GEOTECHNICAL INVESTIGATION

PROPOSED BUILDING
303, 309, 317 SPEEDVALE AVENUE EAST
GUELPH, ONTARIO

CMT Project 23-399.R01

Prepared for:

Habitat for Humanity Guelph-Wellington

August 3, 2023

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August 3, 2023 23-399.R01

Habitat for Humanity Guelph-Wellington
104 Dawson Road
Suite 100B
Guelph, Ontario
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Attention: Mr. Brett Daw

Dear Sir:

Re: Geotechnical Investigation
Proposed Building
303, 309, 317 Speedvale Avenue East
Guelph, Ontario

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above-referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Jake Feeney, P. Eng.

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1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Brett Daw of Habitat for Humanity Guelph-Wellington to conduct a geotechnical investigation for the proposed building to be constructed at 303, 309 and 317 Speedvale Avenue East, in Guelph, Ontario. The location of the subject site is shown on Drawing 1.

It is understood that the proposed project will comprise the construction of the proposed residential development (building) with either half or 1 storey of underground parking as well as surface level parking.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); recommended founding elevations; site classification for seismic site response; dewatering considerations; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; soil design properties; and a summary of the laboratory test results.

2.0 EXISTING SITE CONDITIONS

The site currently consists of an existing parking lot and three (3) commercial/residential buildings. The site is relatively flat, however a steep hill approximately 1.52 m (5.00 ft) in height is located in front of 317 Speedvale Avenue East.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on July 10, 2023 and comprised the advancement of five (5) boreholes (referenced as Boreholes 1 to 5, inclusive), utilizing a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. The boreholes were advanced in the area of the proposed building to depths of approximately 6.10 m (20.00 ft) below the existing ground surface elevation.

Standard penetration testing and sampling was carried out in the boreholes using 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) intervals to approximately 3.05 m (10.0 ft) depth, and every 1.52 m (5.0 ft) thereafter to borehole termination. Macro core (MC5) direct push sampling was typically conducted between the SPT soil samples conducted below 3.05 m (10.0 ft) depth.

Technical staff from CMT Inc. observed the drilling operation and collected and logged the recovered soil samples. A small portion of each sample was placed in a sealed, marked jar for moisture content determinations.

Representative samples from the boreholes at the following depths were submitted to our laboratory for grain size analyses:

- Borehole 1 – approximate depth 3.05 m to 3.66 m (10.00 ft to 12.00 ft); and
- Borehole 3 – approximate depth 4.57 m to 5.18 m (15.00 ft to 17.00 ft).

The borehole logs are provided in Appendix A and the grain size analyses are provided in Appendix B.

CMT Inc. personnel surveyed the ground surface elevations at the borehole locations (using laser survey equipment) on July 31, 2023. The nail in the existing hydro pole located to the north of the proposed construction was utilized as a benchmark with a reported local elevation of 333.00 m. As such, the ground surface elevations at the borehole locations ranged from approximately 330.06 m to 334.21 m. The locations of the boreholes and the benchmark are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the boreholes are described briefly below with a more detailed stratigraphic description provided on the borehole logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the borehole locations.

4.1. Asphalt

Asphalt was encountered at the surface of Boreholes 1, 2 and 5. The thickness of the asphalt at the borehole locations ranged from approximately 80 mm to 100 mm (average 87 mm). It should be expected that asphalt thicknesses will vary throughout the site.

4.2. Topsoil

Loose, silty, organic topsoil was encountered at the surface of Boreholes 3 and 4 and buried topsoil was encountered underlying the silty sand fill at Borehole 3. The thickness of the topsoil at the borehole locations ranged from approximately 300 mm to 610 mm (average 403 mm). It should be expected that topsoil thicknesses will vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.3. Sand and Gravel Fill

Brown sand and gravel fill with trace silt was encountered underlying the asphalt at Boreholes 1, 2 and 5. The sand and gravel fill had a thickness ranging between approximately 660 mm and 680 mm and was considered to be compact, with SPT N-values ranging between 13 and 21 blows per 0.30 m (average 18 blows per 0.30 m). The sand and gravel fill was considered to be moist, with moisture contents ranging from about 2.8% to 7.4% (average 5.5%).

4.4. Silty Sand Fill

Brown silty sand fill with some clay and trace gravel was encountered underlying the sand and gravel fill at Borehole 1 and underlying the topsoil at Borehole 3. The silty sand fill had a thickness ranging between approximately 610 mm and 760 mm and was considered to be loose to compact, with SPT N-values ranging between 4 and 11 blows per 0.30 m (average 8 blows per 0.30 m). The silty sand fill was considered to be moist, with moisture contents ranging from about 8.6% to 19.1% (average 13.9%). Organics were observed within the silty sand fill at Borehole 1.

4.5. Silt Fill

Brown silt fill with some sand and trace gravel was encountered underlying the topsoil at Borehole 4. The silt fill had a thickness of approximately 1.22 mm and was considered to be compact, with an SPT N-value of 20 blows per 0.30 m. The silt fill was considered to be moist, with a reported moisture content of about 10.8%.

4.6. Silty Sand

Brown to grey silty sand with some clay and trace to some gravel was encountered underlying the silty sand fill at Borehole 1, the sand and gravel fill at Boreholes 2 and 5, the sand and silt at Borehole 2, the buried topsoil and sand at Borehole 3 and the silt fill at Borehole 4. The silty sand was observed to extend to the termination depth of Boreholes 2 and 3. The silty sand was considered to be compact to dense, with SPT N-values ranging from 10 to 43 blows per 0.30 m (average 21 blows per 0.30 m). The silty sand was considered to be moist to saturated, with moisture contents ranging from about 3.1% to 19.8% (average 8.6%). A wet sand and gravel layer was encountered within the silty sand layer at Borehole 1.

4.7. Sand and Silt

Brown to grey sand and silt with some clay and trace gravel was encountered underlying the silty sand at Boreholes 1, 2, 4 and 5. The sand and silt was observed to extend to the termination depth of Borehole 4. The sand and silt was considered to be compact to very dense, with SPT N-values ranging from 18 to greater than 100 blows per 0.30 m (average 54 blows per 0.30 m). The sand and silt was considered to be moist, with moisture contents ranging from about 6.9% to 9.6% (average 8.1%).

4.8. Sand

Brown to grey sand with trace to some silt and gravel was encountered underlying the sand and silt at Boreholes 1 and 5 and within the silty sand at Borehole 3. The sand was observed to extend to the termination depth of Boreholes 1 and 5. The sand was considered to be dense, with SPT N-values ranging from 18 to 37 blows per 0.30 m (average 28 blows per 0.30 m). The sand was considered to be moist to saturated, with moisture contents ranging from about 3.0% to 20.6% (average 14.7%).

4.9. Groundwater

Saturated soils, typically sand, were observed within Boreholes 1, 2 and 5 ranging from approximately 3.66 m to 6.10 m below the ground surface. It should be noted that groundwater conditions will likely fluctuate due to seasonal and weather conditions at the time of construction and clearances from groundwater or aquifers must be maintained for this project. In order to prevent excavating through the saturated zones and to avoid water seepage into the proposed parking garage, it is typically recommended that the underside of the footings be placed at least one footing width above the long-term groundwater level. Should wet soil conditions be encountered, excavations could become difficult. It should be expected that caving or sloughing of the excavation walls will likely occur, especially when excavating into any wet to saturated soils.

5.0 DISCUSSION AND RECOMMENDATIONS

The following sections of the report provide an interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like. Utilizing the information gathered during the geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the boreholes, the following table provides a summary of the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) at the various elevations, including soil types:

BH No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevations (m)	Depth Below Existing Grade to Founding Elevation (m)	Soil Type
1	332.36	150 (3,000)	225 (4,500)	330.84 to 327.79	1.52	Silty Sand
		200 (4,000)	300 (6,000)	327.79 to 326.26 (termination)	4.57	Sand and Silt/Sand

BH No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevations (m)	Depth Below Existing Grade to Founding Elevation (m)	Soil Type
2	332.30	150 (3,000)	225 (4,500)	331.54 to 327.42	0.76	Silty Sand/Sand and Silt
		200 (4,000)	300 (6,000)	327.42 to 326.20 (termination)	4.88	Silty Sand
3	334.21	150 (3,000)	225 (4,500)	332.69 to 331.16	1.52	Silty Sand/Sand
		200 (4,000)	300 (6,000)	328.11 to 328.11 (termination)	3.05	
4	332.76	150 (3,000)	225 (4,500)	332.46 to 329.71	0.30	Silt Fill/Silty Sand/Sand and Silt
		200 (4,000)	300 (6,000)	329.71 to 326.66	3.05	
5	330.06	150 (3,000)	225 (4,500)	329.30 to 323.96 (termination)	0.76	Silty Sand/Sand and Silt/Sand

*Highest founding elevations presented above do not take into account groundwater conditions.

Based on the bearing capacities and elevations provided in the table above, suitable founding elevations for conventional foundations designed with a minimum bearing capacity of 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS were generally encountered within the native soils encountered underlying the fill materials at depths ranging from 0.3 m to 1.52 m below the existing ground surface.

Should footings be designed to be constructed at elevations higher than the elevations indicated in the table above, then structural fill will be required in order to achieve the design grades for the proposed foundations. The serviceability limit pressure for good quality granular structural fill placed and compacted in accordance with Section 5.4.4 of this report and constructed on approved competent native soil is estimated to be at least 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS. Lean mix concrete fill could also be utilized for this application. Alternatively, footings could be stepped down to bear on approved undisturbed founding soil.

Footings may be placed at a higher elevation relative to another footing provided that the slope between the outside face of the footings is separated by a minimum slope of 10 horizontal to 7 vertical (10H:7V) with an imaginary line projected from the underside of the footings. This must be taken into account for any deep structures such as elevator pits, sump pits and/or pump chambers.

It is recommended that structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively, assuming a minimum footing width of 0.6 m.

All exterior footings must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation in order to provide protection against frost action.

It should be noted that the native soils that exist at or below founding elevations in a wet state at the time of construction, may be too wet to provide suitable bearing for foundations without drainage or construction of a mud mat or granular drainage layer. It is imperative that the subgrade soil be inspected and approved by competent geotechnical personnel to ensure that the founding soils are suitable for bearing. Dewatering during construction may be required (see Section 5.8 of this report).

At the time of investigation, the proposed founding elevations were not available. CMT Inc. would be pleased to review design drawings when they become available and provide further recommendations with respect to bearing and foundation elevations.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30.0 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 6.10 m of strata. Based on the information gathered in the geotechnical field investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the native soils at the recommended founding elevations provided in Section 5.1 of this report. For foundations constructed on the existing engineered fill or structural fill, placed in accordance with Section 5.4.4 of this report, the site classification for seismic site response would be considered Site Class D (stiff soil). The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides the estimated soil design parameters for imported granular fill, as well as the existing fill and native soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, as required:

Soil Type	Soil/Rock Density (kg/m^3)	Friction Angle (Degree)	Coefficient of Active Pressure (K_a)	Coefficient of Passive Pressure (K_p)	Coefficient of At-Rest Pressure (K_o)	Coefficient of Friction (μ)	Cohesion (kPa)
Imported Granular 'A' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Imported Granular 'B' (OPSS 1010)	2,050	32°	0.31	3.25	0.47	0.41	0
Existing Fill	1,800	28°	0.36	2.77	0.53	0.35	0
Sand	1,850	33°	0.29	3.39	0.46	0.43	0
Silty Sand/Sand and Silt	1,800	32°	0.31	3.25	0.47	0.41	0

5.4. Site Preparation

The site preparation for the proposed building is anticipated to consist of topsoil stripping, building demolition, vegetation grubbing, removal of fill and unsuitable soils, the removal or relocation of any existing services, the subexcavation of all unsuitable native soils deemed not capable of supporting the design bearing capacity, followed by the placement of structural fill (as required) and site grading to achieve proposed grades.

5.4.1. Topsoil Stripping and Vegetation Grubbing

All topsoil (including buried topsoil) must be removed from within any proposed building, driveway, and parking lot envelopes to expose approved competent subgrade soils. The topsoil may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

Any vegetation (including tree stumps and root structures, as well as any loose soils that are typically associated with root structures) must be removed from within any proposed building, driveway and/or parking lot envelopes to expose approved competent subgrade soils.

5.4.2. Fill/Unsuitable Soil Removal

Any existing fill containing organic material or unsuitable deleterious materials, as well as any fill or native soils that are deemed unsuitable to support foundations or slab-on-grades, must be subexcavated from within the proposed building envelope to expose approved competent subgrade soils. It would also be sound construction practice to subexcavate all existing loose fill from any parking lot and driveway areas; however, this may not be cost-effective. At a minimum, any fill with intermixed organic material should be subexcavated to prevent issues associated with frost heaving such as loss of structural integrity and frost boils. Thorough inspection will be required at the time of construction to assess any existing fill to ensure there is no buried topsoil or other deleterious materials within the subgrade. Remedial action may also be required to further consolidate any existing fill if it is decided to leave it in place under the driveway and/or parking lot areas. It would be expected that some air-drying may be required in order to achieve the design compaction. If any existing fill is left in place in the driveway/parking lot, provisions for alterations to the design of the pavement structure should be included in the tender documents. Review of the subgrade including proof-roll and potential changes to the design of the pavement structure, as required, will have to be addressed at the time of construction.

Any subexcavated fill that may be intermixed with organics could be used in non-structural landscaped areas where some settlement can be tolerated; otherwise, it should be disposed of accordingly off-site.

5.4.3. Removal/Relocation of Existing Services

Any existing/abandoned underground services (if present) that may be located within any proposed building envelope, parking lot and/or driveway areas should be removed/relocated. If left in place, the location of existing services must be reviewed to ensure that they do not conflict with the proposed foundation locations. Any terminated piping that is left in place must be completely sealed with watertight mechanical covers, concrete or grout at termination points to prevent the migration of soils into pipe voids which can result in potential settlement. All existing trench backfill material associated with underground services must be subexcavated and the subsequent excavation should be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

5.4.4. Site Grading

Following the subexcavation of any soils deemed unsuitable of supporting foundations, slab-on-grades and/or the driveway and parking lot pavement structure, the exposed subgrade soils must be proof-rolled and any loose/soft or unstable areas must be subexcavated and replaced with approved fill materials.

Any fill materials required to achieve the design site grades should be placed according to the following procedures:

- Should the native subgrade soils at the design founding elevation in any proposed building envelope(s) be comprised of wet or saturated soils, then a granular drainage layer constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC) may be required. Alternatively, a lean mix concrete mud mat may be placed overlying the subgrade soils to provide a stable base;

- Prior to placement of any structural fill, the subgrade for any proposed new building, as well as the parking lots and driveways, must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed foundation and pavement/concrete edge (where feasible) down to the approved competent founding soils;

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for granular soils (recommended fill materials) and 0.2 m (8") in depth for silts and clays, or the capacity of the compactor (whichever is less);

- Imported granular fill materials (OPSS 1010 Type I or Type III Granular 'B' recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum compaction equipment;

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- Approved fill materials must be at suitable moisture contents to achieve the specified compaction. The wet soils encountered in the boreholes would generally be considered difficult for use as structural fill as they would require extensive air-drying in order to achieve the specified density. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including foundations, interior slab-on-grades, sidewalks, and large expansive exterior slabs) must be compacted to 100% standard Proctor maximum dry density (SPMDD);

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading, bulk fill for driveways and parking lots) must be compacted to a minimum 95% SPMDD;

- Granular 'B' subbase and Granular 'A' base materials for the roadway and driveways must be compacted to 100% SPMDD.

Based on the subsurface conditions observed in the boreholes, wet soils may be encountered, depending on the depth of excavation. As such, for soils excavated from the zone of saturation, significant air-drying along with working of the soils may be required in order to achieve the specified compaction of 100% SPMDD for structural fill and 95% SPMDD for bulk fill for the parking lot and driveways. Utilizing the existing soils during site grading may be more achievable if work is completed during the generally drier summer months. Reuse of excavated soils on-site will be subject to approval from qualified geotechnical personnel.

5.4.5. Building Demolition

Currently, multiple buildings exist on the property and are to be demolished. All above-grade structures as well as all foundations, concrete slabs and loose backfill must be removed within the proposed building envelope, driveways, and surface parking lot areas.

All excavations must be inspected and then backfilled as required according to the procedures outlined in Section 5.4.5 of this report. It is recommended that good quality imported sand and gravel (OPSS 1010 Type II or Type III Granular 'B' or an approved alternative) be placed as structural fill as required. Provided any concrete from former building foundations and slab-on-grades, as well as any other concrete on-site (if encountered) is reduced to a maximum size of 100 mm, and all reinforcing steel and any deleterious materials are removed, the reduced concrete material may be combined with imported granular fill to be utilized as fill on-site. The reuse of this material will be subject to approval from qualified geotechnical personnel.

5.5. Foundation Subgrade Preparation

The native soils encountered in the boreholes are sensitive to changes in moisture content and can become loose/soft if subjected to additional water or precipitation as well as severe drying conditions. The native subgrade soils could also be easily disturbed if traveled on during construction. Once they become disturbed, they are no longer considered adequate for the support of shallow foundations. To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- During construction, the subgrade should be sloped/ditched to a sump (as required) located outside the building footprint (if feasible) in the excavation to promote surface drainage of rainwater or seepage, and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions;

- Should the native subgrade soils at the design founding elevations in any proposed building envelope(s) comprise of wet/saturated soils, then a granular drainage layer, constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC), may be required;

- Construction equipment travel and foot traffic on the founding soils should be minimized;

- If construction is to be undertaken during subzero weather conditions, the founding native soils and any potential fill materials must be maintained above freezing;

- Prior to placing concrete for the foundation, the area must be cleaned of all disturbed or caved materials;

- The foundation formwork and concrete should be installed as soon as practical following the excavation, inspection, and approval of the founding soils. The longer that the excavated soils remains open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur;

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be placed in order to protect the structural integrity of the founding soils.

As previously indicated, it is recommended that the underside of the footings be constructed at least one footing width above the long-term groundwater level (highest elevation recorded throughout all seasons).

5.6. Slab-on-Grade/Modulus of Subgrade Reaction

Prior to the placement of the granular base for the slab-on-grade construction, the subgrade should be proof-rolled. Any soft or weak zones, as well as any potential unsuitable fill in the subgrade, should be subexcavated and backfilled with approved fill materials (see Sections 5.4.4 and 5.11 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for the native soils encountered on-site:

Soil Type	Estimated Modulus of Subgrade Reaction (k)
Imported Granular 'A'/Granular 'B' (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Sand	54,300 kN/m^3 (200 lb/in^3)
Silty Sand	68,000 kN/m^3 (250 lb/in^3)
Sand and Silt	68,000 kN/m^3 (250 lb/in^3)

Due to the high moisture content of some of the native soils in the area of the proposed building, it would be recommended that the slab-on-grade be founded on 150 mm (6") of 19 mm clear crushed stone (OPSS 1004). Utilizing clear crushed stone for the slab-on-grade base can assist in providing a moisture barrier by reducing the potential for capillary rise of moisture from the subgrade soils. Compactive effort is required to consolidate the clear stone. The 19 mm clear crushed stone should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade (sidewalks, accessibility ramps and exterior stairs) be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to provide rapid drainage and reduce the effects of frost heaving. This is particularly critical at all barrier-free access points. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. Excavations

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 3 Soils - In general, the fill and native soils encountered in the boreholes in a drained state (not wet or saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily for the protection of workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

The very dense/hard strata (soils with N-values in excess of 50 blows per 0.30 m) may prove difficult to remove with conventional excavating equipment, impacting the production schedule. It is imperative that when these very dense strata are utilized for backfilling of service trenches, the material must be broken down (pulverized) to minimize voids and reduce the potential for settlement. It is not recommended that these blocky excavated soils be utilized as structural fill.

5.8. Construction Dewatering Considerations

Saturated soils were encountered during the borehole advancement. Groundwater levels (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should be adequately controlled using conventional construction dewatering techniques such as pumping from sump pits. However, if heavy seepage occurs, it may be necessary to increase the number of pumps or install a dewatering system during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment. It is recommended that the environmental consultant for this project be consulted prior to any on-site water being discharged to municipal outlets to ensure proper procedures are followed.

5.9. Service Pipe Bedding

The existing native soils encountered in the geotechnical investigation are generally considered suitable for indirect support of the site service pipes. Should instability due to saturated soil conditions be encountered, it may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows:

Flexible Pipes - The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the centreline of the pipe. The granular material placed under the haunches of the pipe must be compacted to 100% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible for protecting existing and new service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

In order to assist in maintaining dry buildings with respect to surface water seepage, it is recommended that exterior grades around any buildings be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges with positive drainage at least 1.5 m away from the building foundations and/or beyond external slab-on-grades to a drainage swale or appropriate storm drainage system.

Depending on the design founding elevations and groundwater levels at the time of construction, it may be necessary to install a granular drainage layer to provide a suitable base for the foundations. The granular drainage layer must conform to the general requirements listed in Section 9.14.4 of the OBC 2012.

It is understood that an underground parking structure is proposed to be constructed. Should the underground parking be constructed, an exterior perimeter drainage system comprising perforated drainage pipe with a factory installed filter sock, bedded in 19 mm clear crushed stone, and wrapped in a geotextile filter fabric such as Terrafix 270R (or equivalent), is recommended to improve drainage around the buildings. The drainage pipe should be installed at the founding elevation and be constructed with positive drainage into a sump pit or other suitable outlet that provides positive drainage away from the structure. The portion of the piping that connects any exterior drainage tile system into an interior sump pit must comprise solid piping to prevent exterior water from being introduced into the interior subslab stone. It may be prudent to install perforated drainage pipe in the interior area as well as to provide an outlet for any water that may collect in the subslab stone. It is also recommended that a capped cleanout port(s) be extended up to the ground surface elevation to provide future access (if required). Rainwater leaders must not be connected to the perimeter drainage system. Any foundation walls that are constructed below the water table must be waterproofed, not dampproofed. A waterproofing system should be installed in accordance with the OBC (2012). It is recommended that a waterproofing specialist be consulted for a waterproofing system to suit the site conditions.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as imported sand or Granular 'B' Type I or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extend a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled, and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 98% SPMDD.

It is recommended that frost tapers be constructed (refer to OPSD 3101.150 for typical details) in order to minimize differential frost action between the foundation wall backfill and any paved areas. The frost taper must be constructed utilizing the OPSS 1010 granular material that is used for the foundation wall backfill.

The native mineral soils, free of any organics or deleterious materials are generally considered suitable for reuse as trench backfill and bulk fill; however, wet soils encountered may require air-drying in order to achieve the specified compaction. Air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project (keeping in mind that frost tapers, as noted above, would be recommended to minimize differential frost heave).

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for silt soils or the capacity of the compactor (whichever is less);

- The soils must be at suitable moisture contents to achieve compaction to a minimum 95% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

5.11. Pavement Design/Drainage

All loose/soft existing fill and/or native soils must be stripped and subexcavated from within any proposed sidewalks, driveways, and surface parking lot areas; however, this may not be cost-effective. At a minimum, any buried topsoil and existing fill with intermixed organic material, or other deleterious material should be subexcavated from the driveways and parking lot areas to prevent problems associated with frost heaving such as loss of structural integrity and frost boils. Thorough inspection and proof-rolling will be required at the time of construction to assess the existing fill to ensure there is no deleterious material within the subgrade. Remedial action will also be required to further consolidate any existing fill and/or loose/soft native soils if it is decided to leave them in place. It would be expected that significant air-drying may be required in order to achieve the design compaction. If any existing fill is left in place in the parking lot, provisions for the alterations to the design of the pavement structure such as increasing the thickness of the Granular 'B' base, installing a reinforcing geotextile and/or installing biaxial geogrids, should be included in the tender documents. Review of the subgrade and potential changes to the design of the pavement structure, as required, will have to be addressed at the time of construction.

Prior to placement of the granular base, the subgrade must be proof-rolled and any soft or unstable areas should be subexcavated and replaced with suitable drier materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward catch basins or to the parking lot/driveway edge (provided collection and proper gravity drainage to a suitable outlet is provided). When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.10 and 5.11 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. The requirement for subdrains will be dependent on the composition of the prepared pavement subgrade soils. The existing soils encountered in the boreholes are considered to be frost-susceptible soils and as such, it is recommended to install subdrains (provided gravity drainage to a suitable outlet can be provided). It is recommended to install minimum 100 mm diameter perforated subdrains to collect and redirect water beneath the pavement surface. Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If Granular 'A' bedding (OPSS 1010) is utilized, the subdrains should be equipped with a factory installed filter sock. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain, then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent) and a factory installed filter sock is not required. Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that, at a minimum, subdrains be installed through all low areas in the parking areas and driveways, and ideally along the curb lines as well to prevent water from entering the granular subbase. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native subgrade soils are sensitive to changes in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

It is expected that the driveways and/or parking lots will experience mostly light traffic (personal vehicles) and some heavy traffic (delivery trucks, maintenance, and emergency vehicles).

Based on the anticipated loading, the following pavement design is provided:

Material	**Recommended Thickness For New Pavement**
	Light Traffic
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")
Granular 'A' Base	150 mm (6.0")
Granular 'B' Subbase	400 mm (16.0")

Should wet to saturated conditions be encountered during construction, site assessments may be required at the time of construction to determine what options can be undertaken to construct a stable driveway and parking lot base. These options may include subexcavation and increasing the thickness of the Granular 'B' subbase, the use of reinforcing geotextile and/or geogrid, or a combination of all. As such, it is recommended that provisions for subexcavation and disposal of wet soils, importing and placing additional Granular 'B' (OPSS 1010), as well as supply and placement of a reinforcing geotextile (Terrafix 270R or equivalent) and geogrid (Tensar BX1200 or equivalent) should be included in the tender documents.

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed, and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

Construction joints in the surface asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Frost tapers must be constructed at any changes from light traffic to heavy traffic areas. If heavy traffic routes are not delineated by barriers or if it is anticipated that heavy equipment (such as loaders and dump trucks) will be utilized for snow removal, it would be recommended that the heavy traffic pavement structure be utilized throughout.

Where new asphalt is joined into existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 80 mm and a width of 300 mm as per OPSD 509.010. It is recommended that a tackcoat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The damage can occur from both passenger vehicles as well as large vehicles. The condition is further intensified during hot weather. In high traffic/tight turning areas, it is recommended that rigid Portland cement pavement be considered.

5.12. Chemical Analyses/Excess Soil Management

5.13.1. Chemical Testing was NOT Undertaken by CMT Engineering Inc.

Generally, if surplus soils are to be exported off-site, it will be necessary to perform chemical analysis of the soils. Chemical analysis was not undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by the general contractor.

5.13.2. Leachate Testing Requirement

If soils are transported to a landfill facility, additional chemical testing in accordance with Ontario Regulation 347, Schedule 4, as amended to Ontario Regulation 558/00, dated March 2001, Toxicity Characteristic Leaching Procedure (TCLP) will be required.

When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, who must agree to receive the material.
- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material.
- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the pre-approved site.
- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

5.14. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock, and water. When radon escapes the earth outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

6.0 SITE INSPECTIONS

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading and site servicing. This will ensure that footings are founded in the proper strata and that proper material and techniques are used and the specified compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed development.

7.0 LIMITATIONS OF THE INVESTIGATION

This report is intended for the Client named herein and for their Client. The report should be read in its entirety, and no portion of this report may be used as a separate entity. 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.

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made.

We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by:

Jake Feeney, P. Eng.

ht

Reviewed by:

Nathan Chortos, P.Eng.
Senior Engineer

NOTES:

Base map provided by Google.

Legend

CMT Borehole - 2023

Benchmark

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

PROJECT:

PROPOSED BUILDING
303, 309, 317 Speedvale Ave. East
Guelph, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
23-399	July 26, 2023
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

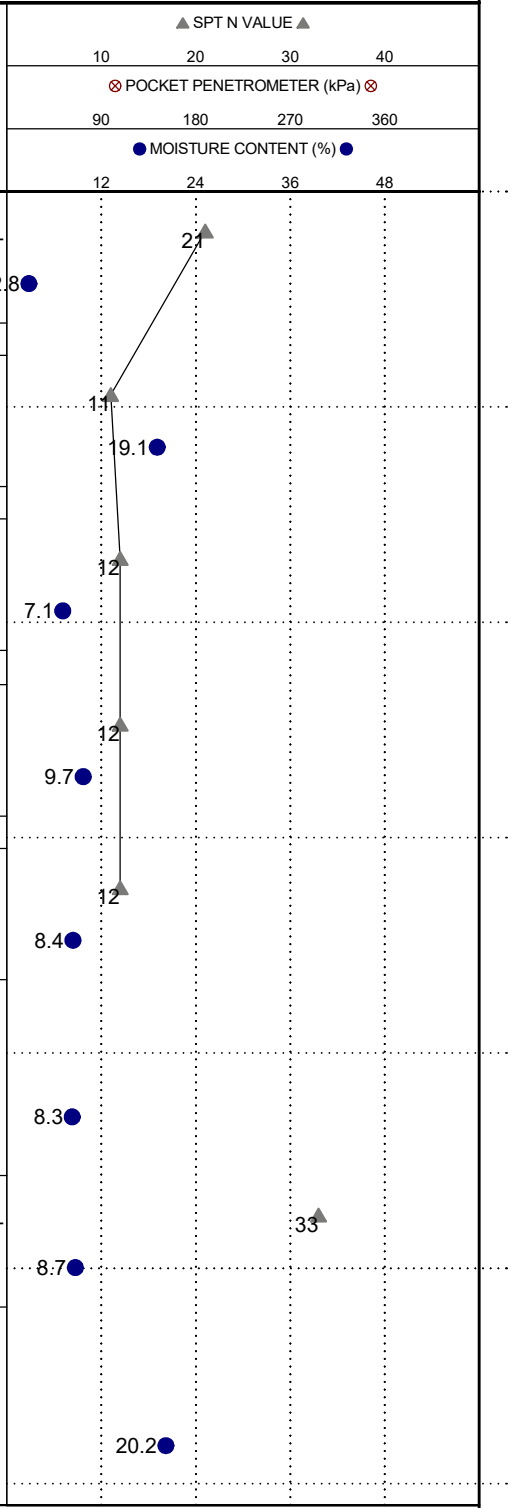
BOREHOLE LOGS

CMT Engineering Inc.
1011 Industrial Crescent. St. Clements
N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 1

PROJECT: Proposed Building
PROJECT ADDRESS: 303, 309, 317 Speedvale Ave E
PROJECT NUMBER: 23-399
PROJECT LOCATION: Guelph, Ontario
DRILLING DATE: 23-7-10
GROUND ELEVATION: 332.36 m
DRILLING CONTRACTOR: CMT Drilling Inc
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Asphalt: (80 mm)	0.00, 332.36			
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.08, 332.28	SPT 1	49	18-10-11-12 (21)
1	**Silty Sand Fill:** Compact, brown silty sand fill, some clay, trace gravel, moist Organics observed	0.76, 331.60	SPT 2	49	8-6-5-6 (11)
2	**Silty Sand:** Compact, brown silty sand, some clay and gravel, moist Wet sand and gravel seam observed at about 4.27 m below the ground surface [150 mm]	1.52, 330.84	SPT 3	49	3-4-8-9 (12)
			SPT 4	100	5-7-5-6 (12)
3			SPT 5	100	4-4-8-13 (12)
4			MC5 6	100	
5	**Sand and Silt:** Dense, grey sand and silt, some clay, trace gravel, moist	4.57, 327.79	SPT 7	100	16-16-17-19 (33)
			MC5 8	100	
6	**Sand:** Dense, brown sand, some gravel, trace silt, saturated	5.64, 326.72			



Borehole caved at about 5.18 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 6.10 m, Elevation 326.26 m.

CMT Engineering Inc.
1011 Industrial Crescent. St. Clements
N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

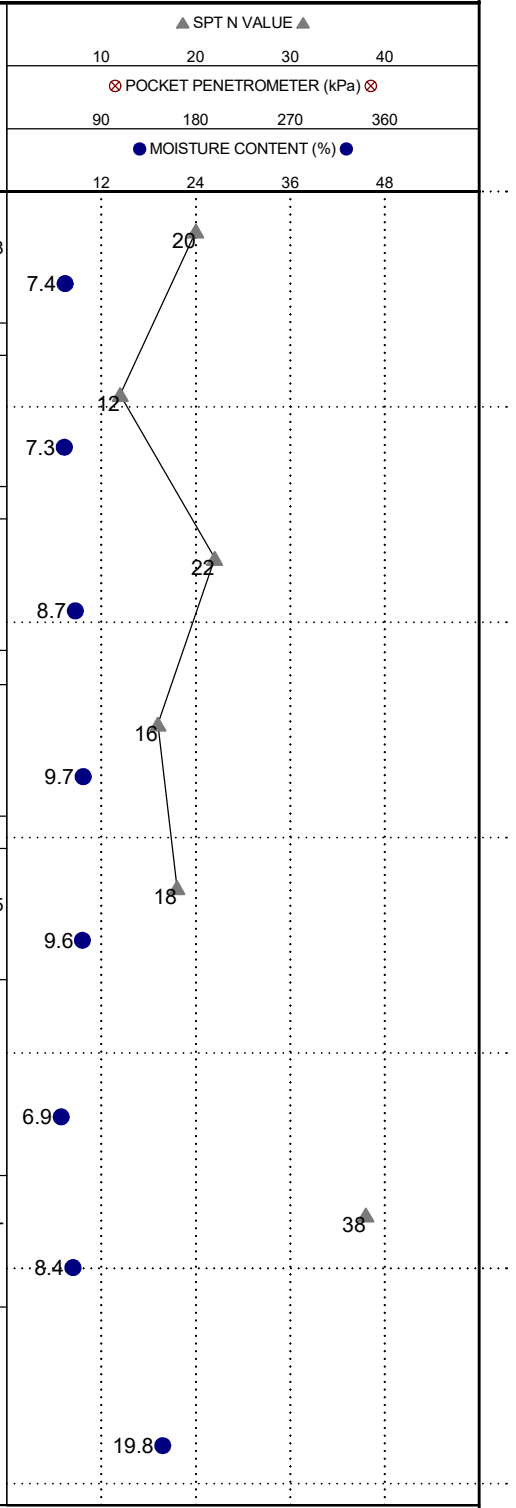
BOREHOLE NUMBER 2

PROJECT: Proposed Building
PROJECT ADDRESS: 303, 309, 317 Speedvale Ave E
PROJECT NUMBER: 23-399
PROJECT LOCATION: Guelph, Ontario
DRILLING DATE: 23-7-10
GROUND ELEVATION: 332.30 m
DRILLING CONTRACTOR: CMT Drilling Inc
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Asphalt: (80 mm)	0.00, 332.30			
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.08, 332.22	SPT 1	49	25-12-8-8 (20)
1	**Silty Sand:** Compact, brown silty sand, some clay and gravel, very moist to wet	0.76, 331.54	SPT 2	74	4-5-7-7 (12)
2			SPT 3	49	9-14-8-9 (22)
			SPT 4	49	9-9-7-8 (16)
3					
	Sand and Silt: Compact, grey-brown sand and silt, some clay, trace gravel, moist	3.05, 329.25	SPT 5	49	7-7-11-15 (18)
4			MC5 6	100	
			SPT 7	100	20-18-20-25 (38)
5	**Silty Sand:** Dense, grey-brown silty sand, some clay and gravel, wet to saturated	4.88, 327.42			
			MC5 8	100	
6					

Borehole caved at about 4.57 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 6.10 m, Elevation 326.20 m.



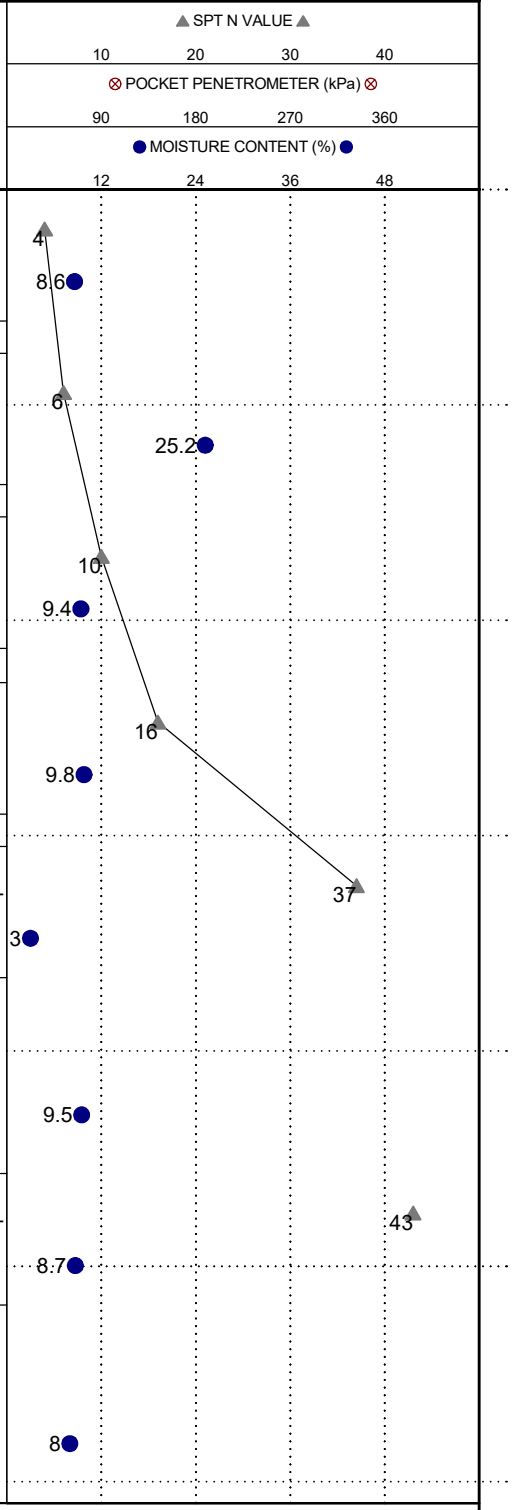
BOREHOLE LOG2 23-399.GPJ CMT_TEMPLATE_2020-05-15.GDT 23-8-3

CMT Engineering Inc.
1011 Industrial Crescent. St. Clements
N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Proposed Building
PROJECT ADDRESS: 303, 309, 317 Speedvale Ave E
PROJECT NUMBER: 23-399
PROJECT LOCATION: Guelph, Ontario
DRILLING DATE: 23-7-10
GROUND ELEVATION: 334.21 m
DRILLING CONTRACTOR: CMT Drilling Inc
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Topsoil: Loose, silty, organic topsoil, moist	0.00, 334.21	SPT 1	49	0-1-3-8 (4)
	Silty Sand Fill: Loose, brown silty sand fill, some clay, trace gravel, moist	0.30, 333.91			
1	**Topsoil:** Loose, dark brown, silty, organic, buried topsoil, moist	0.91, 333.30	SPT 2	100	5-3-3-3 (6)
	Silty Sand: Compact, brown silty sand, some clay, trace gravel, moist	1.52, 332.69	SPT 3	100	4-4-6-6 (10)
2			SPT 4	100	4-7-9-7 (16)
3	**Sand:** Dense, brown sand, some silt, trace gravel, moist	3.05, 331.16	SPT 5	100	15-16-21-29 (37)
4			MC5 6	100	
	Silty Sand: Dense, brown silty sand, some clay and gravel, moist	4.42, 329.79	SPT 7	100	23-24-19-15 (43)
5			MC5 8	100	
6					



Borehole caved at about 5.79 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 6.10 m, Elevation 328.11 m.

CMT Engineering Inc.
1011 Industrial Crescent. St. Clements
N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

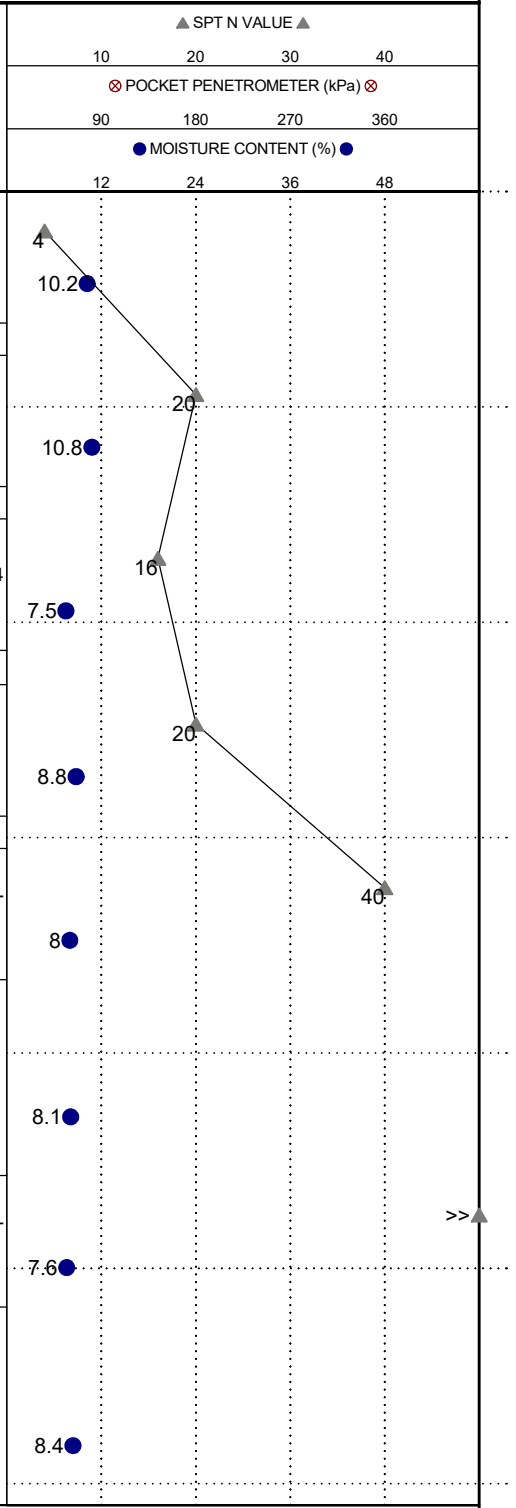
BOREHOLE NUMBER 4

PROJECT: Proposed Building
PROJECT ADDRESS: 303, 309, 317 Speedvale Ave E
PROJECT NUMBER: 23-399
PROJECT LOCATION: Guelph, Ontario
DRILLING DATE: 23-7-10
GROUND ELEVATION: 332.76 m
DRILLING CONTRACTOR: CMT Drilling Inc
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Topsoil: Loose, dark brown, silty, organic topsoil, moist	0.00, 332.76	SPT 1	49	1-1-3-6 (4)
	Silt Fill: Compact, brown silt fill, some sand, trace gravel, moist	0.30, 332.46			
1			SPT 2	49	7-13-7-5 (20)
	Silty Sand: Compact, brown silty sand, some clay and gravel, moist	1.52, 331.24	SPT 3	49	6-6-10-14 (16)
2			SPT 4	100	11-12-8-10 (20)
3	becoming dense	3.05, 329.71	SPT 5	100	17-18-22-25 (40)
4			MC5 6	85	
	Sand and Silt: Very dense, brown sand and silt, some clay, trace gravel, moist	4.57, 328.19	SPT 7	100	29-41-46-50 (87)
5					
			MC5 8	100	
6					

Borehole open to about 6.10 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 6.10 m, Elevation 326.66 m.

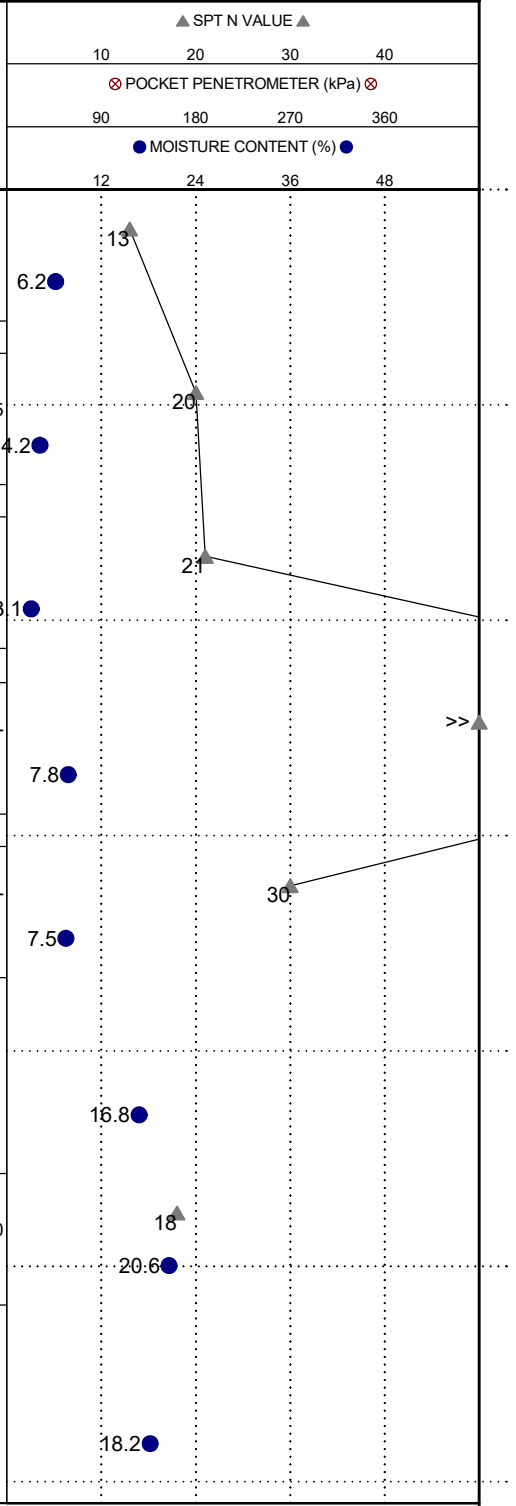


CMT Engineering Inc.
1011 Industrial Crescent. St. Clements
N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 5

PROJECT: Proposed Building
PROJECT ADDRESS: 303, 309, 317 Speedvale Ave E
PROJECT NUMBER: 23-399
PROJECT LOCATION: Guelph, Ontario
DRILLING DATE: 23-7-10
GROUND ELEVATION: 330.06 m
DRILLING CONTRACTOR: CMT Drilling Inc
LOGGED BY: J. Feeney
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	Asphalt: (100 mm)	0.00, 330.06			
	Sand and Gravel Fill: Compact, brown sand and gravel fill, trace silt, moist	0.10, 329.96	SPT 1	74	9-5-8-8 (13)
1	**Silty Sand:** Compact, brown silty sand, some clay, trace gravel, moist	0.76, 329.30	SPT 2	49	5-8-12-15 (20)
2			SPT 3	100	16-12-9-11 (21)
	Sand and Silt: Dense to very dense, brown sand and silt, some clay, trace gravel, moist	2.29, 327.77	SPT 4	16	50-50-50-50 (100)
3			SPT 5	100	11-12-18-20 (30)
	Sand: Dense to compact, grey sand, trace silt and gravel, saturated	3.66, 326.40	MC5 6	100	
4					
			SPT 7	100	7-8-10-10 (18)
5					
			MC5 8	100	
6					



Borehole caved at about 4.42 m below the ground surface. No accumulated groundwater observed upon completion.

Bottom of borehole at 6.10 m, Elevation 323.96 m.

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	10.6	5.3	13.5	23.7	32.8	14.1

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	5	3.05-3.66m	silty sand, some clay and gravel	SM
				Sampled by JF of CMT Engineering Inc. July 10, 2023	
				Tested by JM of CMT Engineering Inc. July 11, 2023	

CMT Engineering Inc.

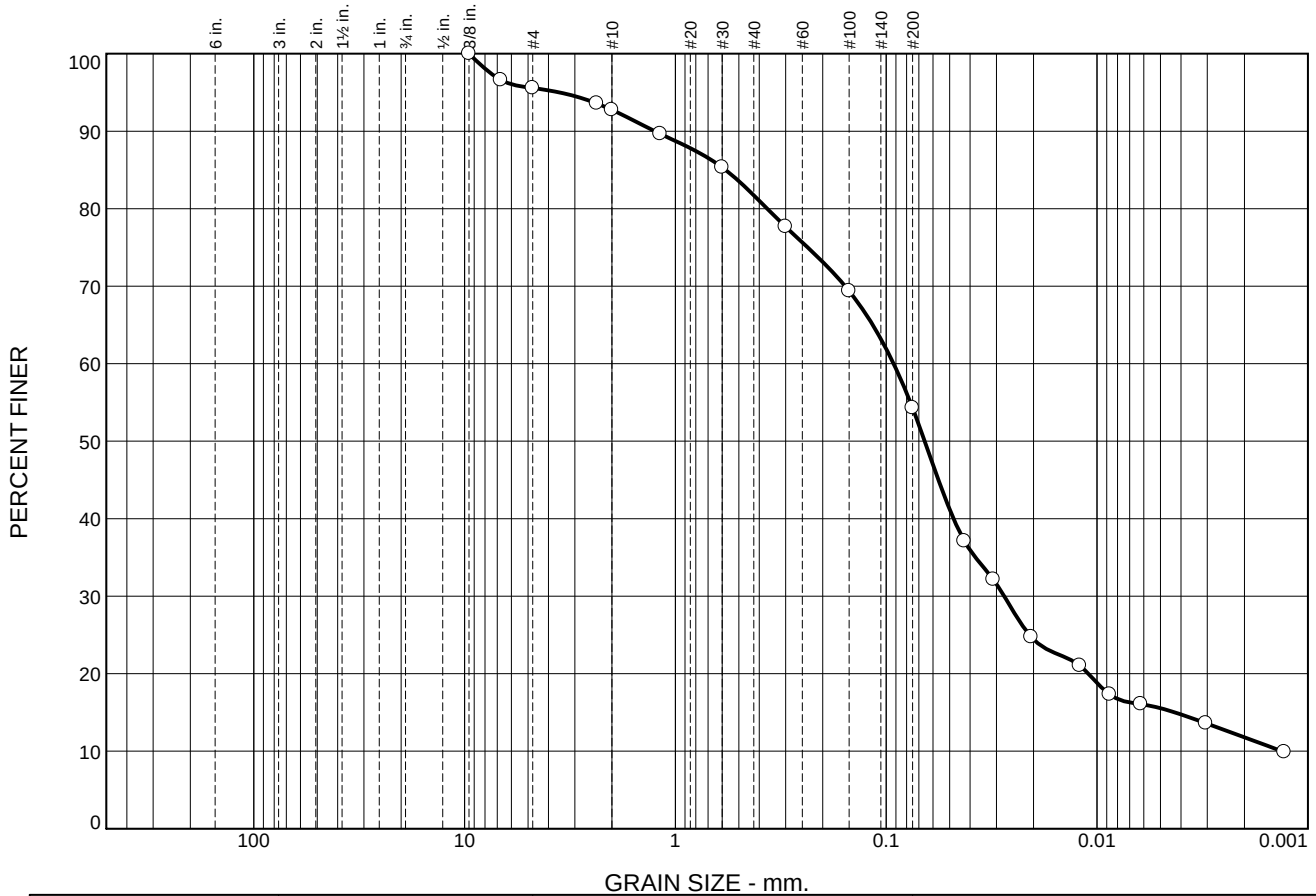
St. Clements, ON

Client: Habitat for Humanity Guelph-Wellington

Project: Proposed Building
303, 309, 317 Speedvale Avenue East, Guelph, Ontario

Project No.: 23-399 **Figure** 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	4.4	2.8	11.1	27.4	38.8	15.5

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	7	4.57-5.18m	sand and silt, some clay, trace gravel	ML
				Sampled by JF of CMT Engineering Inc. July 10, 2023	
				Tested by JM of CMT Engineering Inc. July 11, 2023	

CMT Engineering Inc.

St. Clements, ON

Client: Habitat for Humanity Guelph-Wellington

Project: Proposed Building
303, 309, 317 Speedvale Avenue East, Guelph, Ontario

Project No.: 23-399 **Figure** 2