GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
306 WOODVIEW DRIVE
ATWOOD, ONTARIO

CMT Project 23-975.R01

Prepared for:

1000535777 Ontario Inc.

February 12, 2024

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February 12, 2024 23-975.R01

1000535777 Ontario Inc.
200-260 King Street West
Kitchener, Ontario
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Attention: Bernie Nimer

Dear Sir:

Re: Geotechnical Investigation
Proposed Residential Subdivision
306 Woodview Drive
Atwood, 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,

Brittany Lingelbach, C.Tech., rcji

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1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Scott J. Patterson of Patterson Planning Consultants Inc. on behalf of the landowner/developer (1000535777 Ontario Inc.) to conduct a geotechnical investigation for the proposed development to be constructed at 306 Woodview Drive in Atwood, Ontario. A hydrogeological study was also completed for this site by Hydrogeology Consulting Services (HCS) and will be provided under separate cover. The location of the site is shown on Drawing 1.

It is understood that the project will comprise the construction of a new residential subdivision with sixty-two (62) residential lots as well as associated roadways, driveways, and underground services.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes and monitoring wells. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding the estimated geotechnical resistance (bearing capacity); estimated serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; 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 results.

The recommendations in this report are solely based on the soil conditions encountered in the boreholes advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

Currently, the site comprises vacant agricultural land, previously used for crop production. At the time of the investigation, the field had been tilled and was snow-covered. Near the West corner of the site is a concrete-block shed with a driveway from the end of Woodview Drive. No other existing structures are currently located on the property.

The site is bounded by residential properties to the West, a former rail line/recreational trail to the North, and vacant land and wooded areas to the South and East. A creek is located along the Southeast boundary of the site. In general, the site topography is relatively flat.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on January 8 and 9, 2024 and comprised the advancement of eight (8) boreholes (referenced as Boreholes 1 to 8) utilizing a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc.

Boreholes 1, 2, 7 and 8 were advanced to depths of approximately 10.67 m (35.0 ft) below the existing ground surface, while Boreholes 3, 4, 5 and 6 were advanced to depths ranging from 4.57 m to 5.18 m (15.0 ft to 17.0 ft) below the existing ground surface.

Boreholes 1, 2, 7 and 8 were equipped with 38 mm diameter PVC monitoring wells comprising a 3.05 m long screen backfilled with filter sand and then riser pipe, backfilled with bentonite. The monitoring wells were installed according to the Ontario Water Resources Act, Regulation 903 (O.Reg. 903) by well technicians licensed by the Ministry of the Environment, Conservation and Parks (MECP). The boreholes that were not instrumented with monitoring wells were backfilled with bentonite in accordance with O.Reg. 903. The monitoring wells are registered with the MECP and must be decommissioned in accordance with O.Reg. 903 prior to future construction. The MECP well log records are provided in Appendix C.

Standard penetration testing (SPT) and sampling was carried out in all 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 3.0 m (10.0 ft) and every 1.52 m (5.0 ft) thereafter to 5.18 m (17.0 ft). Macro core (MC5) direct push sampling in accordance with ASTM D6282/D6282M-14 "Standard Guide for Direct Push Soil Sampling" was generally conducted between the SPT samples below 3.0 m (10.0 ft) in the boreholes to termination.

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 the CMT Inc. laboratory in St. Clements, Ontario for grain size analyses:

- Borehole 1 – depth 2.29 m to 2.90 m (7.5 ft to 9.5 ft),
- Borehole 5 – depth 3.05 m to 3.66 m (10.0 ft to 12.0 ft),
- Borehole 7 – depth 1.52 m to 2.13 m (5.0 ft to 7.0 ft), and
- Borehole 8 – depth 7.62 m to 9.14 m (25.0 ft to 30.0 ft).

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

The ground surface elevations at the borehole locations were surveyed by CMT Inc. personnel, using laser surveying equipment. The manhole cover located on Woodview Drive was used as a temporary benchmark, with a reported geodetic elevation of 364.41. The ground surface elevations at the borehole locations ranged from approximately 363.57 m at Borehole 8 to 364.18 m at Borehole 1. The locations of the boreholes and temporary benchmark are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the boreholes are described briefly below and a more detailed stratigraphic description is 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. Topsoil

Loose, moist, dark brown, silty topsoil was encountered at the surface of all boreholes and was observed to range in thickness from approximately 200 mm to 330 mm (average 260 mm). The topsoil thickness should be expected to 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.

4.2. Clayey Silt/Silt and Clay

Mottled Grey-brown, brown, or grey clayey silt/silt and clay, with some sand to sandy, trace gravel and occasional cobbles was the predominant soil type encountered underlying the topsoil at all of the borehole locations. The clayey silt/silt and clay soils were considered to be soft near the surface to very stiff in the lower extents, with SPT N-values ranging from 1 to 100+ blows per 0.3 m (average 22 blows per 0.3 m) and estimated undrained shear strength values (pocket penetrometer) ranging from approximately 200 kPa to 450 kPa (average 400 kPa). The clayey silt/silt and clay was considered to be moist (drier than the plastic limit), with moisture contents ranging from about 10.2% to 18.8% (average 14.5%).

4.3. Silty Sand

Brown silty sand with trace to some clay was encountered within the clayey silt soils in Borehole 3. The silty sand soils were considered to be loose, with an SPT N-value of 9 blows per 0.3 m. The silty sand was considered to be very moist with moisture content of about 14.8%.

4.4. Groundwater

Four (4) monitoring wells were installed as part of the geotechnical and hydrogeological investigation. The monitoring wells were installed and registered in accordance with the Ontario Water Resources Act, Regulation 903 (O.Reg. 903) by well technicians licensed by the Ministry of the Environment (MECP), working for a contractor also licensed by the MECP.

The following table provides groundwater elevations in the monitoring wells, measured by HCS on January 24, 2024:

Location	Ground Surface Elevation (m)	Approximate Elevation (and Depth) of Water in Monitoring Wells (m) January 3, 2024	Approximate Bottom of Monitoring Well Elevation (m)
1	364.18	361.80 (depth 2.38 m)	353.51
2	363.71	361.66 (depth 2.05 m)	353.04
7	363.82	360.90 (depth 2.92 m)	353.15
8	363.57	360.62 (depth 2.95 m)	352.90

Due to the fine-grained nature and slow response time of the native, predominantly clay and silt-based soils, accumulated groundwater was not observed upon completion of any of the boreholes. The fine-grained clayey silt/silt and clay soils encountered throughout the site are typically low in permeability and have the potential to create perched water conditions in any overlying soils. It should be noted that groundwater conditions (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.

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report.

5.0 DISCUSSION AND RECOMMENDATIONS

It is understood that the project will comprise the construction of a new residential subdivision with sixty-two (62) residential lots as well as associated roadways, driveways, and underground services.

The following sections of the report provides 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 the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) pressures at the various elevations, including soil types:

Borehole No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevation (m)	Depth to Highest Founding Elevation (m)	Soil Type
1	364.18	75 (1,500)	112 (2,250)	363.11 to 362.66	1.07 to 1.52	Clayey Silt
		150 (3,000)	225 (4,500)	362.66 to 353.51 (termination)	1.52 to 10.67 (termination)	
2	363.71	75 (1,500)	112 (2,250)	362.80 to 361.88	0.91 to 1.83	Clayey Silt
		150 (3,000)	225 (4,500)	361.88 to 353.04 (termination)	1.83 to 10.67 (termination)	
3	363.67	150 (3,000)	225 (4,500)	362.15 to 358.49 (termination)	1.52 to 5.18 (termination)	Clayey Silt
4	363.96	75 (1,500)	112 (2,250)	363.20 to 362.44	0.76 to 1.52	Clayey Silt
		150 (3,000)	225 (4,500)	362.44 to 358.78 (termination)	1.52 to 5.18 (termination)	
5	363.61	75 (1,500)	112 (2,250)	362.70 to 361.78	0.91 to 1.83	Clayey Silt/ Silt and Clay
		150 (3,000)	225 (4,500)	361.78 to 359.04 (termination)	1.83 to 4.57 (termination)	
6	363.70	150 (3,000)	225 (4,500)	362.18 to 358.52 (termination)	1.52 to 5.18 (termination)	Clayey Silt
7	363.82	150 (3,000)	225 (4,500)	363.06 to 353.15 (termination)	0.76 to 10.67 (termination)	Clayey Silt

Borehole No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevation (m)	Depth to Highest Founding Elevation (m)	Soil Type
8	363.57	75 (1,500)	112 (2,250)	362.81 to 362.05	0.76 to 1.52	Clayey Silt
		150 (3,000)	225 (4,500)	362.05 to 352.90 (termination)	1.52 to 10.67 (termination)	

Based on the information obtained from the geotechnical investigation and summarized in the table above, suitable founding soils capable of supporting conventional foundations designed with a minimum bearing capacity of 75 kPa (1,500 psf) at SLS were generally encountered between approximately 0.76 m and 1.52 m below the existing ground surface (elevations of approximately 363.20 m to 362.15 m).

The soils were observed to increase in density with depth, and as such soils capable of supporting conventional foundations designed with a minimum bearing capacity of 150 kPa (3,000 psf) at SLS were generally encountered at depths ranging from 0.76 m to 1.83 m (elevations of approximately 363.06 m to 361.78 m).

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 on suitable subgrade soils and compacted in accordance with Section 5.4.4 of this report is estimated to be at least 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS. Alternatively, lean mix concrete fill could be used, or footings could be stepped down to bear on approved undisturbed founding soils. It is imperative that the founding soils be assessed at the time of construction by qualified geotechnical personnel in order to confirm their founding suitability.

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.

Should wet to saturated soils be encountered during excavation, it is recommended that widened footings are considered for the support of the structure.

Footings founded on soil 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.

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).

All exterior footings must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation (sufficient thermal insulation is required to protect all footings and slab-on-grades during construction until such a time that the structure is heated) in order to provide protection against frost action.

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 4.57 m to 10.67 m (15.0 ft to 35.0 ft) 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 as well as structures founded on structural fill placed in accordance with Section 5.4.4 of this report. 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 estimated soil design parameters for imported granular fill, as well as the native soils encountered on the subject 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 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 (Undrained) (kPa)
Imported Granular 'A'	2,100	34°	0.28	3.54	0.44	0.45	0
Imported Granular 'B'	2,050	32°	0.31	3.25	0.47	0.41	0
Clayey Silt/ Silt and Clay	1,850	28°	0.36	2.77	0.53	0.35	–5-10
Silty Sand	1,800	30°	0.33	3.00	0.50	0.38	0

5.4. Site Preparation

The site preparation for the proposed residential subdivision is anticipated to consist of the stripping of topsoil, removal of the existing structures, the sub-excavation of any loose/soft fill or native soils deemed not capable of supporting the design bearing capacity, removal or relocation of any existing services and buried piping (including any drainage tiles), followed by the placement of structural fill or lean mix concrete (as required) and site grading to achieve proposed grades.

5.4.1. Topsoil Stripping/Vegetation Grubbing

All existing topsoil and vegetation (including roots and all loose/disturbed soils associated with the roots) must be removed from within any proposed building envelopes, roadways, and driveways 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.

The volume of topsoil removed during the stripping process is also relative to the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping. If an excavator with a smooth bucket is utilized for stripping, there would generally be less potential for topsoil to become intermixed with the underlying relatively loose subsoil and therefore less concern of over-excavation to remove all topsoil. If the topsoil is stripped with wheeled equipment or bulldozers, then there is an increased potential for the topsoil and subsoil to become intermixed, subsequently requiring additional excavation to remove all topsoil. This is further influenced by rutting which can occur during wet conditions.

5.4.2. Removal of Existing Building

It is assumed that the existing concrete-block shed, and the associated foundation will be removed to make way for the proposed access road for the new development. All foundations, foundation backfill and any other subsurface infrastructure should be removed prior to the subgrade preparation for the proposed roadway. All excavations must be inspected and then backfilled as required according to the procedures outlined in Section 5.4.4 of this report. It is recommended that good quality imported sand and gravel (OPSS 1010 Type I, II or III Granular 'B' or an approved alternative) be placed as structural fill as required. Provided any concrete from the foundation 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, or any other site material, will be subject to approval from qualified geotechnical personnel.

5.4.3. Removal/Relocation of Existing Services and Buried Piping

Any existing services and buried pipes (including field drainage tiles) that may be located within the proposed building envelopes must be removed/relocated. Any piping that is left in place that is no longer active must be completely sealed with watertight mechanical covers, concrete, or grout at termination points to prevent the migration of soils into pipe voids, which may result in potential settlement. All existing trench backfill material associated with any existing buried pipes must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.4 of this report.

It is a requirement of the Ontario Water Resources Act, Regulation 903, that any wells be decommissioned by an MECP licensed well contractor if they are no longer required. The three (3) monitoring wells that have been installed to determine static water levels and/or collect environmental samples can be decommissioned by an MECP licensed well contractor with a Class 1, Class 2, or Class 3 license in accordance with Reg. 903.

5.4.4. Site Grading/Structural Fill

Currently, the proposed final grades for the subject site are unknown. Following the stripping of all topsoil/vegetation, as well as the subexcavation of any relatively loose native soils that are not considered suitable to support foundations, the exposed subgrade soils must be proof-rolled, and any observed soft or unstable areas must be further 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 elevations in the proposed building envelopes be comprised of wet to 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 founding soils to provide a stable base;

- Prior to placement of any structural fill or bulk fill, the subgrade 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 foundations 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 imported granular soils (recommended fill material) and 0.2 m (8") in depth for the existing, fine-grained soils (site grading utilizing the existing relatively fine-grained clay/silt based soils could be difficult if there are fluctuations in moisture content due to inclement weather or long dry periods), or the capacity of the compactor (whichever is less);

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

- Fine-grained silt and clay soils must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- Approved fill materials must be at suitable moisture contents (at or near to the optimum moisture content as determined by laboratory Proctor testing) to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Soils may require the addition of water or air drying in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including house foundations, retaining walls, interior slab-on-grades, sidewalks, large expansive exterior slabs, and decks) must be compacted to a minimum of 100% standard Proctor maximum dry density (SPMDD). The native clayey silt/silt and clay soils may be difficult to use as structural fill, as cohesive soils can be subject to excess void space and potential settlement if not properly placed and compacted and may require air-drying (depending on the time of year and weather conditions at the time of construction);

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading, bulk fill for roads and driveways) must be compacted to a minimum 95% SPMDD. It would be expected that the existing on-site native soils, free of any deleterious materials, would be suitable for use as bulk fill; however, depending on the time of year and weather conditions when construction takes place, soils will likely require air-drying in order to achieve the specified density;

- Granular 'B' subbase and Granular 'A' base materials for any proposed roads and driveways must be compacted to 100% SPMDD.

Due to the fine-grained nature of the native, predominantly clay and silt-based soils encountered in the boreholes, they can be easily disturbed and subject to strength losses, making travel on this material somewhat difficult with conventional rubber-tired construction equipment such as dump trucks and even smooth drum vibratory compactors. Conditions should be expected to worsen if the soils are in a wet condition. Therefore, it is recommended that construction traffic be minimized, where possible, from driving on the subgrade soils. Depending on the time of year, it may be required to construct a haul road utilizing a Granular 'B' base.

It should be noted that the existing native clayey silt/silt and clay soils were observed to become very stiff with depth. It is imperative that if the very stiff soils are utilized as fill, the material must be broken down (pulverized) to minimize void space and reduce the potential for settlement. Problems associated with compacting very stiff soils include the potential for long-term settlement due to excessive void space caused by the generally blocky structure of the excavated soils. As such, the very stiff, blocky material must not be used as structural fill. The contractor must have equipment on-site that can effectively break down (pulverize) the very stiff excavated soil into workable sizes (as required). Backfilling utilizing this material must be performed in thin lifts with considerable compactive effort applied, thereby reducing the void space, and minimizing long-term settlement. This process could be difficult and time-consuming.

5.5. Foundation Subgrade Preparation

The soils encountered in the boreholes are sensitive to changes in moisture content and can become loose/soft if the soils are subjected to additional water or precipitation, as well as severe drying conditions. The 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 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 footprints (if feasible) in the excavations 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 soils at the design founding elevation in the proposed building envelopes be comprised 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. Alternatively, a lean mix concrete mud mat may be placed over top of the subgrade soils to provide a stable base;

- 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 footings, the footing 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 remain 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.

If wet soils are encountered at the founding elevations, pumping from properly constructed and filtered sumps located in the base of the excavation and outside of the bearing areas of any footings may be required to remove water from the excavation.

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

Prior to the placement of the granular base material for any slab-on-grade construction, the subgrade soils should be proof-rolled. Any soft or weak zones, as well as the unsuitable fill in the subgrade, should be subexcavated and backfilled with approved fill materials (see Sections 5.4.4 and 5.10 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	Estimated Modulus of Subgrade Reaction (k)
Imported Sand and Gravel (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Clayey Silt/Silt and Clay	40,700 kN/m^3 (150 lb/in^3)
Silty Sand	54,300 kN/m^3 (200 lb/in^3)

In dry conditions, the floor slab can be founded on a minimum thickness of 150 mm (6") of Granular 'A' (OPSS 1010) and compacted to 100% SPMDD. Alternatively, (particularly in wet conditions), 150 mm (6") of 19 mm clear crushed stone (OPSS 1004) could be utilized instead of Granular 'A'. The use of 19 mm clear crushed stone assists in creating a moisture barrier by reducing/preventing capillary rise of moisture from the subgrade. 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 (including any entrance slabs, and other large expansive slabs such as sidewalks) be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points and at the location of out swinging doors. 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 2 Soils - In general, the native clayey silt/silt and clay soils in a drained state (not wet or saturated), would be classified as Type 2 soils under Reg 213/91. The Type 2 soils must be sloped from within 1.2 m of the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or 4 soils that are exposed in the excavation must be treated Type 3 or 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 3 Soils - In general, the native silty sand soils encountered, and any fill soils that may be encountered, 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. Soils underlain by Type 4 soils that are exposed in the excavation must be treated Type 4 soils (see below). All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils (if encountered) 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 to protect 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. If the excavation is not a trench, no worker should be required to be closer to a wall of the excavation than the height of the excavated wall.

Sloughing/caving of the excavation walls should be expected when excavating into wet to saturated soils, if encountered. As such, it may be necessary to increase the width of the excavation to accommodate sloughing/caving soils.

5.8. Construction Dewatering Considerations

Monitoring wells were installed in Boreholes 1, 2, 7 and 8 as part of the hydrogeological study by HCS. The hydrogeological study should be referred to for additional information regarding the site groundwater conditions.

The relatively fine-grained clay and silt-based soils encountered throughout the site have the potential to create perched water conditions in any overlying soils. It should be noted that groundwater conditions (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 generally 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 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.

5.9. Service Pipe Bedding

The native soils encountered in the geotechnical investigation are generally considered suitable for indirect support of the site service pipes. Should instability due to wet 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 95% 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 to protect service piping from damage by heavy equipment.

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

Based on the observations in the boreholes, there is a potential for occasional wet soil seams to be encountered. If applicable, the construction of foundations or slabs-on-grade within or below any zones of saturation will require design of site-specific waterproofing systems constructed in accordance with the 2012 OBC. If required, it would be recommended that a waterproofing supplier/specialist be consulted to recommend an appropriate product and installation requirements that would be suited to this site.

Since foundations constructed within wet soils may be subject to flooding, it is generally recommended that foundations be constructed at least one footing width (minimum 0.5 m) above the static water level, if possible. Groundwater elevations (perched and regional water tables) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year and should be expected to fluctuate.

It is expected that the proposed new residences will include basements, in which case perimeter drainage systems would be required. The drainage systems 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. Perforated subdrains should be installed around the exterior perimeter (if there is potential for wet conditions, and non-perforated pipe should be installed to direct the collected exterior water to a sump pit and good quality sump pump. Each unit should have its own separate sump pump system. It is recommended that good quality sump pumps be utilized, and that the systems be equipped with a battery backup in the event of power failure (keeping in mind that a battery backup system does not typically have a long run-time). 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 systems. Foundation wall and slab-on-grade waterproofing must conform to current OBC regulations (as required).

In order to assist in maintaining dry buildings with respect to surface water seepage, it is recommended that exterior grades around the new residences 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 foundations and/or beyond external slab-on-grades such as sidewalks to a drainage swale or appropriate storm drainage system.

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 extends 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 the paved driveways. The frost taper must be constructed utilizing the OPSS 1010 granular material that is used for the foundation wall backfill.

The native soils, free of any organics or deleterious materials, are generally considered suitable for reuse as trench backfill and bulk fill for the roads and driveways, however, some soils 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 or smooth drum vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of cohesive soils;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for clayey 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.

As noted previously, the existing native clayey silt/silt and clay soils typically become very stiff with depth. It is imperative that if these soils are utilized for backfilling of service trenches, the material must be broken down (pulverized) to minimize voids and reduce the potential for settlement.

5.11. Pavement Design/Drainage

Any soils containing organics or other deleterious materials must be subexcavated from within the proposed roads and driveways. It is recommended to either subexcavate any existing loose subgrade materials or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable subgrade. 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 materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. As such, it is recommended to install subdrains for this project (provided gravity drainage to a suitable outlet can be provided). 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 (recommended for this application), then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent). Installation of rigid subdrains allows for better grade control and less potential for damage during installation or service. 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 subdrains be installed at regular intervals (to be designed based on layout of catch basins and storm sewers) along the curb line of the proposed roads. It is also recommended to install subdrains through any areas that cannot tolerate differential frost heave such as accessibility ramps/sidewalks. 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.

In general, the native clay and silt based soils are highly 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.

Should wet conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement structure. These options may include subexcavation of loose/soft soils, increasing the thickness of the granular base, the use of reinforcing geotextiles or geogrids, or a combination of all.

It is expected that the new roads and driveways entrances will experience mostly light traffic (personal vehicles) and some heavy traffic (emergency vehicles, moving trucks, delivery trucks, and maintenance vehicles).

Based on the anticipated vehicle loading and frost-susceptibility of the subgrade soils, the following pavement design is provided:

Material		**Recommended Thickness for Light Traffic**	**Recommended Thickness for Heavy Traffic**	**Compaction Requirements**
Asphaltic Concrete (OPSS 1150 and OPSS 310)	HL3 Surface Coarse	40 mm (1.5")	40 mm (1.5")	92% MRD
	HL4 or HL8 Binder Coarse	50 mm (2.0")	70 mm (2.75")	
Granular 'A' Base (OPSS 1010)		150 mm (6.0")	150 mm (6.0")	100% SPMDD
Granular 'B' Subbase (OPSS 1010 Type III)		450 mm (16.0")	450 mm (18.0")	

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 and binder 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.

Should any new asphalt be 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 tack coat 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 condition is further intensified during hot weather. In high traffic areas or areas subjected to frequent turning of heavy vehicles, it is recommended that rigid Portland cement pavement be considered.

5.12. 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 in the 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"*.

5.13. Chemical Analysis/Excess Soil Management

As per Ontario Regulation 406/19, if surplus/excess soils are to be exported off-site, it is typically necessary to undertake some environmental reporting and chemical analyses 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.

This testing can be undertaken at the time of construction; however please keep in mind that the testing is currently taking in excess of ten (10) business days to complete which could lead to contractor delays at the time of construction.

It should be noted that additional samples and testing parameters may be required based on the disposal site chosen by the contractor; as well, if any of the soils sampled are found to be impacted then additional parameters and leachate testing (TCLP/SPLP) may be required.

5.13.1. 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, leaching testing 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, whom 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 preapproved 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.

6.0 SITE INSPECTION

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 residential subdivision.

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. This geotechnical investigation was carried out in conjunction with a hydrogeological study completed by HCS, provided under separate cover.

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.

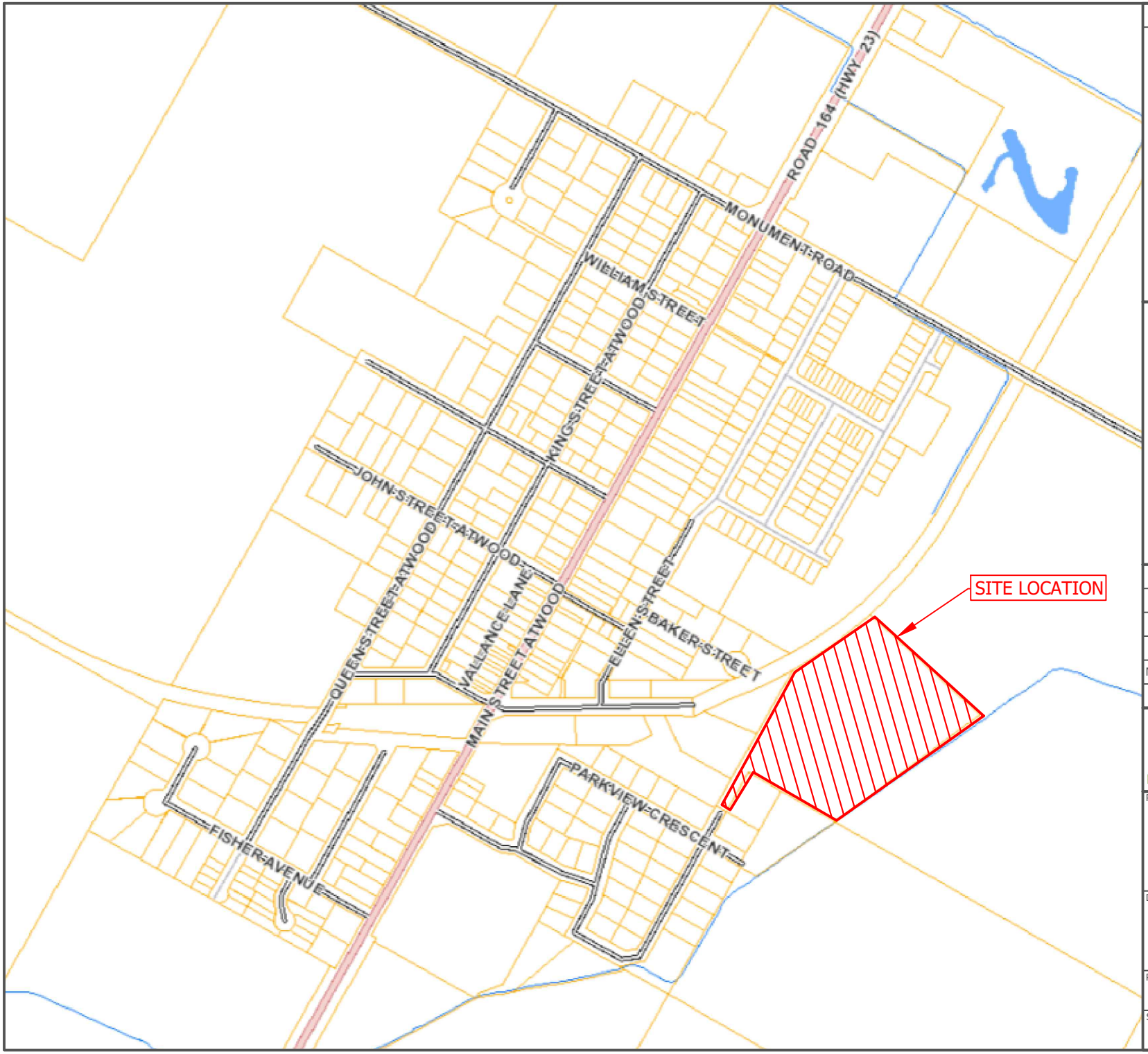
Prepared by:

Brittany Lingelbach, C. Tech., rcji

ht

Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotechnical Engineer



NOTES:

Base map provided by Perth County Mapping.

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:
Geotechnical Investigation
Proposed Residential Subdivision
306 Woodview Drive
Atwood, Ontario

DRAWING TITLE:
SITE LOCATION MAP

PROJECT NO.:	DATE:
23-975	January 9, 2024
SCALE:	DRAWING NO.
N.T.S.	1

NOTES:

Base map provided by Client and Perth County Mapping.

Legend

- CMT Borehole
- CMT Borehole with Monitoring Well
- Temporary Benchmark (TBM)
  Top of Manhole Cover
  Elevation = 364.41m

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
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PROJECT:
Geotechnical Investigation
Proposed Residential Subdivision
306 Woodview Drive
Atwood, Ontario

DRAWING TITLE:
AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
23-975	January 9, 2024
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

BOREHOLE LOGS

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

BOREHOLE NUMBER 1

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-9
GROUND ELEVATION: 364.18 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (250 mm)	0.00, 364.18	SPT 1	50	0-1-1-1 (2)	2
		0.25, 363.93				
1	**CLAYEY SILT:** Soft to firm, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit) becoming stiff, brown	1.07, 363.11	SPT 2	50	2-4-4-5 (8)	8 16.8
2	becoming very stiff to hard, grey, occasional cobbles	1.52, 362.66	SPT 3	100	7-10-9-10 (19)	19 17.1
3			SPT 4	100	7-14-13-21 (27)	27 11.1
4			SPT 5	100	40-18-26-18 (44)	44 40 11.7
			MC5 6	100		12.4
5			SPT 7	100	9-18-26-18 (44)	44
6			MC5 8	100		15.1
7			MC5 9	100		16.2
8			MC5 10	100		17.3
9						
10			MC5 11	100		16.2

WELL DIAGRAM: 38mm Riser; Water Level measured at 2.38m (Elev. 361.80m) on Jan. 24, 2024; Bentonite Seal; #2 Sand Pack; 38mm Screen

Bottom of borehole at 10.67 m, Elevation 353.51 m.
Monitoring well installed at an elevation of approximately 353.51m on January 9, 2024.

Groundwater measured at approximately 2.38m below the ground surface (Elev. 361.80m) on January 24, 2024.

CMT Engineering Inc.
1011 Industrial Crescent
St. Clements, Ontario, N0B 2M0
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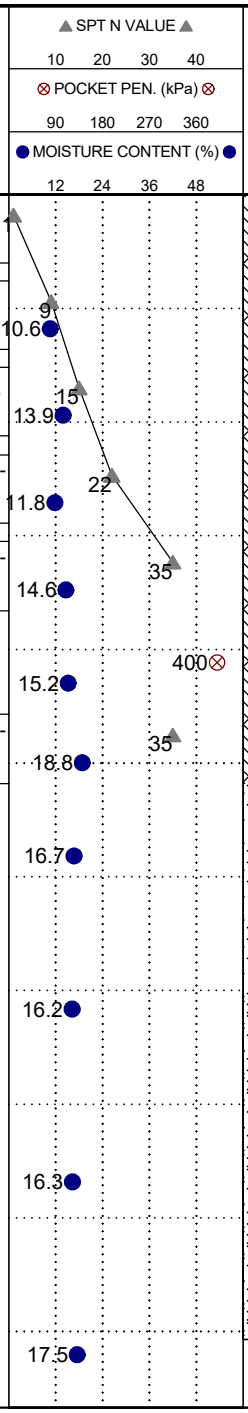
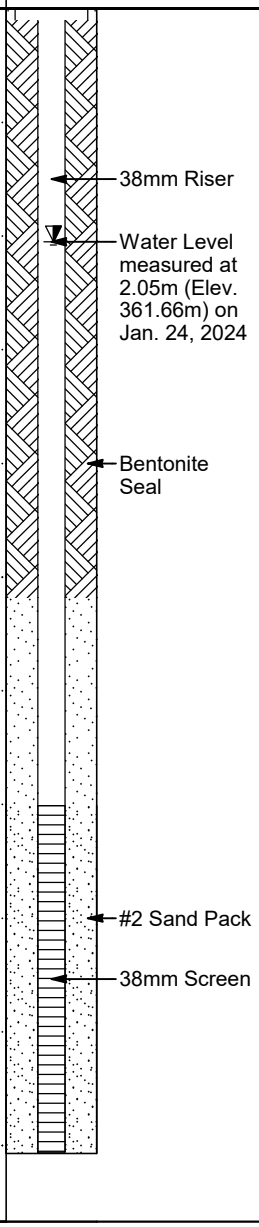
BOREHOLE NUMBER 2

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-9
GROUND ELEVATION: 363.71 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (230 mm)	0.00, 363.71	SPT 1	50	0-1-0-2 (1)
		0.23, 363.48			
1	**CLAYEY SILT:** Soft, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit) becoming stiff, brown, some sand	0.91, 362.80	SPT 2	10	1-4-5-6 (9)
2			SPT 3	100	4-7-8-13 (15)
3	becoming very stiff to hard, occasional cobbles	2.29, 361.42	SPT 4	100	13-12-10-14 (22)
			SPT 5	100	15-17-18-17 (35)
4			MC5 6	100	
5			SPT 7	100	14-13-22-21 (35)
6			MC5 8	100	
7			MC5 9	100	
8			MC5 10	100	
9					
10			MC5 11	100	





WELL DIAGRAM

Bottom of borehole at 10.67 m, Elevation 353.04 m.
Monitoring well installed at an elevation of approximately 353.65m on January 9, 2024.

Groundwater measured at approximately 2.05m below the ground surface (Elev. 361.66m) on January 24, 2024.

CMT Engineering Inc.
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St. Clements, Ontario, N0B 2M0
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BOREHOLE NUMBER 3

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-9
GROUND ELEVATION: 363.67 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
		TOPSOIL: Loose, dark brown silty topsoil, moist (250 mm)	0.00, 363.67					
			0.25, 363.42	SPT 1	50	0-1-1-1 (2)	2	
1		**CLAYEY SILT:** Soft, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit)		SPT 2	75	2-3-6-7 (9)	9 14.8	
			0.91, 362.76					
		SILTY SAND Loose to compact, brown silty sand, trace to some clay, very moist						
2			1.52, 362.15	SPT 3	100	8-11-11-9 (22)	22 15.2	
		CLAYEY SILT: Stiff to very stiff, grey-brown clayey, sandy silt, trace gravel, occasional cobbles, moist (drier than the plastic limit)		SPT 4	100	9-13-17-18 (30)	30 15.6	
3				SPT 5	100	8-15-16-16 (31)	31 13.8	
4				MC5 6	100		14.7	
5				SPT 7	100	15-17-13-15 (30)	30 16.1	

Bottom of borehole at 5.18 m, Elevation 358.49 m.
Borehole open to termination.

No accumulated groundwater encountered upon completion.

CMT Engineering Inc.
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St. Clements, Ontario, N0B 2M0
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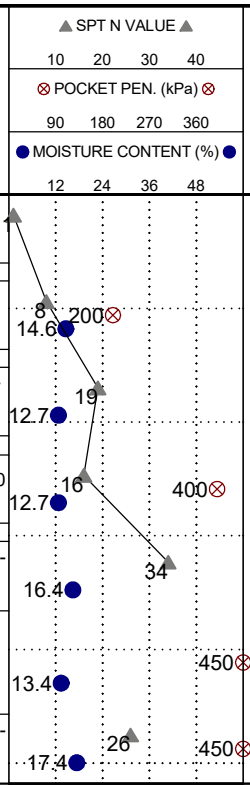
BOREHOLE NUMBER 4

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-8
GROUND ELEVATION: 363.96 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	TOPSOIL: Loose, dark brown silty topsoil, moist (230 mm)	0.00, 363.96	SPT 1	50	0-0-1-2 (1)
		0.23, 363.73			
1	**CLAYEY SILT:** Soft, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit) becoming stiff, brown	0.76, 363.20	SPT 2	75	4-4-4-6 (8)
2	very stiff to hard, occasional cobbles	1.52, 362.44	SPT 3	25	19-9-10-10 (19)
3	becoming grey-brown	2.29, 361.67	SPT 4	25	9-6-10-10 (16)
			SPT 5	100	34-19-15-12 (34)
4			MC5 6	100	
5			SPT 7	100	14-14-12-13 (26)



WELL DIAGRAM

Bottom of borehole at 5.18 m, Elevation 358.78 m.
Borehole open to termination.

No accumulated groundwater encountered upon completion.

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

BOREHOLE NUMBER 5

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-9
GROUND ELEVATION: 363.61 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
		TOPSOIL: Loose, dark brown silty topsoil, moist (300 mm)	0.00, 363.61	SPT 1	83	0-1-0-1 (1)	9, 14.9	
			0.30, 363.31					
1		**CLAYEY SILT/SILT AND CLAY:** Soft, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit) becoming stiff, brown	0.91, 362.70	SPT 2	83	2-4-5-5 (9)		
2		becoming very stiff to hard, grey-brown silt and clay, some sand, occasional cobbles	1.83, 361.78	SPT 3	100	4-10-12-10 (22)	22, 13.4	
3				SPT 4	100	7-11-16-11 (27)	27, 15.7	
				SPT 5	100	7-9-50-50 (59)	>>, 15.6	
4				MC5 6	100		15.4	

Bottom of borehole at 4.57 m, Elevation 359.04 m.
Borehole open to termination.

No accumulated groundwater encountered upon completion.

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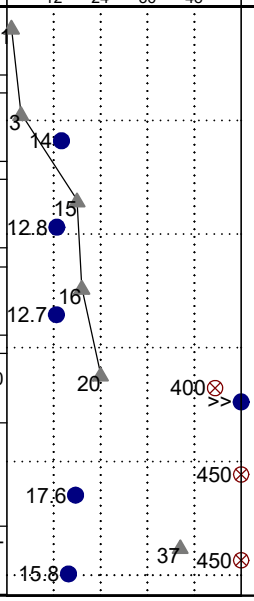
BOREHOLE NUMBER 6

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-8
GROUND ELEVATION: 363.70 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (300 mm)	0.00, 363.70	SPT 1	50	0-0-1-3 (1)
		0.28, 363.42			
1	**CLAYEY SILT:** Soft, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit)		SPT 2	10	1-1-2-3 (3)
	wet seam encountered	1.52, 362.18	SPT 3	100	6-7-8-7 (15)
2	becoming very stiff to hard, grey-brown, some clay, occasional cobbles	1.83, 361.87			
3			SPT 4	100	9-8-8-14 (16)
			SPT 5	100	8-9-11-10 (20)
4			MC5 6	100	
5			SPT 7	100	17-21-16-14 (37)



WELL DIAGRAM

Bottom of borehole at 5.18 m, Elevation 358.52 m.
Borehole open to termination.

No accumulated groundwater encountered upon completion.

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BOREHOLE NUMBER 7

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-8
GROUND ELEVATION: 363.82 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (330 mm)	0.00, 363.82	SPT 1	50	1-1-3-4 (4)	MC 4
		0.33, 363.49				
1	**CLAYEY SILT:** Soft to firm, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit) becoming stiff	0.76, 363.06	SPT 2	50	8-13-12-50 (25)	MC 15.7
2	becoming brown wet seam becoming very stiff to hard, grey-brown, occasional cobbles	1.52, 362.30	SPT 3	75	7-6-8-7 (14)	MC 15
		1.68, 362.14				
		1.70, 362.12	SPT 4	100	7-10-13-8 (23)	MC 12
3			SPT 5	100	7-10-13-12 (23)	MC 11.3
4			MC5 6	100		MC 13.7
5			SPT 7	100	16-18-20-24 (38)	MC 15.1
6			MC5 8	100		MC 15.7
7			MC5 9	100		MC 16.9
8			MC5 10	100		MC 13
9						
10			MC5 11	100		MC 13.2

WELL DIAGRAM: 38mm Riser; Water Level measured at 2.92m (Elev. 360.90m) on Jan. 24, 2024; Bentonite Seal; #2 Sand Pack; 38mm Screen

Bottom of borehole at 10.67 m, Elevation 353.15 m.
Monitoring well installed at an elevation of approximately 353.15m on January 8, 2024.

Groundwater measured at approximately 2.92m below the ground surface (Elev. 360.90m) on January 24, 2024.

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BOREHOLE NUMBER 8

PROJECT: Proposed Residential Subdivision
PROJECT ADDRESS: 306 Woodview Drive
PROJECT NUMBER: 23-975
PROJECT LOCATION: Atwood, Ontario
DRILLING DATE: 24-1-8
GROUND ELEVATION: 363.57 m
DRILLING CONTRACTOR: CMT DRILLING INC.
LOGGED BY: BL
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (200 mm)	0.00, 363.57	SPT 1	50	0-0-1-2 (1)	14.2
		0.02, 363.55				
1	**CLAYEY SILT:** Soft to firm, mottled grey-brown clayey, sandy silt, trace gravel, moist (drier than the plastic limit)		SPT 2	10	4-3-4-7 (7)	7
	wet seam encountered	1.52, 362.05	SPT 3	50	4-21-16-50 (37)	37, 10.7
2	becoming stiff to very stiff, brown, occasional cobbles encountered	1.55, 362.02				
	becoming grey stiff to hard, grey-brown	2.29, 361.28	SPT 4	100	8-16-14-13 (30)	30, 12
3			SPT 5	100	11-14-19-21 (33)	33, 10.2
4			MC5 6	100		400⊗, 11.9
5			SPT 7	0	20-50-50-50 (100)	>>
6			MC5 8	100		400⊗, 14.8
7			MC5 9	100		450⊗
8			MC5 10	100		400⊗, 15.7
9						
10			MC5 11	100		14.1

WELL DIAGRAM: 38mm Riser; Water Level measured at 2.95m (Elev. 360.62m) on Jan. 24, 2024; Bentonite Seal; #2 Sand Pack; 38mm Screen

Bottom of borehole at 10.67 m, Elevation 352.90 m.
Monitoring well installed at an elevation of approximately 352.90m on January 8, 2024.

Groundwater measured at approximately 2.95m below the ground surface (Elev. 360.62m) on January 24, 2024.

BOREHOLE LOG WITH WELL2 23-975.GPJ CMT_TEMPLATE_2020-05-15.GDT 24-2-9

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.9	2.4	5.7	13.9	45.8	30.3

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	4	2.29-2.90m	clayey, sandy silt, trace gravel	ML
				Sampled by BL of CMT Engineering Inc. January 9, 2024	
				Tested by JM of CMT Engineering Inc. January 16, 2024	

CMT Engineering Inc.

St. Clements, ON

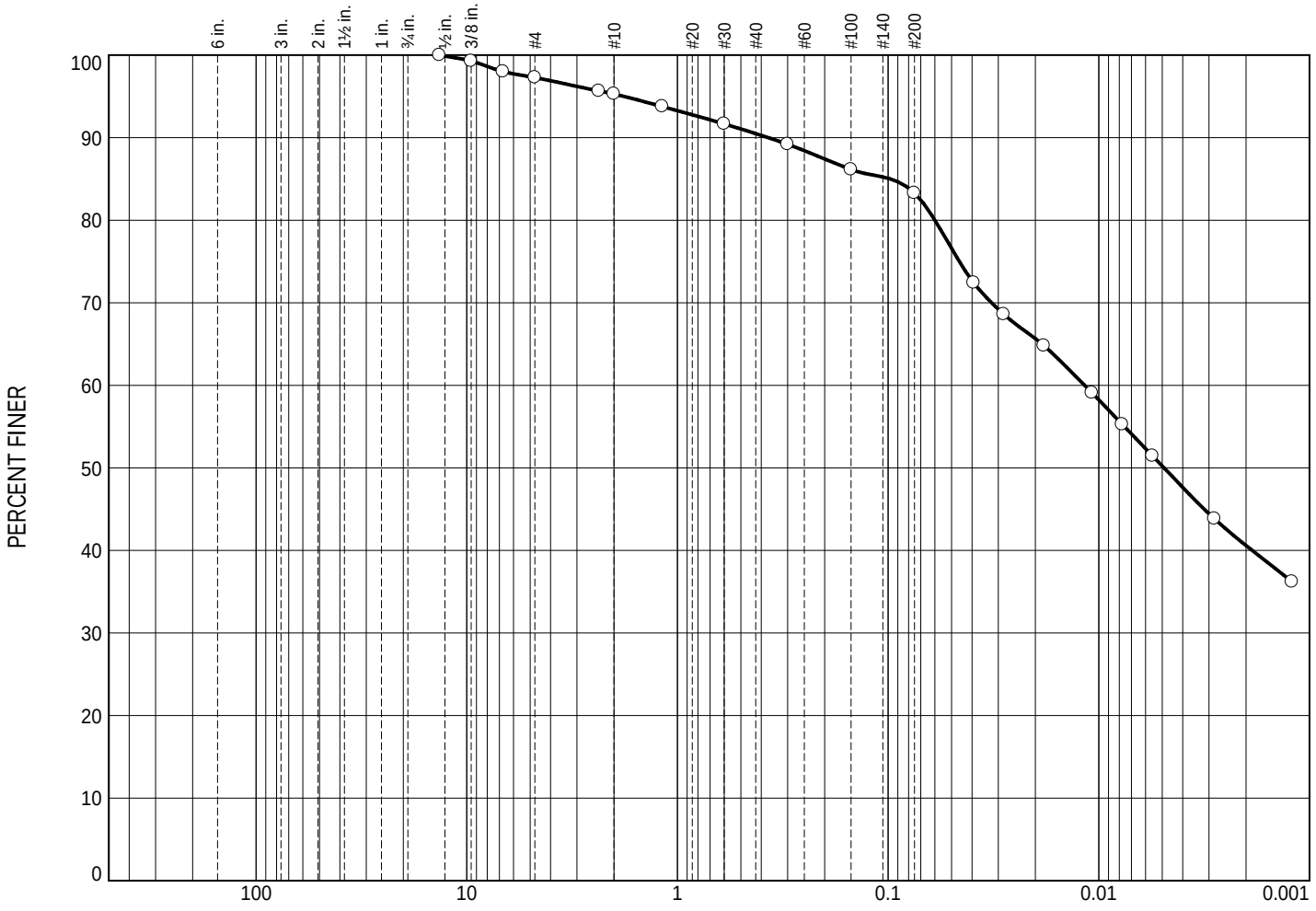
Client: 1000535777 Ontario Inc.

Project: Proposed Residential Subdivision
306 Woodview Drive, Atwood, Ontario

Project No.: 23-975

Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.7	2.0	4.8	7.2	42.7	40.6

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH5	5	3.05-3.66m	silt and clay, some sand, trace gravel	ML
				Sampled by BL of CMT Engineering Inc. January 9, 2024	
				Tested by JM of CMT Engineering Inc. January 16, 2024	

CMT Engineering Inc.

St. Clements, ON

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Figure 2

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	4.0	4.6	5.4	10.3	41.1	34.6

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH7	3	1.52-2.13m	clayey, sandy silt, trace gravel	ML
				Sampled by BL of CMT Engineering Inc. January 9, 2024	
				Tested by JM of CMT Engineering Inc. January 16, 2024	

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St. Clements, ON

Client: 1000535777 Ontario Inc.

Project: Proposed Residential Subdivision
306 Woodview Drive, Atwood, Ontario

Project No.: 23-975

Figure 3

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.3	1.6	4.1	5.2	42.9	44.9

SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH8	10	7.62-9.14m	clay and silt, some sand, trace gravel	ML
				Sampled by BL of CMT Engineering Inc. January 9, 2024	
				Tested by JM of CMT Engineering Inc. January 16, 2024	

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St. Clements, ON

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306 Woodview Drive, Atwood, Ontario

Project No.: 23-975

Figure 4

APPENDIX C

WELL RECORDS