# SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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**PROJECT NO.: SM 166996-G**

November 10, 2016
Revised December 20, 2018

LIV COMMUNITIES
1005 Skyview Road – Suite 301
Burlington, Ontario
L7P 5B1

Attention: Andrew Mulder
Executive Director of Land Development

**PRELIMINARY GEOTECHNICAL INVESTIGATION**
**PROPOSED RESIDENTIAL DEVELOPMENT**
**1085 CLEARVIEW AVENUE & 1082-1090 ST. MATTHEWS AVENUE**
**BURLINGTON, ONTARIO**

Dear Mr. Mulder,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS Ltd. has completed the fieldwork and laboratory testing, and report preparation in connection with the above noted project. The work was undertaken in general accordance with our proposal P6441 dated September 15, 2016. In addition, this report has been revised to include the results of subsequent Phase Two ESA investigations on the site, as well as to include adjacent properties on Matthew's Avenue as part of the development lands. Our comments and recommendations, based on our findings at the various borehole locations, are presented in the following paragraphs.

## 1. INTRODUCTION

We understand that it is proposed to construct a mid-rise residential building with one underground parking level at the properties located at 1085 Clearview Avenue and 1082 to 1090 St. Matthews Avenue in Burlington, Ontario. The proposed mid-rise structure is anticipated to be 6 storeys above grade, with one underground parking level. Construction will also include the installation of associated underground services and asphalt paved parking areas. The purpose of this geotechnical investigation work was to determine the subsurface soils information at a number of borehole locations, and to provide comments and recommendations with respect to the design and construction of the proposed buildings and related earthworks 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, such as the addition of a basement level or additional storeys, may void the recommendations given in this report. If significant changes are made to the proposed design, this office must be consulted to review the new design with respect to the results of this investigation. It is noted that the information contained in this report does not reflect upon the environmental aspects of the site, which therefore have not been addressed in this document.

## 2. PROCEDURE

During our initial geotechnical investigation and subsequent environmental assessments, a total of sixteen [16] sampled boreholes were advanced at the locations illustrated on the attached Borehole Location Plans. These boreholes have been identified as Borehole Nos. 1 to 5, 201 to 206, and 301 to 306. The borings were advanced using hollow stem continuous flight auger equipment on various dates between September, 2016 and November 2018 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The boreholes were advanced to depths ranging from approximately 3.7 to 11.1 metres below the present grade. Groundwater observations were made during the course of the drilling operations. Upon completion of drilling, groundwater monitoring wells were installed at thee [3] borehole locations. The monitoring wells consisted of 50-millimetre diameter PVC pipe, screened in the lower 3 metres. The wells were encased in well filter sand up to approximately 0.3 metres above the screened portion, then with a bentonite 'hole plug' up to the surface, and fitted with protective steel 'flush mount' casings. The remaining boreholes were backfilled in general accordance with Ontario Regulation 903, and the grade reinstated even with the existing pavement surface using a premixed concrete product.

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. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The ground surface elevation at the borehole locations was referenced to geodetic data provided to our office (J.D. Barnes Ltd. Drawing Ref. No. 16-30-008-00-topo, dated September 27, 2018

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Borehole Log Nos. 1 through 5, 201 to 206, and 301 to 306, 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.

## 3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The site is located at 1085 Clearview Avenue and 1082 to 1090 St. Mathews Avenue in Burlington, Ontario. 1085 Clearview Avenue is currently occupied by a high single storey commercial building and asphalt paved parking areas, while 1082 to 1090 St. Matthews Avenue are occupied by three single family dwellings with grass surfaced rear yards. The site is bound to the west by Clearview Avenue, by Masonry Court to the north, to the south by existing residential properties, and to the east by St. Matthews Avenue. The above descriptions consider Clearview Avenue to run at a north-south alignment.

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

### Pavement Structure

All of the boreholes were advanced through the pavement structure of the existing paved parking areas around the existing structure at 1085 Clearview Avenue. The existing pavement structure was found to consist of approximately 75 to 90 millimetres of asphaltic concrete overlying 150 to 225 millimetres of compact granular base.

### Sand Fill

A deposit of sand fill was encountered beneath the pavement structure in Borehole No. 4, 204, 205, 206, 304, 305, and 305. This fill deposit of was brown in colour, medium in gradation, contained trace to some gravel and trace silt, in a generally very loose state.

The fill deposit was proven to a depths of approximately 1.2 to 4 metres beneath the existing pavement surface where encountered.

### Sand

Native brown sand was encountered beneath the pavement structure and/or fill material at all borehole locations. The sand is medium in gradation, contains trace to some gravel and trace silt, with occasional cobbles, and is generally in a compact to dense state. The upper levels tend to be a in a loose to compact condition, likely a result of disturbance during grading and servicing for the existing building and parking lot. The sand was proven to depths of approximately 4.8 to 6.4 metres.

### Clayey Silt

Native clayey silt was encountered beneath the sand at Borehole Nos. 1 to 5, 201, 202, and 205. The clayey silt encountered was reddish brown in colour, contained trace to some sand and gravel, and was generally firm to stiff in consistency. The clayey silt was proven to termination at a depth of approximately 10.1 metres in Borehole No. 5, and to termination at all other boreholes where encountered.

### Sand and Gravel

Coarse sand and gravel was encountered in Borehole No. 5 beneath the clayey silt, at a depth of approximately 10.1 metres. This coarse granular soil is brown, and generally in a compact state. The sand and gravel was proven to termination at a depth of 11.1 metres.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicates the subsurface soils to consist of coarse-textured glaciolacustrine deposits of sand and gravel, with minor silt and clay. These conditions are consistent with our experience in the area and observations during our fieldwork.

### Groundwater Observations

All of the boreholes were recorded as 'wet' at depths ranging from approximately 3.7 to 7.9 metres 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 three Borehole locations. Measurements of the groundwater level taken within these monitoring wells have been summarised as follows:

**TABLE A**
**SUMMARY OF GROUNDWATER LEVELS**

| Borehole No. | Surface Elevation (m) | May 17, 2017 | | May 26, 2017 | | July 11, 2017 | |
|---|---|---|---|---|---|---|---|
| | | Depth [m] | Elev. [m] | Depth [m] | Elev. [m] | Depth [m] | Elev. [m] |
| BH-#201 | 104.81 | 4.20 | 100.61 | 4.33 | 100.48 | - | - |
| BH-#202 | 104.90 | 4.30 | 100.60 | 4.32 | 100.58 | - | - |
| BH-#205 | 104.68 | 4.45 | 100.23 | 4.45 | 100.23 | 4.70 | 99.98 |

It is noted that the water level at Borehole No. 205 only was measured on July 11, 2017 as part of additional groundwater sampling required at this location only. Based on the above groundwater readings, the static groundwater level is estimated at a depth of approximately 4 to 5 metres below the existing grade, and would be expected to fluctuate seasonally.

## 4. FOUNDATION CONSIDERATIONS

The soil conditions encountered in the boreholes are generally considered suitable for supporting the proposed building on conventional spread footings founded on the native sand or clayey silt. Spread footings founded in the undisturbed native sand or clayey silt, below any fill or otherwise unsuitable material, may be designed using a factored Ultimate Limit State [ULS] bearing capacity of 225 kPa [~4,500 psf] and a Serviceability Limit State [SLS] of 150 kPa [~3,000 psf], based on total and differential settlements not exceeding 25 and 20 millimetres, respectively. If these bearing pressures result in a building footprint coverage by the foundations of greater than 50 per cent, then the structure should be founded on a raft slab using a reduced bearing capacity of 200 kPa [~4,000 psf] ULS and 125 kPa [~2,500 psf] SLS. If a flexible design approach is used, a value of subgrade modulus of k = 25 MN/m$^3$ [~90 pci] may be considered. It should be noted that the provided raft slab design data are only valid for a uniform founding depth.

The founding soils are noted to be susceptible to disturbance, such as from construction traffic. In this regard consideration should be given to the provision of a thin concrete mud slab over the footing beds as soon as possible after excavation and evaluation. This will serve to protect the founding soils from disturbance, and provide a clean working surface for the placement of reinforcing steel.

If higher bearing values are required than may be achieved with spread footings or a raft slab as recommended above, consideration may be given to ground improvement methods such as rammed aggregate piers [RAP], or deep foundation options such as caissons, helical piers or micropiles. Should such alternative foundation schemes be considered, it would be necessary to undertake additional investigations to greater depth.

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 structures and larger for more flexible buildings.

All footings exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost damage. All footings and foundations should be designed and constructed in accordance with the current Ontario 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, if possible. To limit stress transfer from the higher footings to the lower footings, 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. The addition foundations [adjacent the existing structure] should be constructed to 'match' the founding level of the existing building foundations where possible.

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. Considering that the founding soils are 'granular' in nature, we expect that the settlement will be pseudo-elastic in nature [occur as the loads are applied]. However, as is typical in most new construction, 'cosmetic' cracking of plasterboard, foundation walls, etc. may occur within the first year of construction as a result of shrinkage, minor settlement, etc. Subsequent to repair, additional cracking should be minimal.

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.

## 5. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12. 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.

The seismic data, from Supplementary Standard SB-1 of the 2012 Ontario Building Code [effective September 1, 2013], for Burlington are as follows:

| $S_a[0.2]$ | $S_a[0.5]$ | $S_a[1.0]$ | $S_a[2.0]$ | PGA |
|---|---|---|---|---|
| 0.320 | 0.170 | 0.064 | 0.022 | 0.180 |

## 6. FLOOR SLAB AND PERMANENT DRAINAGE

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 using a smooth drum compactor. Any soft 'spots' delineated during this operation or other site work must be sub-excavated and replaced with quality backfill material compacted to 100 per cent of its standard Proctor maximum dry density.

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 provisions 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.

The basement foundation walls must be suitably water proofed, including the provision of a dimple type drainage board to promote rapid drainage to a perimeter drainage system. The perimeter drainage system should consist of 150-millimetre diameter perforated pipe, encased in a geofabric sock and covered with a minimum of 200 millimetres of a 20-millimetre clear crushed stone product, and the clear crushed stone in turn encased by a heavy filter geotextile product. The suppliers of the filter geotextile should be consulted as to the type best suited for this project. This office should examine the installation of the drains. 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 gravity sewer connection or a sump pit a minimum of 150 millimetres below the underside of finished floor. 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 a schematic of the typical requirements for basement construction.

## 7. EXCAVATIONS

Excavations for the installation of foundations and underground services are anticipated to extend to depths of up to approximately 3 to 4 metres. The side of excavations through the granular soils above the static groundwater level would be expected to

remain stable for the short construction period at inclinations of up to 45 degrees to the horizontal. Where 'wet' seams are encountered or during wet weather the excavation sides may have a tendency to 'slump-in' to as flat as 3 horizontal to 1 vertical, or flatter. Some minor infiltration of groundwater through more permeable seams and from surface runoff should be anticipated. However any such infiltration should be readily controlled with typical construction dewatering methods, i.e. pumping from sumps in the base of excavations.

As noted above the static groundwater level is anticipated to be at a depth of 4 to 5 metres below grade. Where deeper excavations are required, extending to within perhaps 0.5 metres of the static groundwater level, difficulties should be anticipated with base and side slope stability, groundwater control, etc. The sides and base of excavations will have a tendency to become unstable, requiring stabilisation such as the placement of coarse ballast stone material, additional bedding material, etc. Additional sumps may be required to control groundwater infiltration, and the use of more sophisticated groundwater control methods may be required for excavations deeper than about 0.5 metres below the groundwater level.

Notwithstanding the foregoing, all excavations must be made in compliance with the current Occupational Health and Safety Act, 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 inspect the work.

## 8. BACKFILL CONSIDERATIONS

The majority of excavated soil will consist of the sand encountered in the boreholes, as described above. This material is generally considered suitable for use as service trench backfill and engineered fill, provided that it is free or organics or otherwise deleterious materials and the moisture content can be controlled to within 3 per cent of its standard Proctor maximum dry density. Any cobbles (with major dimension greater than 300 millimetres) or boulders, if encountered during excavation, should be separated and discarded. Proper handling of the sand soils based on the moisture content and weather conditions during construction will be important to achieving a successful compaction operation. The on-site soils are generally considered to be near, to slightly 'dry', of their standard Proctor optimum moisture content. Some moisture conditioning may be required depending upon weather conditions at the time of construction.

The on-site sandy soils are generally considered to be reasonably free draining, however may be affected by variation in the silt content, and may present some difficulty in achieving effective compaction in areas of restricted access. The use of a free draining, well-graded granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular B, Type II (crushed bedrock) is often preferred for backfill against foundation walls or to raise the interior grade to the design subgrade level. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for concrete floor slabs and exterior pavement.

It is very important that the placement moisture content of the backfill soils be within 3 per cent of its 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 provision of uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. All structural fill should be compacted to 100 per cent of its standard Proctor maximum dry density [SPMDD]. Backfill within service trenches, areas to be paved, etc., should be compacted to a minimum of 95 per cent of SPMDD, and to 100 per cent of SPMDD in the upper 1 metre below the design subgrade level. 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.

## 9. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved should be cleared of all organic or otherwise unsuitable materials and the exposed subgrade proof rolled with 3 to 4 passes of a 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 subexcavated and replaced with suitable backfill material. Where the subgrade is disturbed and weaker it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50mm clear stone, 'rip rap' stone, black rock, etc.] 'punched' into the soft areas.

Consideration may be given to the use of a heavy geofabric over the stabilized 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 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 B are based on subgrade parameters estimated on the basis of visual and tactile examinations of the on-site soils and past experience. The outlined pavement structure may be expected to have an approximate ten-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 B**
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 | 65 millimetres | 40 millimetres |
| Binder Course OPSS HL 8 | 92 per cent Marshall MRD | | 65 millimetres |
| Base Course OPSS Granular A | 100% SPMDD | 150 millimetres | 150 millimetres |
| Sub-base Course OPSS Granular B Type II | 100% SPMDD | 200 millimetres | 350 millimetres |

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

Depending on the arrangement of light duty and heavy duty pavement sections, the transition between sections may present some difficulty for contractors. In this regard, consideration might be given to a slightly increased light duty pavement structure consisting of 50 millimetres of HL8 binder course and 40 millimetres of HL3 surface course asphaltic concrete. This structure will provide for a continuous depth of surface course asphalt allowing for ease of construction. As well such a structure would have an improved performance over an increased design life. Such an arrangement of asphalt layers would also allow for future rehabilitation with a 'mill and pave' type operation.

Where asphalt pavement is to be constructed above the roof deck of a 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.

## 10. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the borehole locations. Contractors placing bids or undertaking this project should carry out due diligence in order to verify the results of this investigation and to determine how the subsurface conditions will affect their operations.

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.

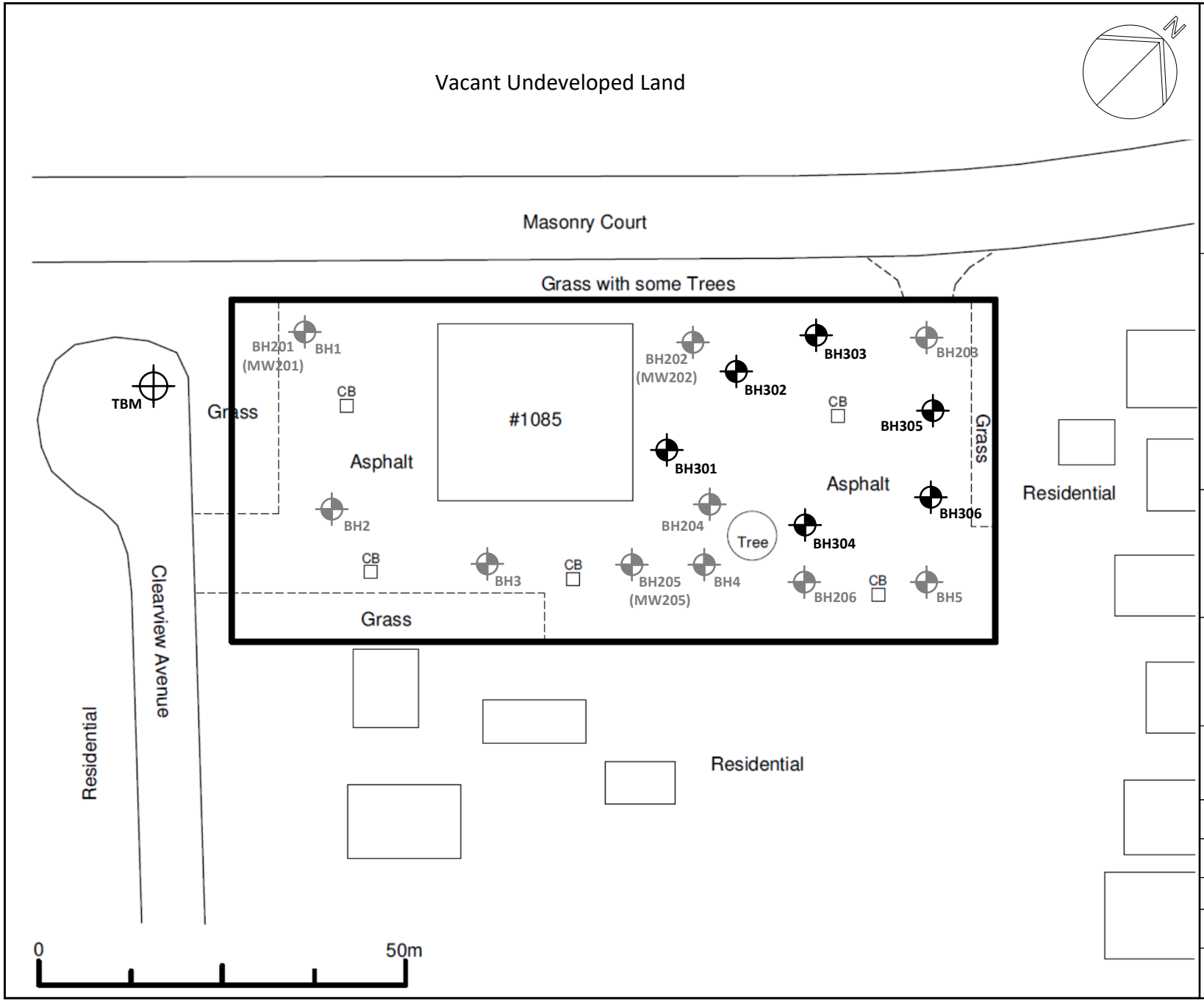



Kyle Richardson, P.Eng.
Project Engineer

Ian Shaw, P. Eng.
Senior Engineer

Enclosures: Borehole Location Plan (SM 188634-E)
Log of Borehole Log Nos. 1 to 5, 201 to 206, 301 to 306 inclusive
Drawing No. 2, Typical Design Requirements, Drainage and Backfill for Basement Walls

Distribution: LIV Communities [2, plus pdf]




LEGEND

BH# Borehole Location

BH# Previous Borehole Location

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 188634-E.

2. Borehole locations are approximate.

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Supplemental Phase Two Environmental Site Assessment
1085 Clearview Avenue
Burlington, Ontario

Borehole Location Plan

Project No. SM 188634-E

Date: November 2018

Drawn: JY | Checked: IS

SM 188634-E Borehole Location Plan

Drawing No. 1

**Project No:** SM 166996-G

**Project:** 1085 Clearview Avenue

**Location:** Burlington, Ontario

**Client:** LIV Communities

# Log of Borehole No. 1

**Project Manager:** Ian Shaw, P.Eng

**Borehole Location:** See Drawing No. 1

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## SUBSURFACE PROFILE

| Depth (ft) | Depth (m) | Elevation [m] | Description |
|---|---|---|---|
| 0 | 0 | 104.84 | Ground Surface |
| 0 | 0 | 104.57 | **Pavement Structure** — Approximately 90 millimetres of asphaltic concrete over 175 millimetres of compact granular base. |
| | | | **Sand** — Brown, medium in gradation, trace to some gravel, trace silt, compact to very dense. |
| | | 100.03 | **Clayey Silt** — Reddish brown, trace to some sand and gravel, stiff. |
| 26 | 8 | 96.74 | End of Borehole |

NOTES:

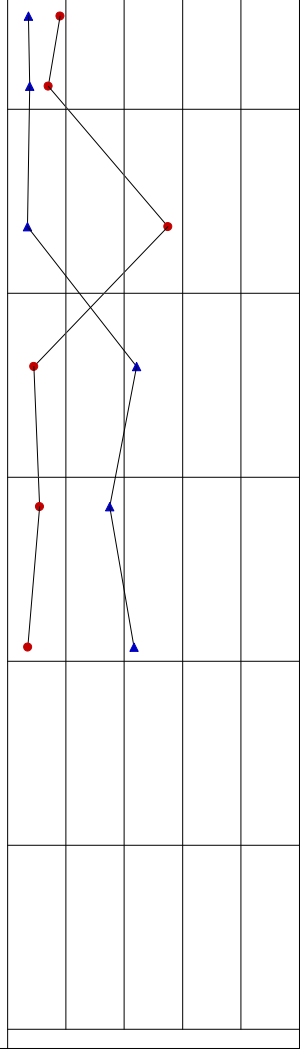
1. Borehole was advanced using hollow stem auger equipment on September 26, 2016 to termination at a depth of 8.1 metres.
2. Borehole was recorded as 'caved and wet' at a depth of 3.7 metres upon completion of drilling and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

## SAMPLE

| Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| SS | 1 | 6,8,10 | 18 | | | |
| SS | 2 | 5,6,8 | 14 | | | |
| SS | 3 | 30,39,16 | 55 | | | |
| SS | 4 | 8,6,3 | 9 | | | |
| SS | 5 | 2,6,5 | 11 | | | |
| SS | 6 | 3,3,4 | 7 | | | |

Moisture Content w% (10, 20, 30, 40)

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




Drill Method: Hollow Stem Augers
Drill Date: September 26, 2016
Hole Size: 200mm
Drill Contractor: DDSI

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
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Datum: Geodetic
Field Logged by: AS
Checked by: IS
Sheet: 1 of 1

**Project No:** SM 166996-G

**Project:** 1085 Clearview Avenue

**Location:** Burlington, Ontario

**Client:** LIV Communities

# Log of Borehole No. 2

**Project Manager:** Ian Shaw, P.Eng

**Borehole Location:** See Drawing No. 1

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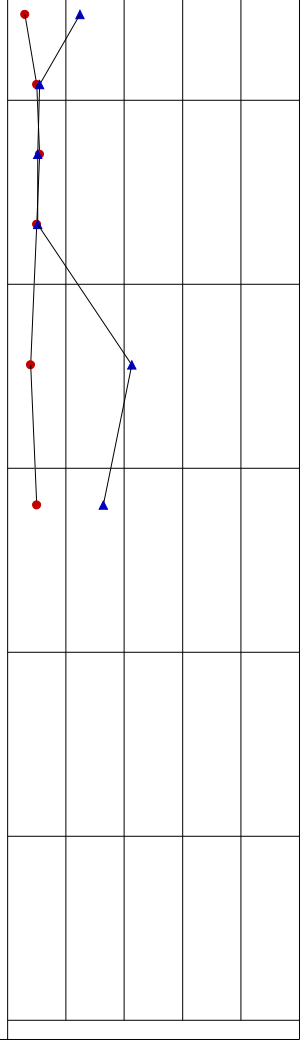
## SUBSURFACE PROFILE

## SAMPLE

| Depth (ft) | Depth (m) | Elevation [m] | Symbol | Description | Well Data | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.84 | | Ground Surface | | | | | | | | |
| 0 | 0 | 104.61 | | **Pavement Structure**<br>Approximately 75 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | | | | | | | |
| 2 | | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose to compact. | | | | | | | | |
| 4 | | | | | | SS | 1 | 3,2,4,4 | 6 | | | |
| 6 | 2 | | | | | SS | 2 | 3,5,5,6 | 10 | | | |
| 8 | | | | | | SS | 3 | 4,5,6,6 | 11 | | | |
| 10 | | | | | | SS | 4 | 7,5,5,6 | 10 | | | |
| 12 | | | | | | | | | | | | |
| 14 | 4 | | | | | | | | | | | |
| 16 | | 99.95 | | **Clayey Silt**<br>Reddish brown, trace to some sand and gravel, stiff. | | SS | 5 | 4,5,3,4 | 8 | | | |
| 18 | | | | | | | | | | | | |
| 20 | 6 | | | | | SS | 6 | 4,4,6,5 | 10 | | | |
| 22 | | 98.14 | | End of Borehole | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 26 | 8 | | | | | | | | | | | |
| 28 | | | | NOTES:<br>1. Borehole was advanced using hollow stem auger equipment on September 26, 2016 to termination at a depth of 6.7 metres.<br>2. Borehole was recorded as open and 'wet' at a depth of 5.8 metres upon completion of drilling and backfilled as per Ontario Regulation 903.<br>3. Soil samples will be discarded after 3 months unless otherwise directed by our client. | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32 | 10 | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
| 36 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |

Moisture Content w%: 10 20 30 40

Standard Penetration Test blows/300mm: 20 40 60 80



Drill Method: Hollow Stem Augers
Drill Date: September 26, 2016
Hole Size: 200mm
Drill Contractor: DDSI

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

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

**Project No:** SM 166996-G

**Project:** 1085 Clearview Avenue

**Location:** Burlington, Ontario

**Client:** LIV Communities

# Log of Borehole No. 3

**Project Manager:** Ian Shaw, P.Eng

**Borehole Location:** See Drawing No. 1

Soil-Mat

## SUBSURFACE PROFILE

| Depth (ft) | Depth (m) | Elevation [m] | Description |
|---|---|---|---|
| 0 | 0 | 104.72 | Ground Surface |
| 0 | 0 | 104.49 | **Pavement Structure** — Approximately 75 millimetres of asphaltic concrete over 150 millimetres of compact granular base. |
| | | | **Sand** — Brown, medium in gradation, trace to some gravel/cobbles, trace silt, loose to dense. |
| | | 99.12 | |
| | | | **Clayey Silt** — Reddish brown, trace to some sand and gravel, firm to stiff. |
| | | 95.12 | |
| 32 | 10 | | End of Borehole |

## SAMPLE

| Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| SS | 1 | 3,3,5,6 | 8 | | | |
| SS | 2 | 4,5,7,7 | 12 | | | |
| SS | 3 | 5,12,27 | 39 | | | |
| SS | 4 | 7,10,13 | 23 | | | |
| SS | 5 | 14,17,12 | 29 | | | |
| SS | 6 | 4,5,6 | 11 | | | |
| SS | 7 | 2,3,3 | 6 | | | |
| SS | 8 | 4,5,4 | 9 | | | |

Moisture Content w% (10 20 30 40)

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

NOTES:

1. Borehole was advanced using hollow stem auger equipment on September 26, 2016 to termination at a depth of 9.6 metres.
2. Borehole was recorded as 'caved and wet' at a depth of 6.1 metres upon completion of drilling 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 Augers
Drill Date: September 26, 2016
Hole Size: 200mm
Drill Contractor: DDSI

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130 Lancing Drive, Hamilton, ON L8W 3A1
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Datum: Geodetic
Field Logged by: AS
Checked by: IS
Sheet: 1 of 1

**Project No:** SM 166996-G

**Project:** 1085 Clearview Avenue

**Location:** Burlington, Ontario

**Client:** LIV Communities

# Log of Borehole No. 4

**Project Manager:** Ian Shaw, P.Eng

**Borehole Location:** See Drawing No. 1

Soil-Mat

## SUBSURFACE PROFILE

| Depth (ft) | Depth (m) | Elevation [m] | Description |
|---|---|---|---|
| 0 | 0 | 104.67 | Ground Surface |
| | | 104.35 | **Pavement Structure** — Approximately 90 millimetres of asphaltic concrete over 225 millimetres of compact granular base. |
| | | | **Sand Fill** — Brown, medium in gradation, trace to some gravel, trace silt, very loose. |
| | 2 | 100.67 | |
| | | | **Sand** — Brown, medium in gradation, trace to some gravel, trace silt, compact. |
| | 6 | 98.31 | |
| | | 98.11 | **Clayey Silt** — Reddish brown, trace to some sand and gravel, stiff. |
| | | | End of Borehole |

NOTES:

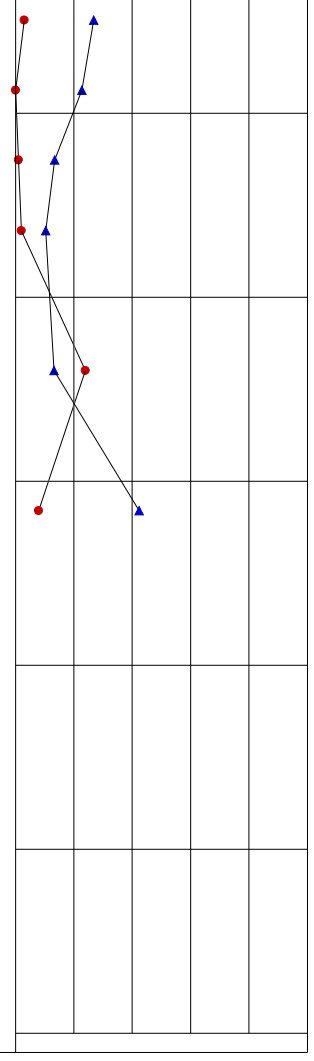
1. Borehole was advanced using hollow stem auger equipment on September 26, 2016 to termination at a depth of 6.6 metres.
2. Borehole was recorded as 'caved and wet' at a depth of 5.5 metres upon completion of drilling and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

## SAMPLE

| Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| SS | 1 | 1,2,1 | 3 | | | |
| SS | 2 | 0,0,0 | 0 | | | |
| SS | 3 | 1,0,1 | 1 | | | |
| SS | 4 | 0,1,1 | 2 | | | |
| SS | 5 | 15,14,10 | 24 | | | |
| SS | 6 | 3,3,5 | 8 | | | |

Moisture Content w% (10 20 30 40)

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



Drill Method: Hollow Stem Augers
Drill Date: September 26, 2016
Hole Size: 200mm
Drill Contractor: DDSI

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

**Project No:** SM 166996-G

**Project:** 1085 Clearview Avenue

**Location:** Burlington, Ontario

**Client:** LIV Communities

# Log of Borehole No. 5

**Project Manager:** Ian Shaw, P.Eng

**Borehole Location:** See Drawing No. 1

Soil-Mat

## SUBSURFACE PROFILE

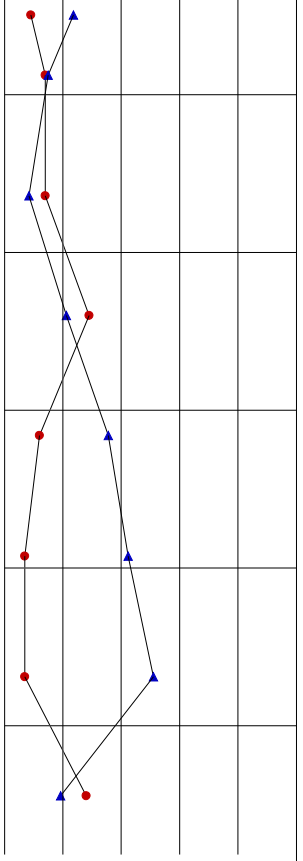
| Depth (ft) | Depth (m) | Elevation [m] | Description |
|---|---|---|---|
| 0 | 0 | 104.49 | Ground Surface |
| 0–2 | 0 | | **Pavement Structure** — Approximately 90 millimetres of asphaltic concrete over 175 millimetres of compact granular base |
| 2–18 | 0–6 | | **Sand** — Brown, medium in gradation, trace to some gravel/cobbles, trace silt, loose to compact. |
| 18 | 6 | 98.88 | |
| 18–34 | 6–10 | | **Clayey Silt** — Reddish Brown, with some sand and trace fine gravel, firm to stiff. |
| 34 | 10 | 94.38 | |
| 34–36 | 10 | | **Sand and Gravel** — Brown, coarse in gradation, compact |
| 36 | 10 | 93.39 | End of Borehole |

## SAMPLE

| Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| SS | 1 | 5,6,3 | 9 | | | |
| SS | 2 | 4,7,7 | 14 | | | |
| SS | 3 | 4,7,7 | 14 | | | |
| SS | 4 | 13,10,19 | 29 | | | |
| SS | 5 | 3,5,7 | 12 | | | |
| SS | 6 | 2,3,4 | 7 | | | |
| SS | 7 | 3,3,4 | 7 | | | |
| SS | 8 | 13,13,15 | 28 | | | |

Moisture Content w% (10, 20, 30, 40)

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



NOTES:

1. Borehole was advanced using hollow stem auger equipment on September 26, 2016 to termination at a depth of 11.1 metres.
2. Borehole was recorded as 'caved and wet' at a depth of 7.9 metres upon completion of drilling 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 Augers
Drill Date: September 26, 2016
Hole Size: 200mm
Drill Contractor: DDSI

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

# Log of Borehole No. 201

***Project No:*** SM 177469-E
***Project:*** Phase 2 ESA
***Location:*** 1085 Clearview Avenue
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No. 1
***UTM Coordinates - N:***
***E:***

Soil-Mat

| Depth (ft / m) | Elevation (m) | Symbol | 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 ft / 0 m | 104.81 | | Ground Surface | | | | | | | | | |
| 0 | 104.61 | | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | | | | | | | | |
| 0 – 5 ft / 0 – 1.5 m | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose to compact. | | | | | | | | | |
| 5 ft / 1.5 m | 99.91 | | **Clayey Silt**<br>Reddish brown, trace to some sand and gravel, stiff. | | | | | | | | | |
| 25 ft / 7.6 m | 97.21 | | End of Borehole | | | | | | | | | |

Notes:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 7.6 metres.
2. Borehole was recorded as 'dry' upon completion of drilling 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 and the following groundwater level readings have been measured:

   May 17, 2017 - 4.20m
   May 26, 2017 - 4.33m

***Drill Method:*** Hollow Stem Augers
***Drill Date:*** May 8, 2017
***Hole Size:*** 200mm
***Drilling Contractor:*** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

***Datum:*** Geodetic
***Field Logged by:*** K.F.
***Checked by:*** J.Y.
***Sheet:*** 1 of 1

# Log of Borehole No. 202

***Project No:*** SM 177469-E
***Project:*** Phase 2 ESA
***Location:*** 1085 Clearview Avenue
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No. 1
***UTM Coordinates - N:***
***E:***

Soil-Mat

| 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 | 104.90 | | Ground Surface | | | | | | | | |
| 0 / 0 | 104.70 | | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | | | | | | | |
| 1 / 0 | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | | SS | 1 | 6 9 14 14 | 23 | | | |
| 3 / 1 | | | | | SS | 2 | 2 5 5 6 | 10 | | | |
| 6 / 2 | | | | | SS | 3 | 2 6 10 10 | 16 | | | |
| 9 / 3 | | | | | SS | 4 | 3 5 8 11 | 13 | | | |
| 11 / 4 | | | | | SS | 5 | 4 9 11 11 | 20 | | | |
| 16 / 5 | 100.00 | | **Clayey Silt**<br>Reddish brown, trace to some sand and gravel, firm. | | SS | 6 | 3 3 4 4 | 7 | | 2.5 | |
| 20 / 6 | | | | | SS | 7 | 2 2 4 5 | 6 | | 2.0 | |
| 26 / 8 | 96.70 | | End of Borehole | | SS | 8 | 1 3 4 6 | 7 | | 1.0 | |

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

NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 8.2 metres.
2. Borehole was recorded as 'dry' upon completion of drilling 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 and the following groundwater level readings have been measured:

May 17, 2017 - 4.3m  May 26, 2017 - 4.32m

***Drill Method:*** Hollow Stem Augers
***Drill Date:*** May 8, 2017
***Hole Size:*** 200mm
***Drilling Contractor:*** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
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***Datum:*** Geodetic
***Field Logged by:*** K.F.
***Checked by:*** J.Y.
***Sheet:*** 1 of 1

# Log of Borehole No. 203

***Project No:*** SM 177469-E
***Project:*** Phase 2 ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No. 1
***UTM Coordinates - N:***
***E:***

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Symbol | Description | Well Data | SAMPLE Type | SAMPLE Number | SAMPLE Blow Counts | SAMPLE Blows/300mm | SAMPLE Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.95 | | Ground Surface | | | | | | | | |
| 0 | 0 | 104.75 | | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | SS | 1 | 4 10 4 8 | 14 | | | |
| 1 | | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | | SS | 2 | 5 5 5 5 | 10 | | | |
| 2 | 1 | | | | | SS | 3 | 1 2 4 10 | 6 | | | |
| 3 | | | | | | SS | 4 | 3 7 8 8 | 15 | | | |
| 4 | 2 | 101.29 | | | | SS | 5 | 5 8 9 10 | 17 | | | |
| 5 | | | | End of Borehole | | | | | | | | |
| 6 | 3 | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | 4 | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | 5 | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | 6 | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | 7 | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | 8 | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | 9 | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | 10 | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | 11 | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | 12 | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | 13 | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | 14 | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | 15 | | | | | | | | | | | |
| 31 | | | | | | | | | | | | |
| 32 | 16 | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |

Moisture Content w%
10 20 30 40

Standard Penetration Test blows/300mm
20 40 60 80



NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 3.7 metres.

2. Borehole was recorded as 'dry' upon completion of drilling 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 Augers
***Drill Date:*** May 8, 2017
***Hole Size:*** 200mm
***Drilling Contractor:*** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
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***Datum:*** Geodetic
***Field Logged by:*** K.F.
***Checked by:*** J.Y.
***Sheet:*** 1 of 1

# Log of Borehole No. 204

***Project No:*** SM 177469-E
***Project:*** Phase 2 ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

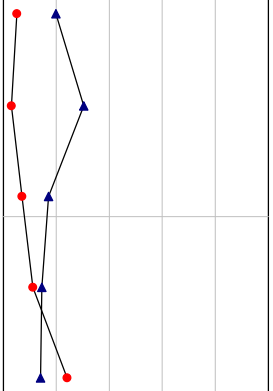
***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No. 1
***UTM Coordinates - N:***
***E:***

Soil-Mat

| 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 | 104.68 | | Ground Surface | | | | | | | | |
| 0 / 0 | 104.45 | | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | | | | | | | |
| 3 / 1 | 103.48 | | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace clay, loose to very loose. | | SS | 1 | 5 2 3 2 | 5 | | | |
| | | | | | SS | 2 | 2 2 1 3 | 3 | | | |
| 6 / 2 | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose to compact. | | SS | 3 | 1 3 4 6 | 7 | | | |
| | | | | | SS | 4 | 2 4 7 6 | 11 | | | |
| 10 / 3 | | | | | SS | 5 | 4 11 13 10 | 24 | | | |
| 11 / 3 | 101.02 | | End of Borehole | | | | | | | | |

Moisture Content w% (10 20 30 40)

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



NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 3.7 metres.

2. Borehole was recorded as 'dry' upon completion of drilling 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 Augers
***Drill Date:*** May 8, 2017
***Hole Size:*** 200mm
***Drilling Contractor:*** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

***Datum:*** Geodetic
***Field Logged by:*** K.F.
***Checked by:*** J.Y.
***Sheet:*** 1 of 1

# Log of Borehole No. 205

**Project No:** SM 177469-E
**Project:** Phase 2 ESA
**Location:** 1085 Clearview Avenue
**Client:** LIV Communities

**Project Manager:** Ian Shaw, P. Eng.
**Borehole Location:** See Drawing No. 1
**UTM Coordinates - N:**
**E:**

Soil-Mat

| Depth (ft / m) | Elevation (m) | Description | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|
| 0 / 0 | 104.68 | Ground Surface | | | | | | | |
| 0 / 0 | 104.48 | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 150 millimetres of compact granular base. | | | | | | | |
| 1 / 0 | | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose. | SS | 1 | 4 7 6 7 | 13 | | | |
| 3 / 1 | | | SS | 2 | 4 4 2 3 | 6 | | | |
| 5 / 1 | 102.88 | | SS | 3 | 2 2 5 4 | 7 | | | |
| 6 / 2 | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | SS | 4 | 2 5 8 9 | 13 | | | |
| 9 / 2 | | | SS | 5 | 4 10 12 11 | 22 | | | |
| 12 / 3 | | | | | | | | | |
| 15 / 4 | | | SS | 6 | 5 7 9 7 | 16 | | | |
| 18 / 5 | | | | | | | | | |
| 19 / 6 | 98.48 | | | | | | | | |
| 20 / 6 | | **Clayey Silt**<br>Reddish brown, trace to some sand and gravel, firm. | SS | 7 | 1 2 2 4 | 4 | | | |
| 23 / 7 | | | | | | | | | |
| 26 / 8 | 96.48 | | SS | 8 | 2 3 4 3 | 7 | | | |
| 27 / 8 | | End of Borehole | | | | | | | |

Moisture Content w% (10 20 30 40)

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

NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 8.2 metres.
2. Borehole was recorded as 'dry' upon completion of drilling 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 and the following groundwater level readings have been measured:

May 17, 2017 - 4.45m May 26, 2017 - 4.45m

**Drill Method:** Hollow Stem Augers
**Drill Date:** May 8, 2017
**Hole Size:** 200mm
**Drilling Contractor:** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
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**Datum:** Geodetic
**Field Logged by:** K.F.
**Checked by:** J.Y.
**Sheet:** 1 of 1

# Log of Borehole No. 206

***Project No:*** SM 177469-E
***Project:*** Phase 2 ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

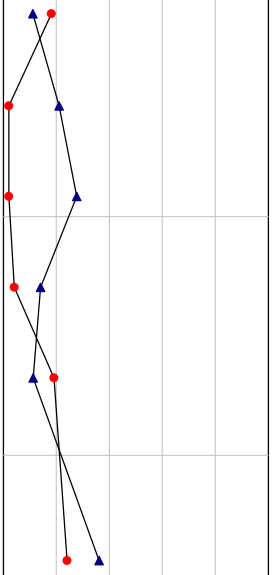
***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No. 1
***UTM Coordinates - N:***
***E:***

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Description | Sample Type | Sample Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.63 | Ground Surface | | | | | | | |
| 0 | 0 | 104.45 | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 125 millimetres of compact granular base. | | | | | | | |
| 1 | | | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace clay, very loose. | SS | 1 | 7 9 9 6 | 18 | | | |
| 2 | | | | SS | 2 | 3 1 1 1 | 2 | | | |
| 3 | 1 | | | SS | 3 | 2 1 1 2 | 2 | | | |
| 4 | | | | SS | 4 | 1 2 2 6 | 4 | | | |
| 5 | | 101.63 | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | SS | 5 | 8 9 10 10 | 19 | | | |
| 6 | 2 | | | | | | | | | |
| 7 | | | | SS | 6 | 12 13 11 12 | 24 | | | |
| 8 | | 99.45 | End of Borehole | | | | | | | |
| 9 | 3 | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | 4 | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | 5 | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | 6 | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | 7 | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | 8 | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | 9 | | | | | | | | | |
| 31 | | | | | | | | | | |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |

Moisture Content w% (10 20 30 40)

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



NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 8, 2017 to a depth of 5.2 metres.

2. Borehole was recorded as 'dry' upon completion of drilling 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 Augers
***Drill Date:*** May 8, 2017
***Hole Size:*** 200mm
***Drilling Contractor:*** Tri-Phase

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

***Datum:*** Geodetic
***Field Logged by:*** K.F.
***Checked by:*** J.Y.
***Sheet:*** 1 of 1

# Log of Borehole No. 301

***Project No:*** SM 188634-E
***Project:*** Supplemental Phase Two ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No.1
***:***
***:***

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Description | Well Data | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.83 | Ground Surface | | | | | | | | |
| 0 | 0 | | **Pavement Structure**<br>Approximately 75 millimetres of asphaltic concrete over 75 millimetres of compact granular base. | | | | | | | | |
| 3 | 1 | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose to compact. | | SS | 1 | 6,4,5,6 | 9 | | | |
| 6 | 2 | | | | SS | 2 | 5,5,5,5 | 10 | | | |
| 9 | 3 | | | | SS | 3 | 5,8,10,11 | 18 | | | |
| 11 | | 101.20 | | | SS | 4 | 8,8,8,10 | 16 | | | |
| 12 | 4 | | End of Borehole | | | | | | | | |
| 17 | 5 | | NOTES:<br>1. Borehole was advanced using solid stem auger equipment on October 25, 2018 to termination at a depth of 3.7 metres.<br>2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.<br>3. Soil samples will be discarded after 3 months unless otherwise directed by our client. | | | | | | | | |
| 20 | 6 | | | | | | | | | | |
| 23 | 7 | | | | | | | | | | |
| 26 | 8 | | | | | | | | | | |
| 29 | 9 | | | | | | | | | | |
| 33 | | | | | | | | | | | |




***Drill Method:*** Solid Stem Augers
***Drill Date:*** October 25, 2018
***Hole Size:*** 150 millimetres
***Drilling Contractor:*** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

***Datum:*** Geodetic
***Field Logged by:*** MC
***Checked by:*** JY
***Sheet:*** 1 of 1

# Log of Borehole No. 302

**Project No:** SM 188634-E
**Project:** Supplemental Phase Two ESA
**Location:** 1085 Clearview Avenue, Burlington
**Client:** LIV Communities

**Project Manager:** Ian Shaw, P. Eng.
**Borehole Location:** See Drawing No.1
**:**
**:**

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Description | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.85 | Ground Surface | | | | | | | |
| 0 | 0 | | **Pavement Structure**<br>Approximately 100 millimetres of asphaltic concrete over 200 millimetres of compact granular base. | | | | | | | |
| 3 | 1 | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, loose to compact. | SS | 1 | 6,5,5,5 | 10 | | | |
| 7 | 2 | | | SS | 2 | 5,6,6,7 | 12 | | | |
| 10 | 3 | | | SS | 3 | 4,7,10,14 | 17 | | | |
| 13 | 4 | | | SS | 4 | 5,8,10,11 | 18 | | | |
| 16 | 5 | 99.70 | | SS | 5 | 8,10,17,11 | 27 | | | |
| 17 | | | | SS | 6 | 6,7,11,17 | 18 | | | |
| | | | End of Borehole | | | | | | | |

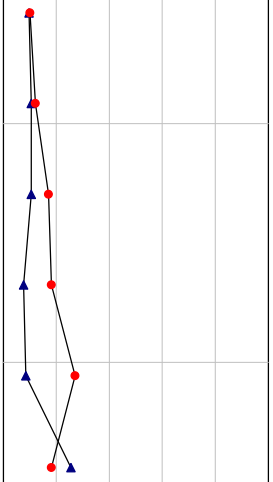
NOTES:

1. Borehole was advanced using solid stem auger equipment on October 25, 2018 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.

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



**Drill Method:** Solid Stem Augers
**Drill Date:** October 25, 2018
**Hole Size:** 150 millimetres
**Drilling Contractor:** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
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**Datum:** Geodetic
**Field Logged by:** MC
**Checked by:** JY
**Sheet:** 1 of 1

# Log of Borehole No. 303

**Project No:** SM 188634-E
**Project:** Supplemental Phase Two ESA
**Location:** 1085 Clearview Avenue, Burlington
**Client:** LIV Communities

**Project Manager:** Ian Shaw, P. Eng.
**Borehole Location:** See Drawing No.1
**:**
**:**

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Description | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.94 | Ground Surface | | | | | | | |
| 0 | 0 | 104.59 | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 300 millimetres of compact granular base. | | | | | | | |
| 3 | 1 | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | SS | 1 | 6,9,6,8 | 15 | | | |
| 6 | 2 | | | SS | 2 | 5,7,12,9 | 19 | | | |
| 9 | 3 | | | SS | 3 | 4,6,13,15 | 19 | | | |
| 11 | | 101.30 | | SS | 4 | 9,12,12,15 | 24 | | | |
| 12 | 4 | | End of Borehole | | | | | | | |

Moisture Content w% (10 20 30 40)

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

NOTES:

1. Borehole was advanced using solid stem auger equipment on October 25, 2018 to termination at a depth of 3.7 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 Augers
**Drill Date:** October 25, 2018
**Hole Size:** 150 millimetres
**Drilling Contractor:** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
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**Datum:** Geodeitc
**Field Logged by:** MC
**Checked by:** JY
**Sheet:** 1 of 1

# Log of Borehole No. 304

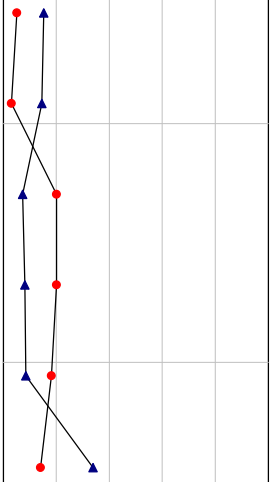
**Project No:** SM 188634-E
**Project:** Supplemental Phase Two ESA
**Location:** 1085 Clearview Avenue, Burlington
**Client:** LIV Communities

**Project Manager:** Ian Shaw, P. Eng.
**Borehole Location:** See Drawing No.1
**:**
**:**

Soil-Mat

| 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 | 104.66 | Ground Surface | | | | | | | | |
| 0 / 0 | 104.23 | **Pavement Structure**<br>Approximately 25 millimetres of asphaltic concrete over 400 millimetres of compact granular base. | | | | | | | | |
| 3 / 1 | | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace silt, very loose to loose. | | SS | 1 | 3,3,2,1 | 5 | | | |
| 6 / 2 | 102.45 | | | SS | 2 | 1,1,2,2 | 3 | | | |
| 8 / 3 | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | | SS | 3 | 7,9,11,13 | 20 | | | |
| 11 / 4 | | | | SS | 4 | 8,10,10,10 | 20 | | | |
| 13 / 4 | | | | SS | 5 | 5,9,9,19 | 18 | | | |
| 16 / 5 | 99.50 | | | SS | 6 | 6,7,7,6 | 14 | | | |
| 17 / 5 | | End of Borehole | | | | | | | | |
| 20 / 6 | | NOTES:<br>1. Borehole was advanced using solid stem auger equipment on October 25, 2018 to termination at a depth of 5.2 metres.<br>2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.<br>3. Soil samples will be discarded after 3 months unless otherwise directed by our client. | | | | | | | | |

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



**Drill Method:** Solid Stem Augers
**Drill Date:** October 25, 2018
**Hole Size:** 150 millimetres
**Drilling Contractor:** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
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**Datum:** Geodetic
**Field Logged by:** MC
**Checked by:** JY
**Sheet:** 1 of 1

# Log of Borehole No. 305

***Project No:*** SM 188634-E
***Project:*** Supplemental Phase Two ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No.1
***:***
***:***

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Description | Well Data | Type | Number | Blow Counts | Blows/300mm | Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.84 | Ground Surface | | | | | | | | |
| 0 | 0 | 104.49 | **Pavement Structure**<br>Approximately 50 millimetres of asphaltic concrete over 300 millimetres of compact granular base. | | | | | | | | |
| 3 | 1 | 103.40 | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace clay, loose. | | SS | 1 | 4,3,4,6 | 8 | | | |
| 6 | 2 | | | | SS | 2 | 4,8,10,10 | 18 | | | |
| | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | | | | | | | | |
| 10 | 3 | | | | SS | 3 | 5,5,7,13 | 12 | | | |
| 11 | | 101.20 | | | SS | 4 | 9,9,11,12 | 20 | | | |
| 12 | 4 | | End of Borehole | | | | | | | | |
| 16 | 5 | | NOTES:<br>1. Borehole was advanced using solid stem auger equipment on October 25, 2018 to termination at a depth of 3.7 metres.<br>2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.<br>3. Soil samples will be discarded after 3 months unless otherwise directed by our client. | | | | | | | | |
| 20 | 6 | | | | | | | | | | |
| 23 | 7 | | | | | | | | | | |
| 26 | 8 | | | | | | | | | | |
| 29 | 9 | | | | | | | | | | |
| 33 | | | | | | | | | | | |

SAMPLE

Moisture Content w%
10 20 30 40

Standard Penetration Test blows/300mm
20 40 60 80



***Drill Method:*** Solid Stem Augers
***Drill Date:*** October 25, 2018
***Hole Size:*** 150 millimetres
***Drilling Contractor:*** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
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***Datum:*** Geodetic
***Field Logged by:*** MC
***Checked by:*** JY
***Sheet:*** 1 of 1

# Log of Borehole No. 306

***Project No:*** SM 188634-E
***Project:*** Supplemental Phase Two ESA
***Location:*** 1085 Clearview Avenue, Burlington
***Client:*** LIV Communities

***Project Manager:*** Ian Shaw, P. Eng.
***Borehole Location:*** See Drawing No.1
***:***
***:***

Soil-Mat

| Depth (ft) | Depth (m) | Elevation (m) | Symbol | Description | Well Data | SAMPLE Type | SAMPLE Number | SAMPLE Blow Counts | SAMPLE Blows/300mm | SAMPLE Recovery | PP (kgf/cm2) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 104.72 | | Ground Surface | | | | | | | | |
| 0 | 0 | 104.24 | | **Pavement Structure**<br>Approximately 75 millimetres of asphaltic concrete over 400 millimetres of compact granular base. | | | | | | | | |
| 1 | | | | | | SS | 1 | 4,2,3,3 | 5 | | | |
| 2 | 1 | 102.90 | | **Sand Fill**<br>Brown, medium in gradation, trace to some gravel, trace clay, loose. | | SS | 2 | 2,2,3,2 | 5 | | | |
| 3 | | | | **Sand**<br>Brown, medium in gradation, trace to some gravel, trace silt, compact. | | SS | 3 | 6,10,8,13 | 18 | | | |
| 4 | 2 | | | | | | | | | | | |
| 5 | | | | | | SS | 4 | 7,10,12,13 | 22 | | | |
| 6 | | 101.05 | | | | | | | | | | |
| 7 | 3 | | | End of Borehole | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | 4 | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | 5 | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | 6 | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | 7 | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | 8 | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | 9 | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |

Moisture Content w%
10 20 30 40

Standard Penetration Test blows/300mm
20 40 60 80



NOTES:

1. Borehole was advanced using solid stem auger equipment on October 25, 2018 to termination at a depth of 3.7 metres.

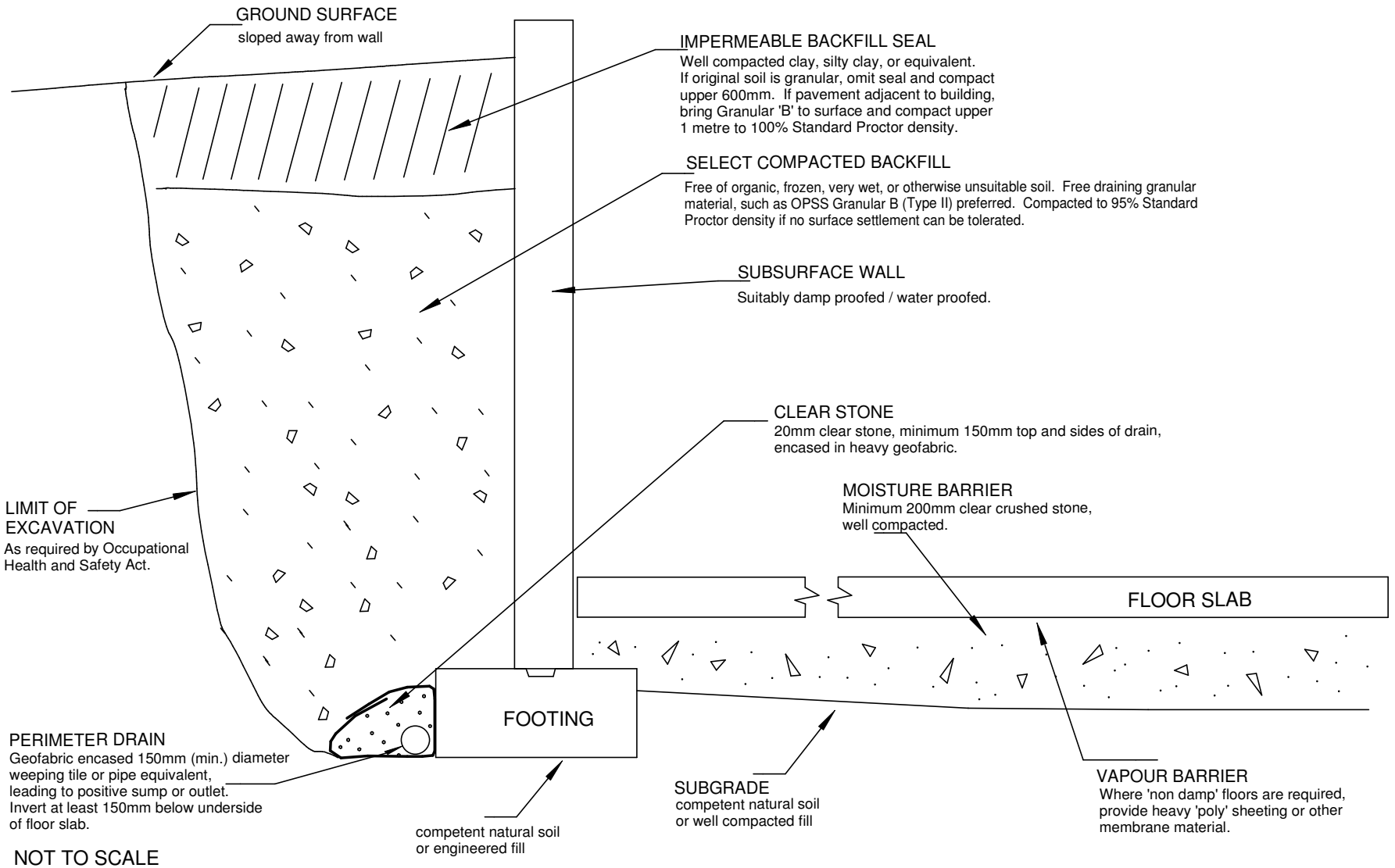
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

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

***Drill Method:*** Solid Stem Augers
***Drill Date:*** October 25, 2018
***Hole Size:*** 150 millimetres
***Drilling Contractor:*** Davis Drilling

**Soil-Mat Engineers & Consultants Ltd.**
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

***Datum:*** Geodetic
***Field Logged by:*** MC
***Checked by:*** JY
***Sheet:*** 1 of 1




NOT TO SCALE

Soil-Mat

# Soil-Mat Engineers & Consultants Ltd.

Typical Design Requirements
Drainage and Backfill for Basement Walls

| | |
|---|---|
| Project No.: | SM 166996-G |
| Date: | October 2016 |

DRAWING No. 2