GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
31 CHURCH STREET
ALMA, ONTARIO

CMT Project 20-732.R01

Prepared for:

Exact Construction

December 18, 2020

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

December 18, 2020 20-732.R01

Exact Construction
8262 Wellington Road 19
R. R. 3
Fergus, Ontario
N1M 2W4

Attention: Mr. Kevin Vanleeuwen

Dear Sir:

Re: Preliminary Geotechnical Investigation
Proposed Residential Subdivision
31 Church Street
Alma, 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 Brown

Brittany Brown, C.Tech., rcji

ks

TABLE OF CONTENTS

1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Kevin Vanleeuwen of Exact Construction to conduct a preliminary geotechnical and hydrogeological investigation for the proposed residential subdivision to be located at 31 Church Street, Alma, Ontario. The hydrogeological study was completed 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 residential subdivision, although no site plan has been provided at this time. It is assumed that the development will include the construction of new road(s) and approximately twenty (20) residential homes with associated driveways. Drilled water wells and septic systems will likely service the new residences.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes/monitoring wells. 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); 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 provided in this report are solely based on the information obtained in the boreholes advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

The existing site currently comprises vacant agricultural land, previously used for crop production. The site is bounded by Peel Street West (Wellington Road 17) to the west, residential properties to the north and east, and a former CNR rail line to the south. The general site topography slopes gently towards the eastern extent of the site.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on December 11, 2020 and comprised the advancement of three (3) boreholes with monitoring wells (referenced as Boreholes 1 to 3), using a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. Boreholes 1 and 2 were advanced to depths of approximately 9.14 m (30.0 ft) below the ground surface, while Borehole 3 was advanced to a depth of approximately 7.62 m (25.0 ft).

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) to 1.52 m (5.0 ft) intervals to approximately 5.18 m (17.0 ft). Macro core (MC5) direct push sampling was conducted between the SPT samples conducted below 3.66 m (12.0 ft), and continuously below 5.18 m (17.0 ft) to borehole 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 1.52 m to 2.13 m (5.0 ft to 7.0 ft)
- Borehole 2 - depth 7.62 m to 9.14 (25.0 ft to 30.0 ft)
- Borehole 3 - depth 6.10 m to 7.62 m (20.0 ft to 25.0 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 following the completion of drilling. The top of the existing water well (A299778) was used as a temporary benchmark, with an assumed elevation of 100.00 m. A geodetic benchmark elevation was not available at this time, although the geodetic elevations of the boreholes can be updated if that information becomes available. The ground surface elevations at the borehole locations ranged from approximately 101.75 m at the west extent of the site to approximately 92.78 m at the east extent. Although the site appears to be relatively flat, the overall topography differs by approximately 9.0 m from west to east. The locations of the boreholes 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, dark brown, silty topsoil was encountered at the surface of all three boreholes, ranging in thickness from approximately 360 mm to 410 mm (average 377 mm). The topsoil thickness is anticipated 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

Brown, grey, and grey-brown clayey silt, with some sand to sandy and trace to some gravel was encountered underlying the topsoil in all three boreholes and was considered to be the predominant soil type encountered on the site. Occasional seams of wet to saturated silty sand were noted throughout the clayey silt. The soils were considered to be soft to hard, with SPT N-values ranging from 3 to 45 blows per 0.3 m (average 20 blows per 0.3 m). The clayey silt was considered to be drier than the plastic limit to about the plastic limit, with moisture contents ranging from 11.1% to 17.8% (average 13.4%).

4.3. Sand

Compact, brown sand with trace silt and clay was encountered underlying the clayey silt in Borehole 2. The sand was considered wet, with a moisture content of about 12.2%.

4.4. Silt

Loose to compact, grey silt with trace sand and clay was encountered in the lower extents of Boreholes 1 and 3 underlying the clayey silt. The silt was considered moist to wet, with moisture contents ranging from about 14.8% to 22.0% (average 19.0%).

4.5. Groundwater

A total of three (3) monitoring wells were installed on December 11, 2020 as part of the hydrogeological study carried out by HCS. The water levels were measured by HCS on December 14, 2020.

The reported elevations of groundwater in the monitoring wells, as well as the ground surface and bottom of borehole elevations, are provided in the following table:

Borehole/ Monitoring Well No.	Ground Surface Elevation (m)	Approximate Elevation of Water in Monitoring Well (m) Dec. 14, 2020	Approximate Depth of Water in Monitoring Well (m) Dec. 14, 2020	Bottom of Monitoring Well Elevation (m)
BH 1	97.43	90.03	7.40	88.88
BH 2	92.78	92.72	0.06	83.70
BH 3	101.75	100.49	1.26	94.96

It should be noted that 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.

The high groundwater levels and wet soil conditions encountered could make some excavations difficult. It should be expected that caving or sloughing of the excavation walls will occur. As such, it is recommended to keep foundations at least one footing width (0.5 m minimum) above the static water level, if applicable.

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 residential subdivision. Although no site plan has been provided at this time, it is assumed that the development will include the construction of new road(s) and approximately twenty (20) residential homes with associated driveways. Drilled water wells and septic systems will likely service the new residences. Utilizing the information gathered during the preliminary geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

This section of the report provides CMT Inc.'s interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the owner and 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.

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) at the various elevations, including soil type:

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
BH 1	97.43	75 (1,500)	112 (2,250)	97.02 to 95.60	0.41	Clayey Silt
		200 (4,000)	300 (6,000)	95.60 to 90.06	1.83	Clayey Silt
		75 (1,500)	112 (2,250)	90.06 to 88.29 (termination)	7.37	Silt
BH 2	92.78	150 (3,000)	225 (4,500)	91.71 to 83.64 termination	1.07	Clayey Silt/Sand
BH 3	101.75	100 (2,000)	150 (3,000)	100.99 to 100.23	0.76	Clayey Silt
		200 (4,000)	300 (6,000)	100.23 to 95.86	1.52	Clayey Silt
		75 (1,500)	112 (2,250)	95.86 to 94.13 (termination)	5.89	Silt

The proposed founding elevations and required bearing capacities were not available at the time of report preparation. Based on the data provided in the table above, suitable founding elevations for the proposed residences with conventional foundations designed with a bearing capacity of 75 kPa (1,500 psf) at SLS and 112 kPa (2,250 psf) at ULS range from depths of about 0.41 m to 1.07 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 5.4.3 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. 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.

If wet to saturated soil conditions are encountered during excavation, it may be necessary to widen the footings or install a granular drainage layer to provide a suitable base for the foundations. This will depend on the bearing capacity required for the founding strata. If required, the granular drainage layer must conform to the requirements listed in Section 9.14.4 of the OBC 2012.

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.

All exterior foundations 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 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 7.62 m to 9.14 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 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 5.4.3 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 the estimated soil design parameters for imported granular fill, as well as the existing 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, lateral earth pressure calculations, 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'/ Granular 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Clayey Silt	1,850	30°	0.33	3.00	0.50	0.38	10 - 20
Sand	1,850	33°	0.29	3.39	0.46	0.43	0
Silt	1,750	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 comprise the stripping of topsoil, removal or relocation of any existing services, and site grading to achieve the design grades.

5.4.1. Topsoil Stripping/Vegetation Removal

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, driveways and roads 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/Relocation of Existing Services

Any existing servicing that may be located within the proposed building envelopes must be removed/relocated. This includes any existing field tiles that are expected to be present. 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 5.4.3 of this report.

The monitoring wells that have been installed as part of the hydrogeological study must be decommissioned by a Ministry of the Environment, Conservation and Parks (MECP) licensed well contractor with a Class 1, Class 2 or Class 3 license in accordance with Reg. 903. CMT Drilling Inc. would be pleased to provide these services when required.

5.4.3. Site Grading/Structural Fill

Following the removal of topsoil and any unsuitable bearing soils, the exposed subgrade soils must be proof-rolled, and any 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 the proposed building envelopes comprise wet 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 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 granular soils, such as the sand and gravel encountered on-site (recommended fill material) and 0.2 m (8") in depth for clayey silt (not recommended for this application), 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 (not recommended) 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. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including townhome 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 soils are generally not recommended for use as structural fill as they can be subject to excess void space and potential settlement if not properly placed and compacted;

- 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 roads) 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 may require air-drying or the addition of water in order to achieve the specified density;

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

Due to the fine-grained nature of some of the native soils encountered throughout the boreholes, they will 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 subgrade 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.

5.5. Foundation Subgrade Preparation

The fine-grained native soils encountered throughout the boreholes are sensitive to change 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 to a sump (as required) located outside the footprint of any foundations (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;

- It is possible that some of the subgrade soils at the design founding elevation in the proposed building envelopes comprise wet soils, in which case 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 poured 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 fill materials must be maintained above freezing;

- Prior to placing concrete for the footings, the founding soils 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 poured in order to protect the structural integrity of the founding soils.

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

Prior to the placement of the granular base for slab-on-grade construction, the subgrade soils should be proof-rolled. Any soft or weak zones in the subgrade should be subexcavated and backfilled with approved fill materials (see Sections 5.4.3 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	Modulus of Subgrade Reaction (k)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Clayey Silt	40,700 kN/m^3 (150 lb/in^3)
Sand	61,000 kN/m^3 (225 lb/in^3)
Silt	33,900 kN/m^3 (125 lb/in^3)

Floor slabs can be founded on a minimum thickness of 100 mm (4") of coarse, clean granular material containing not more than 10% of material that will pass a 4 mm sieve in accordance with the current OBC. 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 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 encountered in the boreholes, in a drained state (not wet or saturated), would be classified as Type 2 soils under Reg 213/91. Type 2 soils must be sloped from within 1.2 m (4.0 ft) of the bottom of the excavation with a slope having a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or Type 4 soils that are exposed in the excavation must be treated accordingly as Type 3 or Type 4 soils (see below). Soils in a saturated condition (if encountered) must be treated as Type 4 soils, addressed below.

Type 3 Soils - In general, the existing silt and sand encountered in the boreholes, as well as any fill soils which 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. 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.

Sloughing of the excavation walls should be expected when excavating into non-cohesive or wet to saturated soils. As such, it may be necessary to increase the width of the excavation to accommodate sloughing soils.

5.8. Construction Dewatering Considerations

Wet to saturated soils were observed in the lower extent of the boreholes. Also, occasional wet seams were encountered. It should be noted that 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 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 existing native soils that are free of any organics or deleterious materials, are generally considered suitable for indirect support of the site service pipes. Relatively high groundwater levels were observed in several of the boreholes and 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-803.030 and 803.031. The trench excavations should be symmetrical with respect to the centre-line 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

Foundations constructed within wet soils as noted in the boreholes may be subject to flooding in the event of a power failure or equipment malfunction. Therefore, it would be recommended that foundations be constructed at least one footing width (minimum 0.5 m) above the static water level, if applicable. 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 residences will have basements, and as such, a perimeter drainage system will be required. The drainage system 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. It is recommended that sump pumps be equipped with a battery backup (in the event if a power outage). 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. Foundation wall and slab-on-grade dampproofing and/or 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 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 such as sidewalks and accessibility ramps 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 in the driveways and roads; however, some of the soils may require air-drying or the addition of water 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 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.

5.11. Pavement Design/Drainage

Any soils containing organics or other deleterious material must be subexcavated from within the proposed driveways and roads. 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 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 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) and a factory installed filter sock is not required. 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) through paved driveways and parking areas. 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.

The native clayey silt subgrade soils are highly sensitive to change 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 road(s) and driveways will experience mostly light traffic (personal vehicles) and some heavy traffic (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
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 62.5 mm (2.5")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	450 mm (18.0")	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 40 mm and a width of 150 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 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. Septic System T-Time

A grain size analysis was performed on a representative sample of the native soil, as it is expected that new septic systems will be part of the proposed residential development. The following table provides the sample location, depth, corresponding estimated T-Time as well as soil type:

Borehole No.	Depth (m)	Estimated Percolation Rate (T) (min/cm)	Soil Type
1	1.52 – 2.13	50	Clayey, sandy silt, trace gravel (ML)

CMT Engineering Inc. would be pleased to provide septic system designs once information on the proposed residences is available.

5.13. 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"*.

5.14 Excess Soil Management

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 general contractor.

Most commonly, the soils are tested for the following:

- Sodium Absorption Ratio (SAR) as per O. Reg. 153/04 as amended by R511.
- Chemical analysis including:
  - F1 – F4, VOC's, BTEX as per O. Reg 153/04;
  - SVOC as per O. Reg 153/04 as amended by R511; and
  - Metals / inorganics as per O. Reg 153/04 amended by R511.

The chemical analysis results are then compared to Ontario Regulation 153/04 - as amended by O.Reg. 511 – April 15, 2011 Standards = [Suite] – ON-511-T1/T2-SOIL-RPI.

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, 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 pre-approved site; and
- 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.

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 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. 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:

Brittany Brown

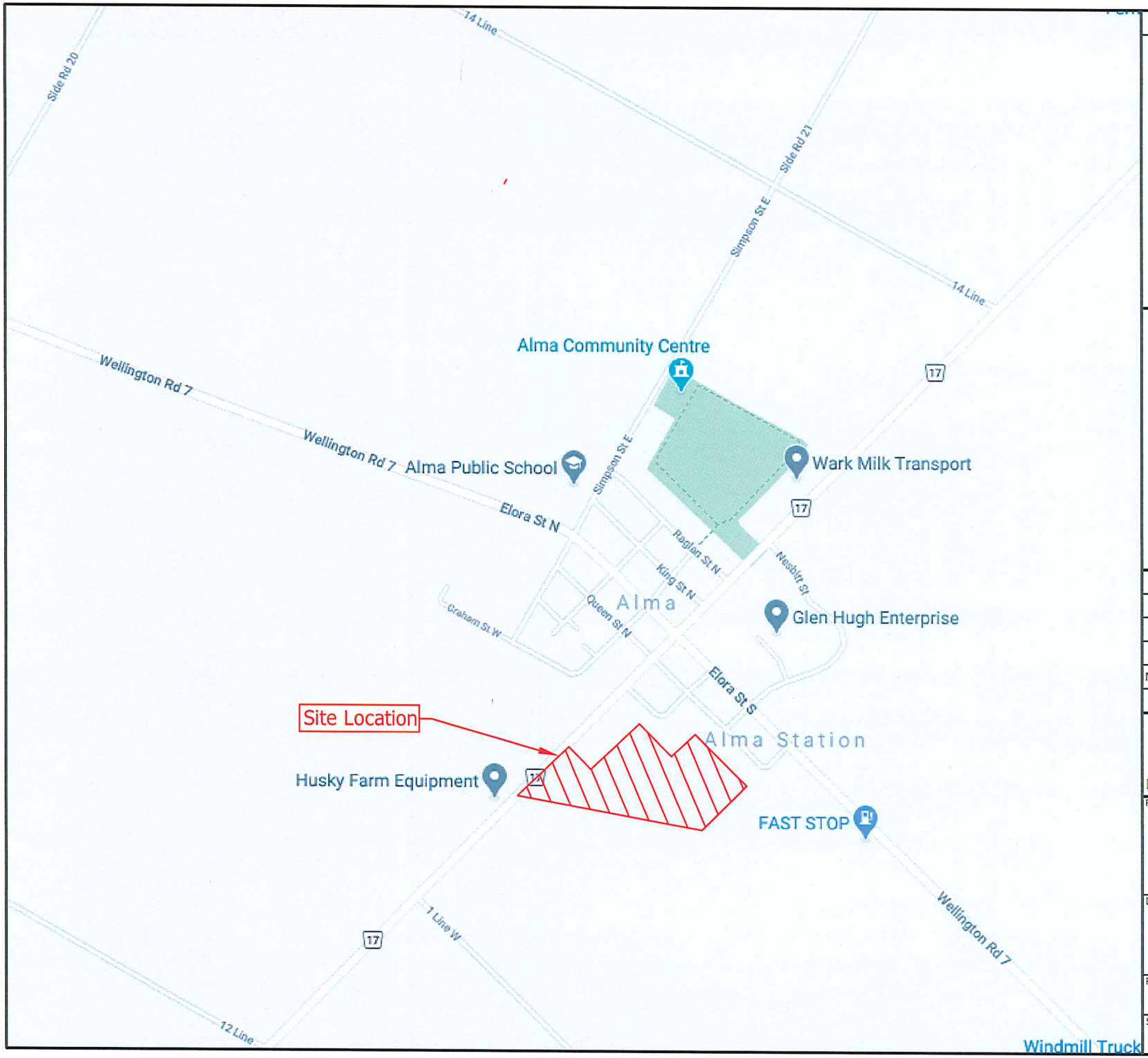
Brittany Brown, C. Tech., rcji

ks

Reviewed by:

Nathan Chortos, P.Eng.

Senior Geotechnical Engineer



NOTES:

Base map provided by Google.

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

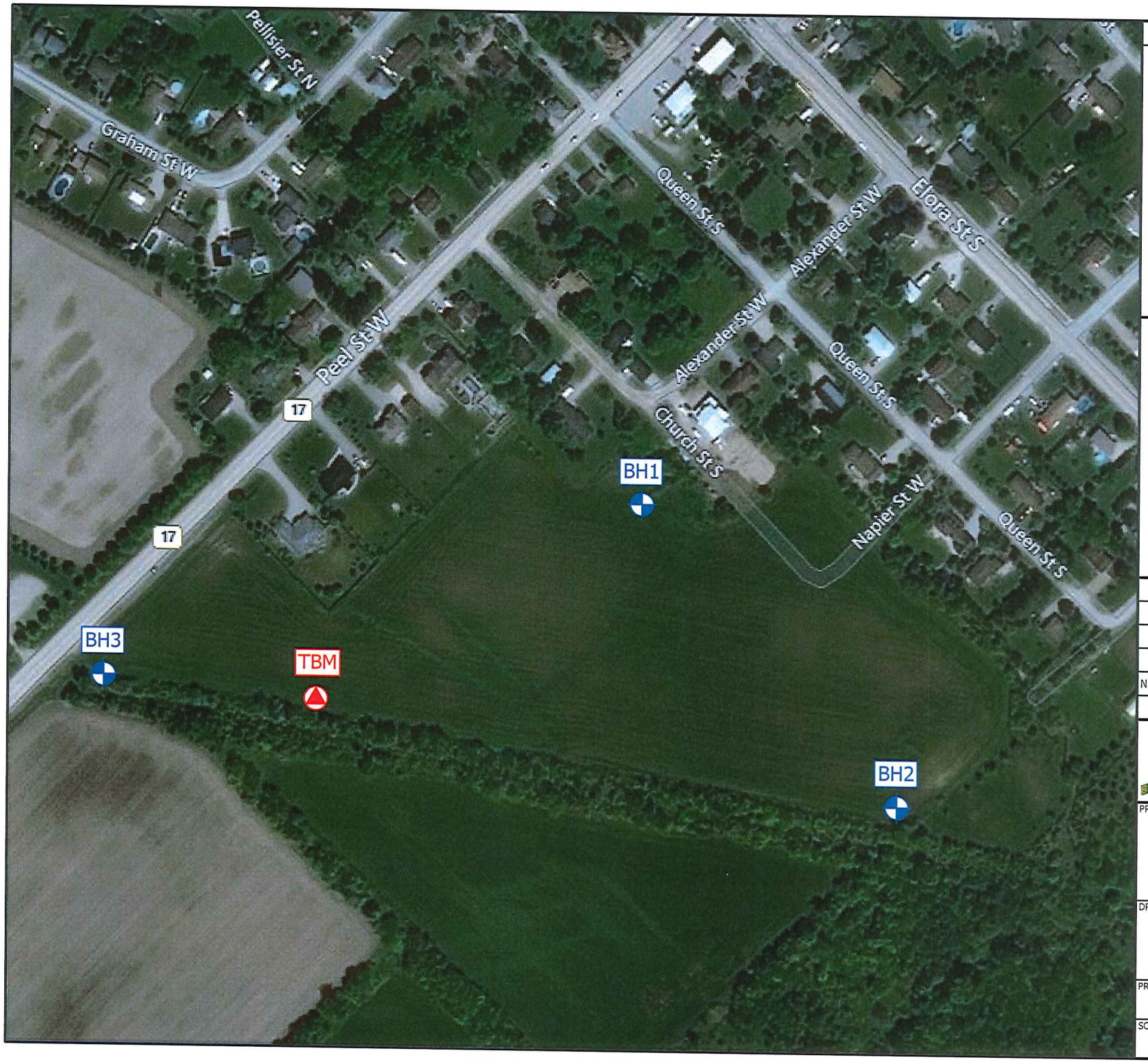
PROJECT:

Proposed Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
20-732	December 18 2020
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

Base map provided by Bing.

Legend

CMT Borehole with Monitoring Well

Temporary Benchmark (TBM)
Top of Existing Water Well (A299778)
Assumed Elevation: 100.00 m

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 Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
20-732	December 18, 2020
SCALE: N.T.S.	DRAWING NO. 2

APPENDIX A

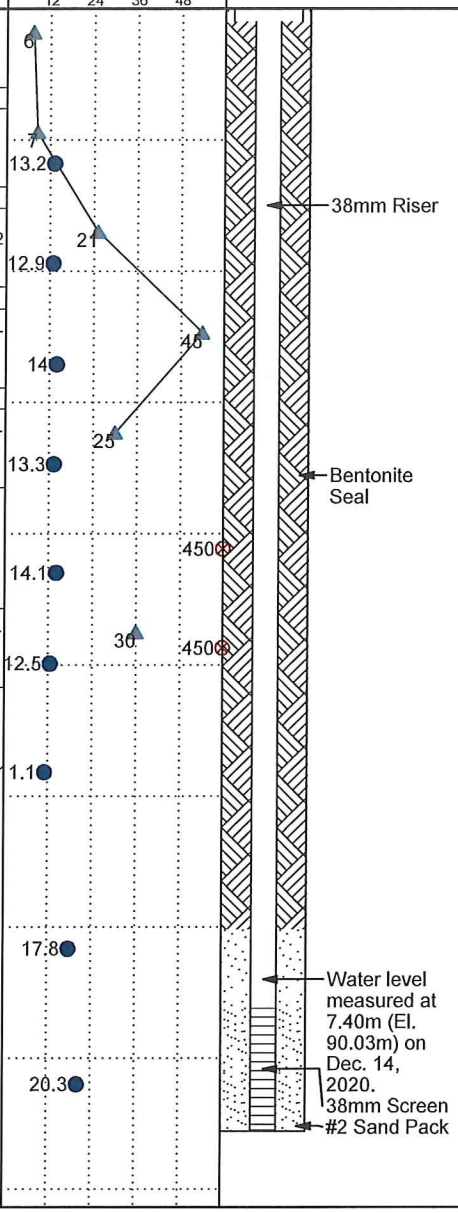
BOREHOLE LOGS

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 1

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 97.43 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
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 (410 mm)	0.00, 97.43	SS 1	67	2-3-3-3 (6)
1	**CLAYEY SILT:** Firm, brown clayey silt, some sand to sandy, trace gravel, drier than the plastic limit	0.41, 97.02	SS 2	100	2-3-4-4 (7)
2	becoming stiff to hard, some sand	1.83, 95.60	SS 3	100	4-6-15-12 (21)
3			SS 4	33	13-20-25-38 (45)
4			SS 5	100	12-11-14-13 (25)
			MC5 6	100	
5	becoming grey	4.65, 92.78	SS 7	100	12-14-16-21 (30)
6	occasional wet seams encountered	5.49, 91.94	MC5 8	100	
7			MC5 9	100	
8	**SILT:** Compact, grey silt, trace clay and sand, moist	7.37, 90.06			
	becoming loose, wet	7.92, 89.51	MC5 10	100	
9	becoming compact, moist	8.69, 88.74			



Bottom of borehole at 9.14 m, Elevation 88.29 m.
Groundwater measured at approximately 7.40 m below ground surface (elevation 90.03 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT LOCATION: Alma, Ontario
PROJECT NUMBER: 20-732
DRILLING DATE: 20-12-11
GROUND ELEVATION: 92.78 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
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 (360 mm)	0.00, 92.78	SS 1	50	1-1-2-2 (3)	3
	CLAYEY SILT: Soft, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 92.42				
1	becoming stiff to very stiff	1.07, 91.71	SS 2	100	1-2-7-7 (9)	9 14.7
2			SS 3	100	6-8-11-12 (19)	19 13.8
3	becoming sandy, some gravel	2.67, 90.11	SS 4	100	9-10-12-15 (22)	22 14.1
	becoming stiff, more plastic (about the plastic limit)	3.30, 89.48	SS 5	100	8-7-6-8 (13)	13 13.3
4			MC5 6	100		175 13
5			SS 7	67	7-6-7-9 (13)	13 13.1
6			MC5 8	100		14.6
7			MC5 9	100		14.1
8	**SAND:** Compact, brown sand, trace silt and clay, wet	7.82, 84.96	MC5 10	100		12.2
9						

WELL DIAGRAM: Water level measured at 0.06m (El. 92.72m) on Dec. 14, 2020. / 38mm Riser / Bentonite Seal / #2 Sand Pack / 38mm Screen

Bottom of borehole at 9.14 m, Elevation 83.64 m.
Groundwater measured at approximately 0.06 m below ground surface (elevation 92.72 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT LOCATION: Alma, Ontario
PROJECT NUMBER: 20-732
DRILLING DATE: 20-12-11
GROUND ELEVATION: 101.75 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
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 (%)
	TOPSOIL: Loose, dark brown silty topsoil, moist (360 mm)	0.00, 101.75	SS 1	67	1-2-2-4 (4)	4
	CLAYEY SILT: Soft, mottled grey-brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 101.39				
1	becoming stiff	0.76, 100.99	SS 2	100	6-6-6-7 (12)	12 / 12.5
	becoming very stiff, brown	1.52, 100.23	SS 3	100	5-9-12-12 (21)	21 / 12.2
2			SS 4	100	13-15-16-20 (31)	31 / 450 / 12.9
3			SS 5	100	9-12-18-20 (30)	30 / 450 / 13.1
4			MC5 6	100		12.8
	becoming hard, grey, about the plastic limit	4.22, 97.53				
5	(-5.03 m) wet silty sand seam encountered		SS 7	100	8-29-16-18 (45)	45 / 250 / 11.5
	(-5.49 m) saturated silty sand seam encountered		MC5 8	100		17
6	**SILT:** Loose, grey silt, trace clay and sand, wet	5.89, 95.86				22
7	becoming compact, moist	7.01, 94.74	MC5 9	100		14.8

WELL DIAGRAM:
- Water level measured at 1.26m (El. 100.49m) on Dec. 14, 2020.
- Bentonite Seal
- 38mm Riser
- #2 Sand Pack
- 38mm Screen

Bottom of borehole at 7.62 m, Elevation 94.13 m.

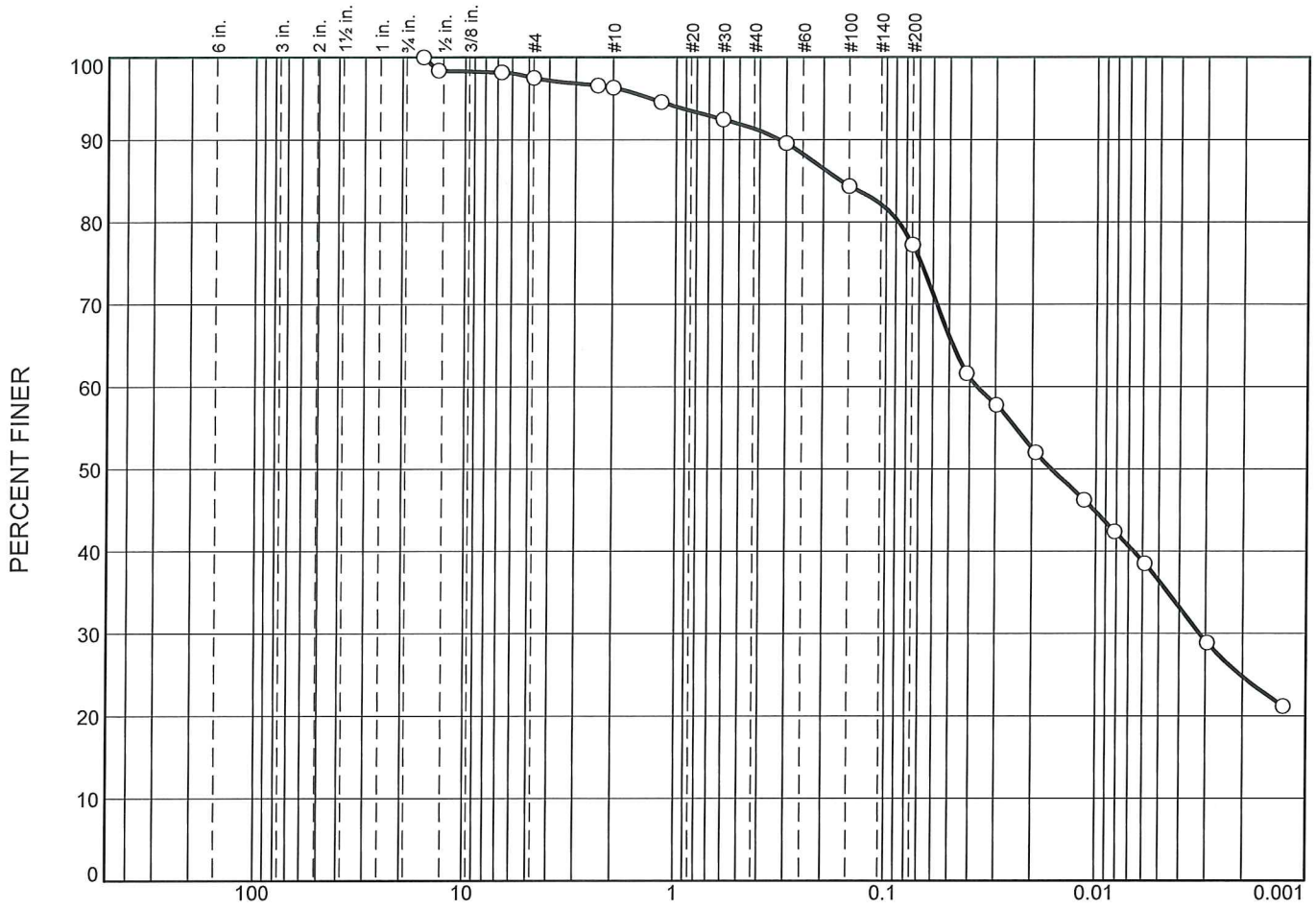
Groundwater measured at approximately 1.26 m below ground surface (elevation 100.49 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.5	1.2	5.0	14.1	52.4	24.8

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	3	1.52-2.13m	clayey, sandy silt, trace gravel	ML
				Estimated Percolation Rate; T = 50 min/cm	
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

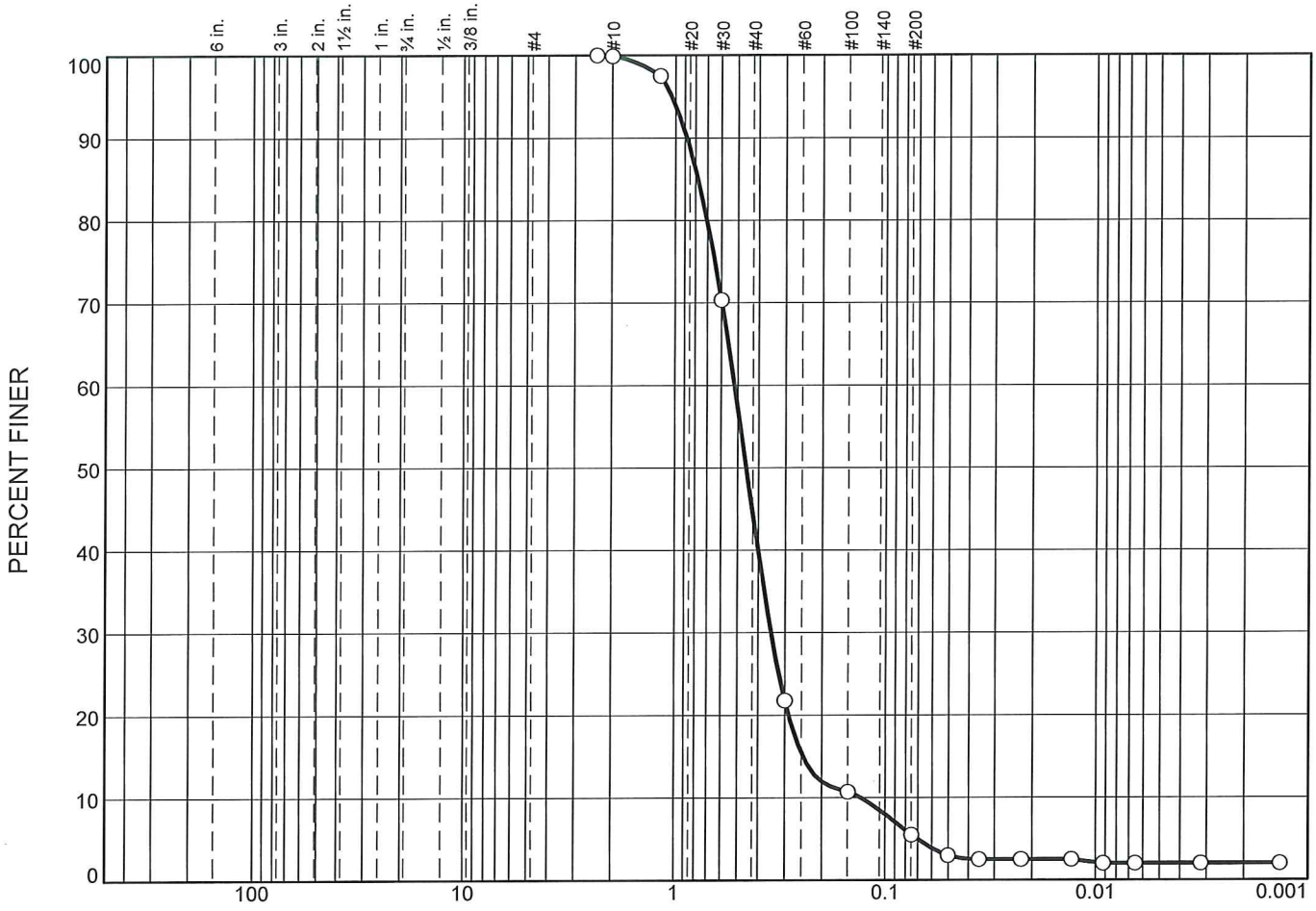
Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	55.4	39.0	3.5	2.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH2	10	7.62-9.14m	sand, trace silt and clay	SP-SM
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

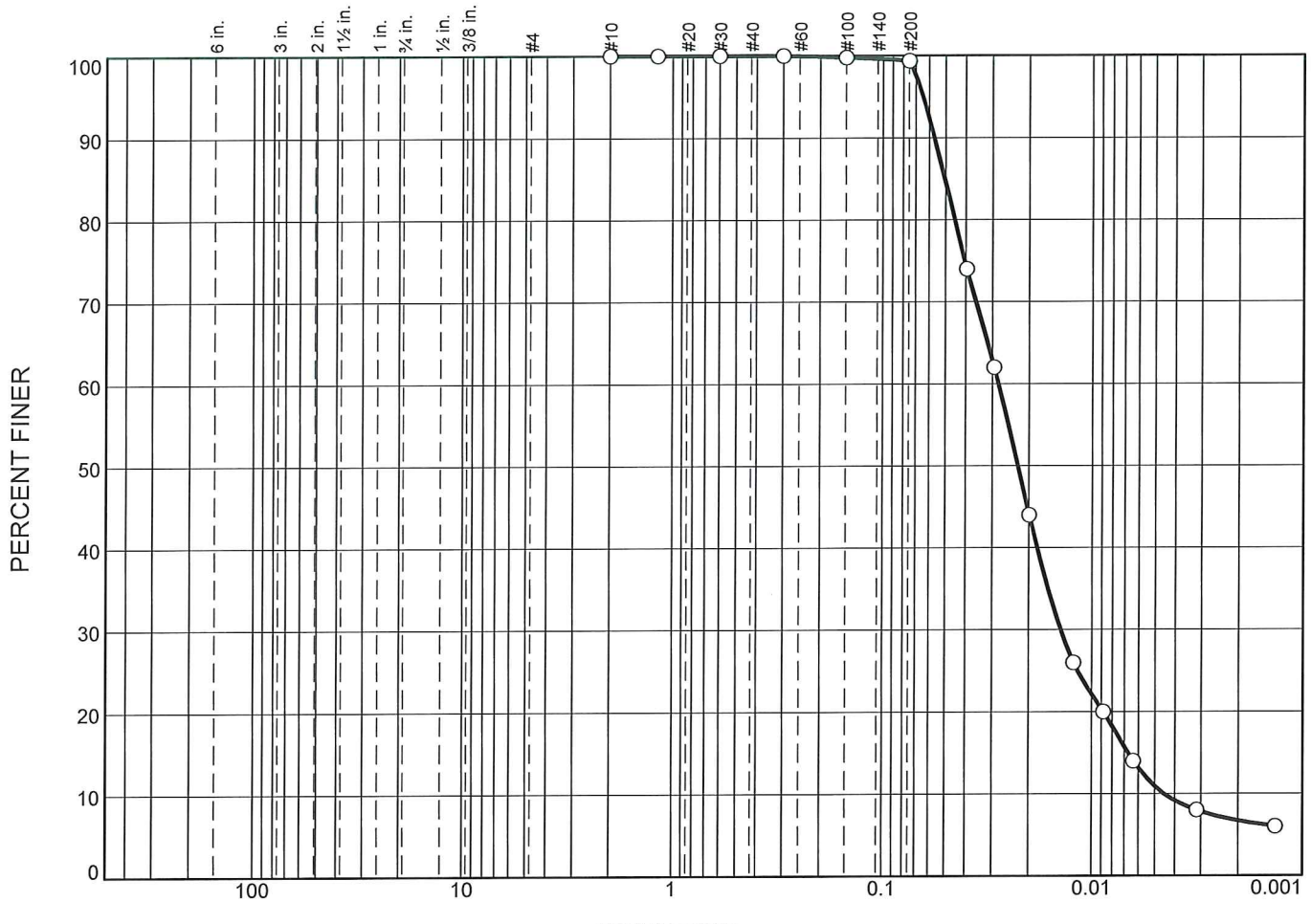
Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 2

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	0.6	92.7	6.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	9	6.10-7.62m	silt, trace clay and sand	ML
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 3

APPENDIX C

WELL RECORDS

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A 313249

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON	N0B2M0	

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	540060	4841716	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 30 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay	Till	0	30

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	23	3/8 HOLEPLUG	0.5
23	30	#2 SAND	0.15

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	25

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	25	30

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh	☐ Untested	☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	30	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? * ☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:08:50 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

SXUO S4YK

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A 313250

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON	N0B2M0	

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	540190	4841566	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 30 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay		0	25
Brown	Sand			25	30

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	20	3/8 HOLEPLUG	0.43
20	30	#2 SAND	0.21

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	25

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	25	30

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh	☐ Untested	☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	30	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? *
				☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:17:17 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

J6QZ 3EYX

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A 313251

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON		

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALAMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	539734	4841635	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 23 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay		0	15
Grey	Silt			15	23

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	16	3/8 HOLEPLUG	0.34
16	23	#2 SAND	0.15

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	18

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	18	23

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh	☐ Untested	☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	23	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? * ☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:45:08 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

4JQV AM7M