25.6 to 27.5 metres below the existing ground surface.

Queenston Shale

Queenston Shale was encountered beneath the native sandy and silty gravel at Borehole Nos. 1A and 5A. The shale was red, severely weathered in the upper levels, becoming sounder with depth, and containing occasional more resistant grey layers. The degree of weathering in the upper levels of the Queenston Shale is such that it tends to exhibit the properties of a hard cohesive soil, or weak rock, as evidenced by the ability to penetrate the bedrock with the solid stem augers of the drill. As such, the transition between hard soil and weak rock is somewhat indistinct.

As noted above, the bedrock was cored in Borehole Nos. 1A and 5A using Hq size diamond core barrel equipment. The Rock Quality Designation [RQD] of the recovered rock cores was determined to range from approximately 0 to 95 per cent, generally increasing with depth, indicative of a sound quality rock mass. The results of the rock coring are summarized in the following table.

Table B - Bedrock Core Data

Core ID		Depth (m)	Recovery (%)	RQD (%)
Borehole No. 1A	Run 1	27.5 – 29.0	88%	82%
	Run 2	29.0 – 30.5	95%	89%
	Run 3	30.5 – 32.0	95%	90%
Borehole No. 5A	Run 1	25.6 – 26.0	38%	0%
	Run 2	26.0 – 27.6	95%	86%
	Run 3	27.6 – 29.2	90%	76%
	Run 4	29.2 – 30.6	98%	95%

Compressive strength testing was carried out on eight [8] core samples, yielding strengths in the range of approximately 47.5 to 80.5 MPa [6890 to 11670 psi], with an average of 53.2 MPa [7710 psi], summarised as follows.

Table C - Bedrock Compressive Strength Data

Core ID		Depth (m)	Unconfined Compressive Strength q_u (MPa)
Borehole No. 1A	Run 1	28.3	55.7
	Run 2	29.4	58.5
	Run 2	30.2	56.5
	Run 3	31.7	63.9
Borehole No. 5A	Run 2	26.4	58.4
	Run 2	27.3	80.5
	Run 3	29.0	57.5
	Run 4	30.3	47.5

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicates the surficial geology of the subject site to consist of Pleistocene deposits of sand and gravel, consistent with our experience in the area and observations during fieldwork.

Groundwater Observations

As mentioned above, all boreholes were fitted with monitoring wells to allow for measurement of the static groundwater level. The groundwater depth was measured at the wells by SOIL-MAT ENGINEERS with the following results:

Table C - Ground Water Level Measurements

Borehole No.	Ground Surface Elev. [m]	May 3, 2024		May 7, 2024		May 30, 2024	
		Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)
1A	103.07	14.80	88.27	-	-	15.15	88.55
1B	103.08	13.19	89.89	-	-	13.15	89.93
2	103.12	-	-	13.10	90.02	13.07	90.05
3	103.15	-	-	12.93	90.22	12.90	90.25
4	103.26	-	-	-	-	12.95	90.31
5A	103.19	-	-	14.19	89.00	15.16	88.03
5B	103.23	-	-	12.84	90.36	13.19	90.04
6	103.31	13.09	90.22	-	-	13.07	90.24

Based on our observations during drilling, the available data, and our experience in the area, the static groundwater level is estimated at an elevation of approximately 88 to 91 metres. The groundwater elevation was observed at a depth of approximately 13 metres below the existing grade, with some deeper aquifers encountered from the bedrock wells installed. It is noted that the groundwater level would be subject to seasonal variation due to prevailing weather conditions. As noted above, it is understood a more thorough hydrogeological assessment is being completed by Terra-Dynamics, which will speak further to the hydrogeological setting.

4. GEOTECHNICAL LABORATORY TESTING

As noted above, four [4] selected samples of the recovered soil were subjected to grain size analyses including sieve and hydrometer tests. The results of these grain size analyses have been summarised in Table D as follows:

Table D - Grain Size Analyses Summary

Sample	Sample Depth [m]	Clay [%]	Silt [%]	Sand [%]	Gravel [%]	Effective Diameter [mm]	Estimated Permeability [cm/sec]
BH1A SS17	19.8	48	52	0	0	0.0004	10^{-7}
BH1A SS20	24.4	9	21	34	36	0.003	10^{-6}
BH2 SS13	13.7	4	9	87	0	0.034	10^{-3}
BH4 SS12	12.2	6	14	80	0	0.010	10^{-3}
BH5A SS15	18.3	48	51	1	0	0.0004	10^{-7}
BH6 SS12	12.2	3	10	87	0	0.034	10^{-3}

The results outlined above indicate Sand with some silt and a trace of clay in Samples BH2 SS13, BH4 SS12, and BH6 SS12. According to the Unified Soil Classification System these soil samples are generally classified as S.M. – Sand-silt mixtures, to S.C. – Sand-clay mixtures. Samples BH1A SS17 and BH5A SS15 generally indicate Silt and Clay. According to the Unified Soil Classification System these soil samples are classified as M.L. – Inorganic silts to C.L. – Inorganic clays of low to medium plasticity. These results are consistent with our observations of the sand soils encountered within shallower depths, and silt/clay mixtures encountered in the lower levels across the site during drilling, our visual assessment of the recovered samples, as well as our experience in the area. It is noted that there is some variation in the overall permeability of the native soils, as a function of natural variation within the soil layers.

5. FOUNDATION CONSIDERATIONS

5.1 SHALLOW FOUNDATIONS

As noted above, it is understood that the proposed development will be a twenty-four-storey structure with three basement levels for underground parking, totalling 10.3 metres of underground height. Upon accounting for utilities, elevator pits, and the depth of foundations themselves, it would be anticipated that the structure is founded approximately 11 to 12 metres below the existing ground surface. Spread footings found within the native sand soils at this depth are considered suitable in terms of support conditions for the proposed structure. The spread footings may be designed considering Ultimate Limit State [ULS] bearing values of 225 kPa [~4,500 psf], and Serviceability Limit State [SLS] bearing values of 150 kPa [~3,000 psf], based on the total and differential settlements not exceeding 25 and 20 millimetres, respectively. Alternatively, the native sand soils are considered capable of supporting the structure on a raft slab foundation. The raft slab may similarly be designed considering design bearing values of 225 kPa [~4,500 psf] ULS and 150 kPa [~3,00 psf] SLS.

5.2 CAISSONS

The proposed 24-storey building may be supported on caisson foundations extending into the underlying Queenston Shale bedrock, and may be conservatively designed considering the bearing capacity as follows:

SLS = ULS = 2,500 kPa [~50,000 psf]

It is noted the SLS and ULS values are the same, as in order for serviceability limits of deflection to be realised, failure of the Queenston Shale bedrock would have to occur. Where caissons extend through the upper weathered rock and into more sound bedrock [a minimum of 1.5 metres or more] it would be feasible to design caissons to also take advantage of skin friction within the rock. A unit skin friction resistance of ULS = SLS = 250 kPa [~5,000 psf] may be considered. Higher bearing and skin friction values may be available; however, these increased values would need to be confirmed through additional investigation including bedrock coring. Uplift capacity could be readily achieved with the skin friction on deeper caissons.

5.3 GENERAL FOUNDATION CONSIDERATIONS

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 an 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 values would be lower for very settlement sensitive structure and larger for more flexible buildings.

The support conditions afforded by the founding soils are usually not uniform across the site, neither are the loads on the various foundation elements. It is therefore recommended that the footings and foundation walls be structurally reinforced to account for potential variable support and loading conditions.

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 an imaginary line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical. This practice will limit stress transfer from the higher footings to lower footings.

All footings, grade beams, etc. exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost damage. This frost protection would also be required if construction were undertaken during the winter months. All footings and foundations should be designed and constructed in accordance with the current Ontario Building Code.

With foundations designed as outlined above and as required by the 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 noted that the performance of deep foundation schemes is greatly dependent on the method, equipment, and workmanship utilised during construction. It is therefore essential that installation procedures for such foundations be monitored/evaluated by SOIL-MAT ENGINEERS.

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

6. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 203/24, which takes effect in January 2025. 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 site specific shear wave velocity testing may further refine the applicable seismic design values, however, on the preliminary basis considering a seismic site class of D, the applicable 2%-in-50-year seismic hazard data from the 2020 National Building Code for the subject site are as follows:

$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	$S_a(5.0)$	$S_a(10.0)$	PGA	PGV
0.392	0.318	0.178	0.0819	0.0211	0.00649	0.247	0.207

7. LATERAL EARTH PRESSURE

The lateral earth pressures on basement walls and excavation support systems can be estimated on the basis of the following soil parameters. Any additional pressures due to surcharge loading, such as adjacent structures, roadways, parked vehicles, floor slab loading, etc. must be included in the design.

Table E – Lateral Earth Pressure Parameters

Soil Strata	Soil Unit Weight, γ [kN/m^3]	Angle of Internal Friction, θ [^{o}]	Coefficient of Active Earth Pressure, K_a	Coefficient of At Rest Earth Pressure, K_o	Coefficient of Passive Earth Pressure, K_p
Sand and Gravel	21	35	0.27	0.43	3.69
Sand	20	30	0.33	0.5	3.0
Silty Clay / Clayey Silt	19	25	0.41	0.58	2.46

8. EXCAVATIONS AND EXCAVATION SUPPORT CONSIDERATIONS

Excavations for the installation of building foundations and underground services are generally expected to extend to depths of approximately 11 to 12 metres below the existing grade. Excavations through any fill material and native sand / sand and gravel granular material would be expected to remain stable for the short construction period at slopes of up to 45 degrees to the horizontal while above the groundwater elevation. Excavations through the native silty clay/clayey silt soils should be relatively straightforward, with the sides remaining stable for the short construction period above the groundwater elevation at slopes of up to 60 degrees to the horizontal. Where wet seams are encountered, or during periods of extended precipitation, or where excavations extend below the static groundwater level, the sides of excavations should be expected to 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter. Notwithstanding the foregoing, however, 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.

EXCAVATION SUPPORT

It is anticipated that the new structure will approach the property limits and existing structures. As such it is anticipated that the excavations will require some level of excavation support, which may be accomplished in a number of methods, including 'soldier' pile and timber lagging, or continuous caisson wall. This will be especially prudent where existing structures are founded in close proximity to the excavations. It is noted that a preconstruction survey of adjacent above- and below-grade structures should be conducted to establish a baseline condition.

Caissons to support either soldier piles or a continuous caisson wall should extend a minimum of 1.5 metres beyond the final depth of excavation. Where no lateral movements are acceptable the shoring should be designed considering an 'at rest' lateral earth pressure coefficient as noted in Table E above. Where small lateral movements can be tolerated an 'active' earth pressure coefficient should be considered, and can also be found in Table E above.

The caissons/soldier piles should be provided with lateral bracing, either by using a waler beam and raker supports, or with soil anchors. From a contractor's point of view, soil anchors would be preferred, provided permission can be obtained from the neighbouring property owners to extend the anchors under their property. It is noted that there is a potential for significant movements of the shoring system if rakers are used to support the shores since compression of the rakers and the footings supporting the inclined raker loads must occur before the rakers can begin to carry load. If used, the rakers should be provided with a mechanism for 'jacking-in' preloads.

The excavation support must be designed as required by the Occupational Health and Safety Act and Regulations for Construction Projects and the Canadian Foundation Engineering Manual. This office should be given the opportunity to review the shoring shop drawings and design parameters before construction, and a representative of SOIL-MAT ENGINEERS should be on site to observe the installation of the shoring. The shoring must be monitored for movements, and a plan must be available before the excavations begin, to rectify the shoring system should movements become apparent.

It should be noted that excavations above but approaching the static groundwater level may encounter localized instability when the base of the excavation is exposed to heavy construction equipment loads, due to the 'pumping' of groundwater by fine-grained soils. Heavy construction vehicles should not travel on soils below 3 metres above the excavation base elevation. Consideration should be given to providing a concrete 'mud mat' 50 to 75 millimetres in thickness on top of the excavation base immediately after the soils have been exposed and evaluated by a representative from this office. Such a mud mat protects the excavation base soils from damage by construction equipment and foot traffic, and provides a clean surface for the construction of reinforcing steel cages, etc.

GROUNDWATER CONTROL

As noted above the static groundwater levels in the monitoring wells have been measured at depths as shallow as approximately 12 metres below the existing grade. Excavations to the planned depths are not likely to extend below the static groundwater level, however may still experience groundwater infiltration from perched water in more permeable soil seams at shallower depths. For excavations extending to the static groundwater level, it may be possible to adequately control any water that may seep into the excavations from more permeable seams in the fill material, native sand or sand and gravel, and from surface water using conventional construction 'dewatering' techniques, such as pumping from sumps in the base of the excavations. The need for multiple sumps should be anticipated. Where deeper excavations are required the rate and volume of groundwater infiltration should be anticipated to be much greater. The groundwater control requirements will be significantly influenced by the excavation shoring method implemented, being greatest for open cuts into the soil and much less for a continuous caisson wall. More water should be expected when connections are made with existing services. Surface water should be directed away from the excavations.

As noted above, a detailed hydrogeological assessment of the site is being conducted by Terra-Dynamics Consulting Inc. The findings and recommendations found in the Hydrogeological assessment will speak further to the anticipated pumping rates.

9. FLOOR SLAB AND PERMANENT DRAINAGE/WATERPROOFING CONSIDERATIONS

Depending on the final design, it is anticipated that the basement floor slab will be constructed either using conventional slab-on-grade techniques on a prepared subgrade, or on top of a raft slab foundation. 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.

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.

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.

It is important that the concrete mix design provide a limiting water/cement ratio and total cement content, which will mitigate moisture related problems with low permeance floor coverings, such as debonding of vinyl and ceramic tile. It is equally important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage cracking and curling of the slab.

As noted above, the proposed basement levels are not likely to extend below the measured static groundwater level. However, elevator pits extending below the general basement floor level should be designed to be continuously water-tight with the surrounding structure. This will require the use of foundation wall membrane systems intended for 'blind side' or 'single face' application. The elevator pit(s) will also be required to be designed to resist the hydrostatic pressure.

Consideration may be given to addressing the potential for the build-up of groundwater beneath the basement floor slabs through the means of under-floor drainage, as illustrated in the enclosed Drawing No. 2 – Basement Perimeter Drainage with Underfloor Drains. Under-floor drains may consist of 150-millimetre diameter perforated pipe, with a geofabric sock, placed in the clear stone beneath the floor slabs on nominal 4 to 6 metre centres. 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-pit, though separate systems would be preferred. The need for such under-floor drainage would be best to be further assessed based on the final design slab elevation and the established seasonal high groundwater level.

10. BACKFILL CONSIDERATIONS

It is expected that the majority of the material excavated to accommodate the basement levels will be transported off-site. Where required, select portions of the fill material and native granular soils are considered suitable for use as backfill in service trenches, etc. provided they are free of organics or any other deleterious material.

The use of free draining, well-graded granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II (crushed limestone bedrock) is often preferred for backfill against foundation walls. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for exterior concrete sidewalks, pavement, etc. The use of alternative materials, including recycled concrete aggregates, clear stone materials, etc., may be considered, however should be reviewed and approved by our office prior to use. 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.

Fine-grained cohesive soils such as those occasionally encountered on site are sensitive to moisture absorption and will become practically impossible to compact using conventional compaction equipment if they become wet during the 'wet' periods of the year. After a period of heavy precipitation, any near-surface wet, or softened material, should be allowed to air-dry or be removed and discarded. These soils are not considered to be free draining and therefore should not be used where this characteristic is necessary. They should not be used in confined spaces where access for compaction is difficult.

Backfill materials used in service trenches or to raise the subgrade elevation under exterior pavement areas should have its moisture content within 3 per cent of its optimum moisture content. In service trenches the backfill material should be compacted to a minimum of 98 per cent of its standard Proctor maximum dry density [SPMDD]. Any fill required against the basement walls should consist of free draining granular material compacted to 98 per cent of its standard Proctor maximum dry density. Where asphalt or concrete paving extends up to the building the upper 1 metre of foundation wall backfill should be compacted to 100 per cent of its standard Proctor maximum dry density. Lift thickness would depend on the material type and moisture content of the backfill material and size of the compaction equipment used by the contractor. A representative of SOIL-MAT should be retained to monitor the backfilling and compaction operations to confirm uniform compaction of the backfill material to project specification requirements.

11. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved must be cleared of all organic and otherwise unsuitable materials, and the exposed subgrade proof rolled with 3 to 4 passes of a fully-loaded tandem-axle 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 should be sub-excavated and replaced with suitable backfill material. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50mm clear stone, 'rip rap' stone, etc.] 'punched' into the soft areas. It may also be prudent to consider the provision of a heavy geofabric over the subgrade to act as a separator between the subgrade and granular base materials.

The need for sub-excavations of softened subgrade materials will be reduced if construction is undertaken during dry periods of the year and careful attention is paid to the compaction operations. As noted above the on-site soils are sensitive to disturbance and moisture and may present difficulty for roadway construction during 'wet' periods of the year. Should pavement construction be undertaken during 'wet' periods of the year it should be anticipated that greater stabilisation efforts will be required and/or additional depth of OPSS Granular 'B', Type II (crushed limestone bedrock) sub-base course material may be required.

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 to prevent 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. SOIL-MAT should be given the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.
The suggested pavement structures outlined in Table F 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 F - Recommended 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 MRD	40 millimetres	40 millimetres
Binder Course OPSS HL 8	92 per cent Marshall MRD	50 millimetres	80 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.

Where asphalt pavement is to be constructed above the roof deck of the below grade parking level, the granular base layers recommended for the light duty pavement structure recommended above may be considered for both light duty and heavy-duty areas. It is noted that in such cases the roof deck slab should be sufficiently sloped and/or provided with suitable subdrains, in order to promote rapid drainage of water from beneath the pavement. As well the roof slab should be provided with a suitable water proofing system.

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 coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

12. 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.

Bennett Sabourin, B.Eng.
Junior Engineer

LICENSED PROFESSIONAL ENGINEER
Nov 25/24
S. R. SEARS
PROVINCE OF ONTARIO

Stephen R. Sears, B. Eng. Mgmt., P. Eng., QP$_{ESA}$
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 6, inclusive
Compressive Strength Test Results
Grain Size Analyses
Drawing No. 2, Basement Perimeter Drainage with Underfloor Drains

Distribution: Losani Homes [1, plus pdf]



LEGEND

BH# Bedrock Monitoring Well

BH# Groundwater Monitoring Well

BM Temporary Benchmark
Top of catchbasin with geodetic elevation of 102.89m

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 230581-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Residential Development
127 Plains Road West
Burlington, Ontario

Preliminary Borehole Location Plan

Project No. SM 230581-G

Date: May 2024

Drawn: BS

Checked: AR

Drawing No. 1

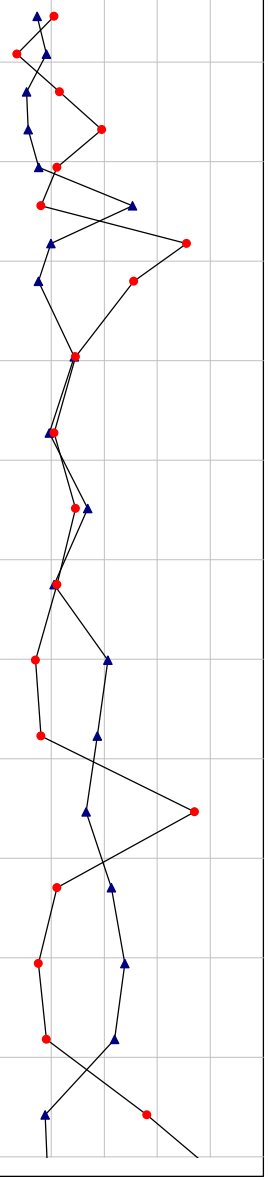
Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.07	Ground Surface							
0–3 / 0–1	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
3–6 / 1–2	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.	SS	1	8,12,9,6	21			
			SS	2	4,4,3,3	7			
6–9 / 2–3			SS	3	6,8,15,29	23			
9–14 / 3–4			SS	4	12,14,25,25	39			
14 / 4	98.60	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	5	5,10,12,15	22			
14–17 / 4–5			SS	6	2,3,13,25	16		1.5	
17–20 / 5–6			SS	7	20,33,38,35	71			
20–23 / 6–7			SS	8	19,27,24,26	51			
23–26 / 7–8		Seam of reddish brown silty clay	SS	9	7,13,16,34	29			
26–33 / 8–10	92.90		SS	10	13,11,10,9	21			
33–36 / 10–11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,12,17,16	29			
36–43 / 11–13			SS	12	11,9,13,18	22			
43–46 / 13–14			SS	13	3,6,8,17 Wet spoon	14			
46–52 / 14–16			SS	14	6,7,9,5 Wet spoon	16			
52–56 / 16–17			SS	15	18,36,38,37	74			
56–59 / 17–18	85.20	**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, stiff to very stiff.	SS	16	6,10,12,14	22		2.0	
59–66 / 18–20			SS	17	5,7,8,10	15		1.0	
66–72 / 20–22			SS	18	3,8,10,28	18		3.0	
72–79 / 22–24	80.70		SS	19	14,27,29,20	56			

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

Depth	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)
25			**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.		SS	20	18,31,59,41	90				
26					SS	21	27,50/5"	100				
27	75.60				SS	22	50/2"	100				
28			**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.		HQ	1	RQD = 82%					Compressive Strength 55.7 MPa
29					HQ	2	RQD = 89%					Compressive Strength 58.5 MPa
30					HQ	3	RQD = 90%					Compressive Strength 56.5 MPa
31	71.00											Compressive Strength 63.9 MPa
32			End of Borehole									
33			NOTES: 1. Borehole was advanced using hollow stem auger equipment on April 29, 2024 to termination at a depth of 27.5 metres. Bedrock was cored to a depth of 32.1 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 3, 2024 - 14.8 metres May 30, 2024 - 15.2 metres									
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												

Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
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Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 1B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795147
E: 592660

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE: Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
0 m	103.08	Ground Surface									
0 – 1 m	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
1 – 2 m	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.									
3 – 4 m	98.60	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense. Seam of reddish brown silty clay									
9 – 10 m	92.90	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
14 – 15 m	87.80	End of Borehole									

Note: Soil stratums inferred from BH1A

NOTES:

1. Borehole was advanced using hollow stem auger equipment on April 30, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 3, 2024 - 13.2 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: April 30, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Log of Borehole No. 2

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795158
E: 592674

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.12	Ground Surface							
0 / 0	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
3 / 1		**Sand and Gravel Fill** Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, loose to dense.	SS	1	8,18,11,8	29			
7 / 2			SS	2	3,2,2,1	4			
10 / 3			SS	3	14,17,14,12	31			
13 / 4			SS	4	9,10,6,6	16			
15 / 4	98.40		SS	5	1,8,24,20	32			
16 / 5			SS	6	6,20,36,38	56			
20 / 6		**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	6,32,20,18	52			
23 / 7			SS	8	10,24,26,29	50			
26 / 8			SS	9	6,11,11,10	22			
30 / 9			SS	10	12,16,14,10	30			
33 / 10	92.90								
36 / 11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,18,18,18	36			
40 / 12			SS	12	12,12,16,12	28			
46 / 14			SS	13	16,30,34,36 Wet spoon	64			
49 / 15	87.90								
		End of Borehole							

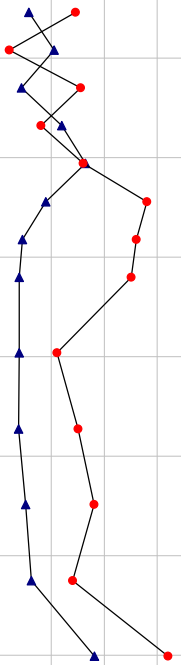
NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 13.1 metres
May 30, 2024 - 13.1 metres

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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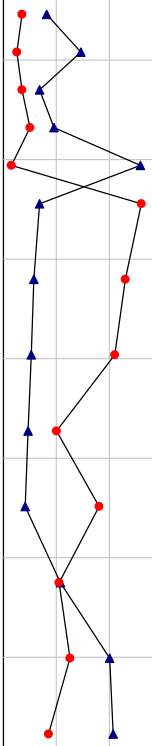
Log of Borehole No. 3

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795179
E: 592693

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.15	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
		Sand and Gravel Fill Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, very loose to loose.	SS	1	2,5,2,2	7			
			SS	2	2,3,2,16	5			
			SS	3	8,3,4,4	7			
			SS	4	5,4,6,7	10			
13 / 4	99.00		SS	5	1,1,2,9	3			
			SS	6	9,23,29,35	52			
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, very dense to compact.	SS	7	17,20,26,23	46			
			SS	8	15,19,23,21	42			
33 / 10	92.90		SS	9	8,11,9,11	20			
		Sand Brown, trace to some silt and gravel, dense to compact.	SS	10	17,20,16,17	36			
			SS	11	9,10,11,10	21			
			SS	12	9,10,15,27 Wet spoon	25			
51 / 16	87.30		SS	13	7,8,9,14 Wet spoon	17			
		End of Borehole NOTES: 1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.9 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 7, 2024 - 12.9 metres May 30, 2024 - 12.9 metres							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: May 6, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
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Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795187
E: 592682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.26	Ground Surface							
0 / 0	102.80	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 300 millimetres of compact granular base.							
6 / 2	100.70	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional cobbles, loose to compact	SS	1	4,7,6,3	13			
			SS	2	4,3,3,1	6			
			SS	3	1,3,3,2	6			
			SS	4	5,7,10,12	17			
13 / 4	99.20		SS	5	11,14,12,12	26			
			SS	6	1,1,0,1	1		<1.0	
16 / 5	97.70	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	1,1,1,1 Wet spoon	2		<1.0	
20 / 6			SS	8	7,17,13,15	30			
26 / 8		**Silty Clay/Clayey Silt** Reddish brown, trace to some sand, very soft.	SS	9	16,20,16,15	36			
33 / 10		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.	SS	10	24,18,16,14	34			
36 / 11			SS	11	10,12,12,16	24			
43 / 13			SS	12	8,11,11,16	22			
46 / 14			SS	13	7,18,11,11 Wet spoon	29			
51 / 16	87.40	End of Borehole	SS	14	2,6,17,24 Wet spoon	23			

NOTES:

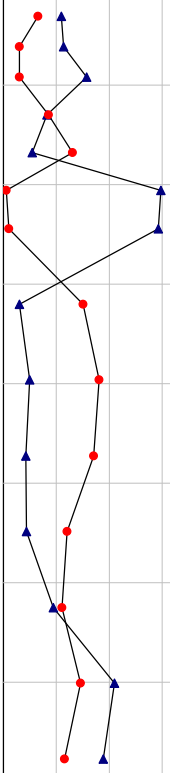
1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.8 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.0 metres

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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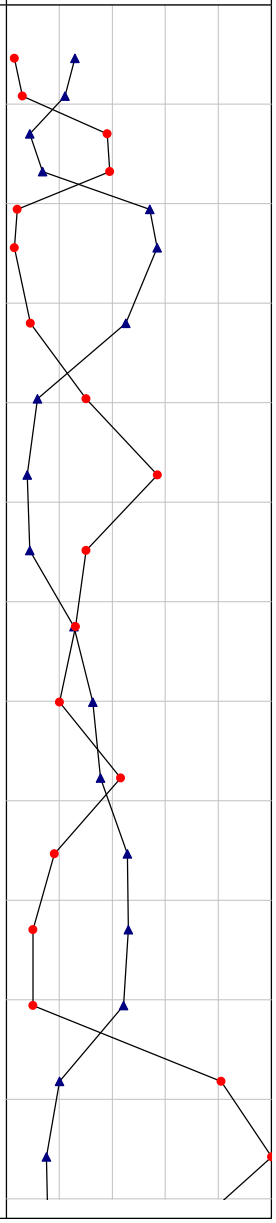
Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.19	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.	SS	1	1,2,1,1	3			
			SS	2	2,2,4,10	6			
			SS	3	9,18,20,27	38			
10 / 3	99.30		SS	4	16,19,20,18	39			
13 / 4		**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.	SS	5	4,2,2,2	4		<1.0	
16 / 5			SS	6	2,1,2,2	3		<1.0	
20 / 6			SS	7	2,4,5,9	9		1.0	
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.							
26 / 8		**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.	SS	8	9,15,15,19	30			
30 / 9			SS	9	9,35,22,25	57			
33 / 10	93.00		SS	10	10,14,16,21	30			
36 / 11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	10,12,14,14	26			
43 / 13			SS	12	6,10,10,12	20			
46 / 14			SS	13	7,14,29,39	43			
53 / 16	86.80	**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, very stiff to stiff.	SS	14	4,8,10,13	18		3.0	
56 / 17			SS	15	3,4,6,6	10		<1.0	
66 / 20			SS	16	4,4,6,8	10		<1.0	
69 / 21	82.30	**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.	SS	17	35,41,40,42	81			
76 / 23			SS	18	65,50/4"	100			
79 / 24									

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
25	77.60				SS	19	44,31,37,50/5	68				
					SS	20	50/4"	100				
26			**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.		HQ	1	RQD = 0%					
27					HQ	2	RQD = 86%					Compressive Strength 58.4 MPa Compressive Strength 80.5 MPa
28					HQ	3	RQD = 76%					Compressive Strength 57.5 MPa
29					HQ	4	RQD = 95%					Compressive Strength 47.5 MPa
30	72.60											
31			End of Borehole NOTES: 1. Borehole was advanced using hollow stem auger equipment on May 2, 2024 to termination at a depth of 25.6 metres. Bedrock was cored to a depth of 30.6 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 7, 2024 - 14.2 metres May 30, 2024 - 15.2 metres									
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 5B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795200
E: 592670

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	SAMPLE PP (kgf/cm2)	SAMPLE U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
0 / 0	103.23	Ground Surface									
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.									
13 / 4	99.30	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.									
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.									
33 / 10	93.00	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.									
45 / 14	89.20	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
		End of Borehole									

Note: Soil stratums inferred from BH5A

NOTES:

1. Borehole was advanced using solid stem auger equipment on May 3, 2024 to termination at a depth of 14.0 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 12.8 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795181
E: 592653

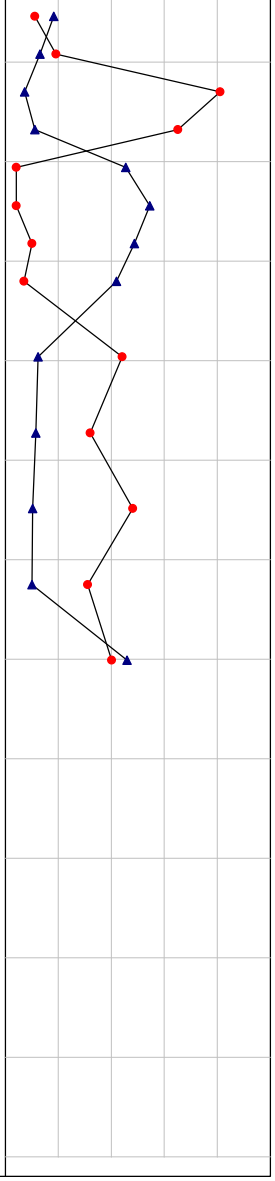
Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.31	Ground Surface								
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.								
6 / 2	101.10	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional to moderate cobbles, compact.		SS	1	6,6,5,2	11			
				SS	2	5,7,12,15	19			
				SS	3	18,46,35,63	81			
13 / 4	99.20			SS	4	16,30,35,21	65			
				SS	5	3,3,1,3	4		<1.0	
				SS	6	1,2,2,2	4		<1.0	
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.		SS	7	0,5,5,7	10		1.5	
23 / 7	96.20			SS	8	2,3,4,7	7		1.5	
		Silty Clay/Clayey Silt Reddish brown, trace to some sand, very soft.		SS	9	9,20,24,33	44			
33 / 10	93.10	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasional cobbles, dense.		SS	10	7,14,18,22	32			
				SS	11	31,26,22,21	48			
		Sand Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.		SS	12	9,14,17,20	31			
				SS	13	5,27,13,13 Wet spoon	40			
49 / 15	88.10	End of Borehole								

NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 1, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.1 metres



Drill Method: Hollow Stem Augers
Drill Date: May 1, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Sheet: 1 of 1

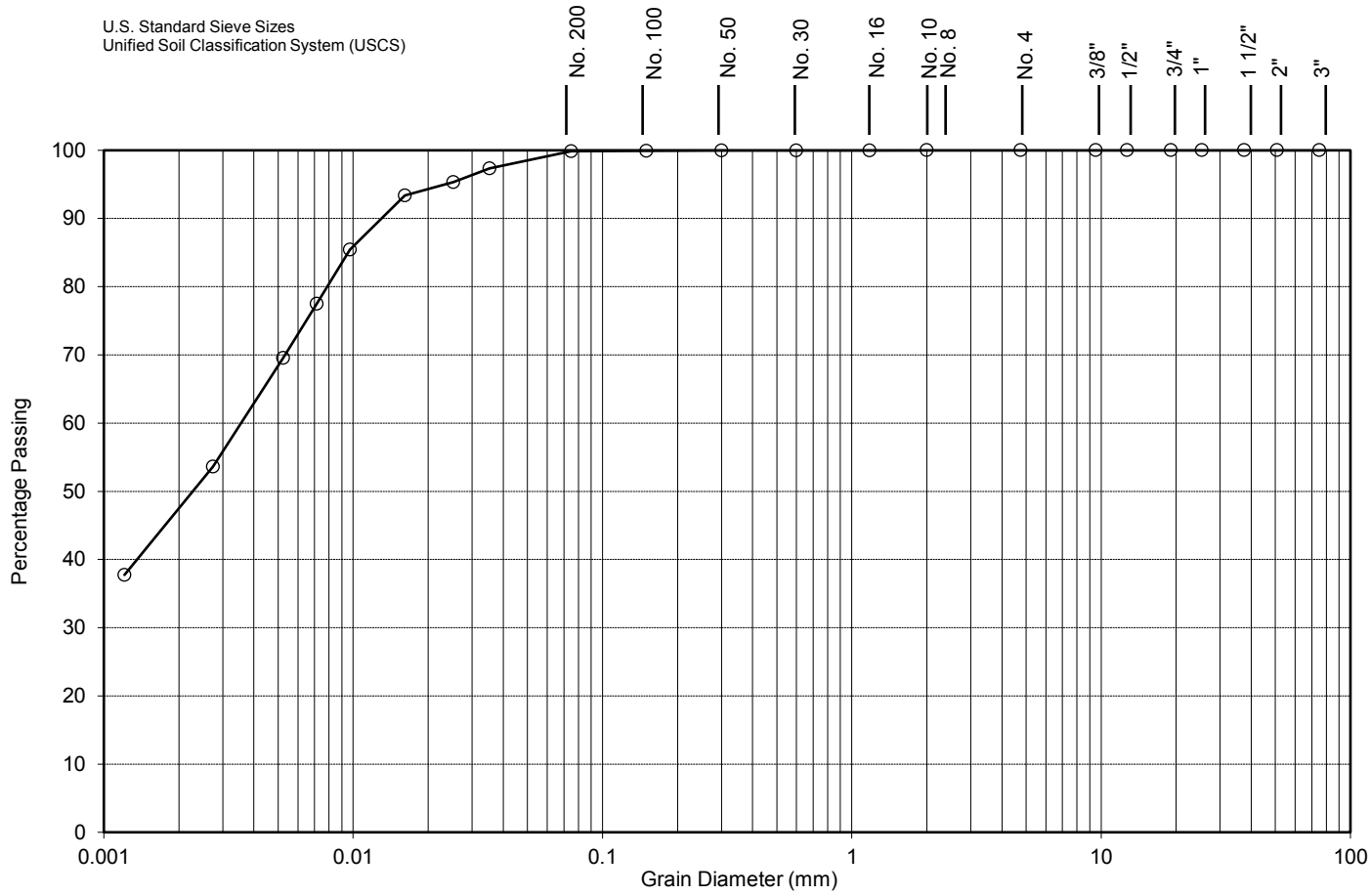
	Rock Core ID	Date Tested	Average Diameter D [mm]	Average Height H [mm]	Dry Weight (mass) [g]	Break Load Q_{ult} [lb]	Break Load Q_{ult} [N]	Aspect Ratio Factor C_F	Cross-Sectional Area A [m^2]	Calculated Volume V [m^3]	Calculated Unit Weight γ_{conc} [kN/m^3]	Calculated Density ρ_{conc} [kg/m^3]	Unconfined Compressive Strength [MPa]
1	1A1 (Run 1)	May-9-24	63.00	124.3	1028.2	39020	173561.0	1.00	0.00312	0.00039	26.0	2653.6	55.7
2	1A2 (Run2)	May-9-24	63.00	123.9	1013.5	40980	182279.0	1.00	0.00312	0.00039	25.7	2624.1	58.5
3	1A3 (Run 2)	May-9-24	63.00	129.8	1064.5	39590	176096.3	1.00	0.00312	0.00040	25.8	2630.9	56.5
4	1A4 (Run 3)	May-9-24	63.00	125.0	1028.4	44790	199225.9	1.00	0.00312	0.00039	25.9	2639.3	63.9
5	5A1 (Run 2)	May-9-24	63.00	108.0	885.8	41760	185748.5	0.98	0.00312	0.00034	25.8	2631.1	58.4
6	5A2 (Run 2)	May-9-24	63.00	111.0	912.5	57580	256115.8	0.98	0.00312	0.00035	25.9	2637.2	80.5
7	5A3 (Run 3)	May-9-24	63.00	127.8	1046.9	40280	179165.4	1.00	0.00312	0.00040	25.8	2627.9	57.5
8	5A4 (Run 4)	May-9-24	63.00	101.2	827.4	34290	152521.9	0.97	0.00312	0.00032	25.7	2622.8	47.5
	Date Cored:	April 29 - May 2, 2024											
	Date Received:	May 8, 2024											
	Project Name:	127 Plains Rd W, Burlington											

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

COMPRESSIVE STRENGTH TEST - ROCK CORE BREAK RESULTS

Project No.: 230581 **Lab Number: 24-598**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

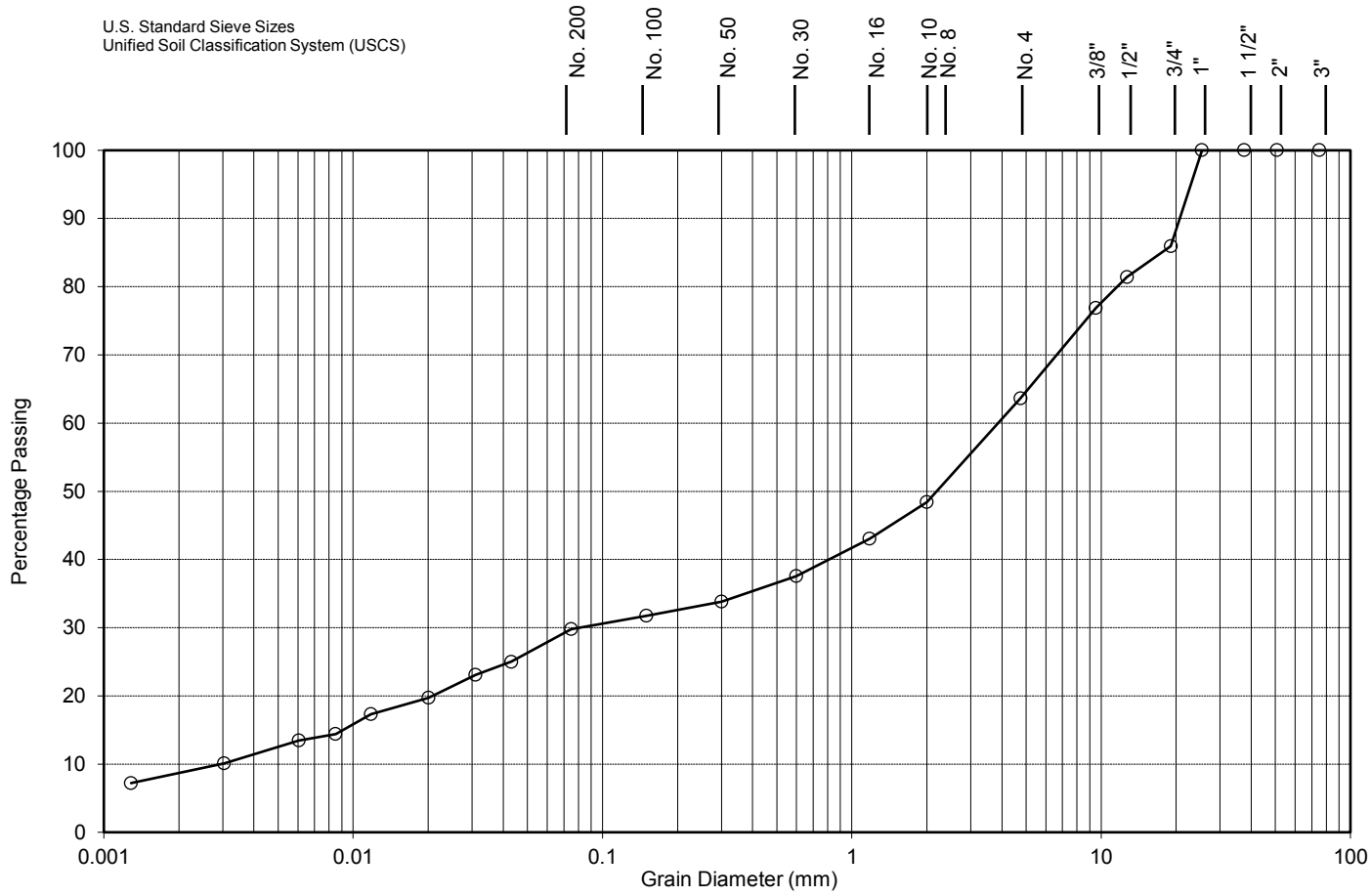
Lab No.:	**24-168**	Notes: Depth: 65'			
Borehole No.:	**1A**				
Sample No.:	**17**				
CLAY [%]:	**48**	Soil Description:	**Grey Silt and Clay**		
SILT [%]:	**52**		**M.L. - Inorganic silts to C.L. - Inorganic clays of low to medium plasticity**		
SAND [%]:	**0**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0004**	Coefficient of Uniformity C_U:	**9.0**	Coefficient of Curvature C_C:	**0.4**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 1**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

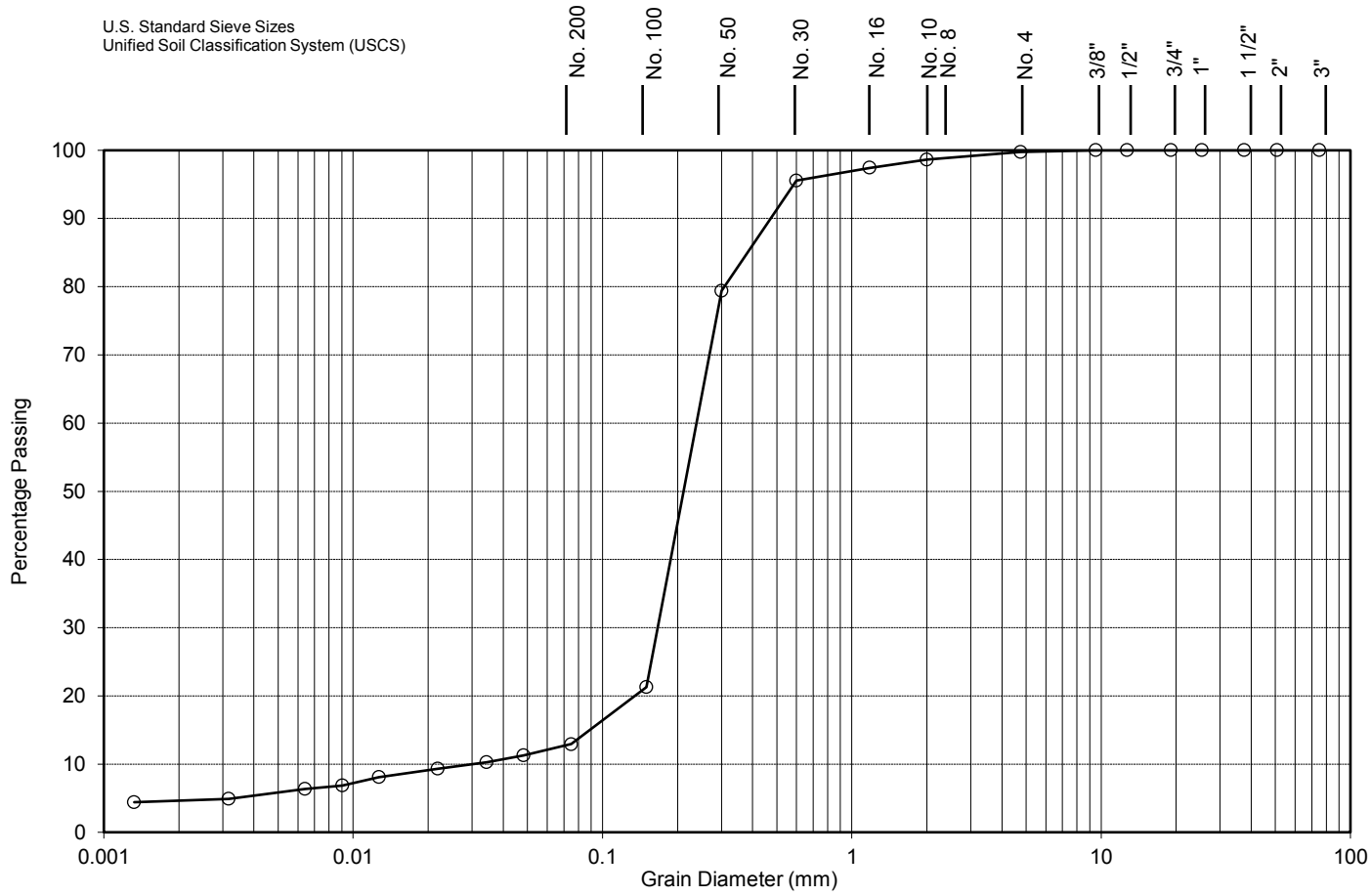
Lab No.:	**24-169**	Notes: Depth: 80'			
Borehole No.:	**1A**				
Sample No.:	**20**				
CLAY [%]:	**9**	Soil Description:	**Reddish Brown Sandy and Silty Gravel w/ a trace of Clay**		
SILT [%]:	**21**		**G.M. - Gravel-sand-silt mixtures, more than 12% fines to**		
SAND [%]:	**34**		**G.C. - Gravel-sand-clay mixtures, more than 12% fines**		
GRAVEL [%]:	**36**	Estimated Infiltration Rate [mm/hr] :	**25 to 30**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.003**	Coefficient of Uniformity C_U:	**1300.0**	Coefficient of Curvature C_C:	**0.7**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 2**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

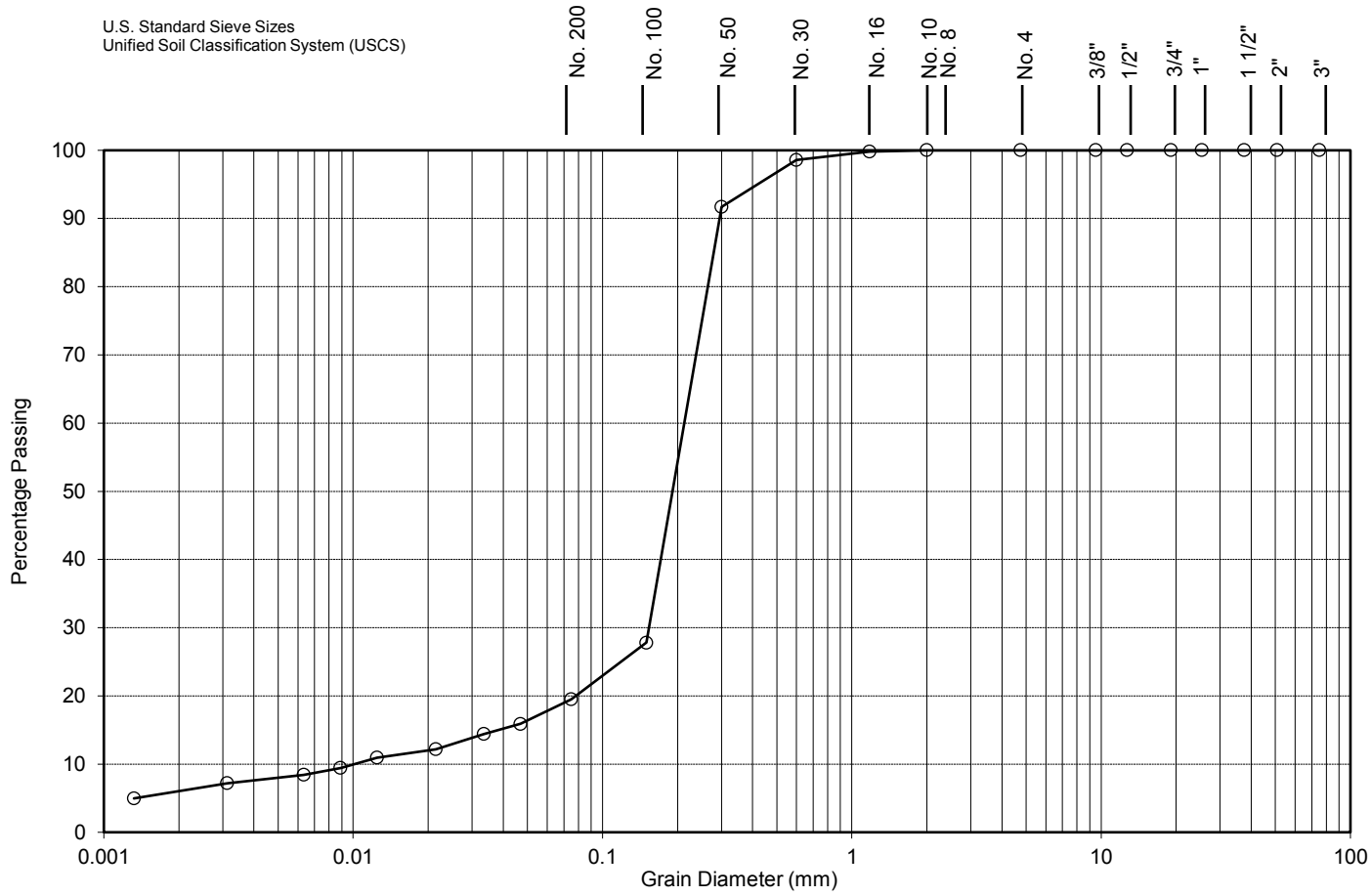
Lab No.:	**24-170**	Notes: Depth: 45'			
Borehole No.:	**2**				
Sample No.:	**13**				
CLAY [%]:	**4**	Soil Description:	**Reddish Brown Sand w/ traces of Silt and Clay**		
SILT [%]:	**9**		**S.M. - Silty sands, Sand-silt mixtures, more than 12% fines**		
SAND [%]:	**87**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**70 to 80**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.034**	Coefficient of Uniformity C_U:	**7.1**	Coefficient of Curvature C_C:	**3.5**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 3**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

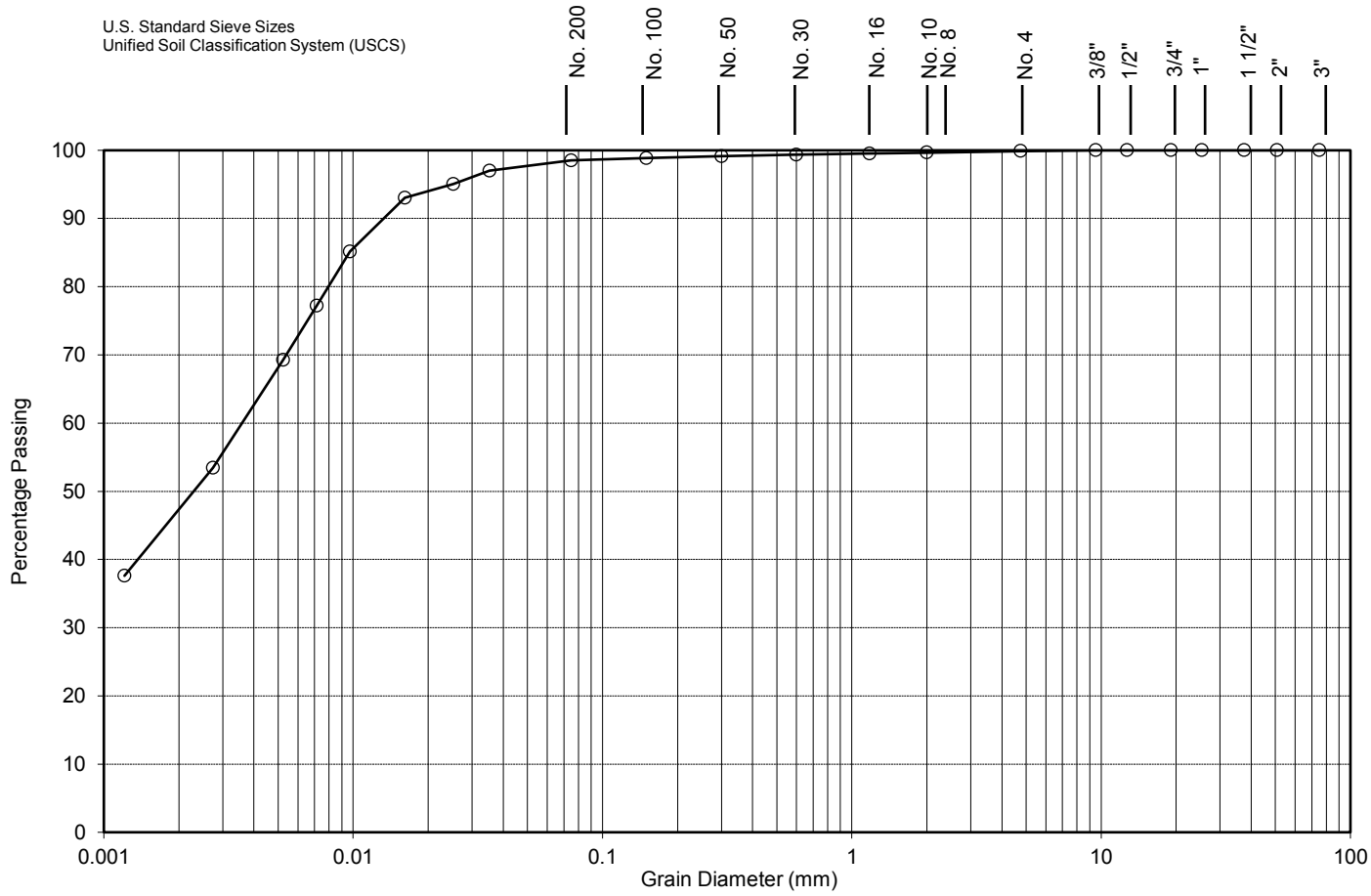
Lab No.:	**24-171**	Notes: Depth: 40'			
Borehole No.:	**4**				
Sample No.:	**12**				
CLAY [%]:	**6**	Soil Description:	**Reddish Brown Sand w/ some Silt and a trace of Clay**		
SILT [%]:	**14**		**S.M. - Sand-silt mixtures, more than 12% fines to**		
SAND [%]:	**80**		**S.C. - Sand-clay mixtures, more than 12% fines**		
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**45 to 55**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.010**	Coefficient of Uniformity C_U:	**21.9**	Coefficient of Curvature C_C:	**12.7**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 4**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

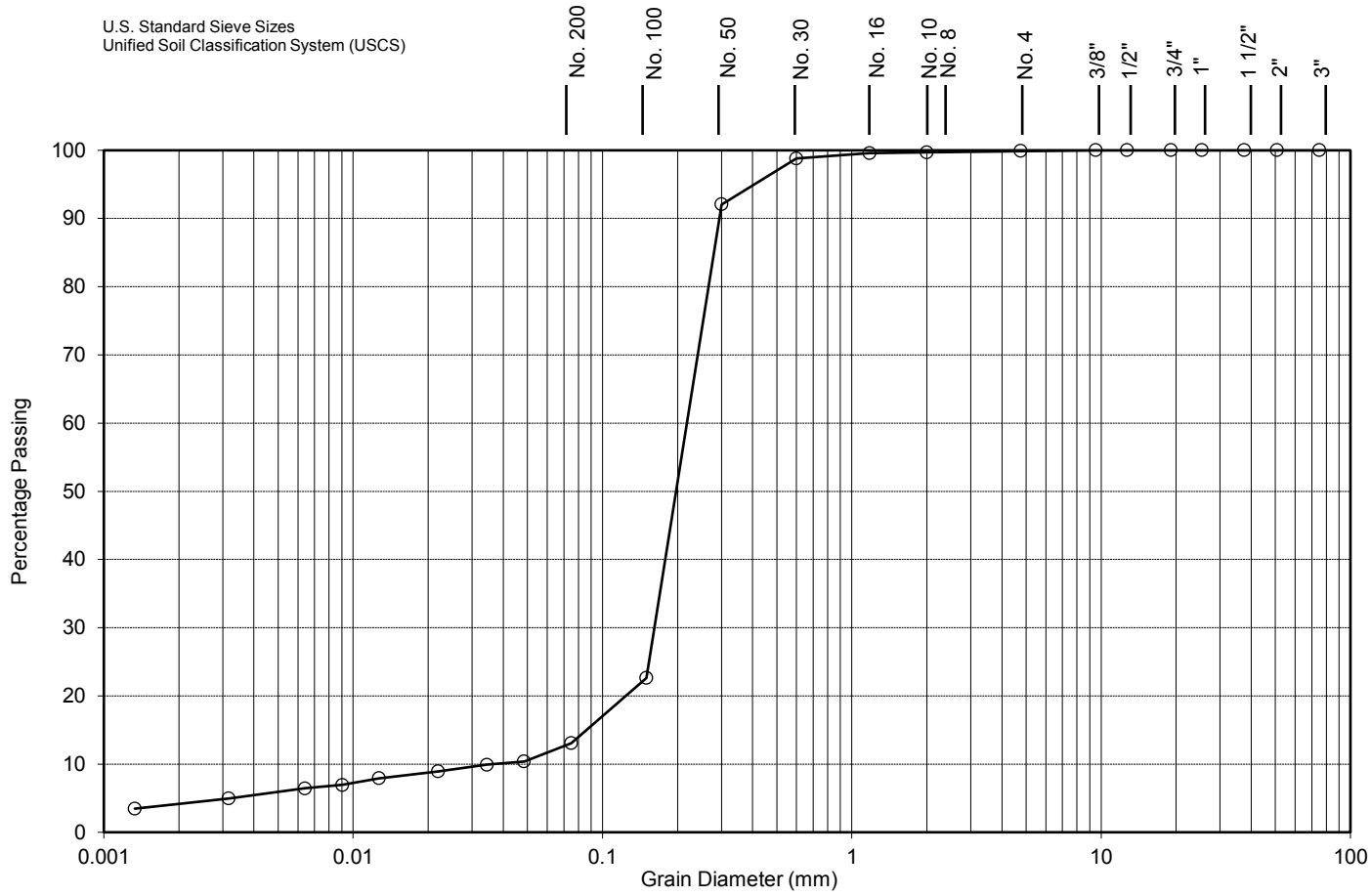
Lab No.:	**24-172**	Notes: Depth: 60'	
Borehole No.:	**5A**		
Sample No.:	**15**		
CLAY [%]:	**48**	Soil Description: **Grey Silt and Clay w/ a trace of Sand**	
SILT [%]:	**51**	**M.L. - Inorganic silts and very fine sands to C.L. - Inorganic clays of low to medium plasticity**	
SAND [%]:	**1**		
GRAVEL [%]:	**0**	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: **9.3**	Coefficient of Curvature C_C: **0.3**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 5**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



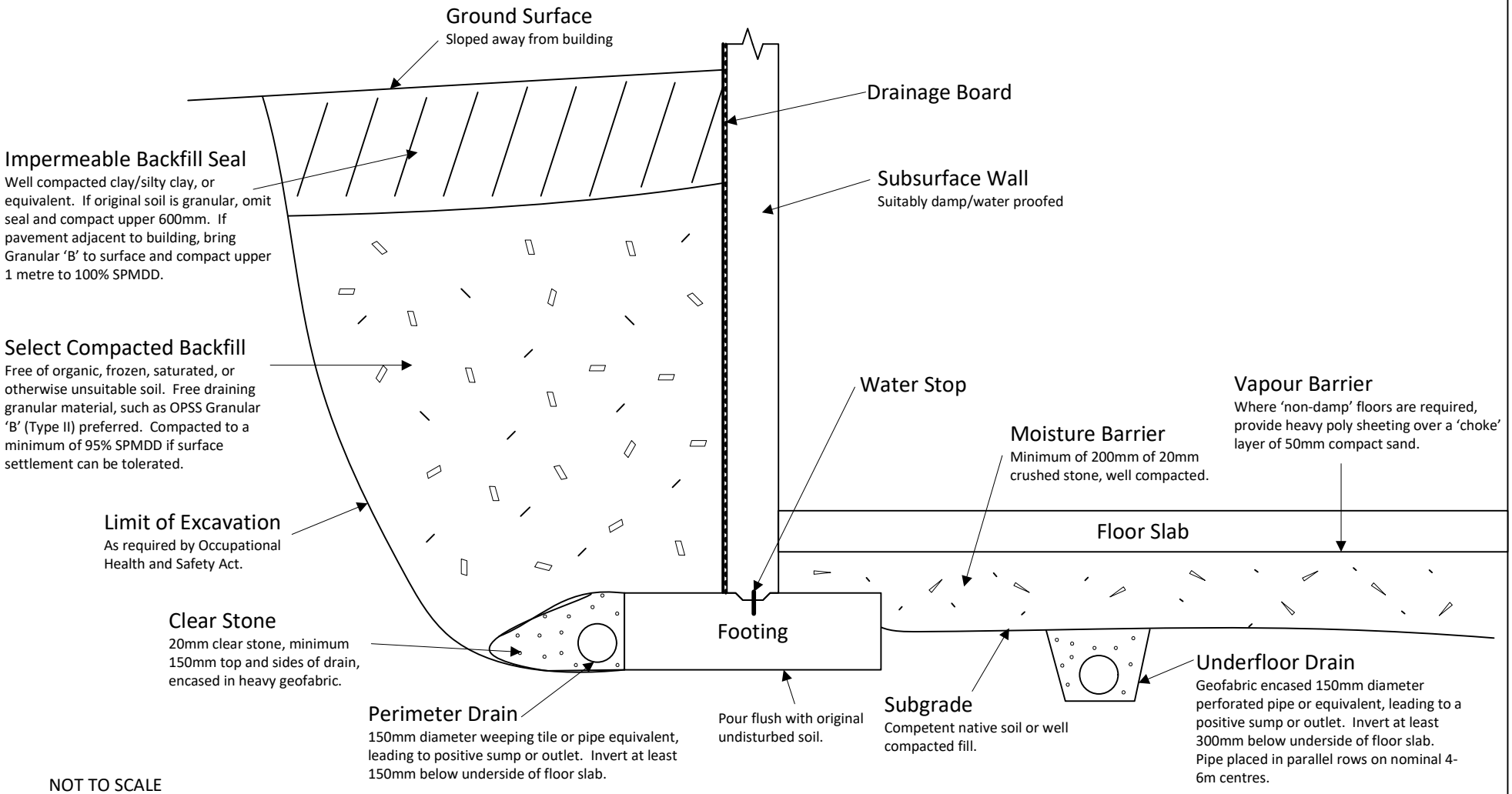
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**24-173**	Notes: Depth: 40'			
Borehole No.:	**6**				
Sample No.:	**12**				
CLAY [%]:	**3**	Soil Description:	**Brown Sand w/ some Silt and a trace of Clay**		
SILT [%]:	**10**		**S.M. - Sand-silt mixtures, more than 12% fines**		
SAND [%]:	**87**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**70 to 80**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.034**	Coefficient of Uniformity C_U:	**6.5**	Coefficient of Curvature C_C:	**3.9**

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127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 6**	**Project No.: SM 230581-T**



NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 230581-G
Date:	November, 2024

Typical Design Requirements
Drainage and Backfill for Basement Walls

Drawing No. 2