Scoped Hydrogeological Investigation

786 William Street
Midland, Ontario
Project 10094

1. INTRODUCTION

Hydrogeology Consulting Services (HCS) was retained by MG2021 Ltd. to conduct a scoped hydrogeological investigation for the proposed redevelopment of 786 William Street in Midland, Ontario. The location of the subject property is shown on Drawing 1 in Appendix A. The property is municipally serviced for water and sewers, with storm sewers discharging to the on-site stormwater management pond.

This assessment has been prepared to respond to requirements from the Severn Sound Environmental Association and Severn Sound Source Protection Authority (SSSPA).

1.1 Previous Studies

Previous study of the property includes the following:

- Geotechnical Investigation, Proposed Residential Development. 786 William Street, Midland Ontario. (CMT Project 20-305.R01) (CMT Engineering Inc., July 2020)

- 786 William Street – Midland. Functional Servicing and Stormwater Management Brief. MTE Consultants Inc., August 2021.

The geotechnical investigation report provides a description of the subsurface soil stratigraphy and geotechnical conditions beneath the property, along with evaluations of geotechnical parameters and requirements for the proposed redevelopment. The geotechnical investigation report should be read in conjunction with this report. It is noted no monitoring wells were installed as part of the geotechnical investigation.

The functional servicing and SWM (FSSWM) brief describes servicing, stormwater management, and infiltration strategies for the property. The FSSWM brief should be read in conjunction with this report.

The geotechnical report and FSSWM Brief are included in Appendix F for reference.

1.2 Scope of Work

On September 01, 2021 HCS observed the drilling of three boreholes to depths of 4.57 – 8.72 metres below ground surface (mBGS). Drilling was carried out by CMT Engineering Inc. using a Geoprobe 7822DT drill rig. Soil samples were obtained from depth during drilling for the purpose of particle size distribution (grain size) analysis.

The three boreholes were completed as 38 mm diameter monitoring wells in order to investigate the presence of shallow groundwater. The wells were completed using 1.52 and 3.05 m slotted

Schedule 40 PVC well screens and PVC riser pipes, with well sand installed around the well screens and the borehole annular spaces sealed with bentonite. All wells were constructed with protective steel casings, and lockable vented protective caps were installed. Monitoring well construction followed Ontario Regulation 903 (as amended). Borehole logs are included in Appendix B for reference.

The three monitoring wells were developed (purged) using a Waterra inertial valve and tubing on September 02, 2021 to remove fine-grained material from the well screen sand pack and mitigate smearing on the borehole walls during drilling. Water chemistry samples were obtained from two wells for analysis of general chemistry parameters, and the three wells were assessed via slug tests to estimate saturated soil hydraulic conductivity.

Stabilized groundwater elevations were measured using an electronic water level tape on September 02, 2021. Water level measurements are summarized in Table 1 in Appendix C.

2. STUDY AREA PHYSIOGRAPHY AND HYDROGEOLOGY

2.1 Site Description

The subject property is a 1.1 hectare vacant lot located within the Town of Midland, approximately 500 m north of the intersection of Highway 12 and William Street. The property is currently vacant with a few shrubs amongst the grassed area. As shown on the appended Drawing 2, there is an asphalt roadway crossing the site, connecting William Street to an existing townhome property.

As shown on the appended Site Plan (Fryett Turner Architects Inc., August 2021) proposed development of the property includes two four-storey apartment buildings with associated at-grade parking areas, plus an existing stormwater management (SWM) pond in the southwest corner of the property.

The property is bounded by William Street to the east, an existing townhouse complex to the northwest, a storage unit complex to the southeast, and a wooded area to the southwest. The north and eastern portions of the site are relatively flat, sloping gently to the southwest, while the southwestern portion of the site slopes approximately 3 to 4 m.

Surveyed elevations of the ground surface at the monitoring wells drilled on site show a change in elevation of approximately 2 m across the property.

2.2 Physiography

The property lies within the Simcoe Uplands physiographic region (Chapman and Putnam, 2007) which is mainly comprised of loose sandy glacial till. The surface soil typically has very low organic content and can be rather stony. The subject property is located within the Sand

Plains physiographic unit, with some drumlins located to the east off-site (Chapman and Putnam, 2007).

2.3 Geology

Surficial Geology mapping of Southern Ontario (Ontario Geological Survey, 2010) indicates that the subject property is underlain by ice-contact stratified deposits of sand and gravel, with minor silt, clay and till.

Overburden soil stratigraphy observed in the three boreholes drilled on the subject property mainly consists of topsoil and fill underlain by silty/sandy tills of varying composition. The borehole logs are included in Appendix B for reference.

Paleozoic Geology mapping (Armstrong and Dodge, 2007) indicates underlying the overburden deposits is the Gull River Formation limestone and dolostone bedrock. Water well records from nearby properties suggest the overburden deposits are more than 27 m thick in the area of the subject property, consisting of vertically extensive silty till deposits underlain by a water-bearing sandy deposit at depths below 21 m.

2.4 Hydrogeology and Groundwater

Groundwater was measured on September 2, 2021 in the silty/sandy till deposits across the property at depths of 4.93 to 8.15 mBGS, corresponding to elevations of 216.54 to 211.77 mASL. Measured groundwater elevations are shown on the appended Table 1.

As shown on the groundwater contour map on the appended Drawing 2, shallow groundwater perched within the low permeability till soils is flowing south-westwards towards the stormwater management pond area.

Locally, overburden groundwater would be expected to flow generally south-westwards following ground surface topography towards the tributary creek of the Wye River. Regional groundwater flow beyond the subject property would be expected to flow north-eastwards towards the Wye River and Georgian Bay.

Urban properties in the area are serviced by municipal water supply and sewers.

Percolation of precipitation into the shallow subsurface is governed by near-surface soil types, in addition to factors such as topography, evapotranspiration, and the degree of soil saturation. Small volumes of precipitation infiltrating into the near-surface fill and till deposits would be expected to become perched within the low permeability soils. This is evidenced by the significant variation in groundwater elevation across the relatively small property. This near-surface perched water would not represent the regional shallow aquifer, but rather a localized, and potentially laterally discontinuous, feature. Over time the perched water would slowly percolate vertically downwards or flow laterally following the topography of the fill/native material interface.

2.4.1 Estimated Seasonally High Groundwater Levels

It is understood that the groundwater level measurements collected in September reflect a snapshot in time, and that groundwater levels fluctuate seasonally due to changes in the frequency, duration, and amount of precipitation. During spring thaw conditions it is expected that groundwater levels would rise to their highest seasonal levels, and based on long term groundwater monitoring programs conducted at numerous residential, commercial, and agricultural properties across southern Ontario it is anticipated that groundwater levels at the subject property could fluctuate upwards by 1.0 m between late-summer levels and spring levels. As a result, it is estimated that seasonally high perched groundwater levels would be approximately 2.87 to 6.07 mBGS beneath the subject property.

2.5 Surface Water Features

There are no surface water features on the property. Ontario Source Protection Information Atlas (OSPIA) mapping shows wetlands and a tributary creek to the southwest and south of the property.

No regulatory mapping was available from the Severn Sound Environmental Association. The closest surface water feature is a wetland area in Trillium Woods Park approximately 60 m southwest of the property. There is an unnamed tributary to the Wye River originating approximately 180 m south of the subject property. The property lies within the Wye River subwatershed of the Nottawasaga River watershed area. According to OSPIA mapping, the tributary flows north-eastwards and discharges into Wye River, which empties into South Georgian Bay approximately 800 m northeast of the subject property.

2.6 Soil Hydraulic Conductivity

Hydraulic conductivity estimates for the site soils were determined using single response hydraulic (slug) tests of the soil deposits screened by the monitoring wells. Estimates of hydraulic conductivity were also made using soil sample grain size analyses and the Kaubisch, Breyer, Kozeny-Carman, and Hazen formulae where appropriate.

2.6.1 Slug Test Results

Prior to conducting slug testing of the monitoring wells, each well was developed (purged) to remove fine-grained material from the sand pack around the well screen and the screened interval, and to mitigate smearing on the borehole walls during drilling.

The slug test methodology followed the procedures developed by Hvorslev (1951), as described in Freeze and Cherry (1979). The slug tests were conducted as falling head tests by introducing a volume (slug) of potable water into the well to cause a temporary rise in the water table; or, as rising head tests by purging a well dry and allowing water to flow naturally back into the well. The displacement and gradual re-equilibration of the water level in the wells was recorded using electronic pressure transducers (dataloggers). Hvorslev's method is expressed by the following equation:

$$K = \frac{r^2 \ln (L/R)}{2LT_{0.37}}$$

where:

K = hydraulic conductivity of the tested material (m/sec)
r = inner radius of the well riser pipe (m)
R = outer radius of the well riser pipe (m)
L = length of screen and sand pack (m)
$T_{0.37}$ = time lag (sec), where $(H-h)/(H-H_0) = 0.37$
h = water level at each time of measurement (m)
H_0 = initial water level (m, start of test)
H = stabilized water level prior to slug testing (m)

The time lag, $T_{0.37}$, represents the time required for the water level to recover to the stabilized level if the initial flow rate from the surrounding aquifer into the well is maintained. This time lag is determined graphically as the time where $(H-h)$ divided by $(H-H_0)$ is equal to 0.37.

Graphical analyses of the slug tests are included in Appendix D, and the hydraulic conductivity estimates are listed in the appended Table 2. Due to the low permeability of the soils screened by the monitoring wells, none of the three slug tests achieved $T_{0.37}$. As a result, the saturated soil hydraulic conductivity is estimated at $<1 \times 10^{-7}$ m/sec representing a low soil permeability.

2.6.2 Grain Size Analysis Results

Samples of soil collected from the three boreholes during drilling were submitted to the CMT Engineering Inc. laboratory in St. Clements, Ontario for analysis of particle size distribution (grain size). The grain size analysis results (included in Appendix E) were used to estimate soil hydraulic conductivity (K) values by applying the Kaubisch, Breyer, Hazen, and Kozeny-Carman formulae where appropriate based on the limitations of each formula. The hydraulic conductivity estimates are summarized in the appended Table 2.

Hydraulic conductivity values for the sandy/silty till soils ranged from 4.51×10^{-8} to 3.42×10^{-7} m/sec, indicating low permeability soils.

The hydraulic conductivity estimates from both slug test and grain size analyses generally correlate reasonably well with published ranges for major soil types (Freeze and Cherry, 1979).

2.7 Soil Infiltration Rates

The Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) provide a method of assessing soil infiltration rate in the Low Impact Development (LID) Stormwater Management (SWM) Planning and Design Guide (TRCA and CVC, 2011). Following the methodology outlined in Appendix C of the Guide the lowest and highest estimated soil hydraulic conductivity values from the appended Table 2 were converted into infiltration rates listed in Table I below.

Table I: Estimated Soil Infiltration Rates from Hydraulic Conductivity Values

Estimated Hydraulic Conductivity (m/sec)	Estimated Soil Infiltration Rate – Unfactored (mm/hr)	Estimated Soil Infiltration Rate - Factored (mm/hr)
3.42×10^{-7}	40	16
4.51×10^{-8}	23	<10

As shown in the table above it is important to consider that the LID SWM Planning and Design Guide requires implementation a Safety Correction factor to calculate design infiltration rates (e.g. for subdivision soakaway pits and infiltration galleries). The unfactored rates listed in the table are considered reasonable for comparative purposes, and the factored rates would be applicable for design of high volume infiltration facilities. The factored infiltration rates suggest some of the native soils underlying topsoil and fill beneath the subject property may be somewhat suitable for use in a high volume infiltration facility; however, it is important to note that issues such as perched water conditions, lateral and vertical variability in soil permeability across the site, and the overall low hydraulic conductivity values calculated from slug tests and grain size analyses suggest that high volume subsurface infiltration facilities would likely not be effective at the site.

2.8 Groundwater Chemistry

On September 2, 2021 water chemistry samples were obtained from monitoring wells at BH 01-21 and BH 03-21. Samples were collected in the appropriate laboratory-supplied containers, stored in a cooler with ice, and delivered to ALS Environmental Laboratories in Waterloo, Ontario for analysis of general chemistry parameters including metals, anions, and nutrients. The laboratory Certificate of Analysis is included in Appendix G for reference, and the appended Table 3 summarizes parameters of interest.

Please Note: It is important to consider that while the sample results are compared to the Provincial Water Quality Objectives (PWQO) for reference purposes, the PWQO are only applicable to surface water. The shallow groundwater encountered in the near-surface soils is not considered surface water.

Additionally, it is important to consider the water chemistry samples were obtained using inertial valve pumps (Waterra tubing and foot valves). The method of water collection inherently results in the inclusion of sediments into the water sample, thereby increasing concentrations of parameters such as colour, turbidity, total suspended solids, total dissolved solids, and total metals where metals are adsorbed onto soil particles.

One or both samples exhibited exceedances of the PWQO for multiple total metals parameters. It is important to note the PWQO requirement to analyze unfiltered samples for total metals, and that the presence of sediments within the samples likely resulted in metals adsorbed on to sediment particles influencing the water chemistry analysis results as they are leached into solution by the lab-added preservative in the metals sampling bottle. Basic filtering of the water samples would be expected to significantly reduce suspended particulate concentrations, therefore reducing concentrations of metals adsorbed onto those suspended particles.

It is understood proposed redevelopment on the site includes slab-on-grade construction with strip footings at elevations of 216.3 – 217.7 mASL. With estimated seasonally high perched groundwater levels ranging from 214.8 to 216.0 mASL and water-bearing soils having low hydraulic conductivity, construction activities at the site are not expected to require significant dewatering. It is important to note, however, that if dewatering discharge is not collected using a hydrovac truck for off-site treatment and disposal, discharge to ground surface or to the on-site stormwater management pond would require discharge chemistry testing to ensure all PWQO criteria are met.

3. WATER USERS

Well Records from the Ministry of the Environment, Conservation, and Parks (MECP) Water Well Record (WWR) Database were reviewed to determine the number of supply wells present. As shown on the well records in Appendix H, five wells are located within an approximate radius of 500 m from the subject property according to the MECP WWR Database.

Of these wells three are identified as monitoring/test wells, and one drilled in 2018 with no completion details is assumed to be a monitoring well as the surrounding subdivisions are municipally serviced for water supply. These wells have been excluded from further consideration.

The remaining well (Well No. 4905240) is located in Caledon, and is erroneously included in the WWR search.

It is concluded there are no private water supply wells located within 500 m of the property.

3.1 Municipal Wellhead Protection Areas

Ontario Source Protection Information Atlas (OSPIA) mapping show the property is not located within a municipal Wellhead Protection Area (WHPA). The subject property is approximately 500 m southeast of the Well 15 Midland Wellhead Protection Area.

3.2 Sensitive Features, and Sensitivity to Contamination

Ontario Source Protection Information Atlas mapping indicates the property falls is not in a Highly Vulnerable Aquifer area; however is located in a Significant Groundwater Recharge Area (SGRA). It is expected the SGRA designation is based on regional mapping rather than on-site sol stratigraphy.

Natural Heritage Area maps from the Ministry of Natural Resources and Forestry (MNRF, 2020) reveal no Areas of Natural and Scientific Interest (ANSIs) within the subject property or surrounding area. There is a wetland approximately 60 m west of the subject property, and a creek tributary approximately 180 m south of the property.

The location of the subject property in an urbanized commercial/industrial area increases the risk of subsurface soil and groundwater contamination by contaminant release from nearby properties. Groundwater chemistry testing measured elevated total metals concentrations; however, the groundwater samples were unfiltered and therefore included metals adsorbed on to soil particles. As development of the property will result in the majority of the property being covered with asphalt pavement and buildings, infiltration of precipitation carrying surficial contaminants would be expected to be minimal under post-development conditions.

4. SITE WATER BALANCE

A site water balance is an empirical calculation and accounting of water in the hydrologic cycle. Precipitation (P) falls as rain and snow. Precipitation can evapotranspire (ET) from the ground surface, impermeable surfaces (such and buildings and roads) and through vegetation; infiltrate (I) into the soil and percolate downwards towards the shallow groundwater table; or, run-off (R) across the ground surface or impermeable surfaces towards surface water features, stormwater collection systems, and topographic low points. When assessed over a long-term period, there is minimal or no net change to groundwater storage (ΔS).

The water balance equation (Thornthwaite and Mather, 1957) can be written as:

$$P = ET + I + R + \Delta S$$

Pre-development and post-development annual water balance calculations have been prepared based on the Thornthwaite and Mather (1957) methodology, along with methodologies by Fenn et al. (1975) and Kmet (1982) as described by Daniel and Koerner (1997). The water balance calculation spreadsheets (Tables A-D) are included in Appendix I for reference.

The Thornthwaite and Mather methodology assesses monthly averages of precipitation and temperature, and uses this information in conjunction with site soils data, and climatological and soils variables, to calculate a variety of parameters. This information is then assessed using methodology and variables from the MECP Stormwater Management Planning and Design Manual (2003) to calculate infiltration, evapotranspiration, and runoff rates and volumes from both pervious and impervious portions of the subject property.

Water balance calculations are included in Appendix I for reference. Data inputs and variables for the water balance calculations were extracted from a number of sources, as described in Table II below:

Table II – Water Balance Calculation Data Sources

SITE INFORMATION	Value	Unit	SOURCE
Monthly Temperature	Varying	Deg C	Env. Canada Climate Normals 1981-2010 (Midland WPCP)
Mean Annual Temp	7.1	Deg C	Env. Canada Climate Normals 1981-2010 (Midland WPCP)
Heat Index	(calculated)		Daniel and Koerner (1997)
Potential EVT	(calculated)	mm	Daniel and Koerner (1997)
Monthly Duration of Sunlight	(estimated)		Daniel and Koerner (1997)
Adjusted EVT	(calculated)		Daniel and Koerner (1997)
Monthly Precipitation	Varying	mm	Env. Canada Climate Normals 1981-2010 (Midland WPCP)
Annual Precipitation	1040.6	mm/yr	Env. Canada Climate Normals 1981-2010 (Midland WPCP)
Runoff Coefficient	(calculated)		Daniel and Koerner (1997)
Runoff	(calculated)	mm	Daniel and Koerner (1997)
Infiltration	(calculated)	mm	Daniel and Koerner (1997)
Accumulated Water Loss	(calculated)	mm	Daniel and Koerner (1997)
Water Stored	(estimated)	mm	Daniel and Koerner (1997)
Change in Water Storage	(calculated)	mm	Daniel and Koerner (1997)
Actual EVT	(calculated)	mm	Daniel and Koerner (1997)
Percolation	(calculated)	mm	Daniel and Koerner (1997)
Latitude	44.7	Deg N	Google Earth (2021)
Elevation	218	mASL	Fryett Turner Architects (2021)
Site Area	1.12	ha	Fryett Turner Architects (2021)
Impervious Area	See Tables 2-4		Approximate (2021)
Pervious Area	See Tables 2-4		Approximate (2021)

Infiltration Factor	See Tables 2-4	MECP SWM Management Planning and Design Manual (2003)
Topo	See Tables 2-4	MECP SWM Management Planning and Design Manual (2003)
Soils	See Tables 2-4	MECP SWM Management Planning and Design Manual (2003)
Cover	See Tables 2-4	MECP SWM Management Planning and Design Manual (2003)
SOIL INFORMATION		
Surficial Soil	Fill, till	HCS Hydrogeology Investigation
Vegetation	Grass, shrubs, pavement	Field observation

It is noted that the pre-development water balance assumes runoff from the existing roadway flows onto adjacent pervious areas where it has the opportunity to infiltrate.

4.1 Post-Development Water Balance, no Mitigation

As shown in Table E in Appendix I, under post-development conditions with no mitigation measures in place, the proposed development results in a 1,362.6 m^3/yr infiltration volume deficit. The deficit is a result of the assumption that runoff from impervious surfaces is lost to the stormwater management pond, rather than having the opportunity to infiltrate. This deficit becomes the target for mitigative measures to achieve in order to maintain the pre-development water balance.

4.2 Post Development Water Balance, with Mitigation

MTE Consultants Inc. have specified mitigation measures in their Functional Servicing and Stormwater Report (FSSWM) comprising the installation of one infiltration gallery to collect post-development runoff up to a 30 mm storm event. As described in the FSSWM Report, the proposed infiltration gallery will receive only clean rooftop runoff.

The infiltration gallery will enhance the on-site infiltration of recharge to the shallow groundwater aquifer and help to ensure the pre-development water balance is met or exceeded under post-development conditions.

As shown in Table E, under post-development conditions with the infiltration gallery in place, the calculations indicate the proposed development with mitigation measures in place results in a 236.56 m^3/yr infiltration volume deficit (approximately 10% of the pre-development target). The deficit is significantly reduced from the no-mitigation scenario, and due to the relatively low permeability of the soil it is not practical to attempt to develop an infiltration facility to detain and infiltration additional volume.

It is important to consider the water balance calculations presented in Appendix I do not consider infiltration of stormwater that flows into the stormwater management (SWM) pond, or that flows from the SWM pond towards toward the Wye River. While quantifying this volume of infiltration would not be practical with the available data, this additional infiltration would further reduce the post-development infiltration deficit.

With the proximity of the site to Georgian Bay, the lack of private water supply wells within 500 m of the subject property, the poor subsurface conditions for focused infiltration of stormwater, and the potential for additional stormwater entering the SWM pond to infiltrate into the ground, it is reasonable to conclude that any small infiltration deficit that may remain under post-development conditions would not result in a material impact to shallow groundwater resources.

5. CLOSURE

Subsurface stratigraphy beneath the subject property is quite heterogeneous, but mainly consists of pavement overlying topsoil and fill underlain by silty/sandy tills of varying composition. Groundwater was encountered perched within the till deposits at depths ranging from 4.93 to 8.15 mBGS, corresponding to elevations of 216.54 to 211.77 mASL. The perched groundwater conditions do not represent a regional shallow aquifer.

Soil hydraulic conductivity estimates from slug tests and grain size analyses indicate the overburden deposits have a relatively low hydraulic conductivity ranging from 4.51 x 10^{-8} to 3.42 x 10^{-7} m/sec. Calculated soil infiltration rates from hydraulic conductivity values suggest that generally subsurface soils are unsuitable for high-volume infiltration facilities.

No surface water features are located on or directly adjacent to the property, and the subject property is not located within a Wellhead Protection Area.

The subject property is located in a Significant Groundwater Recharge Area (SGRA); however, it is expected the SGRA designation is based on regional mapping rather than on-site sol stratigraphy. Nevertheless, minimization of the potential for discharge of contaminants to the ground surface where they could infiltrate into the subsurface, along with maintenance of the site water balance under post-development conditions, is an important requirement.

The water balance calculations performed for the site demonstrate that under post-development conditions, mitigation measures are required in order to maintain the pre-development infiltration rate into subsurface soils. MTE has designed an infiltration mitigation solution consisting of one infiltration gallery collecting clean runoff from impervious surfaces (rooftops) and landscaped areas within a subcatchment of the developed area. Calculations indicate that implementation of this gallery will result in a significant reduction in the post-development infiltration deficit. With the proximity of the site to Georgian Bay, the lack of private water supply wells within 500 m of the subject property, the poor subsurface conditions for focused infiltration of stormwater, and the potential for additional stormwater entering the SWM pond to infiltrate in to the ground, it is reasonable to conclude that any small infiltration deficit that may remain under post-development conditions would not result in a material impact to shallow groundwater resources.

We trust that this report satisfies your present requirements, and we thank you for this opportunity to be of service. If you have any questions, or require further hydrogeological consulting services, please feel free to contact the undersigned directly.

Respectfully submitted,

PROFESSIONAL GEOSCIENTISTS
03-Oct-2021
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6. LIMITATIONS AND USE

This report has been prepared for the exclusive use of the Client indicated in Section 1. Chris F Helmer and Hydrogeology Consulting Services (HCS) hereby disclaims any liability or responsibility to any person or party for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by anyone other than the Client.

The conclusions and recommendations provided in this report are not intended as specifications or instructions to contractors. Any use contractors may make of this report, or decisions made based on it, are the responsibility of the contractors. Contractors must accept responsibility for means and methods of construction they select, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

In preparing this report Chris F Helmer and HCS have relied in good faith on information provided by individuals and companies noted in this report, and assumes that the information provided is factual and accurate. No responsibility is accepted for any deficiencies, misstatements, or inaccuracies contained in this report as a result of errors, omissions, misinterpretations, or fraudulent acts in the resources referenced, or of persons interviewed or consulted during the preparation of this report.

The report and its complete contents are based on data and information collected during investigations conducted by Chris F Helmer and HCS, and pertains solely to the conditions of the site at the time of the investigation, supplemented by historical information and data as described in this report. It is important to note that the investigation involves sampling of the site at specific locations, and the conclusions in this report are based on the information gathered. Limitations of the data and information include the fact that conditions between and beyond the sampling locations may vary; that the assessment is dependent upon the accuracy of the analytical data generated through sample analysis; and that conditions or contaminants may exist for which no analyses have been conducted. Furthermore, no assurance is made regarding potential changes in site conditions and/or the regulatory regime (standards, guidelines, etc.), subsequent to the time of investigation.

The professional services provided for this project include only the hydrogeological aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. No other warranty or representation is either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

7. REFERENCES

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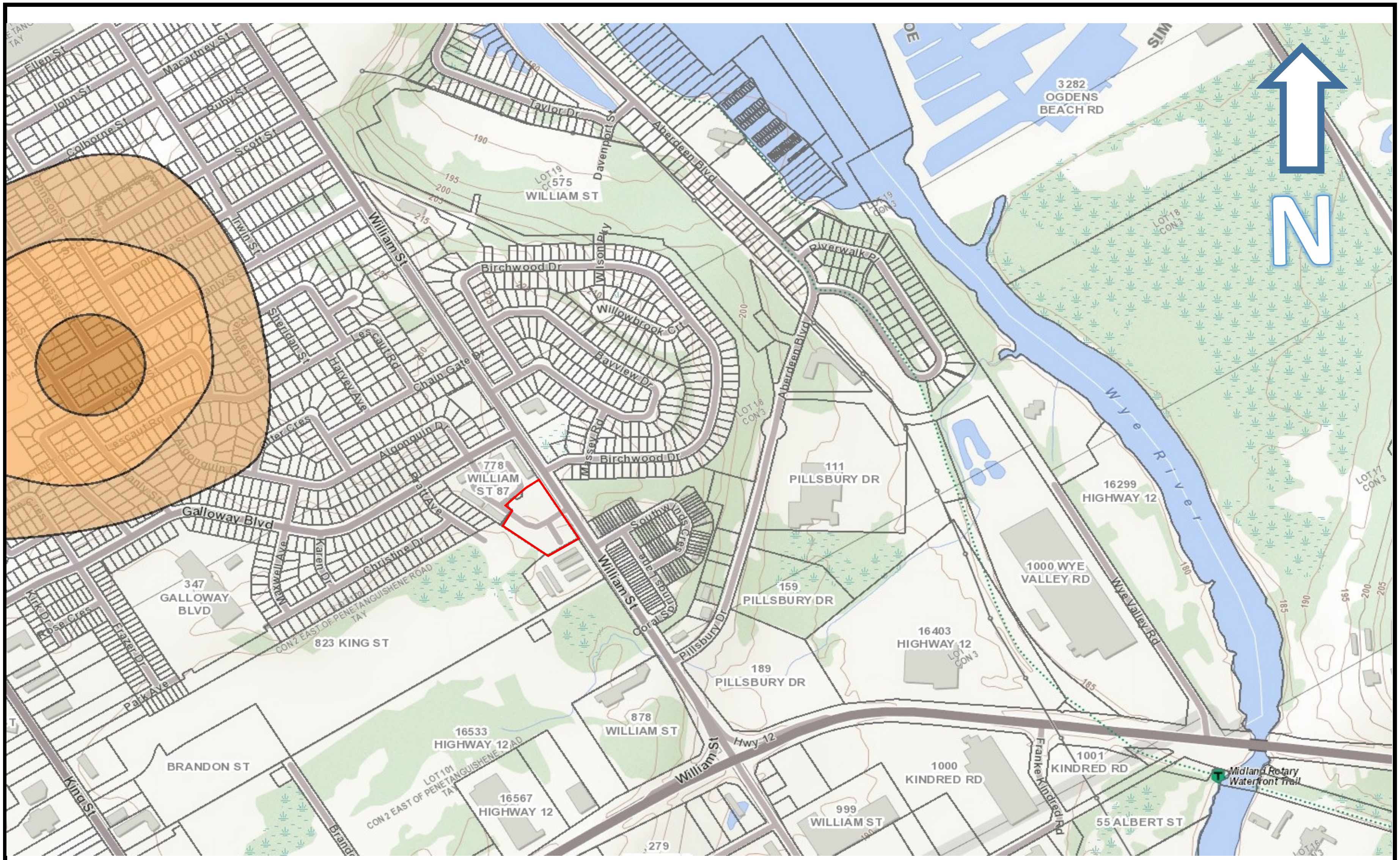
APPENDIX A: DRAWINGS

Drawing 1 – Location Plan
Drawing 2 – Perched Groundwater Contours
Site Plan (Fryett Turner Architects, August 2020)



imagery from OSPIA © 2021

LEGEND

▱	Site Area

Drawing 1 - Location Plan
786 William Street, Midland

HCS
HYDROGEOLOGY CONSULTING SERVICES

Drawn: CFH
Date: 09/22/2021

Drawing 2 - Perched Groundwater Contours
786 William Street, Midland

HCS HYDROGEOLOGY CONSULTING SERVICES

LEGEND	
457.4	Groundwater elevation (mASL)

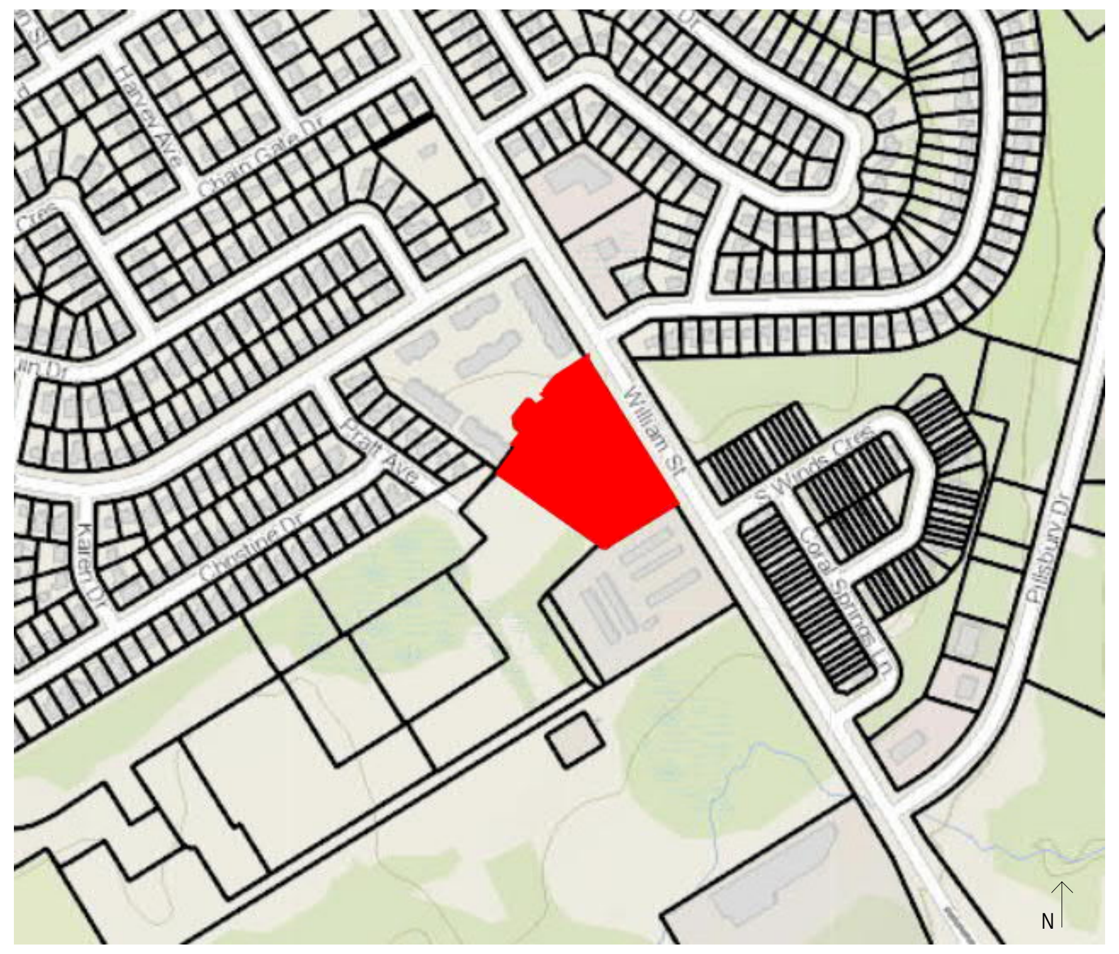
Drawn:	CFH
Date:	9/22/2021

IDENTIFICATION DATA				
PARCEL CODE: CON 2 PT LOT 102 RP 51R-7395 PT PART 2				
LOT AREA: 2.74 ACRES				
PROPOSED LAND USE: RESIDENTIAL				
REGULATIONS GOVERNING RA-12 D73.BH18, RESIDENTIAL APARTMENT ZONE				
ROW	REGULATION	REQUIRED	PROPOSED	COMPLIES
3	MIN. LOT AREA	100 SQ.M./DWELLING UNIT	TOTAL LOT = 11105.18 m² (127.6 m² PER UNIT)	YES
4	MIN. LOT FRONTAGE	40 m	135.5 m	YES
5	MAX. DENSITY UNITS/HA	113 UNITS	87 UNITS	YES
6	MIN. FRONT YARD	6.0 m	6.0 m	YES
7	MIN. INTERIOR SIDE YARD	4.9 m	4.9 m	YES
8	MIN. EXTERIOR SIDE YARD	6.0 m	6.0 m	YES
9	MIN. REAR YARD	1/2 THE BUILDING HEIGHT OR 7.5m WHICHEVER IS GREATER	9.0 m	YES
10	MAX. BLDG HEIGHT	18 m	15.8 m	YES
12	MIN. COMMON AMENITY AREA	10 SQ.M. PER UNIT = 870 m²	INTERIOR PHASE 1 = 145m² INTERIOR PHASE 2 = 67m² EXTERIOR = 1005m² TOTAL = 1217m²	YES
13	MIN. LANDSCAPED OPEN SPACE	30% LOT COVERAGE	LANDSCAPED AREA = 3946.15 m² (35.5%)	YES
18	FLOOR SPACE INDEX (F.S.I.)			N/A
	PARKING CALCULATION 1.5 PER DWELLING UNIT OF WHICH 25% SHALL BE FOR DESIGNATED VISITOR PARKING	87 DWELLING UNITS @ 1.5 = 131 MIN. REQUIRED	5 B.F. PARKING 34 VISITOR PARKING 86 RESIDENTIAL PARKING (INCLUDING 6 E.V. SPACES) 131 TOTAL PARKING	YES

Phase 1 Unit Schedule - Totals

Name	Count	Unit	Comments
Unit A	14	Unit	2 Bed
Unit B	15	Unit	2 Bed
Unit C	6	Unit	2 Bed
Unit D	3	Unit	1Bed
Unit E	3	Unit	2 Bed
Unit F	2	Unit	2 Bed
Grand total	43		

NOTE: SUITE COUNT FOR PHASE 2 INCLUDES ONE ADDITIONAL UNIT B. TOTAL UNIT COUNT OF SITE (PHASE 1 AND PHASE 2 COMBINED) IS 87 UNITS



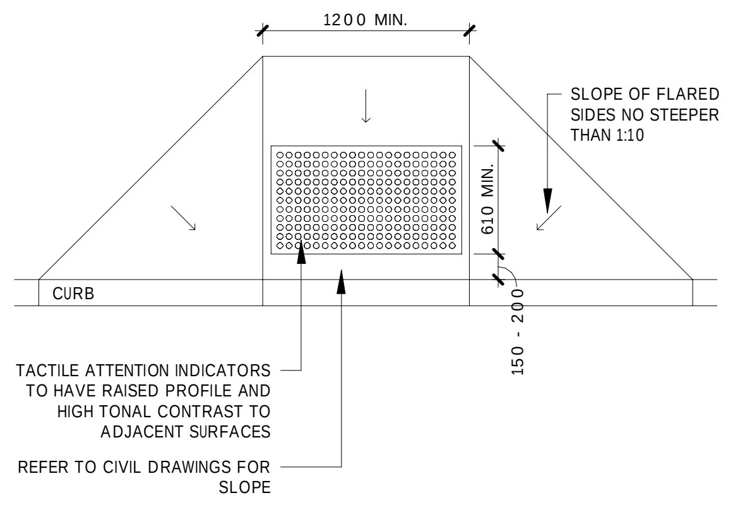
Key Plan
N.T.S.

SITE PLAN LEGEND

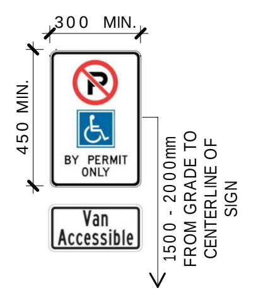
🟩	SOD OR LANDSCAPED AREA
🟦	EXISTING POND
▩	PROPOSED ASPHALT PARKING AREA
☐	PROPOSED WALKWAYS
☐	PROPOSED SITE FEATURES
▩	EXISTING BUILDING STRUCTURES
■	PROPOSED BUILDINGS
⁄⁄	PROPOSED EXTERIOR AMENITY (VISUAL LANDSCAPING)
— — —	SETBACK BOUNDARY
— — —	FIRE ROUTE
- - - - -	EDGE OF EXISTING HARD SURFACE ROADWAY - TO BE REMOVED
- - - - - -	SNOW STORAGE AREA
—○—	RB-93 ACCESSIBLE PARKING SIGN REFER TO TYPICAL ACCESSIBLE PARKING SIGN DETAIL
═	CONCRETE CURB ALL CURBS TO BE SINGLE STAGE PER OPSD 600 04 UNLESS NOTED OTHERWISE. REFER TO CIVIL DRAWINGS FOR DETAILS
●	LIGHT POST (L.P.)
✦	FIRE DEPARTMENT CONNECTION (F.D.C.)
⏢	CURB RAMP (C.R.) COMPLETE WITH TACTILE ATTENTION INDICATOR REFER TO TYPICAL CURB RAMP DETAIL

SITE PLAN NOTES

1. PROHECT TO BE COMPLETED IN TWO PHASES. ALL SITE WORK SHOWN TO BE COMPLETED IN PHASE 1 UNLESS NOTED OTHERWISE.
2. ALL SITE LIGHTING TO BE DIRECTED AWAY FROM ADJACENT RESIDENTIAL LAND.
3. PROPOSED DRIVEWAY AND PARKING TO BE ASPHALT.
4. ALL PARKING LLINES TO BE PAINTED WITH HIGH TONAL CONTRAST AGAINST ASPHALT SURFACE.
5. ALL BARRIER FREE PARKING STALLS TO INCLUDE INTERNATION SYMBOL OF ACCESSIBILITY PAINTED WITH HIGH TONAL CONTRAST AGAINST ASPHALT SURFACE.



DETAIL: CURB RAMP



NOTE: ACCESSIBLE PERMIT PARKING SIGN TO CONFORM TO SECTION 11 OF REGULATION 581 OF THE ONTARIO HIGHWAY TRAFFIC ACT

ALL STALLS TO HAVE ADDITIONAL "VAN ACCESSIBLE" SIGN POSTED BELOW

DETAIL: RB-93 PARKING SIGN

Fryett Turner
ARCHITECTS INC
115 Metcalfe Street
Elora, Ontario N0B 1S0
www.fryettarchitect.com
Tel: 519-846-2201
Fax: 519-846-0343

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE COURSE OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ARCHITECT PRIOR TO THE COMMENCEMENT OF THE WORK. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR PROCEED IN UNCERTAINTY.

ALL DRAWINGS AND SPECIFICATIONS PREPARED BY THE ARCHITECT ARE HIS PROPERTY AS INSTRUMENTS OF HIS SERVICE AND ARE TO BE RETURNED AT HIS REQUEST.

DO NOT SCALE DRAWINGS.

SEAL

PROJECT NORTH

REVISIONS		DATE
3	FOR SPA RESUBMISSION	20210817
2	FOR COORDINATION	20210409
1	FOR SPA	20210311

PROJECT
LANDINGS AT ABERDARE
786 WILLIAM ST. - MIDLAND, ON

TITLE
Site Plan

STATUS	SPA
PROJECT #	20024
CHKD	RT
DRAWN	NA
SCALE	As indicated
DATE DWN	08/12/20
ISSUED	20210312

SHEET #
A1.0

2021-09-16 9:05:51 AM

APPENDIX B: BOREHOLE LOGS

BH-01-21 to BH-03-21

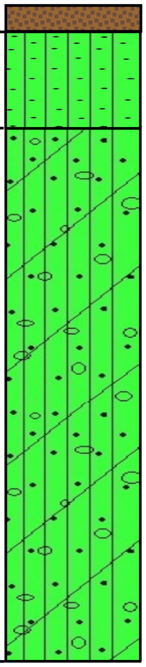
Project: **Landings at Aberdare**
Location: **786 William Street,**
Midland, Ontario

Name: **BH 01-21**
Drill Date: **01-Sep-21**
Field Tech: **AM**
Drilling Method:
Geoprobe 7822DT

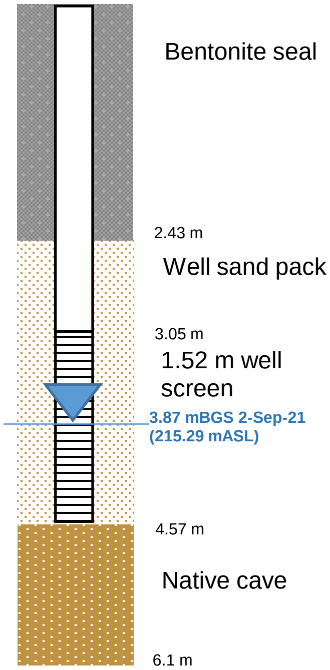
Ground Elevation: **219.16 mASL**
Location (UTM Zone 17): Easting: **590141** Northing: **4954691**

SPT Testing (blow counts)	Elevation (mASL)	Depth (mBGS)	Soil Description
	219.16	0	TOPSOIL - brown topsoil, some gravel, loose, dry. 0.25 m
		0.5	SANDY SILT- brown grey sandy silt, some gravel & cobbles, loose to compact, dry. 1.20 m
		1	
		1.5	SILT TILL - brown silt till, some gravel & cobbles, some sand, compact, moist.
	217.16	2	
		2.5	
		3	-becoming grey.
		3.5	
	215.16	4	-seam of coarse sand, loose, saturated.
		4.5	-compact, moist.
		5	-transition from grey to brown, 5 cm seam of pink coarse sand and minerals.
		5.5	
	213.16	6	-compact, dry. 6.1 m
		6.5	
		7	
		7.5	
	211.16	8	
		8.5	
		9	

Soil Symbol



Monitoring Well Completion (32 mm diameter Schedule 40 PVC pipe and well screen)



Notes:
Native cave to 4.57 m.
Well Casing Stickup: 1.06 m
Measured Water Level: 3.87 mBGS 02-Sep-21
MECP WWR # A333698

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn: CFH
Date: 09/14/2021

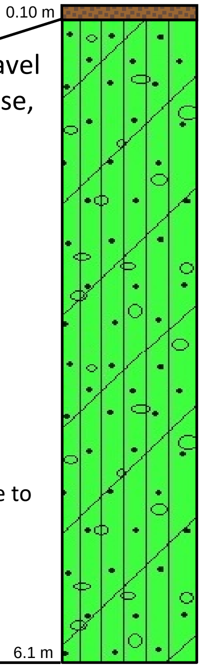
Project: **Landings at Aberdare**
Location: **786 William Street,**
Midland, Ontario

Name: **BH 02-21**
Drill Date: **01-Sep-21**
Field Tech: **AM**
Drilling Method:
Geoprobe 7822DT

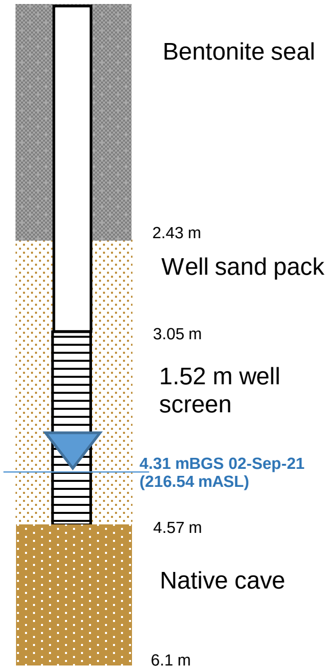
Ground Elevation: **220.85 mASL**
Location (UTM Zone 17): Easting: **590092** Northing: **4954770**

SPT Testing (blow counts)	Elevation (mASL)	Depth (mBGS)	Soil Description
	220.85	0	TOPSOIL - brown topsoil,
		0.5	SILT TILL - brown silt till, some gravel & cobbles, some coarse sand, loose, dry.
		1	
		1.5	
	218.85	2	
		2.5	
		3	-compact, some moisture.
		3.5	
	216.85	4	
		4.5	-greyish brown, dense, some moisture to dry.
		5	
		5.5	-very dense, dry.
	214.85	6	
		6.5	
		7	
		7.5	
	212.85	8	
		8.5	
		9	

Soil Symbol



Monitoring Well Completion (32 mm diameter Schedule 40 PVC pipe and well screen)



Notes:
Native cave to 4.57 m.
Well Casing Stickup: 1.08 m
Measured Water Level: 4.31 mBGS 02-Sep-21
MECP WWR # A333697

Drawn: CFH
Date: 09/14/2021

Project: **Landings at Aberdare**
Location: **786 William Street,**
Midland, Ontario

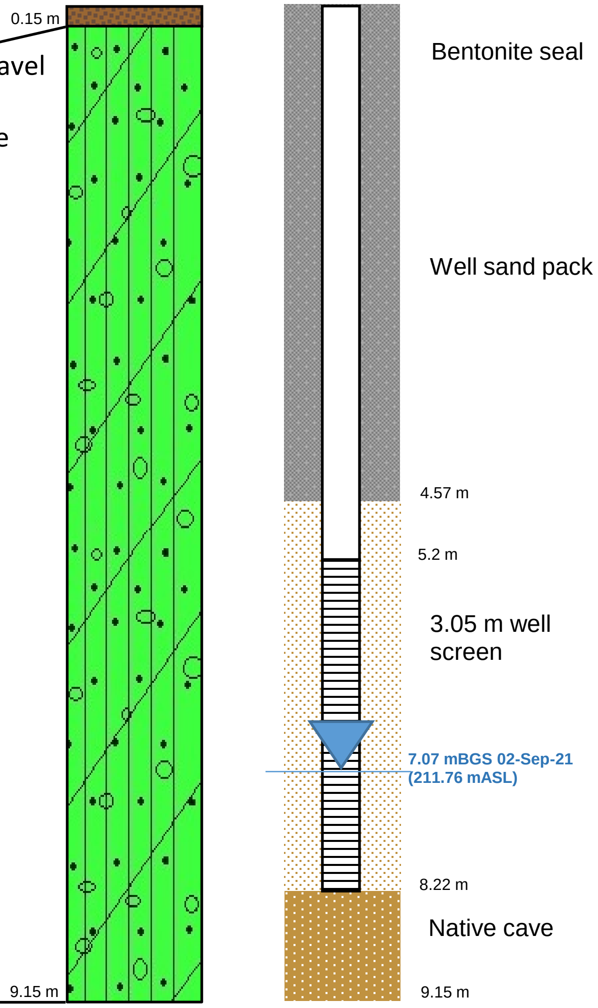
Name: **BH 03-21**
Drill Date: **01-Sep-21**
Field Tech: **AM**
Drilling Method:
Geoprobe 7822DT

Ground Elevation: **218.84 mASL**
Location (UTM Zone 17): Easting: **590059** Northing: **4954698**

SPT Testing (blow counts)	Elevation (mASL)	Depth (mBGS)	Soil Description
	218.84	0	TOPSOIL - brown topsoil, some
		0.5	SILT TILL - brown silt till, some gravel & cobbles, pockets of light grey loose sand, compact, dry to some moisture.
		1	
		1.5	
	216.84	2	
		2.5	-sand pockets, less gravel, increased
		3	
		3.5	-ocassional larger stones, some
	214.84	4	
		4.5	
		5	-greyish brown, dense, increasing moisture.
		5.5	
	212.84	6	
		6.5	
		7	-grey, some moisture.
		7.5	
	210.84	8	
		8.5	
		9	

Soil Symbol

Monitoring Well Completion (32 mm diameter Schedule 40 PVC pipe and well screen)



Notes:
Native cave to 8.22 m.
Well Casing Stickup: 1.08 m
Measured Water Level: 7.07 mBGS 02-Sep-21
MECP WWR # A333696

Drawn: CFH
Date: 09/14/2021

APPENDIX C: TABLES

786 William Street, Midland
Table 1 - Groundwater Level Measurements

Name	Ground Surface Elevation (mASL)	Stickup (m)	02-Sep-21		
			WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-21	219.16	1.08	4.93	3.85	215.31
BH 02-21	220.85	1.08	5.39	4.31	216.54
BH 03-21	218.84	1.08	8.15	7.07	211.77

mBTOP - metres Below Top of Pipe
mBGS - metres Below Ground Surface
mASL - metres Above Sea Level

786 William Street, Midland
Table 2 - Hydraulic Conductivity Estimates

Name	Soil Sample Depth or Screened Interval (mBGS)	Soil Type	Analysis Method	Hydraulic Conductivity (m/sec)
BH 01-21	3.05 - 4.57	silt till	Hvorslev**	$<1 \times 10^{-7}$
BH 01-21	1.52 - 2.13	sand and silt, some gravel, trace clay (till)	Kaubisch	3.42×10^{-7}
BH 02-21	3.05 - 4.57	silt till	Hvorslev**	$<1 \times 10^{-7}$
BH 02-21	1.52 - 2.13	silt and sand, some clay, trace gravel (till)	Kaubisch	2.77×10^{-7}
BH 03-21	5.20 - 8.22	silt till	Hvorslev**	$<1 \times 10^{-7}$
BH 03-21	1.52 - 2.13	silt and sand, some clay, trace gravel (till)	Kaubisch	4.51×10^{-8}

mBGS - metres Below Ground Surface
m/sec - metres per second
** - $T_{0.37}$ was not achieved; therefore, the hydraulic conductivity is considered approximate

786 William Street, Midland
Table 2 - Water Chemistry Analysis Results
02-Sep-21

Parameter	BH 01-21	BH 03-21	Provincial Water Quality Objectives
pH	8.17	8.19	6.5-8.5
Total Dissolved Solids (mg/L)	2220	473	--
Turbidity (NTU)	1240	221	--
Chloride (mg/L)	931	43.6	--
Nitrate (mg/L)	0.12	0.174	--
Nitrite (mg/L)	<0.050	<0.010	--
Sulfate (mg/L)	41.8	26	--
TOTAL METALS			
Aluminum (mg/L)	***3.67***	***13.9***	0.015
Arsenic (mg/L)	0.0023	***0.0114***	0.005
Cadmium (mg/L)	<0.00020	<0.00080	0.0001
Chromium (mg/L)	0.012	0.0221	--
Cobalt (mg/L)	***0.003***	***0.011***	0.0009
Copper (mg/L)	***0.0153***	***0.0656***	0.001
Iron (mg/L)	***6.71***	***32.4***	0.3
Lead (mg/L)	0.00412	***0.0469***	0.001
Manganese (mg/L)	***0.492***	1.58	--
Molybdenum (mg/L)	***0.105***	***0.123***	0.04
Nickel (mg/L)	0.0101	***0.0295***	0.025
Phosphorus (mg/L)	***0.72***	***1.83***	0.01
Sodium (mg/L)	412	17.0	--
Uranium (mg/L)	***0.00641***	***0.00684***	0.005
Vanadium (mg/L)	***0.0103***	***0.0307***	0.006
Zinc (mg/L)	***0.030***	***0.247***	0.02

i- All measured concentrations are in units indicated.

ii- Concentrations in ***bold italicized text*** exceed PWQO criteria.

iii - Samples of groundwater are compared to PWQO criteria for reference purposes only.

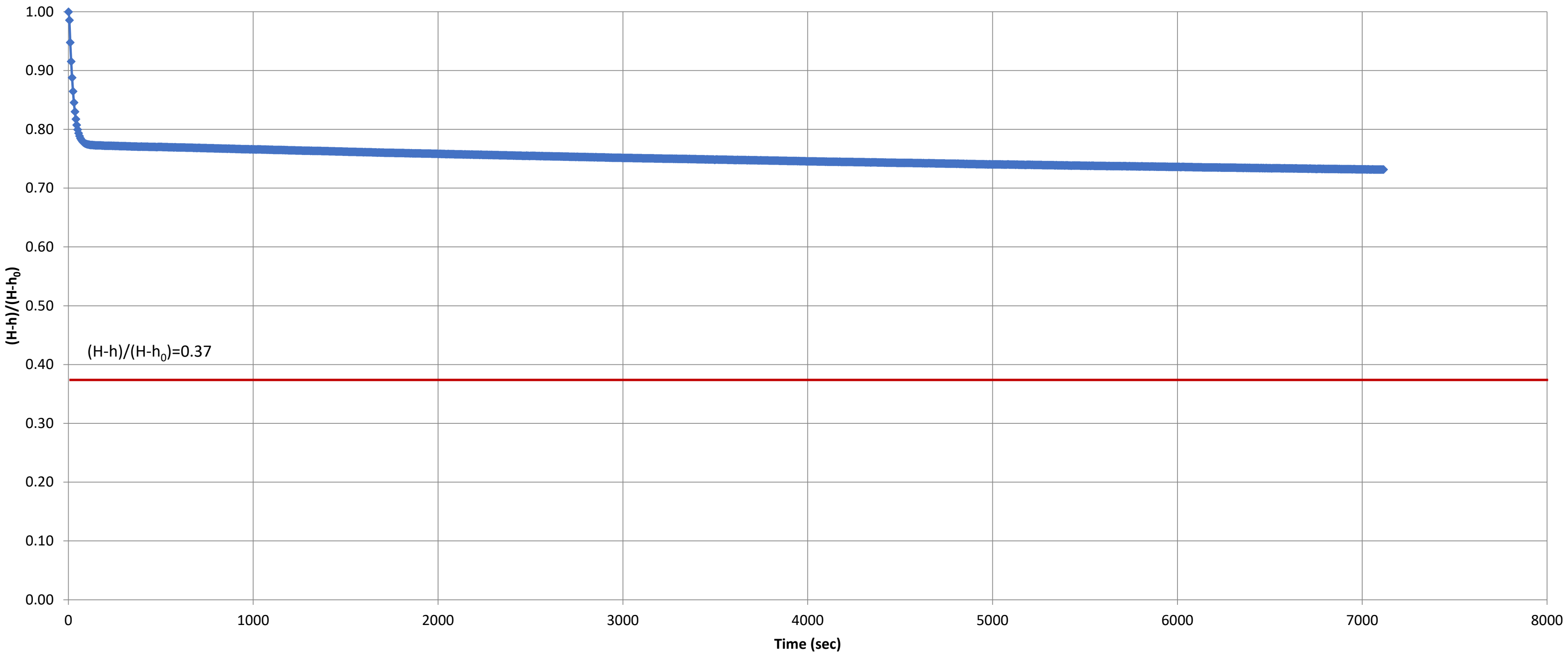
APPENDIX D: SLUG TEST ANALYSIS GRAPHS

Figure 1: BH-01-21
Figure 2: BH-02-21
Figure 3: BH-03-21

Figure 1

BH1 Slug Test Analysis

786 William Street, Midland



Hvorslev Method for Slug Test Analysis

stickup=	1.06	m	casing stickup from ground surface
SWL=	4.94	m	Static Water Level (mBTOP)
r =	0.019	m	casing radius
L =	1.52	m	screen length
R =	0.05	m	borehole radius
$H\text{-}h_o$ =	4.05	m	Water level change at T=0
$T_{0.37}$ =	n/a	sec	T at $(H\text{-}h)/(H\text{-}h_0)=0.37$

$$k = (r^2 \ln⟦(L/R)⟧)/2LT_{0.37}$$

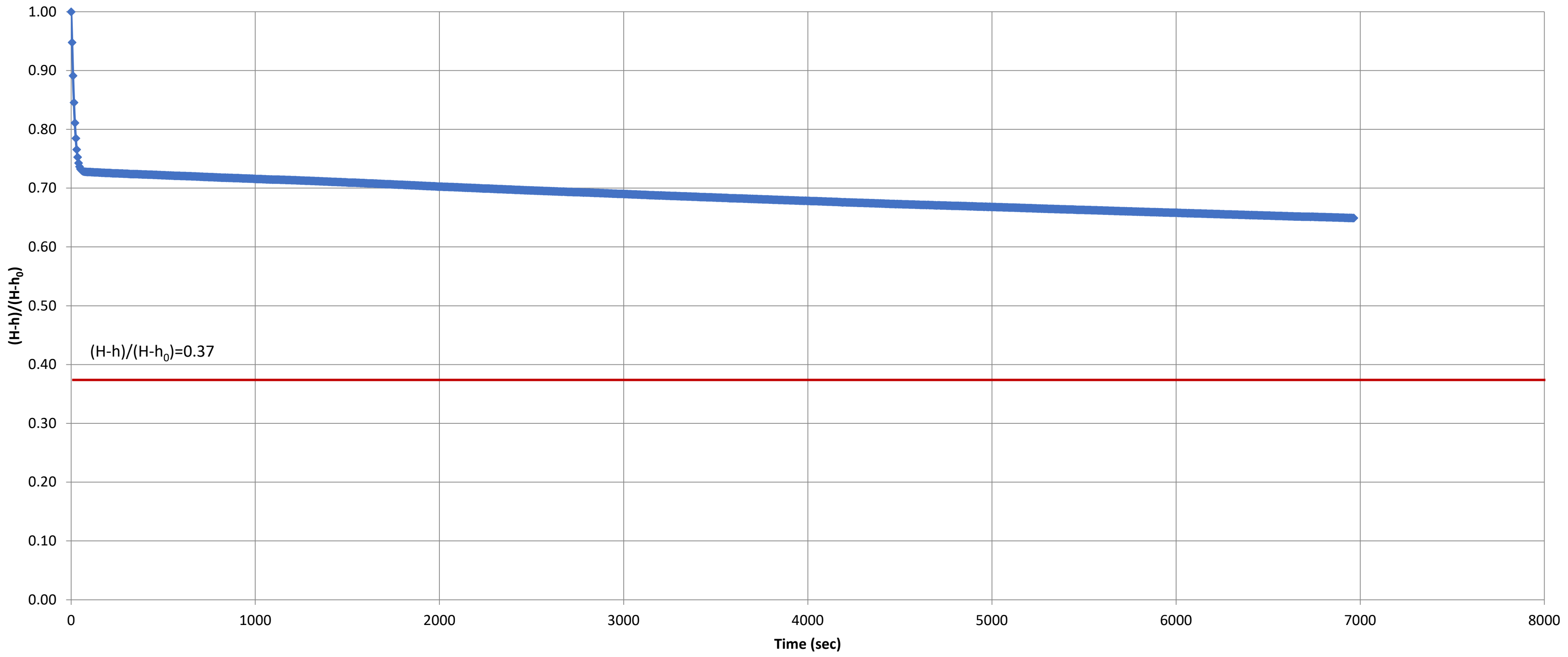
k= <1 x 10^{-7} m/sec

08/09/2021

Figure 2

BH2 Slug Test Analysis

786 William Street, Midland



Hvorslev Method for Slug Test Analysis

stickup= 1.08 m casing stickup from ground surface
SWL= 5.39 m Static Water Level (mBTOP)
r = 0.019 m casing radius
L = 1.52 m screen length
R = 0.05 m borehole radius
$H-h_o$ = 4.42 m Water level change at T=0
$T_{0.37}$ = n/a sec T at $(H-h)/(H-h_0)=0.37$

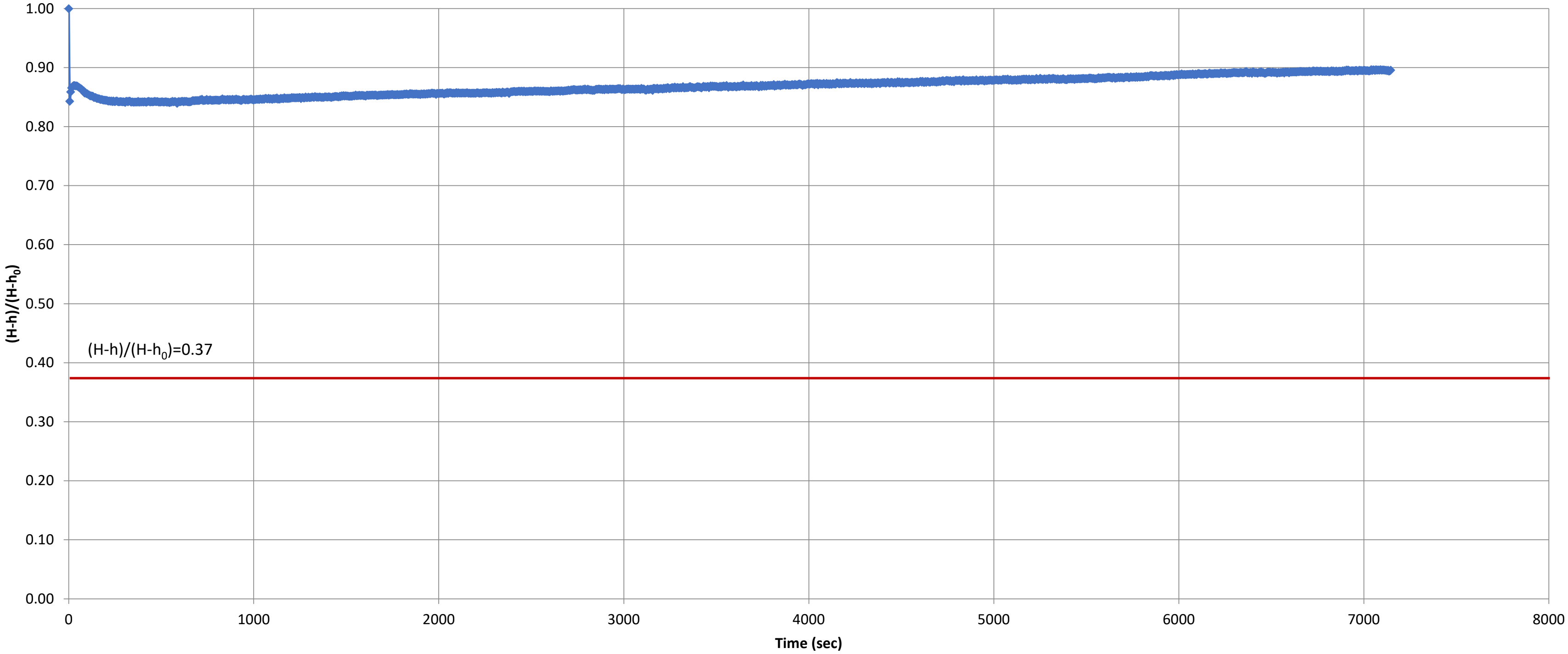
$$k=(r^2 \ln\llbracket(L/R)\rrbracket)/2LT_{0.37}$$

k= <1 x 10^{-7} m/sec

HCS HYDROGEOLOGY CONSULTING SERVICES

08/09/2021

Figure 3
BH3 Slug Test Analysis
786 William Street, Midland



Hvorslev Method for Slug Test Analysis

stickup= 1.09 m casing stickup from ground surface
SWL= 8.17 m Static Water Level (mBTOP)
r = 0.019 m casing radius
L = 3.05 m screen length
R = 0.05 m borehole radius
$H-h_0$ = 0.55 m Water level change at T=0
$T_{0.37}$ = n/a sec T at $(H-h)/(H-h_0)=0.37$

$$k=(r^2 \ln\llbracket(L/R)\rrbracket)/2LT_{0.37}$$

k= <1 x 10^{-7} m/sec

08/09/2021

APPENDIX E: GRAIN SIZE ANALYSIS GRAPHS

Figures 1-3 (CMT Engineering Inc.)

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

September 21, 2021 20-305.R01

Taylor McDaniel
Jennark Homes
66 Wellington Road 7, Unit 1
Elora, Ontario
N0B 1S0

Attn: Mr. Taylor McDaniel

Dear Sir:

Re: Laboratory Test Results
Proposed Residential Development - 786 William Street
Midland, Ontario

As requested, CMT Engineering Inc. (CMT Inc.) has performed gradation analyses on three (3) samples, as well as moisture content testing on three (3) samples obtained from the above-referenced site and submitted to the CMT Inc. laboratory in St. Clements, Ontario on September 15, 2021.

Based on the laboratory results, BH01, sample 1, from an approximate depth of 1.52 m to 2.13 m was found to be sand and silt, some gravel, trace clay and can be classified as SM using the Unified Soil Classification System. The grain size analysis is attached (Figure 1).

Based on the laboratory results, BH02, sample 1, from an approximate depth of 1.52 m to 2.13 m was found to be silt and sand, some clay, trace gravel and can be classified as ML using the Unified Soil Classification System. The grain size analysis is attached (Figure 2).

Based on the laboratory results, BH03, sample 1, from an approximate depth of 1.52 m to 2.13 m was found to be silt and sand, some clay, trace gravel and can be classified as ML using the Unified Soil Classification System. The grain size analysis is attached (Figure 3).

Determination of the moisture content for three (3) samples was also undertaken. Please see the table below which provides the results of the moisture content testing.

Moisture Sample ID	Moisture Content (%)
BH01	8.6
BH02	12.7
BH03	11.9

It should be noted that these test results are based on single samples delivered to our laboratory and do not constitute as guarantees for the entire site. Additional test samples should be obtained and tested if there is a variation observed at any time.

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

Yours truly,

MSmith

Marci Smith
Laboratory Manager

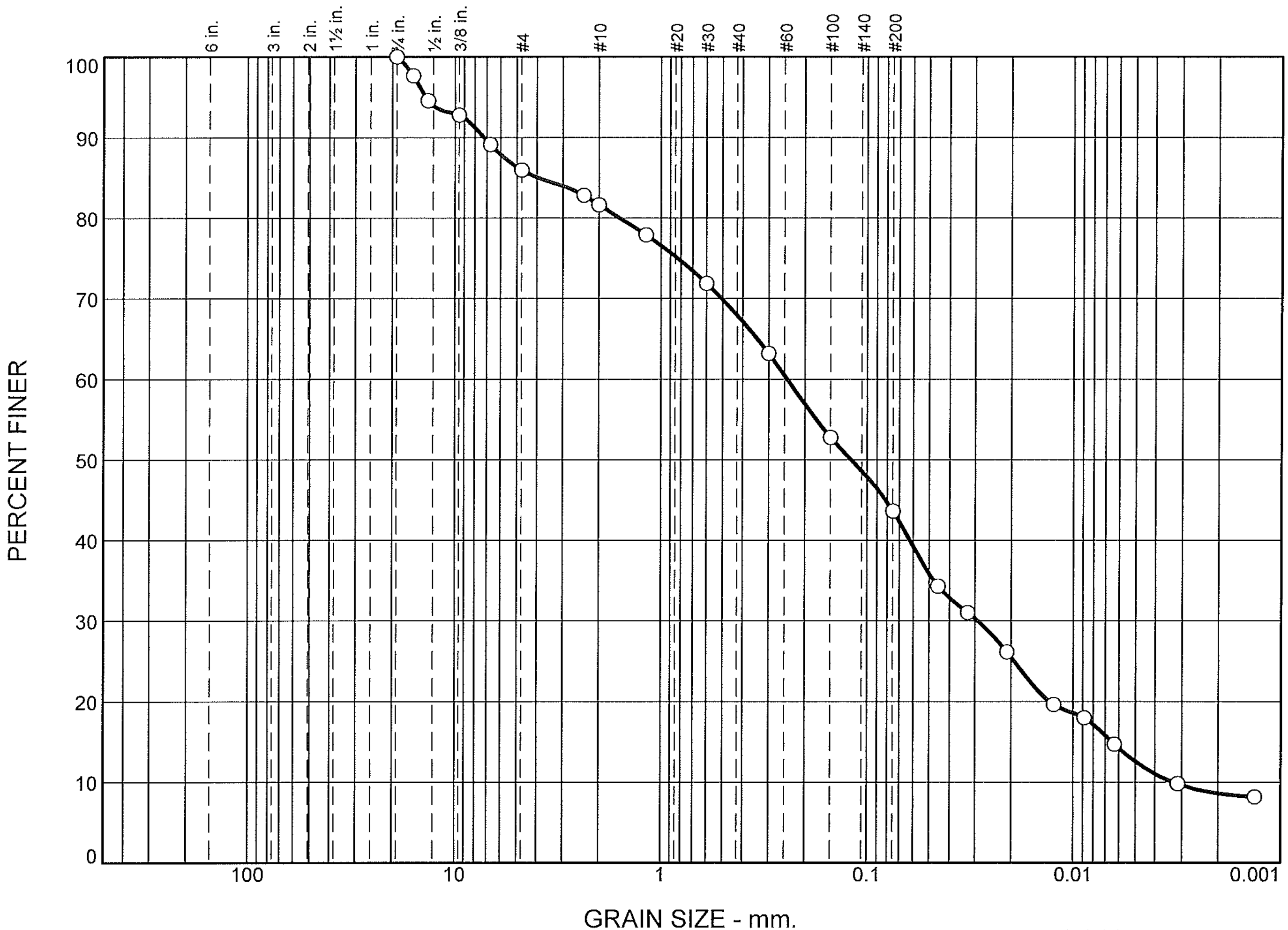
LICENSED PROFESSIONAL ENGINEER
09/21/21
N. J. CHORTOS
100210851
PROVINCE OF ONTARIO

Nathan Chortos, P. Eng.

CC: Mr. Chris Helmer, P.Geo, Hydrology Consulting Services

Encl. Grain Size Analyses

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	14.0	4.3	13.8	24.3	35.0	8.6

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH01	1	1.52-2.13m	sand and silt, some gravel, trace clay	SM
				Submitted to Lab September 15, 2021	
				Tested by MS of CMT Engineering Inc., September 16, 2021	

CMT Engineering Inc.

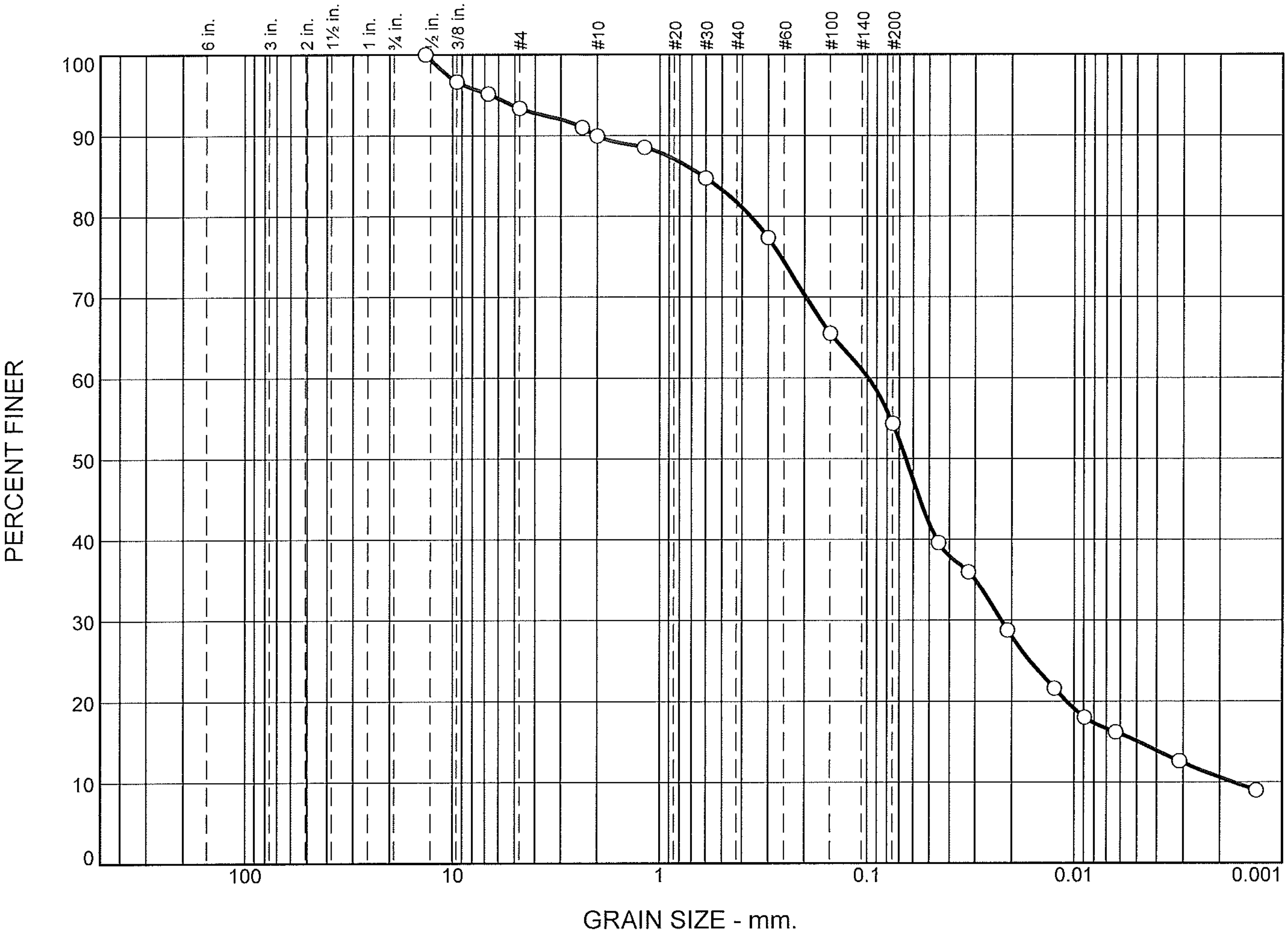
St. Clements, ON

Client: Jennark Homes

Project: Proposed Residential Development
786 William Street, Midland, Ontario

Project No.: 20-305 **Figure** 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.6	3.4	8.3	27.4	43.7	10.6

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH02	1	1.52-2.13m	silt and sand, some clay, trace gravel	ML
				Submitted to Lab September 15, 2021	
				Tested by MS of CMT Engineering Inc., September 16, 2021	

CMT Engineering Inc.

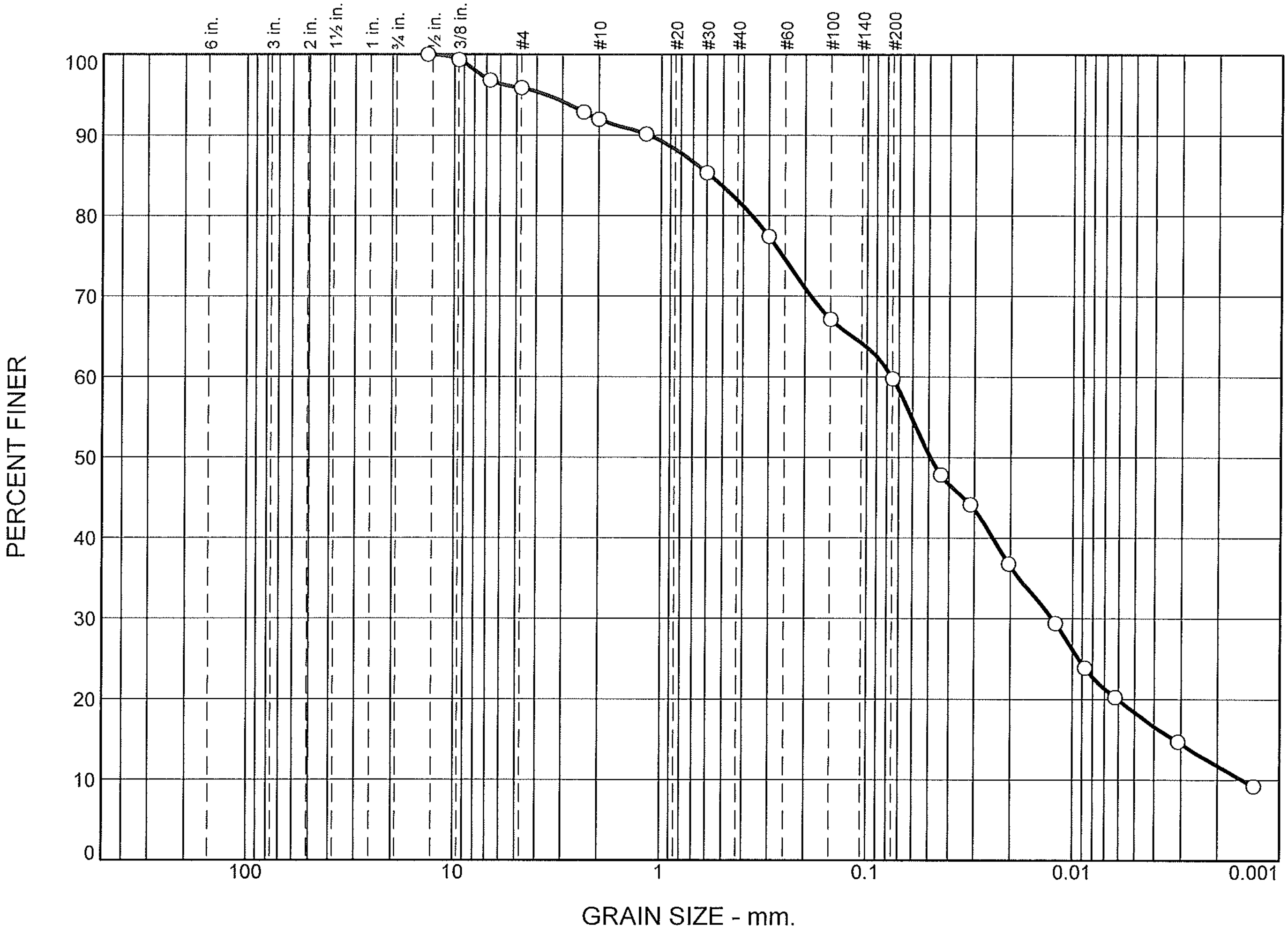
St. Clements, ON

Client: Jennark Homes

Project: Proposed Residential Development
786 William Street, Midland, Ontario

Project No.: 20-305 **Figure** 2

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	4.1	3.9	10.1	22.1	48.1	11.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH03	1	1.52-2.13m	silt and sand, some clay, trace gravel	ML
				Submitted to Lab September 15, 2021	
				Tested by MS of CMT Engineering Inc., September 16, 2021	

CMT Engineering Inc.

St. Clements, ON

Client: Jennark Homes

Project: Proposed Residential Development
786 William Street, Midland, Ontario

Project No.: 20-305

Figure 3

APPENDIX F: PREVIOUS REPORTS

Geotechnical Investigation (CMT Engineering Inc., July 2020)

Functional Servicing and Stormwater Management Brief. (MTE Consultants Inc., August 2021)

GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL DEVELOPEMNT
786 WILLIAM STREET
MIDLAND, ONTARIO

CMT Project 20-305.R01

Prepared for:

Jennark Homes

July 21, 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

July 21, 2020

20-305.R01

Jennark Homes
101 St. Andrew Street West, Suite 201
P.O. Box 85
Fergus, Ontario
N1M 1N6

Attention: Mr. Taylor McDaniel

Dear Sir:

Re: Geotechnical Investigation
Proposed Residential Development
786 William Street
Midland, 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, C.Tech., rcji

ks

TABLE OF CONTENTS

1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Taylor McDaniel of Jennark Homes to conduct a geotechnical investigation for the proposed residential development that is to be constructed at 786 William Street, Midland, Ontario. The location of the site is shown on Drawing 1.

It is understood that the project will comprise the construction of two, 5-storey, 40-unit residential buildings with basements, as well as associated access roads and parking areas. The northwest building is referenced as Building 1, with Building 2 being located to the southeast. The new buildings will be serviced by municipal watermains, sanitary and storm sewers.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); 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; soil design properties; and a summary of the laboratory results.

2.0 EXISTING SITE CONDITIONS

Currently, the site comprises a vacant lot, surfaced with grass and trees/shrubs. Large boulders were observed at the ground surface in the southeast portion of the site. An asphalt-surfaced access road crosses the site, connecting William Street to an existing townhouse complex, reportedly constructed in the 1970s, located to the northwest. A stormwater management pond that was reportedly constructed in 1998 is located in the southwest corner of the site and is to remain as is.

An existing watermain, fire hydrant, as well as sanitary sewers and storm sewers, with several associated manholes and catch basins, are located throughout the site. In some areas, the service trenches are reported to be in excess of 5.0 m below the ground surface.

The site is bounded by William Street to the east, an existing townhouse complex to the northwest, a storage unit complex to the southeast, and a wooded area to the southwest. The northern and eastern portions of the site are relatively flat, sloping slightly to the south, while the southwestern portion of the site slopes down significantly.

3.0 FIELD AND LABORATORY PROCEDURES

A previous site investigation was conducted by The Gonneau Building Group Inc. on August 21, 2017 and comprised the advancement of five (5) test pits throughout the site using a backhoe. The test pit depths ranged from about 1.7 m (5.6 ft) to 2.7 m (8.9 ft) below the existing ground surface.

The field investigation by CMT Inc. was conducted on June 25, 2020 and comprised the advancement of five (5) boreholes (referenced as Boreholes 101 to 105), using a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. The boreholes were advanced to depths of approximately 6.71 m (22.0 ft), with the exception of Borehole 104, which was advanced to approximately 5.18 m (17.0 ft) below the ground surface, due to refusal of the sampler.

Prior to the commencement of the field drilling program, public and private locates were organized by CMT Engineering Inc. to ensure that underground utilities would not be damaged.

Standard penetration testing (SPT) and sampling was carried out in all of the boreholes using 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) intervals to approximately 3.0 m (10.0 ft) and about every 1.52 m (5.0 ft) thereafter to borehole termination in the boreholes. Macro core (MC5) sampling was generally conducted between the deeper SPT soil samples throughout Boreholes 101 to 105. 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. A representative sample from a borehole at the following depth was submitted to the CMT Inc. laboratory in St. Clements, Ontario for grain size analysis:

- Borehole 105 - depth 2.29 m to 2.90 m (7.5 ft to 9.5 ft)

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

The ground surface elevations at the borehole locations were surveyed by CMT Inc. (using laser survey equipment) following the completion of drilling. The top nut of the existing fire hydrant, located northeast of the site, at the corner of William Street and Birchwood Drive, was used as a temporary benchmark, with a reported elevation of 221.88 m based on the drawing by Capes Engineering, provided by the client. The ground surface elevations at the borehole locations ranged from approximately 216.24 m at Borehole 102 to 220.70 m at Borehole 104.

The locations of the temporary benchmark, boreholes and previous test pits 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 of the boreholes. The thickness of the topsoil ranged from approximately 80 mm to 150 mm (average 106 mm) and 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. ***Fill***

Brown to dark brown, silty sand fill with occasional organics, cobbles and boulders were encountered underlying the topsoil in Boreholes 101, 102 and 103. A layer of buried organics with occasional wood pieces was also encountered within the lower zone of the fill in Boreholes 101 and 102 (potential original topsoil layer that has been covered with fill). The fill depth ranged from approximately 0.76 m to 2.29 m below the ground surface and was generally deeper towards the south to southeast end of the site. The fill thickness should be anticipated to vary throughout the site, particularly in the areas mentioned above, and in the areas of existing service trenches. The fill was considered to be loose to compact, with SPT N-values of 6 to 15 blows per 0.3 m (average 9 blows per 0.3 m). Blow counts in excess of 100 blows per 0.3 m were noted within the fill soils in Borehole 102, however these blow counts can be attributed to the cobbles and boulders encountered. The fill was considered to be moist, with moisture contents ranging from about 7.6% to 15.3% (average 11.4%).

4.3. ***Silt and Sand (Till)***

Silt and sand, with trace gravel and clay was the predominant native soil encountered in the borehole locations. The silt and sand was encountered underlying the fill soils in Boreholes 101 to 103 and underlying the topsoil in Boreholes 104 and 105. Occasional cobbles and boulders were also encountered within the silt and sand till and should be anticipated throughout the site. The soil was observed to range in colour from brown to grey, grey-brown, and dark grey. The soil was considered to be compact to very dense, with SPT N-values ranging from 12 to 100+ blows per 0.3 m (average 43 blows per 0.3 m). The soil was considered to be moist to very moist, with moisture contents ranging from about 7.8% to 13.8% (average 10.5%).

4.4. ***Asphalt***

Currently, there is an asphalt-surfaced access road that crosses the site. Borehole sampling was not carried out within the roadway, and as such, the thickness and condition of the asphalt and granular base is unknown.

4.5. ***Groundwater***

Groundwater was not encountered during the drilling investigation on June 25, 2020; however, a wet silt and sand seam was encountered in Borehole 101. This is consistent with the accumulated groundwater encountered upon the completion of Test Pit 1, on August 21, 2017, which was advanced near the Borehole 101 location. Groundwater levels (particularly perched water) will generally depend on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume.

It should be noted that the typically dense silt and sand till has the potential to create perched water conditions in looser overlying soils, such as the fill encountered in Boreholes 101 and 102. It should be expected that caving or sloughing of the excavation walls will occur where soft/wet soils are encountered.

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 two, 5-storey, 40-unit residential buildings with basements, as well as associated access roads and parking areas. The new buildings will be serviced by municipal watermains, sanitary and storm sewers.

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 ID	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevation (m)	Depth to Highest Founding Elevation (m)	Soil Type
101	217.86	250 (5,000)	375 (7,500)	215.57 to 211.15 (termination)	2.29	Silt and Sand
102	216.24	250 (5,000)	375 (7,500)	213.19 to 209.53 (termination)	3.05	Silt and Sand
103	218.54	150 (3,000)	225 (4,500)	217.78 to 211.83 (termination)	0.76	Silt and Sand
104	220.70	250 (5,000)	375 (7,500)	219.94 to 215.52 (termination)	0.76	Silt and Sand
105	218.72	250 (5,000)	375 (7,500)	217.96 to 212.01 (termination)	0.76	Silt and Sand

The proposed founding elevations and required bearing capacities were not available at the time of report preparation. Based on review of the site grading plan by Capes Engineering, dated April 24, 2019, it is understood that the basement floor elevation is anticipated to be **217.89 m for Building 1** and **216.47 m for Building 2**. As such, it is expected that the placement of structural fill may be required to achieve the design grades for the proposed foundations, particularly in the area of Building 2. Given the varying depths of fill encountered in the boreholes, the founding soils must be inspected by qualified personnel prior to structural fill or foundation placement.

The serviceability limit pressure for good quality structural fill (OPSS 1010 Granular 'A', OPSS 1010 Type II or Type III Granular 'B') placed and compacted in accordance with Section 5.4.4 of this report is estimated to be 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf). If a bearing pressure above 150 kPa (3,000 psf) at SLS is required, lean concrete fill should be used to achieve the design grades for the proposed foundations.

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 (existing services and proposed services) 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 anticipated to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively, assuming a minimum foundation width of 0.6 m (2.0 ft).

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.

CMT Inc. would be pleased to review design drawings when they become available and provide further recommendations with respect to bearing and foundation elevations.

5.2. ***Seismic Site Classification***

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 5.18 m to 6.71 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 5.4.4 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 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 (K_a, K_p, K_o) 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 Gran 'A'/ Gran 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Silt and Sand	1,800	32°	0.31	3.25	0.47	0.41	0

5.4. Site Preparation

The site preparation for the proposed residential development is anticipated to comprise the removal of topsoil/vegetation (including the buried organic soil), asphalt and unsuitable fill (as required), the subexcavation of any loose/soft native soils deemed not capable of supporting the design bearing capacity, removal or relocation of any existing services, followed by the placement of structural fill or lean mix concrete (as required) and site grading to achieve proposed grades. It is recommended that a provision for the subexcavation of deleterious fill and subsequent importing of granular fill materials be included in the tender documents. The existing fill soils could be used in landscaped areas where some settlement can be tolerated; otherwise it should be properly disposed of off-site.

5.4.1. Topsoil Stripping/Vegetation and Asphalt Removal

All topsoil, vegetation, trees (including tree root structures as well as any loose soils that are typically associated with root structures) and asphalt must be removed from within the proposed residential buildings, parking areas and driveway envelopes to expose approved competent subgrade soils.

It is understood that the existing asphalt and granular road base is to be stockpiled following removal. Reuse of the granular material will be subject to approval from qualified geotechnical personnel. Otherwise, it may be used in landscaped areas, along with the topsoil, where some settlement can be tolerated. Alternatively, it should be properly disposed of off-site.

5.4.2. Subexcavation of Unsuitable Bearing Soil

The existing fill soils encountered in the boreholes were typically observed to be in a loose to compact state with organics encountered, and as such, would not be considered suitable to support the proposed structures, driveways and parking areas. Additionally, there is the potential that unforeseen unsuitable fill may be encountered and therefore, all existing fill (including the buried organic soils and any existing trench backfill), as well as any native soils that have inadequate bearing capacity or have been disturbed by the site development/construction process and is deemed unsuitable to support foundations or slab-on-grades, must be subexcavated from within the proposed building envelope, to expose approved competent subgrade soils. It would also be sound construction practice to subexcavate all existing unsuitable fill from the proposed driveway and parking lot areas that will be constructed. At a minimum, a thorough inspection will be required at the time of construction to assess the existing soil to ensure there are no deleterious materials (organic soils) within the subgrade.

Prior to reusing excavated site material as bulk fill, thorough field inspection and approval from qualified geotechnical personnel would be required to ensure that the materials do not comprise organics, topsoil or other deleterious materials.

5.4.3. Removal/Relocation of Existing Services

Currently, an existing watermain, fire hydrant, as well as sanitary sewers and storm sewers, with several associated manholes and catch basins, are located throughout the site. In some areas, the service trenches are reported to be in excess of 5.0 m below the ground surface. It is understood that some of the existing services are to be capped, removed and disposed of off-site.

Any existing services that are located within the proposed building envelopes must be removed/relocated. Any piping that has been 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.

5.4.4. Site Grading/Structural Fill

Following the stripping of all topsoil and vegetation, asphalt removal, as well as the subexcavation all existing fill (including buried organic soil) and any relatively loose native soils that are not considered suitable to support foundations, the exposed subgrade 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:

- Prior to placement of any structural fill or bulk fill, the subgrade for the proposed new buildings 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 (recommended fill material) and 0.2 m (8") in depth for silts and clays (not recommended for this application), or the capacity of the compactor (whichever is less);

- Approved imported granular fill materials (OPSS 1010 Type II or III Granular 'B' recommended for this application) or approved existing granular fill (free of asphalt) 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 as well as slab-on-grades that will be subject to heavy loads or point loading (including any entrance slabs and other large expansive slabs) must be compacted to 100% standard Proctor maximum dry density (SPMDD);

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading, bulk fill for driveways and parking areas) must be compacted to a minimum 95% SPMDD. It would be expected that the existing on-site soils, free of any deleterious or organic 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 in order to achieve the specified density; and

- Granular 'B' subbase and Granular 'A' base materials for the parking areas, entrances, and any paved areas must be compacted to 100% SPMDD.

It should be noted that the existing native silt and sand till soils are compact to very dense. It is imperative that if the soils are utilized for backfilling of service trenched, the material must be broken down (pulverized) to minimize voids and reduce the potential for settlement. These soils should not be utilized as structural fill.

5.5. Foundation Subgrade Preparation

The fine-grained silt and sand soils encountered in 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 excavations. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions;

- 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.

All foundation excavations must be reviewed by qualified personnel to confirm the suitability of the founding fill soils prior to foundation placement.

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

Prior to the placement of the granular base for the slab-on-grade construction, the subgrade soils should be proof-rolled. Any soft or weak zones, as well as any unsuitable fill or organics 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	**Modulus of Subgrade Reaction (k)**
Imported Gran 'A'/Gran 'B' (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Silt and Sand	47,500 kN/m^3 (175 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) should 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 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 silt and sand (till) soils encountered in the boreholes, in a drained state (not saturated), would be classified as Type 2 soils under Reg 213/91. 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 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 fill soils 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 wet to saturated soils. As such, it may be necessary to increase the proposed width of the excavations to accommodate sloughing soils.

5.8. Construction Dewatering Considerations

Groundwater was not encountered during the drilling investigation on June 25, 2020; however, a wet silt and sand seam was encountered in Borehole 101. Although wet soils were not encountered in most of the borehole locations, it should be noted that due to the presence of dense, less permeable silt and sand till, perched water conditions should be anticipated, and may increase the moisture content within the overlying soil. Seepage should be expected where perched groundwater is present. Sloughing of excavation walls should also be expected if perched water conditions exist. Groundwater levels 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.

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

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.031. The trench excavations should be symmetrical with respect to the 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.

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

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

It is understood that the proposed new building will have basements, in which case a perimeter weeping tile system will be required. Perforated drainage tile should be installed around both the exterior and interior perimeter, and non-perforated pipe should be installed to direct the collected exterior water to a sump pit and good quality sump pump. Each unit with a basement should have its own separate sump pump system. It is recommended that sump pumps be equipped with a battery backup (in the event if a power outage).

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

The native mineral soils, as well as fill soils which are free of any organics or deleterious materials, are generally considered suitable for reuse as trench backfill and bulk fill in the parking area and driveways. 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 would be recommended to minimize differential frost heave at transitions from granular fill to frost-susceptible soils).

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

- Adequate heavy padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;
- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for silt soils or the capacity of the compactor (whichever is less);
- The soils must be at suitable moisture contents to achieve compaction to a minimum 95% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;
- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;
- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;
- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

It should be noted that the existing native silt and sand soils encountered were typically in a compact to very dense state. It is imperative that if these soils are utilized for backfill 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 driveways and parking areas. 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 and areas of out-swinging doors. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native subgrade soils are sensitive to 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 to saturated conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement base. 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 driveways and parking areas will experience mostly light traffic (personal vehicles) and some heavy traffic (moving trucks, delivery trucks, maintenance and emergency vehicles). Based on the anticipated loading, the following pavement designs are provided for proposed light and heavy traffic areas:

Material	**Recommended Thickness**	
	Light Traffic	**Heavy Traffic**
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 60 mm (2.5")
Granular 'A' Base	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase	400 mm (16.0")	450 mm (18.0")

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

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

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 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.

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 and intermediate binder 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 such a garbage trucks, 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

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 by CMT Inc. as part of this geotechnical investigation; however an environmetal assessment is being completed by Try Environmental and will be forwarded by Try Environmental under separate cover. 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 INSPECTIONS

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

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:

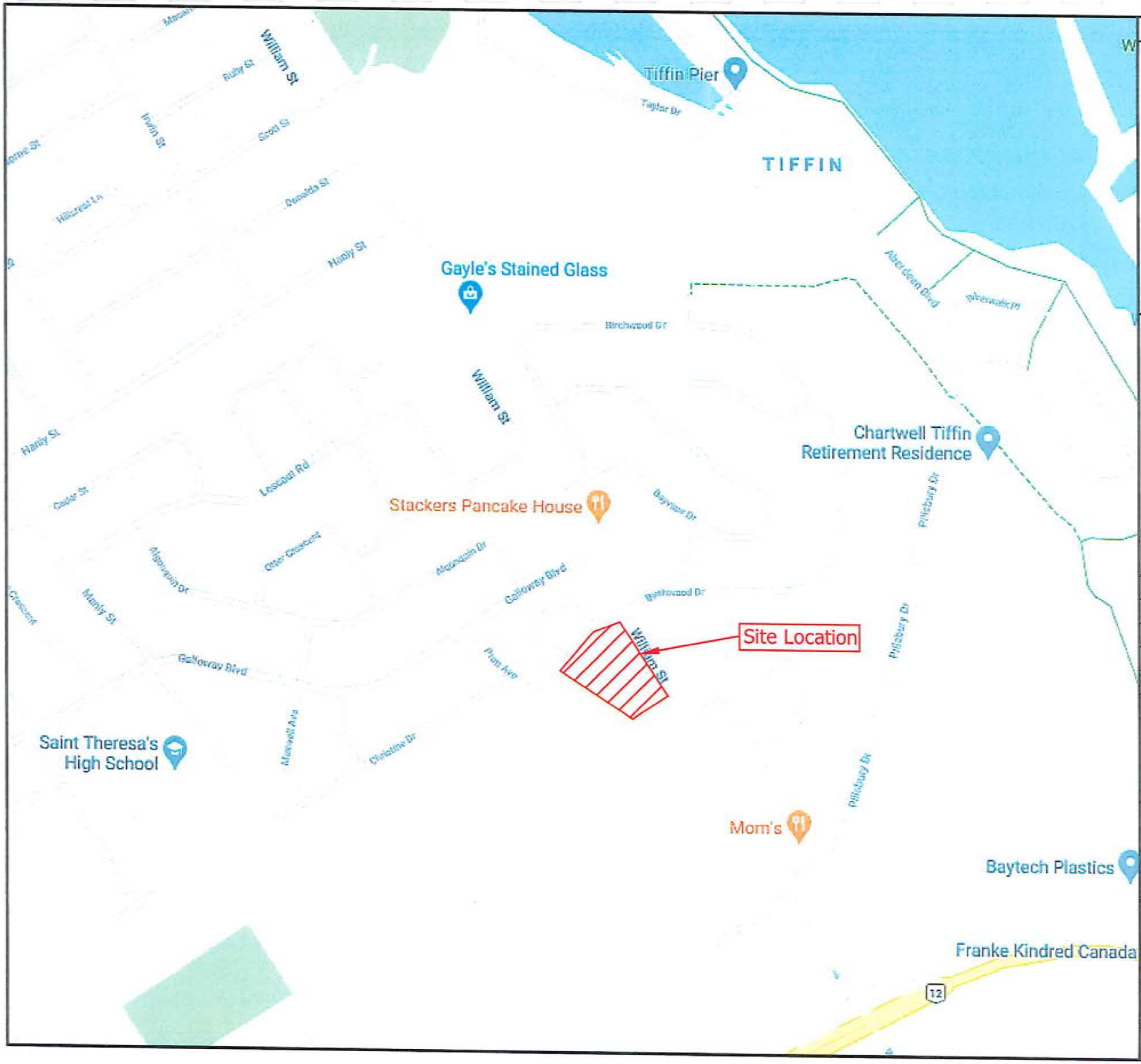
Brittany Brown, C.Tech., rcji

ks

LICENSED PROFESSIONAL ENGINEER
2020/07/22
N. J. CHORTOS
100210851
PROVINCE OF ONTARIO

Reviewed by:

Nathan Chortos, P.Eng.
Senior Geotechnical Engineer



NOTES:

Base map provided by Google.

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

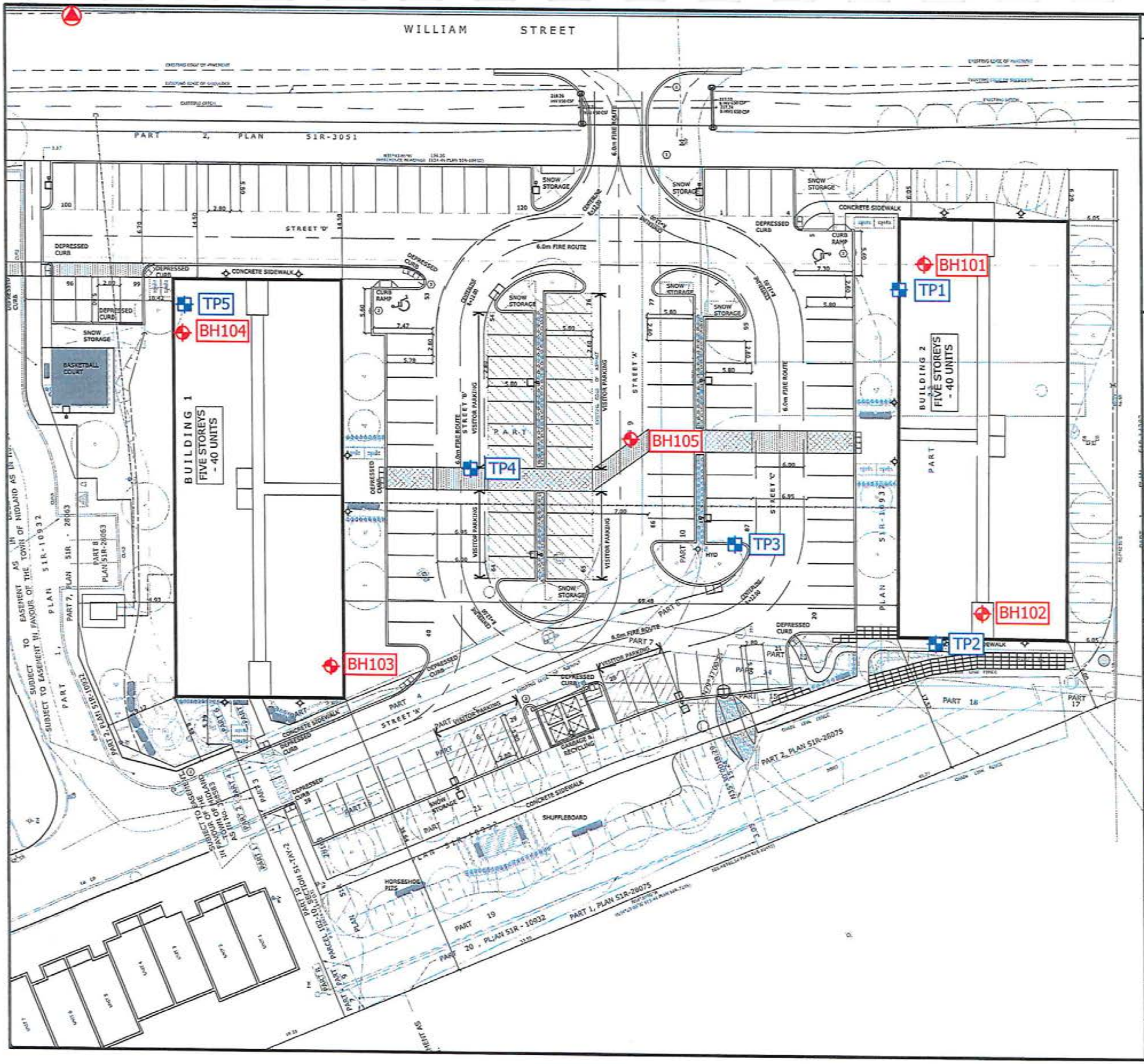
PROJECT:

Proposed Residential Development
786 William Street
Midland, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.: 20-305
DATE: July 9, 2020
SCALE: N.T.S.
DRAWING NO. 1



NOTES:

Base map by Capes Engineering
(Project No. 2018-009)

Legend

- CMT Borehole (June 25, 2020)
- Approximate Location of Previous Test Pits (August 21, 2017)
- Temporary Benchmark (TBM) Top Nut of Fire Hydrant at Corner of Birchwood Drive and William Street Elevation = 221.88 m

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
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Fax: 519-699-4664
www.cmtinc.net

PROJECT:

Proposed Residential Development
786 William Street
Midland, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
20-305	July 9, 2020
SCALE:	DRAWING NO.
N.T.S.	2

APPENDIX A

BOREHOLE LOGS

BOREHOLE 101

Page 1 of 1

Date Drilled: June 25, 2020
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

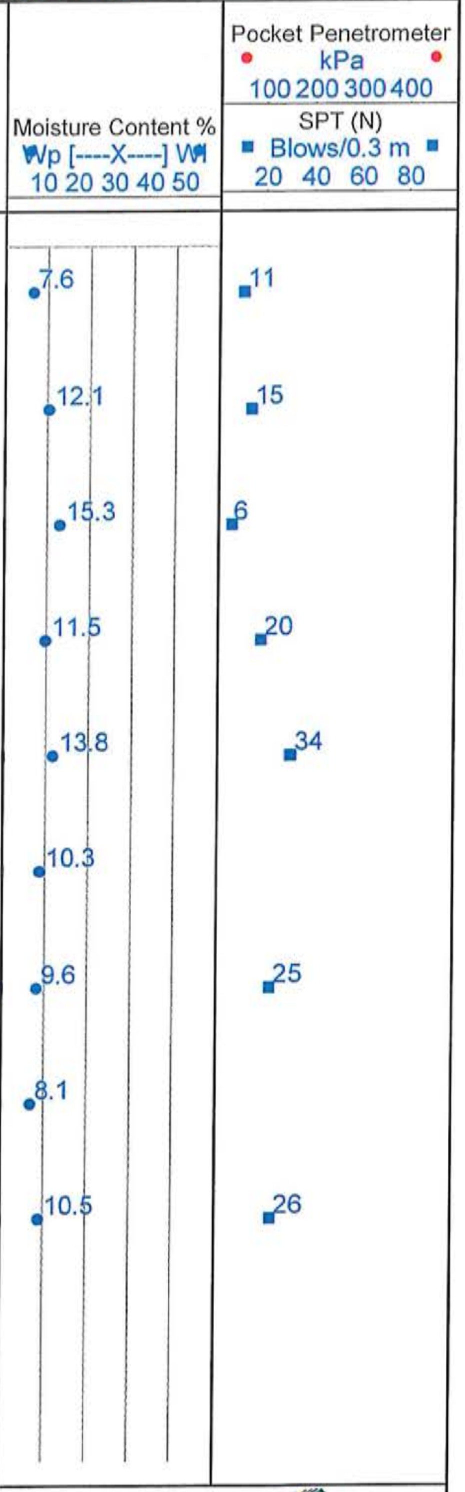
Elevation: 217.86 m
Logged by: BB

Project No.: 20-305
Project: Proposed Residential Development
786 William Street
Location: Midland, Ontario

SOIL DESCRIPTION	Elevation / Depth (m)
Ground Surface (m)	217.86 0.00
TOPSOIL Loose, dark brown silty topsoil, moist (100 mm)	
FILL Loose to compact, brown and dark brown silty sand fill, with occasional organics, cobbles and boulders, moist	217.05 0.81
becoming trace organics	216.34 1.52
becoming dark grey-brown, buried organics, with occasional wood pieces	
SILT AND SAND (TILL) Compact to dense, grey-brown silt and sand, trace gravel and clay, very moist	215.57 2.29
(wet seam from approximately 3.66 m to 3.81 m)	
End of Borehole	211.15 6.71

Borehole open to approximately 5.82 m below ground surface.

Depth (m)	Sample Type	Sample Number	Moisture Content %	SPT (N) Blows/0.3 m
0.0–0.6	SS	1	7.6	11
0.8–1.4	SS	2	12.1	15
1.5–2.1	SS	3	15.3	6
2.3–2.9	SS	4	11.5	20
3.0–3.7	SS	5	13.8	34
3.7–4.6	MC5	6	10.3	
4.6–5.2	SS	7	9.6	25
5.2–6.1	MC5	8	8.1	
6.1–6.7	SS	9	10.5	26



Well Installation

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

BOREHOLE 102

Page 1 of 1

Date Drilled: June 25, 2020
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 216.24 m
Logged by: BB

Project No.: 20-305
Project: Proposed Residential Development
786 William Street
Location: Midland, Ontario

Elevation (m) / Depth (m)	SOIL DESCRIPTION
216.24 0.00	Ground Surface (m)
	TOPSOIL Loose, dark brown silty topsoil, moist (100 mm)
	FILL Loose to compact, brown and dark brown silty sand fill, with occasional organics, cobbles and boulders, moist
214.61 1.63	becoming black buried organic fill with occasional wood pieces, moist
214.16 2.08	***SILT AND SAND (TILL)*** Loose to compact, dark grey silt and sand, trace gravel and clay, with occasional cobbles and boulders, very moist
213.19 3.05	becoming dense, moist
211.87 4.37	becoming brown
210.02 6.22	becoming very moist
209.53 6.71	End of Borehole

Borehole open to approximately 6.40 m below ground surface.

Sample Type	Sample Number	Moisture Content %	SPT (N) Blows/0.3 m
SS	1	12.9	6
SS	2	8.0	100+
SS	3	14.6	9
SS	4	10.7	100+
SS	5	10.0	30
MC5	6	8.5	
SS	7	11.3	49
MC5	8	8.3	
SS	9	9.9	100+

Well Installation

Moisture Content % Wp [----X----] Wl 10 20 30 40 50

Pocket Penetrometer kPa 100 200 300 400

CMT ENGINEERING INC.
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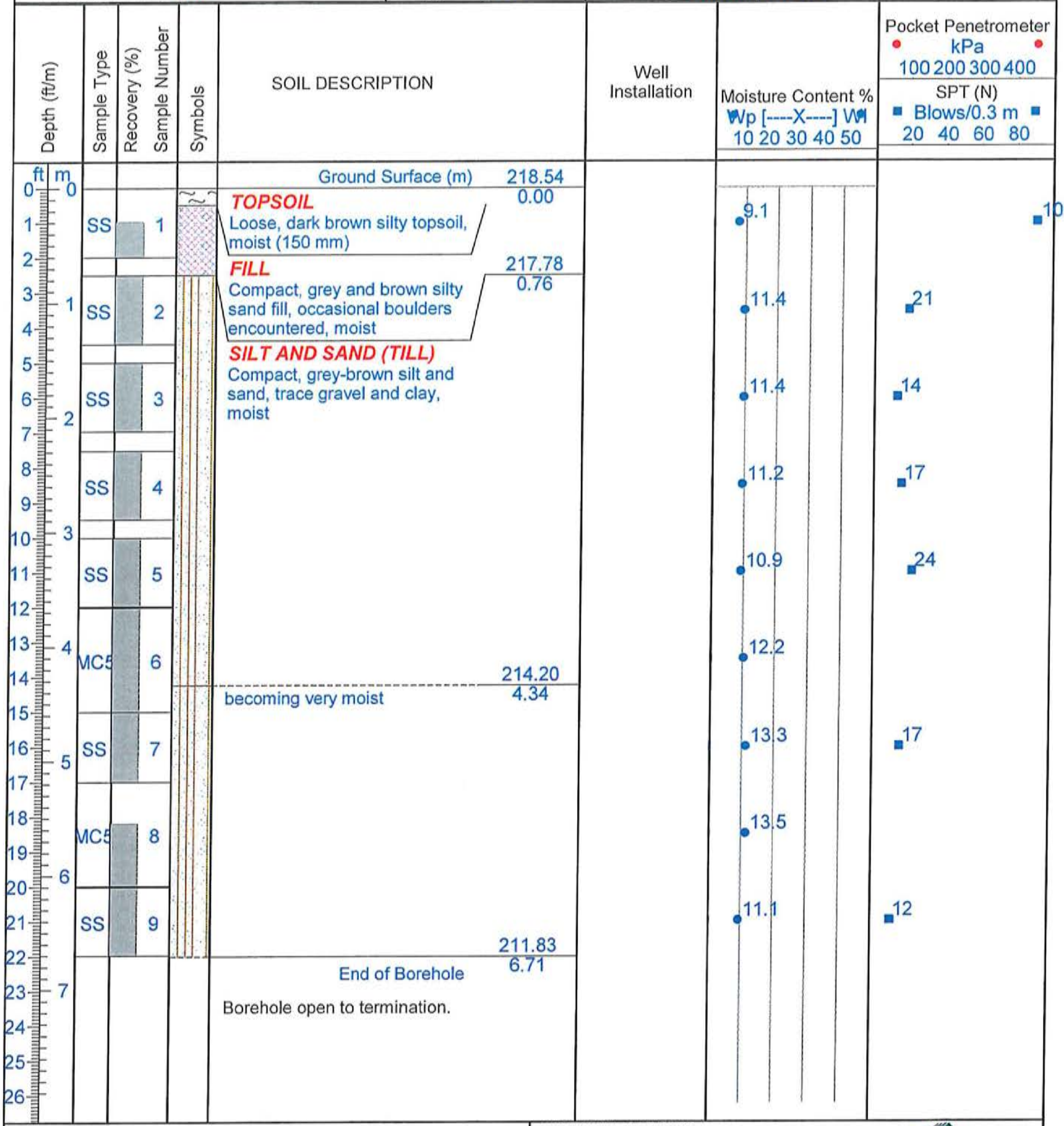
www.cmtinc.net

BOREHOLE 103

Date Drilled: June 25, 2020
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 218.54 m
Logged by: BB

Project No.: 20-305
Project: Proposed Residential Development
786 William Street
Location: Midland, Ontario



SOIL DESCRIPTION

Ground Surface (m) 218.54 / 0.00

TOPSOIL
Loose, dark brown silty topsoil, moist (150 mm)

217.78 / 0.76

FILL
Compact, grey and brown silty sand fill, occasional boulders encountered, moist

SILT AND SAND (TILL)
Compact, grey-brown silt and sand, trace gravel and clay, moist

214.20 / 4.34

becoming very moist

211.83 / 6.71

End of Borehole

Borehole open to termination.

SS	1	9.1	100
SS	2	11.4	21
SS	3	11.4	14
SS	4	11.2	17
SS	5	10.9	24
MC5	6	12.2	
SS	7	13.3	17
MC5	8	13.5	
SS	9	11.1	12

BOREHOLE 104

Date Drilled: June 25, 2020
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

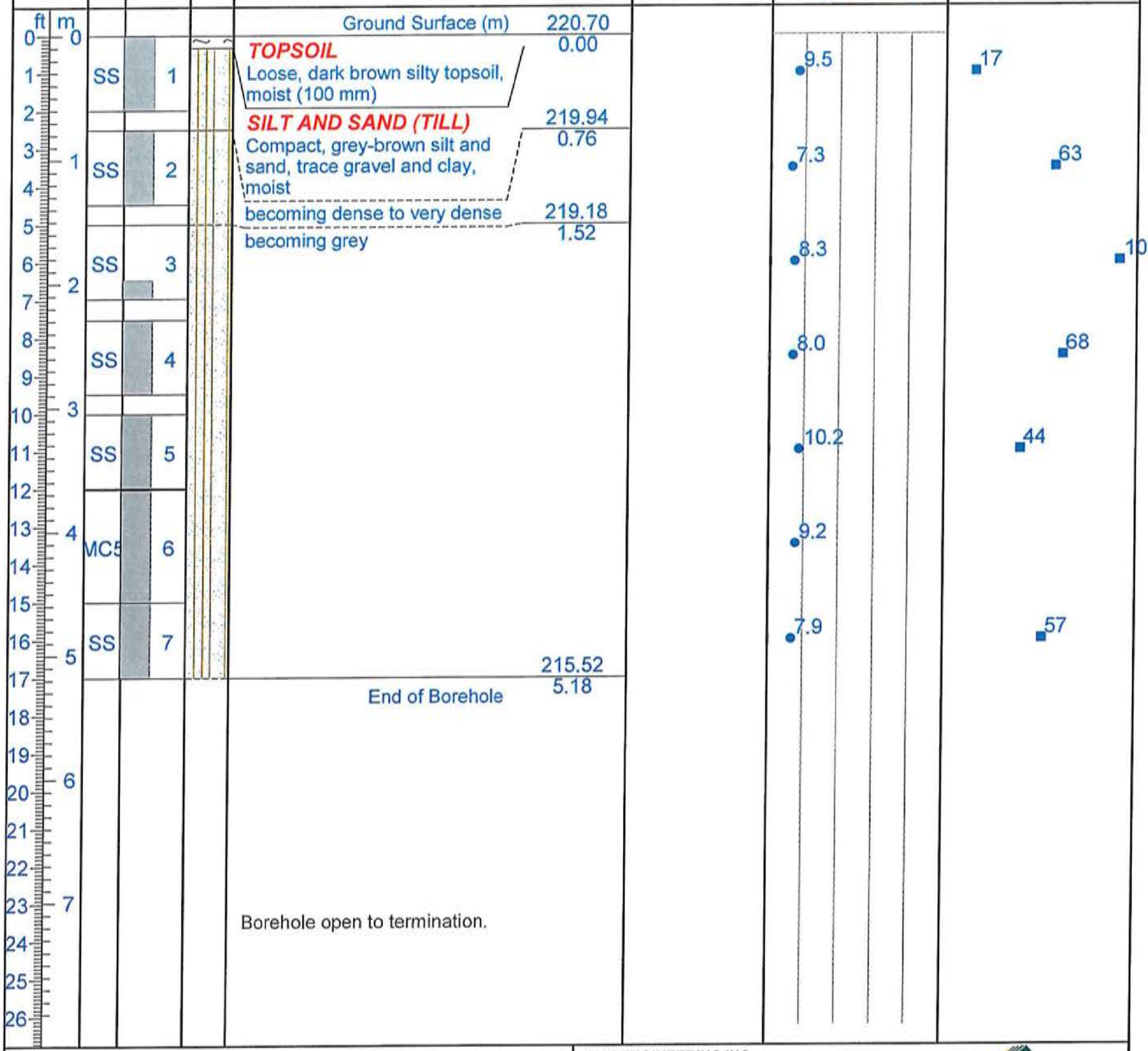
Elevation: 220.70 m
Logged by: BB

Project No.: 20-305
Project: Proposed Residential Development
786 William Street
Location: Midland, Ontario

Elevation / Depth (m)	SOIL DESCRIPTION
220.70 0.00	Ground Surface (m)
	TOPSOIL Loose, dark brown silty topsoil, moist (100 mm)
219.94 0.76	***SILT AND SAND (TILL)*** Compact, grey-brown silt and sand, trace gravel and clay, moist
219.18 1.52	becoming dense to very dense becoming grey
215.52 5.18	End of Borehole

Borehole open to termination.

Sample Type	Sample Number	Moisture Content %	SPT (N) Blows/0.3 m
SS	1	9.5	17
SS	2	7.3	63
SS	3	8.3	100
SS	4	8.0	68
SS	5	10.2	44
MC5	6	9.2	
SS	7	7.9	57



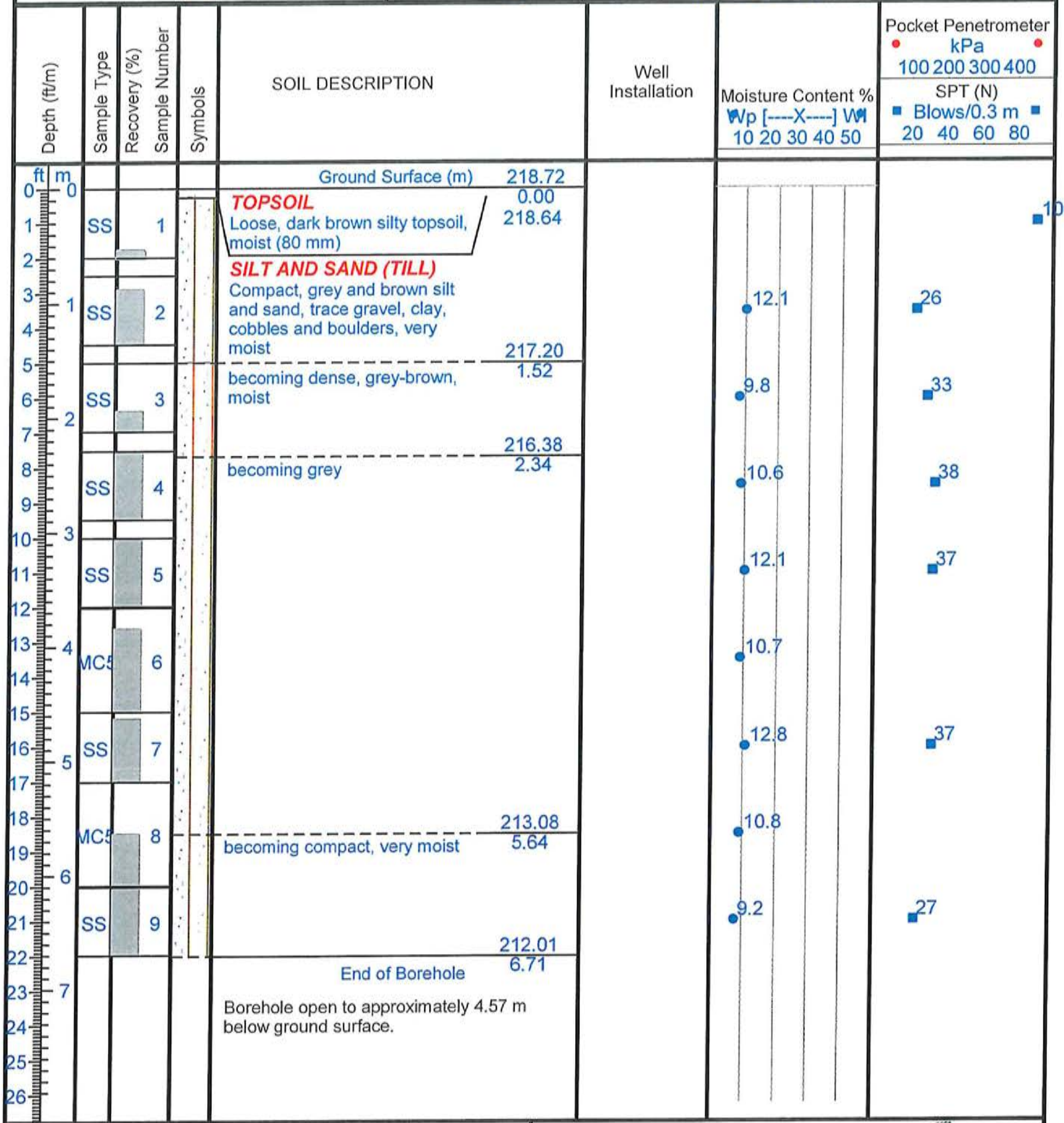
BOREHOLE 105

Page 1 of 1

Date Drilled: June 25, 2020
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 218.72 m
Logged by: BB

Project No.: 20-305
Project: Proposed Residential Development
786 William Street
Location: Midland, Ontario



SOIL DESCRIPTION	
Ground Surface (m)	218.72
TOPSOIL Loose, dark brown silty topsoil, moist (80 mm)	0.00 218.64
SILT AND SAND (TILL) Compact, grey and brown silt and sand, trace gravel, clay, cobbles and boulders, very moist	217.20 1.52
becoming dense, grey-brown, moist	216.38 2.34
becoming grey	213.08 5.64
becoming compact, very moist	212.01 6.71
End of Borehole	

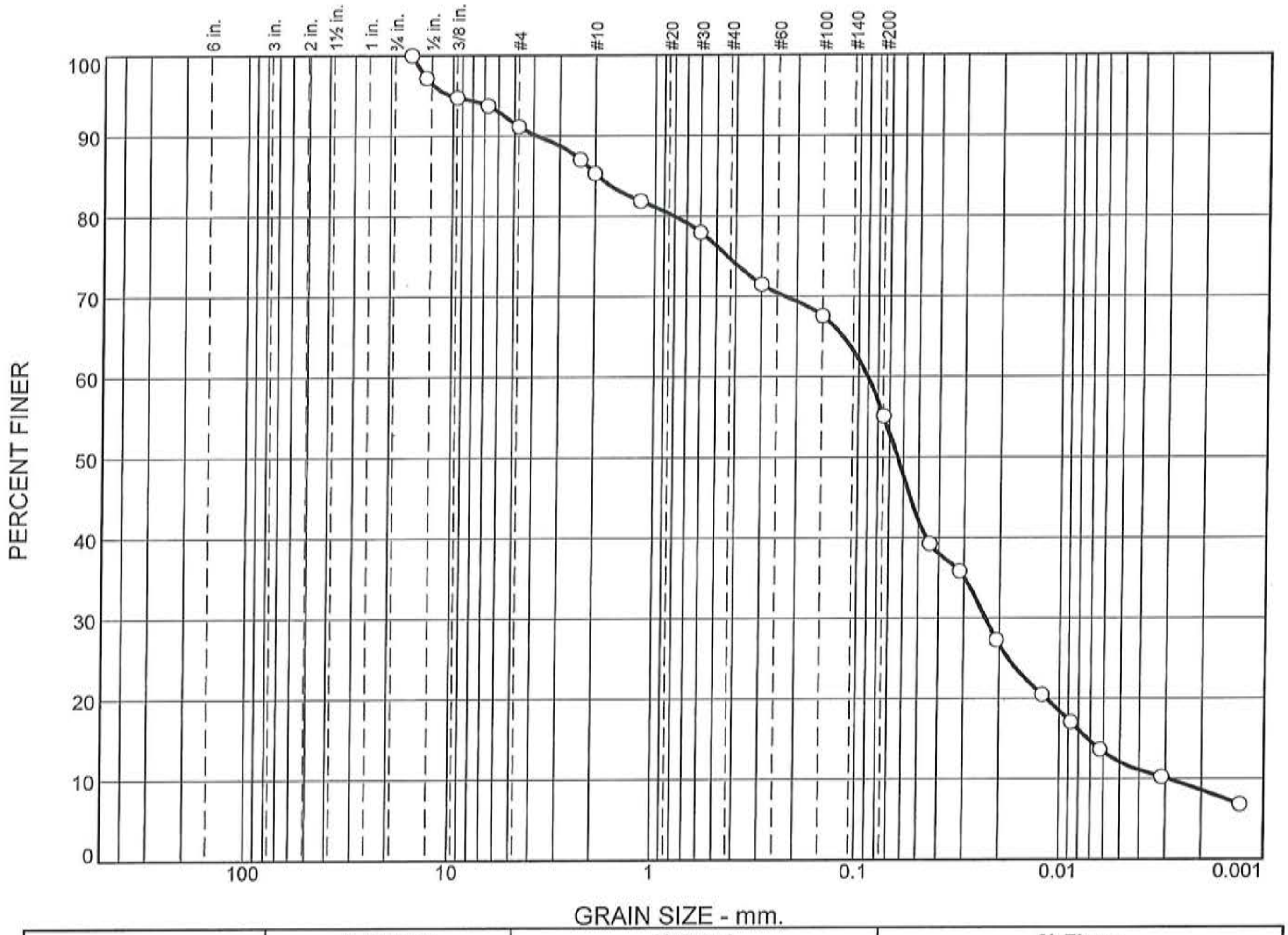
Borehole open to approximately 4.57 m below ground surface.

Sample Type	Sample Number	Moisture Content %	SPT (N) Blows/0.3 m
SS	1		100
SS	2	12.1	26
SS	3	9.8	33
SS	4	10.6	38
SS	5	12.1	37
MC5	6	10.7	
SS	7	12.8	37
MC5	8	10.8	
SS	9	9.2	27

APPENDIX B

GRAIN SIZE ANALYSIS

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	8.9	5.8	10.7	19.5	46.5	8.6

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH105	4	2.29-2.90m	silt and sand, trace gravel and clay	ML
				Sampled by BB of CMT Engineering Inc., June 25, 2020	
				Tested by JM of CMT Engineering Inc., June 29, 2020	

CMT Engineering Inc. **St. Clements, ON**	**Client:** Jennark Homes **Project:** Proposed Residential Development 786 William Street, Midland, Ontario **Project No.:** 20-305 **Figure** 1

MTE

MTE Consultants
520 Bingemans Centre Drive, Kitchener, Ontario N2B 3X9

October 4, 2021

MTE File No.: C48593-100

Manager of Engineering
Town of Midland
575 Dominion Avenue
Midland, Ontario L4R 1R2

RE: 786 William Street - Midland
Functional Servicing and Stormwater Management Brief

Background and Existing Conditions

MTE Consultants Inc. was retained by Fryett Turner Architects Inc. to prepare Site Grading and Servicing Plans and a Stormwater Management (SWM) Brief for the proposed residential development to be constructed at 786 William Street, located in the Town of Midland.

The site is currently vacant and is approximately 1.12 ha. It is bounded by William Street to the east, Midland Self Storage site to the south, an existing woodlot to the west, and Georgian Landing Condominiums to the north. For the exact location, refer to the key plan located on the enclosed engineering drawings.

The development consists of the construction of two five-storey apartment buildings complete with surface parking and two driveway entrances; one off of William Street and a second off of Bowling Green Estates.

As detailed in the report entitled “786 William Street Detailed Design Report Project #2018-009” prepared by Capes Engineering in October 2018, the site was previously owned by Georgian Landing Condominiums (778 William Street) and was to be developed as Phase 2 of their site. The original design was for an additional 43 residential units similar to what currently exists at Georgian Landing. Watermain, sanitary and storm sewers, an internal roadway, and a small stormwater management (SWM) facility were all installed on the subject site as part of the originally proposed Phase 2 development plan.

Servicing

With the 786 William Street site being severed from the Georgian Landing site and now under separate ownership, appropriate easements should be established over the shared services installed on the 786 William Street site.

Sanitary

There is an existing 200mm diameter sanitary sewer that runs from north to south within the site, and outlets at the south west corner of the property. As detailed in the report prepared by Capes Engineering, we understand the sanitary sewer extends west along the north edge of the Midland Self Storage site and ultimately connects with the municipal sanitary sewer on William Street. Based on the surveyed inverts and the information provided in the report prepared by

Capes Engineering, the existing sanitary sewer outlet is at a slope of approximately 2.0%, with a capacity of 46.3 L/s.

A new 200mm diameter sanitary sewer is proposed to connect to the existing 200mm diameter sanitary sewer installed on the site to service the two proposed apartment buildings. The proposed development consists of 86 units. Assuming 2.0 ppl/unit, this equates to a population of 172 people, and an anticipated peak sanitary flow rate of 4.04 L/s. From the information provided in the report prepared by Capes Engineering, the Georgian Landing development was calculated to have an anticipated peak sanitary flow rate of 2.05 L/s. The total peak sanitary flow rate being directed to the existing sanitary sewer outlet is calculated to be 6.09 L/s.

Therefore, the existing sanitary service connection has adequate capacity to convey the combined flow from the proposed development and the Georgian Landing site. Refer to the attached sanitary sewer design sheet for details.

Storm

A series of catch basins and storm sewers were installed on the site to collect runoff from not only the Georgian Landing site but also the subject site at 786 William Street under developed conditions. There is an existing 375mm diameter storm sewer on the site that discharges to the existing SWM facility within the south west corner of the site. There is also an existing 300mm diameter storm sewer on the site that runs parallel to the south property line and also discharges to the existing SWM facility.

As part of the re-development of the site, several new catch basins and storm sewers are proposed on site to collect runoff generated on the proposed parking lots and building rooftops. This runoff will be conveyed to the existing storm sewers outletting to the existing SWM facility. The on-site storm sewers have been sized to convey the 5 year design storm to the existing SWM facility. Refer to the attached storm sewer design sheet for details.

Water

There is an existing 150mm diameter watermain on the site the enters the property off of William Street and continues through the site to service the Georgian Landing site. There is also an existing fire hydrant installed on the site that is proposed to be re-located on the site to accommodate the proposed development plan. A new 150mm private watermain is proposed to be extended from the existing watermain network on the site to service the proposed buildings. The Town of Midland has requested that the existing valve on William Street, which is currently permanently in the closed position, is to be upgraded to a CLA-VAL check valve Model 81-02. Details for the valve are provided on drawing C2.3. It is assumed that adequate water supply is available to service the development. A fire flow analysis will be completed for the site to confirm available flow and pressure, if required by the Town.

Stormwater Management

As detailed in the stormwater management report prepared by Capes Engineering, the stormwater management criteria for the site is to ensure minimal or no negative impacts on the downstream landowner(s), and to adhere to the original design criteria of the existing SWM facility on the site. Through the recreation of a hydrological model for the existing SWM facility, Capes Engineering determined the total contributing drainage area to the existing SWM facility to be 2.49ha, including the Georgian Landing site and the 786 William subject site, with an overall allowable imperviousness of 56%.

The proposed development encompasses an area of 1.12ha with an imperviousness of 63%. The Georgian Landing site encompasses an area of 1.37ha with an imperviousness of 47%. The combined sites have a total drainage area of 2.49ha with a total imperviousness of 54.2%. Therefore, additional on-site water quantity and quality controls are not required. Refer to Figure 1.0 for an illustration of the stormwater catchment areas in the post development of the site.

Infiltration Water Balance

The Town of Midland has requested that a water balance analysis be completed for the proposed development to ensure post development infiltration volumes are maintained on site. A monthly water balance analysis was completed by HCS for the site under current and post-development conditions, to examine the impacts of the proposed development on infiltration. Refer to the Scoped Hydogeological Investigation prepared by HCS for the results of the water balance analysis for the site.

In the post development condition, the infiltration target is to maintain or enhance the infiltration volume as compared to current conditions. Infiltration measures include passive infiltration across the site in pervious areas as well as active infiltration of roof drainage from the proposed buildings. The runoff generated from the Building 1 rooftop and half of the Building 2 rooftop is proposed to be directed to an infiltration gallery on the site. The gallery will be sized to accommodate runoff from a 30mm rainfall event.

The infiltration gallery is proposed to be installed below the proposed parking lot fronting Building 2. No groundwater was encountered in the borehole located within the vicinity of the proposed gallery, however a wet silt and sand seam was encountered at an approximate elevation of 213.20. The bottom of the infiltration gallery is proposed to be at an elevation of 214.30. The proposed gallery will be an ADS Stormtech system with a total depth of 1.7m. An overflow connection will be provided to the on-site storm sewer system.

Erosion and Sedimentation Control

In order to minimize the effects of erosion during the grading of the site, sediment control fencing will be installed, as shown on the enclosed engineering drawings, and around any stockpiles. Any sediment that is tracked onto the road way during the course of construction will be cleaned by the contractor.

Conclusions

Based on the foregoing analysis, it is concluded that:

i) The existing sanitary, water, and storm sewers on the site have adequate capacity to service the proposed development;

ii) The total drainage area being directed to the existing SWM facility is less than 56% imperviousness, and therefore no additional on-site water quantity or quality controls are required;

iii) The proposed infiltration gallery will assist with the pre to post water balance across the site; and,

iv) Upon completion of construction, the site will conform to the design criteria specified by the Town of Midland.

Recommendations

It is recommended that:

i) The site grading be undertaken according to the proposed elevations, details and erosion control measures shown on the enclosed engineering drawings; and,

ii) The proposed civil works be inspected by MTE Consultants Inc., during construction, and certified to the Town of Midland upon completion.

We trust that this information is satisfactory. Please contact the undersigned if you have any questions

Yours Truly,

MTE Consultants Inc.

Chelsea Hiebert

Chelsea Hiebert, P.Eng.
Design Engineer
519-743-6500 ext. 1285
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Design Engineer
519-743-6500 ext. 1381
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CAH:scm
Encl.
M:\48593\100\Reports\rpt_2021-10-04_SWM Brief.docx

786 William Street
Town of Midland

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Project Number: 48593-100
Date: February 17, 2021
Design By: CAH
Checked By:
File: Q:\48593\100\Sanitary Sewer Design Sheet_2021-01-22.xls

Drainage Area Plan No:

Design Parameters

Average Daily Flow
Residential 0.00521 L/s/
Commercial L/s/ha
Industrial L/s/ha
Inst. / School L/s/ha

Mannings "*n*" 0.013
Min. Velocity 0.8 m/sec
Max. Velocity 3.0 m/sec
Residential Harmon Peaking Factor $F = 1 + 14/(4 + P^{0.5})$

Residential Area Infiltration 0.20 L/s/ha

LOCATION				RESIDENTIAL AREAS and POPULATION											SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL				INFILTRATION			DESIGN					
STREET	AREA NO.	MANHOLE LOCATION		HECTARES OF EACH DENSITY							POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	HECTARES AND FLOW OF EACH ZONING									TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY
		FROM MH	TO MH	R2 **36**	R3 **72**	R4/R5 **143**	R6 **196**	R7 **312**	R8 **387**	R9 **775**					0.00 *L/s/ha*			0.00 *L/s/ha*			0.00 *L/s/ha*												
															AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW										
				ha	*ha*	*ha*	*ha*	*ha*	*ha*	*ha*	*1000s*	*1000s*		*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*m*	*%*	*mm*	*L/sec*	*m/s*
Georgian Landing Site		Ex. MH4A	Ex. MH6A								0.080	0.080	4.26886	1.7793											1.37	1.37	0.2740	2.0533	56.0	0.61	200	25.6034	0.815
		Ex. MH6A	Ex. MH7A																									2.0533	27.7	0.94	200	31.7831	1.012
786 William		Bldg 1	MH1A								0.086	0.086	4.26093	1.9092											0.56	0.56	0.1120	2.0212	12.0	2.00	200	46.3604	1.476
		MH1A	MH2A																									2.0212	78.0	2.80	200	54.8544	1.747
		Bldg 2	MH2A								0.086	0.086	4.26093	1.9092											0.56	0.56	0.1120	2.0212	12.0	2.00	200	46.3604	1.476
		MH2A	Ex. MH7A																									4.0423	20.2	1.00	200	32.7818	1.044
		Ex. MH7A	Ex. MH9A																									6.0956	45.6	1.50	200	40.1493	1.279
		Ex. MH9A	Ex. MH10A																									6.0956	7.7	2.00	200	46.3604	1.476

786 William Street

TOWN OF MIDLAND

Project Number: 48593-100
Date: February 17, 2021
Design By: CAH
Checked By:
File: Q:\48593\100\Storm Sewer Design Sheet_2021-01-22.xlsx

STORM SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Drainage Area Plan No:

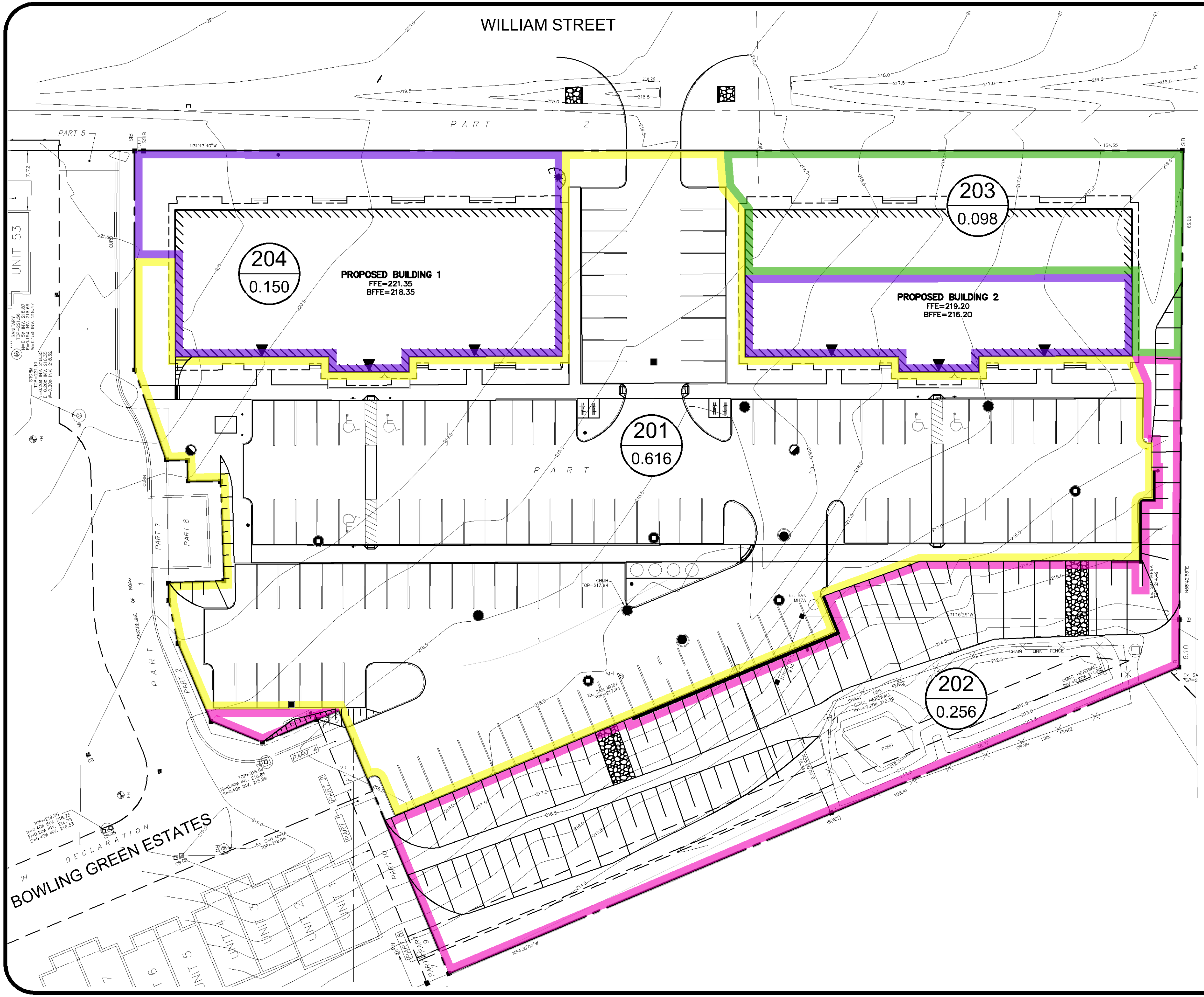
Design Parameters

5 YEAR STORM

Q=kAIC, k=0.00278
Intensity (I) = $a/(tc+b)^c$
a = 1135
b = 7.5
c = 0.841

Manning's "n" 0.013
Min. Velocity 0.800 m/s
Max. Velocity 6.000 m/s

LOCATION				STORMWATER FLOW								DESIGN					
STREET	AREA NUMBER	MANHOLE LOCATION		AREA (A)	RUNOFF COEFF. (C)	A x C	CUMUL. A x C	CONCENTRATION TIME		RAIN INTENSITY (I)	FLOW (Q)	PIPE SIZE	LENGTH	SLOPE	CAPACITY	FULL FLOW VELOCITY	PIPE FULL
		FROM MH	TO MH					TOTAL	IN PIPE								
				ha		*ha*	*ha*	*min*	*min*	*mm/hr*	*L/s*	*mm*	*m*	*%*	*L/s*	*m/s*	*%*
786 William St		CB1	CBMH2	0.063	0.95	0.0598	0.0598	10.0000	0.2734	102.27133	16.98920	300	22.7	2.30	146.65396	2.0747	11.58
		CBMH2	MH11	0.126	0.95	0.1197	0.1795	10.2734	0.2648	100.94657	50.36072	300	16.8	0.50	68.37776	0.9673	73.65
		CB10	MH11	0.184	0.95	0.1748	0.1748	10.0000	0.5499	102.27133	49.69814	300	34.8	0.50	68.37776	0.9673	72.68
		MH11	CBMH8				0.3543	10.5382	0.2249	99.69907	98.18652	375	16.8	0.50	123.97713	1.1225	79.20
		CBMH8	MH9	0.052	0.96	0.0499	0.4042	10.7631	0.0844	98.66530	110.86098	375	8.5	1.00	175.33014	1.5875	63.23
		CBMH3	MH5	0.075	0.96	0.0720	0.0720	10.0000	0.2271	102.27133	20.47063	250	22.8	3.20	106.37875	2.1671	19.24
		CB4	MH5	0.040	0.98	0.0389	0.0389	10.0000	0.6162	102.27133	11.06153	250	26.7	0.50	42.04989	0.8566	26.31
		MH5	CBMH7				0.1109	10.6162	0.2267	99.33794	30.62774	300	16.5	1.00	96.70076	1.3680	31.67
		CBMH7	MH9	0.082	0.98	0.0804	0.1913	10.8428	0.1589	98.30450	52.27042	300	13.3	1.00	96.70076	1.3680	54.05
Georgian Landing Site		Ex. Site	MH9	1.390	0.47	0.6533	0.6533	10.0000	0.0360	102.27133	185.74252	375	8.2	6.20	436.56853	3.9528	42.55
		MH9	Ex. Headwall				1.2487	11.0018	0.0847	97.59377	338.79677	375	22.2	6.20	436.56853	3.9528	77.60



LEGEND

🟨 CATCHMENT 201
PIPED TO SWM FACILITY

🟥 CATCHMENT 202
OVERLAND TO SWM
FACILITY

🟩 CATCHMENT 203
UNCONTROLLED TO
WILLIAM STREET

🟪 CATCHMENT 204
TO INFILTRATION
GALLERY

201 — SUB-CATCHMENT NUMBER

0.616 — AREA (ha.)

FIGURE 1.0
Date: AUG.05/21
Scale: 1:500

POST DEVELOPMENT CATCHMENT AREAS

MTE
Engineers, Scientists, Surveyors

Project No.: 48593-100

786 William Street
WATER BALANCE (INFILTRATION) ANALYSIS
Milford, Ontario

Project Number:	48593-100	Soil Type:	Silt Loam	Precipitation	923mm
Date:	Augst 6, 2021	Vegetation:	Pasture/Shrubs	ET	586mm
Design By:	CAH	Topography:	Hilly Lands (10-30%)	Runoff	185mm
File:	Q:\48593\100\Micro Drainage Analysis_2021-08-05.xlsx			Infiltration	152mm

INFILTRATION

Location	Pre-development			Post-development						Comments
				Pervious			Impervious			
	Area Draining to Location	Infiltration Rate	Infiltration Volume	Area Draining to Location	Infiltration Rate	Infiltration Volume	Area Draining to Location	Infiltration Rate	Infiltration Volume	
	ha	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	
	1.120	152	1702	0.450	152.00	684	0.150	750	1125	[1] See Table 1
Total	1.120	152	**1702**	0.450	152.00	**684**	0.150	750	**1125**	

SUMMARY

Post-development Infiltration Volume			
Pervious		684	*m^3/yr*
Impervious	+	1125	*m^3/yr*
		1809	*m^3/yr*
Pre-development Infiltration Volume	-	1702	*m^3/yr*
Net Gain of Infiltration		**107**	***m^3/yr***

Table 1: Impervious Volume for Roof Areas on Pervious Soils

Rainfall Depth *mm*	Infiltration Rate *mm/yr/m^2*	Infiltration Volume *m^3/yr*
10	550	825
15	630	945
20	670	1,005
25	720	1,080
30	750	1,125

APPENDIX G: LABORATORY CERTIFICATES OF ANALYSIS

L2635133

[redacted]

Hydrogeology Consulting Services
(Kitchener)
ATTN: Chris Helmer
28 Upper Mercer Street
Kitchener ON N2A 4M9

Date Received: 02-SEP-21
Report Date: 16-SEP-21 10:51 (MT)
Version: FINAL REV. 2

Client Phone: 905-550-0969

Certificate of Analysis

Lab Work Order #: L2635133

Project P.O. #: NOT SUBMITTED
Job Reference: MIDLAND
C of C Numbers: 20-896152
Legal Site Desc:

Comments: Report revised to update criteria for comparison - E. Smith (16 Sep 2021).

[redacted]

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

[redacted]

[redacted]

ANALYTICAL GUIDELINE REPORT

MIDLAND

L2635133-1 BH-1
Sampled By: CLIENT on 02-SEP-21 @ 09:30
Matrix: WATER

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1
Physical Tests							
	Colour, Apparent	156		2.0	CU	02-SEP-21	
	Conductivity	3460		1.0	umhos/cm	03-SEP-21	
	Hardness (as CaCO3)	821	HTC	1.3	mg/L	07-SEP-21	
	pH	8.17		0.10	pH units	03-SEP-21	6.5-8.5
	Total Dissolved Solids	2220	DLM	80	mg/L	03-SEP-21	
	Turbidity	1240		0.10	NTU	03-SEP-21	
Anions and Nutrients							
	Alkalinity, Total (as CaCO3)	256		1.0	mg/L	03-SEP-21	
	Ammonia, Total (as N)	0.643	DLHC	0.020	mg/L	07-SEP-21	
	Chloride (Cl)	931	DLDS	2.5	mg/L	03-SEP-21	
	Fluoride (F)	<0.10	DLDS	0.10	mg/L	03-SEP-21	
	Nitrate (as N)	0.12	DLDS	0.10	mg/L	03-SEP-21	
	Nitrite (as N)	<0.050	DLDS	0.050	mg/L	03-SEP-21	
	Orthophosphate-Dissolved (as P)	0.0226		0.0030	mg/L	03-SEP-21	
	Sulfate (SO4)	41.8	DLDS	1.5	mg/L	03-SEP-21	
Total Metals							
	Aluminum (Al)-Total	3.67	DLHC	0.050	mg/L	03-SEP-21	*0.015
	Antimony (Sb)-Total	0.0018	DLHC	0.0010	mg/L	03-SEP-21	0.02
	Arsenic (As)-Total	0.0023	DLHC	0.0010	mg/L	03-SEP-21	0.005
	Barium (Ba)-Total	0.267	DLHC	0.0010	mg/L	03-SEP-21	
	Beryllium (Be)-Total	<0.0010	DLHC	0.0010	mg/L	03-SEP-21	0.011
	Bismuth (Bi)-Total	<0.00050	DLHC	0.00050	mg/L	03-SEP-21	
	Boron (B)-Total	0.18	DLHC	0.10	mg/L	03-SEP-21	0.2
	Cadmium (Cd)-Total	<0.00020	DLM	0.00020	mg/L	03-SEP-21	**0.0001
	Calcium (Ca)-Total	205	DLHC	0.50	mg/L	03-SEP-21	
	Cesium (Cs)-Total	0.00032	DLHC	0.00010	mg/L	03-SEP-21	
	Chromium (Cr)-Total	0.0120	DLHC	0.0050	mg/L	03-SEP-21	
	Cobalt (Co)-Total	0.0030	DLHC	0.0010	mg/L	03-SEP-21	*0.0009
	Copper (Cu)-Total	0.0153	DLHC	0.0050	mg/L	03-SEP-21	*0.001
	Iron (Fe)-Total	6.71	DLHC	0.10	mg/L	03-SEP-21	*0.3
	Lead (Pb)-Total	0.00412	DLHC	0.00050	mg/L	03-SEP-21	*0.001
	Magnesium (Mg)-Total	75.4	DLHC	0.050	mg/L	03-SEP-21	
	Manganese (Mn)-Total	0.492	DLHC	0.0050	mg/L	03-SEP-21	
	Molybdenum (Mo)-Total	0.105	DLHC	0.00050	mg/L	03-SEP-21	*0.04
	Nickel (Ni)-Total	0.0101	DLHC	0.0050	mg/L	03-SEP-21	0.025
	Phosphorus (P)-Total	0.72	DLHC	0.50	mg/L	03-SEP-21	*0.01
	Potassium (K)-Total	23.9	DLHC	0.50	mg/L	03-SEP-21	
	Rubidium (Rb)-Total	0.0146	DLHC	0.0020	mg/L	03-SEP-21	
	Selenium (Se)-Total	0.00051	DLHC	0.00050	mg/L	03-SEP-21	0.1
	Silicon (Si)-Total	10.7	DLHC	1.0	mg/L	03-SEP-21	
	Silver (Ag)-Total	<0.00050	DLHC	0.00050	mg/L	03-SEP-21	**0.0001
	Sodium (Na)-Total	412	DLHC	0.50	mg/L	03-SEP-21	
	Strontium (Sr)-Total	0.601	DLHC	0.010	mg/L	03-SEP-21	
	Sulfur (S)-Total	18.2	DLHC	5.0	mg/L	03-SEP-21	
	Tellurium (Te)-Total	<0.0020	DLHC	0.0020	mg/L	03-SEP-21	
	Thallium (Tl)-Total	0.00011	DLHC	0.00010	mg/L	03-SEP-21	0.0003
	Thorium (Th)-Total	0.0017	DLHC	0.0010	mg/L	03-SEP-21	

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Surface Water PWQO

#1: Surface Water PWQO

[redacted]

ANALYTICAL GUIDELINE REPORT

MIDLAND

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits			
L2635133-1	BH-1									
Sampled By:	CLIENT on 02-SEP-21 @ 09:30									
Matrix:	WATER						#1			
Total Metals										
	Tin (Sn)-Total	0.0130	DLHC	0.0010	mg/L	03-SEP-21				
	Titanium (Ti)-Total	0.269	DLHC	0.0030	mg/L	03-SEP-21				
	Tungsten (W)-Total	0.0018	DLHC	0.0010	mg/L	03-SEP-21	0.03			
	Uranium (U)-Total	0.00641	DLHC	0.00010	mg/L	03-SEP-21	*0.005			
	Vanadium (V)-Total	0.0103	DLHC	0.0050	mg/L	03-SEP-21	*0.006			
	Zinc (Zn)-Total	0.030	DLHC	0.030	mg/L	03-SEP-21	*0.02			
	Zirconium (Zr)-Total	<0.0020	DLHC	0.0020	mg/L	03-SEP-21	0.004			
L2635133-2	BH-3									
Sampled By:	CLIENT on 02-SEP-21 @ 10:00									
Matrix:	WATER						#1			
Physical Tests										
	Colour, Apparent	83.7		2.0	CU	02-SEP-21				
	Conductivity	658		1.0	umhos/cm	03-SEP-21				
	Hardness (as CaCO3)	1490	HTC	1.3	mg/L	07-SEP-21				
	pH	8.19		0.10	pH units	03-SEP-21	6.5-8.5			
	Total Dissolved Solids	473	DLM	80	mg/L	03-SEP-21				
	Turbidity	221		0.10	NTU	03-SEP-21				
Anions and Nutrients										
	Alkalinity, Total (as CaCO3)	267		1.0	mg/L	03-SEP-21				
	Ammonia, Total (as N)	1.16	DLHC	0.050	mg/L	07-SEP-21				
	Chloride (Cl)	43.6		0.50	mg/L	03-SEP-21				
	Fluoride (F)	0.144		0.020	mg/L	03-SEP-21				
	Nitrate (as N)	0.174		0.020	mg/L	03-SEP-21				
	Nitrite (as N)	<0.010		0.010	mg/L	03-SEP-21				
	Orthophosphate-Dissolved (as P)	0.0399		0.0030	mg/L	03-SEP-21				
	Sulfate (SO4)	26.0		0.30	mg/L	03-SEP-21				
Total Metals										
	Aluminum (Al)-Total	13.9	DLHC	0.050	mg/L	03-SEP-21	*0.015			
	Antimony (Sb)-Total	<0.0010	DLHC	0.0010	mg/L	03-SEP-21	0.02			
	Arsenic (As)-Total	0.0114	DLHC	0.0010	mg/L	03-SEP-21	*0.005			
	Barium (Ba)-Total	0.189	DLHC	0.0010	mg/L	03-SEP-21				
	Beryllium (Be)-Total	<0.0010	DLHC	0.0010	mg/L	03-SEP-21	0.011			
	Bismuth (Bi)-Total	<0.00050	DLHC	0.00050	mg/L	03-SEP-21				
	Boron (B)-Total	0.16	DLHC	0.10	mg/L	03-SEP-21	0.2			
	Cadmium (Cd)-Total	<0.00080	DLM	0.00080	mg/L	03-SEP-21	**0.0001			
	Calcium (Ca)-Total	444	DLHC	0.50	mg/L	03-SEP-21				
	Cesium (Cs)-Total	0.00125	DLHC	0.00010	mg/L	03-SEP-21				
	Chromium (Cr)-Total	0.0221	DLHC	0.0050	mg/L	03-SEP-21				
	Cobalt (Co)-Total	0.0110	DLHC	0.0010	mg/L	03-SEP-21	*0.0009			
	Copper (Cu)-Total	0.0656	DLHC	0.0050	mg/L	03-SEP-21	*0.001			
	Iron (Fe)-Total	32.4	DLHC	0.10	mg/L	03-SEP-21	*0.3			
	Lead (Pb)-Total	0.0469	DLHC	0.00050	mg/L	03-SEP-21	*0.001			
	Magnesium (Mg)-Total	92.3	DLHC	0.050	mg/L	03-SEP-21				
	Manganese (Mn)-Total	1.58	DLHC	0.0050	mg/L	03-SEP-21				
	Molybdenum (Mo)-Total	0.123	DLHC	0.00050	mg/L	03-SEP-21	*0.04			

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Surface Water PWQO

#1: Surface Water PWQO

[redacted]

ANALYTICAL GUIDELINE REPORT

MIDLAND

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1
L2635133-2	BH-3						
Sampled By:	CLIENT on 02-SEP-21 @ 10:00						
Matrix:	WATER						
Total Metals							
	Nickel (Ni)-Total	0.0295	DLHC	0.0050	mg/L	03-SEP-21	*0.025
	Phosphorus (P)-Total	1.83	DLHC	0.50	mg/L	03-SEP-21	*0.01
	Potassium (K)-Total	11.0	DLHC	0.50	mg/L	03-SEP-21	
	Rubidium (Rb)-Total	0.0154	DLHC	0.0020	mg/L	03-SEP-21	
	Selenium (Se)-Total	0.00053	DLHC	0.00050	mg/L	03-SEP-21	0.1
	Silicon (Si)-Total	25.9	DLHC	1.0	mg/L	03-SEP-21	
	Silver (Ag)-Total	<0.00050	DLHC	0.00050	mg/L	03-SEP-21	**0.0001
	Sodium (Na)-Total	17.0	DLHC	0.50	mg/L	03-SEP-21	
	Strontium (Sr)-Total	0.676	DLHC	0.010	mg/L	03-SEP-21	
	Sulfur (S)-Total	8.4	DLHC	5.0	mg/L	03-SEP-21	
	Tellurium (Te)-Total	<0.0020	DLHC	0.0020	mg/L	03-SEP-21	
	Thallium (Tl)-Total	0.00020	DLHC	0.00010	mg/L	03-SEP-21	0.0003
	Thorium (Th)-Total	0.0056	DLHC	0.0010	mg/L	03-SEP-21	
	Tin (Sn)-Total	0.0064	DLHC	0.0010	mg/L	03-SEP-21	
	Titanium (Ti)-Total	0.263	DLHC	0.0030	mg/L	03-SEP-21	
	Tungsten (W)-Total	0.0015	DLHC	0.0010	mg/L	03-SEP-21	0.03
	Uranium (U)-Total	0.00684	DLHC	0.00010	mg/L	03-SEP-21	*0.005
	Vanadium (V)-Total	0.0307	DLHC	0.0050	mg/L	03-SEP-21	*0.006
	Zinc (Zn)-Total	0.247	DLHC	0.030	mg/L	03-SEP-21	*0.02
	Zirconium (Zr)-Total	0.0025	DLHC	0.0020	mg/L	03-SEP-21	0.004

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Surface Water PWQO

#1: Surface Water PWQO

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
ALK-WT	Water	Alkalinity, Total (as CaCO3)	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WT	Water	pH	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Reference Information

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-WT	Water	Turbidity	APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

20-896152

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

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Quality Control Report

Workorder: L2635133 Report Date: 16-SEP-21

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT	**Water**							
Batch R5579603								
WG3610982-4 DUP		**WG3610982-3**						
Alkalinity, Total (as CaCO3)		102	101		mg/L	0.8	20	03-SEP-21
WG3610982-2 LCS								
Alkalinity, Total (as CaCO3)			109.7		%		85-115	03-SEP-21
WG3610982-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-SEP-21
CL-IC-N-WT	**Water**							
Batch R5579848								
WG3611383-20 DUP		**WG3611383-18**						
Chloride (Cl)		1.26	1.26		mg/L	0.4	20	03-SEP-21
WG3611383-17 LCS								
Chloride (Cl)			100.4		%		90-110	03-SEP-21
WG3611383-16 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-SEP-21
WG3611383-19 MS		**WG3611383-18**						
Chloride (Cl)			97.2		%		75-125	03-SEP-21
COLOUR-APPARENT-WT	**Water**							
Batch R5579302								
WG3611420-3 DUP		**L2635106-5**						
Colour, Apparent		15.2	14.6		CU	3.8	20	02-SEP-21
WG3611420-2 LCS								
Colour, Apparent			102.5		%		85-115	02-SEP-21
WG3611420-1 MB								
Colour, Apparent			<2.0		CU		2	02-SEP-21
EC-WT	**Water**							
Batch R5579603								
WG3610982-4 DUP		**WG3610982-3**						
Conductivity		762	755		umhos/cm	0.9	10	03-SEP-21
WG3610982-2 LCS								
Conductivity			103.2		%		90-110	03-SEP-21
WG3610982-1 MB								
Conductivity			<2.0		umhos/cm		2	03-SEP-21
F-IC-N-WT	**Water**							
Batch R5579848								
WG3611383-20 DUP		**WG3611383-18**						
Fluoride (F)		0.057	0.056		mg/L	0.9	20	03-SEP-21
WG3611383-17 LCS								

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Quality Control Report

Workorder: L2635133 Report Date: 16-SEP-21

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-WT	**Water**							
Batch R5579848								
WG3611383-17 LCS								
Fluoride (F)			99.8		%		90-110	03-SEP-21
WG3611383-16 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-SEP-21
WG3611383-19 MS		**WG3611383-18**						
Fluoride (F)			99.0		%		75-125	03-SEP-21
MET-T-CCMS-WT	**Water**							
Batch R5577923								
WG3610741-4 DUP		**WG3610741-3**						
Aluminum (Al)-Total		0.143	0.145		mg/L	1.9	20	04-SEP-21
Antimony (Sb)-Total		0.00022	0.00034	J	mg/L	0.00012	0.0002	04-SEP-21
Arsenic (As)-Total		0.00094	0.00098		mg/L	3.3	20	04-SEP-21
Barium (Ba)-Total		0.0650	0.0658		mg/L	1.3	20	04-SEP-21
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-SEP-21
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	04-SEP-21
Boron (B)-Total		0.060	0.060		mg/L	1.0	20	04-SEP-21
Cadmium (Cd)-Total		0.0000070	0.0000119	J	mg/L	0.0000049	0.00001	04-SEP-21
Calcium (Ca)-Total		66.4	66.1		mg/L	0.5	20	04-SEP-21
Chromium (Cr)-Total		<0.00050	0.00052	RPD-NA	mg/L	N/A	20	04-SEP-21
Cesium (Cs)-Total		0.000018	0.000018		mg/L	0.6	20	04-SEP-21
Cobalt (Co)-Total		0.00019	0.00019		mg/L	1.0	20	04-SEP-21
Copper (Cu)-Total		0.00190	0.00190		mg/L	0.0	20	04-SEP-21
Iron (Fe)-Total		0.236	0.238		mg/L	1.1	20	04-SEP-21
Lead (Pb)-Total		0.000280	0.000291		mg/L	3.6	20	04-SEP-21
Magnesium (Mg)-Total		20.0	20.2		mg/L	0.6	20	04-SEP-21
Manganese (Mn)-Total		0.0337	0.0337		mg/L	0.1	20	04-SEP-21
Molybdenum (Mo)-Total		0.00113	0.00108		mg/L	4.4	20	04-SEP-21
Nickel (Ni)-Total		0.00102	0.00108		mg/L	5.7	20	04-SEP-21
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	04-SEP-21
Potassium (K)-Total		4.41	4.47		mg/L	1.3	20	04-SEP-21
Rubidium (Rb)-Total		0.00204	0.00209		mg/L	2.6	20	04-SEP-21
Selenium (Se)-Total		0.000128	0.000089	J	mg/L	0.000039	0.0001	04-SEP-21
Silicon (Si)-Total		3.13	3.09		mg/L	1.4	20	04-SEP-21
Silver (Ag)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	04-SEP-21

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Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5577923								
WG3610741-4 DUP		**WG3610741-3**						
Sodium (Na)-Total		90.2	90.3		mg/L	0.0	20	04-SEP-21
Strontium (Sr)-Total		0.451	0.449		mg/L	0.4	20	04-SEP-21
Sulfur (S)-Total		15.0	14.7		mg/L	2.2	20	04-SEP-21
Thallium (Tl)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	04-SEP-21
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	04-SEP-21
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-SEP-21
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-SEP-21
Titanium (Ti)-Total		0.00359	0.00317		mg/L	12	20	04-SEP-21
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-SEP-21
Uranium (U)-Total		0.000544	0.000537		mg/L	1.2	20	04-SEP-21
Vanadium (V)-Total		0.00089	0.00091		mg/L	3.0	20	04-SEP-21
Zinc (Zn)-Total		0.0037	0.0047	J	mg/L	0.0010	0.006	04-SEP-21
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	04-SEP-21
WG3610741-2 LCS								
Aluminum (Al)-Total			100.9		%		80-120	04-SEP-21
Antimony (Sb)-Total			102.7		%		80-120	04-SEP-21
Arsenic (As)-Total			101.7		%		80-120	04-SEP-21
Barium (Ba)-Total			100.6		%		80-120	04-SEP-21
Beryllium (Be)-Total			97.4		%		80-120	04-SEP-21
Bismuth (Bi)-Total			98.0		%		80-120	04-SEP-21
Boron (B)-Total			96.8		%		80-120	04-SEP-21
Cadmium (Cd)-Total			98.7		%		80-120	04-SEP-21
Calcium (Ca)-Total			96.7		%		80-120	04-SEP-21
Chromium (Cr)-Total			98.7		%		80-120	04-SEP-21
Cesium (Cs)-Total			98.8		%		80-120	04-SEP-21
Cobalt (Co)-Total			99.4		%		80-120	04-SEP-21
Copper (Cu)-Total			96.5		%		80-120	04-SEP-21
Iron (Fe)-Total			99.4		%		80-120	04-SEP-21
Lead (Pb)-Total			99.0		%		80-120	04-SEP-21
Magnesium (Mg)-Total			99.8		%		80-120	04-SEP-21
Manganese (Mn)-Total			100.5		%		80-120	04-SEP-21
Molybdenum (Mo)-Total			103.0		%		80-120	04-SEP-21
Nickel (Ni)-Total			97.6		%		80-120	04-SEP-21

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Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5577923								
WG3610741-2 LCS								
Phosphorus (P)-Total			103.0		%		70-130	04-SEP-21
Potassium (K)-Total			100.7		%		80-120	04-SEP-21
Rubidium (Rb)-Total			99.5		%		80-120	04-SEP-21
Selenium (Se)-Total			101.4		%		80-120	04-SEP-21
Silicon (Si)-Total			106.3		%		60-140	04-SEP-21
Silver (Ag)-Total			99.1		%		80-120	04-SEP-21
Sodium (Na)-Total			99.9		%		80-120	04-SEP-21
Strontium (Sr)-Total			101.6		%		80-120	04-SEP-21
Sulfur (S)-Total			101.2		%		80-120	04-SEP-21
Thallium (Tl)-Total			98.9		%		80-120	04-SEP-21
Tellurium (Te)-Total			95.2		%		80-120	04-SEP-21
Thorium (Th)-Total			95.8		%		80-120	04-SEP-21
Tin (Sn)-Total			99.1		%		80-120	04-SEP-21
Titanium (Ti)-Total			100.1		%		80-120	04-SEP-21
Tungsten (W)-Total			99.8		%		80-120	04-SEP-21
Uranium (U)-Total			99.0		%		80-120	04-SEP-21
Vanadium (V)-Total			99.1		%		80-120	04-SEP-21
Zinc (Zn)-Total			98.5		%		80-120	04-SEP-21
Zirconium (Zr)-Total			96.7		%		80-120	04-SEP-21
WG3610741-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	04-SEP-21
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Arsenic (As)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Barium (Ba)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	04-SEP-21
Boron (B)-Total			<0.010		mg/L		0.01	04-SEP-21
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	04-SEP-21
Calcium (Ca)-Total			<0.050		mg/L		0.05	04-SEP-21
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	04-SEP-21
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	04-SEP-21
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Copper (Cu)-Total			<0.00050		mg/L		0.0005	04-SEP-21
Iron (Fe)-Total			<0.010		mg/L		0.01	04-SEP-21

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Quality Control Report

Workorder: L2635133 Report Date: 16-SEP-21

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5577923								
WG3610741-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	04-SEP-21
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	04-SEP-21
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	04-SEP-21
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	04-SEP-21
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	04-SEP-21
Phosphorus (P)-Total			<0.050		mg/L		0.05	04-SEP-21
Potassium (K)-Total			<0.050		mg/L		0.05	04-SEP-21
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	04-SEP-21
Selenium (Se)-Total			<0.000050		mg/L		0.00005	04-SEP-21
Silicon (Si)-Total			<0.10		mg/L		0.1	04-SEP-21
Silver (Ag)-Total			<0.000050		mg/L		0.00005	04-SEP-21
Sodium (Na)-Total			<0.050		mg/L		0.05	04-SEP-21
Strontium (Sr)-Total			<0.0010		mg/L		0.001	04-SEP-21
Sulfur (S)-Total			<0.50		mg/L		0.5	04-SEP-21
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	04-SEP-21
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	04-SEP-21
Thorium (Th)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Tin (Sn)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	04-SEP-21
Tungsten (W)-Total			<0.00010		mg/L		0.0001	04-SEP-21
Uranium (U)-Total			<0.000010		mg/L		0.00001	04-SEP-21
Vanadium (V)-Total			<0.00050		mg/L		0.0005	04-SEP-21
Zinc (Zn)-Total			<0.0030		mg/L		0.003	04-SEP-21
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	04-SEP-21
WG3610741-5 MS		**WG3610741-6**						
Aluminum (Al)-Total			N/A	MS-B	%		-	04-SEP-21
Antimony (Sb)-Total			100.7		%		70-130	04-SEP-21
Arsenic (As)-Total			102.4		%		70-130	04-SEP-21
Barium (Ba)-Total			N/A	MS-B	%		-	04-SEP-21
Beryllium (Be)-Total			100.8		%		70-130	04-SEP-21
Bismuth (Bi)-Total			91.1		%		70-130	04-SEP-21
Boron (B)-Total			N/A	MS-B	%		-	04-SEP-21
Cadmium (Cd)-Total			94.2		%		70-130	04-SEP-21
Calcium (Ca)-Total			N/A	MS-B	%		-	04-SEP-21

[redacted]

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5577923								
WG3610741-5 MS		**WG3610741-6**						
Chromium (Cr)-Total			97.3		%		70-130	04-SEP-21
Cesium (Cs)-Total			97.9		%		70-130	04-SEP-21
Cobalt (Co)-Total			97.1		%		70-130	04-SEP-21
Copper (Cu)-Total			N/A	MS-B	%		-	04-SEP-21
Iron (Fe)-Total			N/A	MS-B	%		-	04-SEP-21
Lead (Pb)-Total			90.3		%		70-130	04-SEP-21
Magnesium (Mg)-Total			N/A	MS-B	%		-	04-SEP-21
Manganese (Mn)-Total			N/A	MS-B	%		-	04-SEP-21
Molybdenum (Mo)-Total			N/A	MS-B	%		-	04-SEP-21
Nickel (Ni)-Total			89.9		%		70-130	04-SEP-21
Phosphorus (P)-Total			109.2		%		70-130	04-SEP-21
Potassium (K)-Total			N/A	MS-B	%		-	04-SEP-21
Rubidium (Rb)-Total			N/A	MS-B	%		-	04-SEP-21
Selenium (Se)-Total			100.7		%		70-130	04-SEP-21
Silicon (Si)-Total			N/A	MS-B	%		-	04-SEP-21
Silver (Ag)-Total			93.4		%		70-130	04-SEP-21
Sodium (Na)-Total			N/A	MS-B	%		-	04-SEP-21
Strontium (Sr)-Total			N/A	MS-B	%		-	04-SEP-21
Sulfur (S)-Total			N/A	MS-B	%		-	04-SEP-21
Thallium (Tl)-Total			92.2		%		70-130	04-SEP-21
Tellurium (Te)-Total			90.9		%		70-130	04-SEP-21
Thorium (Th)-Total			74.2		%		70-130	04-SEP-21
Tin (Sn)-Total			95.2		%		70-130	04-SEP-21
Titanium (Ti)-Total			N/A	MS-B	%		-	04-SEP-21
Tungsten (W)-Total			95.3		%		70-130	04-SEP-21
Uranium (U)-Total			N/A	MS-B	%		-	04-SEP-21
Vanadium (V)-Total			103.4		%		70-130	04-SEP-21
Zinc (Zn)-Total			N/A	MS-B	%		-	04-SEP-21
Zirconium (Zr)-Total			75.3		%		70-130	04-SEP-21
NH3-F-WT	**Water**							
Batch R5580043								
WG3610702-3 DUP		**L2635098-1**						
Ammonia, Total (as N)		0.658	0.637		mg/L	3.3	20	07-SEP-21
WG3610702-2 LCS								

[redacted]

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-WT	**Water**							
Batch R5580043								
WG3610702-2 LCS								
Ammonia, Total (as N)			108.0		%		85-115	03-SEP-21
WG3610702-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	03-SEP-21
WG3610702-4 MS		**L2635098-1**						
Ammonia, Total (as N)			N/A	MS-B	%		-	07-SEP-21
NO2-IC-WT	**Water**							
Batch R5579848								
WG3611383-20 DUP		**WG3611383-18**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	03-SEP-21
WG3611383-17 LCS								
Nitrite (as N)			100.1		%		90-110	03-SEP-21
WG3611383-16 MB								
Nitrite (as N)			<0.010		mg/L		0.01	03-SEP-21
WG3611383-19 MS		**WG3611383-18**						
Nitrite (as N)			96.9		%		75-125	03-SEP-21
NO3-IC-WT	**Water**							
Batch R5579848								
WG3611383-20 DUP		**WG3611383-18**						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	03-SEP-21
WG3611383-17 LCS								
Nitrate (as N)			99.9		%		90-110	03-SEP-21
WG3611383-16 MB								
Nitrate (as N)			<0.020		mg/L		0.02	03-SEP-21
WG3611383-19 MS		**WG3611383-18**						
Nitrate (as N)			95.6		%		75-125	03-SEP-21
PH-WT	**Water**							
Batch R5579603								
WG3610982-4 DUP		**WG3610982-3**						
pH		8.33	8.33	J	pH units	0.00	0.2	03-SEP-21
WG3610982-2 LCS								
pH			6.99		pH units		6.9-7.1	03-SEP-21
PO4-DO-COL-WT	**Water**							
Batch R5577925								
WG3610865-7 DUP		**L2635106-11**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	03-SEP-21
WG3610865-6 LCS								

[redacted]

Quality Control Report

Workorder: L2635133 Report Date: 16-SEP-21

Client: Hydrogeology Consulting Services (Kitchener)
28 Upper Mercer Street
Kitchener ON N2A 4M9
Contact: Chris Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R5577925								
WG3610865-6 LCS								
Orthophosphate-Dissolved (as P)			96.5		%		80-120	03-SEP-21
WG3610865-5 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	03-SEP-21
WG3610865-8 MS		**L2635106-11**						
Orthophosphate-Dissolved (as P)			103.9		%		70-130	03-SEP-21
SO4-IC-N-WT	**Water**							
Batch R5579848								
WG3611383-20 DUP		**WG3611383-18**						
Sulfate (SO4)		0.62	0.63		mg/L	0.6	20	03-SEP-21
WG3611383-17 LCS								
Sulfate (SO4)			101.6		%		90-110	03-SEP-21
WG3611383-16 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	03-SEP-21
WG3611383-19 MS		**WG3611383-18**						
Sulfate (SO4)			97.9		%		75-125	03-SEP-21
SOLIDS-TDS-WT	**Water**							
Batch R5580211								
WG3611239-3 DUP		**L2635177-2**						
Total Dissolved Solids		415	414		mg/L	0.1	20	03-SEP-21
WG3611239-2 LCS								
Total Dissolved Solids			102.2		%		85-115	03-SEP-21
WG3611239-1 MB								
Total Dissolved Solids			<10		mg/L		10	03-SEP-21
TURBIDITY-WT	**Water**							
Batch R5577922								
WG3611060-2 LCS								
Turbidity			96.5		%		85-115	03-SEP-21
WG3611060-1 MB								
Turbidity			<0.10		NTU		0.1	03-SEP-21

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS www.alsglobal.com

Chain o

L2635133-COFC

COC Number: 20 - 896152

Page of

Report To	Contact and company name below will appear on the final report
Company:	HCS
Contact:	CHRIS Helmer
Phone:	905 550 0969
	Company address below will appear on the final report
Street:	28 Upper Mercer St
City/Province:	ON KITCHENER
Postal Code:	N2A 4M9
Invoice To	Same as Report To ☒ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax CHRISHelmer@hydrog.ca

Email 2

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

Project Information

ALS Account # / Quote #:

Job #: Midland

PO / AFE:

LSD:

ALS Lab Work Order # (ALS use only): L2635133 AP

Oil and Gas Required Fields (client use)

AFE/Cost Center:

PO#

Major/Minor Code:

Routing Code:

Requisitioner:

Location:

ALS Contact:

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	General Chem. 1	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH-1	02-09-2	09:30		4				
	BH-3		10:00		4				

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

☐ YES ☒ NO

Are samples for human consumption/ use?

☐ YES ☒ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INIITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C 9.2

SHIPMENT RELEASE (client use)

Released by: Alona Malyshevski

Date: 02.Sept.21

Time: 15:05

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:

Date:

Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:

Date: 9/2/21

Time: 1545

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

APPENDIX H: MECP WATER WELL RECORDS

Water Well Records

September 16, 2021

10:23:36 AM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
CALEDON TOWN (CALEDO HS E 04 001	17 590264 4954524 W	1977-11 4919	30	UK 0012	10/18//0:30	ST DO		4905240 ()	BRWN LOAM HARD 0001 BRWN CLAY HARD 0012 BRWN SAND LOOS 0020 GREY GRVL LOOS 0020
MIDLAND TOWN	17 590122 4954339 W	2019-08 7190	1.25		///:	MO	0015 5	7341922 (MU7UXRFY) A188992	BRWN SILT CLYY 0005 BRWN SAND SLTY 0015 GREY BLDR BLDR 0016 BRWN SAND SLTY 0020
MIDLAND TOWN	17 590271 4954428 W	2018-05 7190						7313561 (C39470) A247398 P	
MIDLAND TOWN	17 589972 4955213 W	2015-11 7360	2			MO	0015 10	7254670 (Z208192) A194052	BRWN SAND GRVL 0008 GREY SAND SILT BLDR 0025
TAY TOWNSHIP	17 590099 4954882 W	2014-06 7241	2			MT	0006 10	7223976 (Z191910) A167749	BLCK 0003 BRWN FILL 0006 GREY SILT 0016

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX I: WATER BUDGET CALCULATIONS

Table A – Climatic Water Budget Calculations
Table B – Pre-Development Water Balance
Table C – Post-Development Water Balance (no Mitigation)
Table D – Water Balance Summary

786 William Street, Midland
Table A - Climatic Water Budget Calculations

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	Units	
A	Temp	-8.50	-6.40	-1.90	5.80	12.20	18.1	20.8	19.9	15.9	9.3	3.2	-3.10		Degrees C	
B	Heat Index (Hm) (***depends on T*** !)	0.00	0.00	0.00	1.25	3.86	7.01	8.66	8.10	5.76	2.56	0.51	0.00	37.71		
C	Unadjusted Potential EVT (UPET) (***depends on T*** !)	0.00	0.00	0.00	0.85	1.92	2.95	3.44	3.27	2.56	1.42	0.44	0.00		mm	***A= 1.094648559***
D	Possible Monthly Duration of Sunlight (N)	24.0	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5			
	Daylight Correction Value	0.80	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75			
E	Adjusted Potential EVT (PET)	0.00	0.00	0.00	28.79	73.59	114.22	135.06	118.85	79.90	40.15	10.50	0.00	601.06	mm	
F	Precipitation (P)	109.80	69.90	65.70	65.10	92.80	89.50	72.70	77.90	99.10	90.10	103.60	104.40	1040.60	mm	
G	Runoff Coefficient (C)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20			
H	Runoff (R)	21.96	13.98	13.14	13.02	18.56	17.90	14.54	15.58	19.82	18.02	20.72	20.88	208.12	mm	
I	Infiltration (IN)	87.84	55.92	52.56	52.08	74.24	71.60	58.16	62.32	79.28	72.08	82.88	83.52		mm	
J	IN - PET	87.84	55.92	52.56	23.29	0.65	-42.62	-76.90	-56.53	-0.62	31.93	72.38	83.52		mm	
K	Accumulated Water Loss (WL) (****Depends on Data!***)	0.00	0.00	0.00	0.00	0.65	-41.97	-118.87	-175.40	-176.02	-176.02	-176.02	-176.02		mm	
L	Water Stored (WS)	36.00	36.00	36.00	70.00	70.68	36.99	22.14	30.04	69.35	36.00	36.00	36.00		mm	
																Wsmax= 70
																b= 0.0065
M	Change in Water Storage (CWS)	0.00	0.00	0.00	0.00	0.68	-33.69	-14.84	7.89	39.31	-33.35	0.00	0.00		mm	
N	Actual EVT (AET)	0.00	0.00	0.00	28.79	73.56	105.29	73.00	54.43	39.97	40.15	10.50	0.00	425.69	mm	
O	Percolation (PERC)	87.84	55.92	52.56	23.29	0.00	0.00	0.00	0.00	0.00	65.28	72.38	83.52	440.79	mm	
P	Data Check	109.80	69.90	65.70	65.10	92.80	89.50	72.70	77.90	99.10	90.10	103.60	104.40			***should equal precipitation***
	Precipitation Surplus	109.80	69.90	65.70	36.31	19.21	0.00	0.00	0.00	19.20	49.95	93.10	104.40	567.57	mm	
	Precipitation Deficit	0.00	0.00	0.00	0.00	0.00	24.72	62.36	40.95	0.00	0.00	0.00	0.00	128.03	mm	

Total Water Surplus **439.54** **mm**

Methodology from Thornthwaite, C.W. and Mather, J.R. (1955) as described in Daniel, David E. and Koerner, Robert M. (1997)

HCS
HYDROGEOLOGY
CONSULTING
SERVICES

786 William Street, Midland

Table B: Pre-Development Water Balance

	Grass/ Trees	Built/ Paved	Total	
Inputs (per Unit Area)				
Total Area (m2)	10192.00	1008.00	11200.00	
Pervious Area (m2)	10192.00		10192.00	***91.0%***
Impervious Area (m2)		1008.00	1008.00	***9.00%***
Infiltration Factors				
Topography [a]	0.15	0.15	--	
Soil [a]	0.14	0.14	--	
Land Cover [a]	0.11	0.11	--	
MOECC Infiltration Factor	0.40	n/a	--	
Actual Infiltration Factor	0.40	n/a	--	
Run-Off Coefficient	0.60	1.00	--	
Runoff from Impervious Surfaces [b]	n/a	0.80	--	
Precipitation (mm/yr) [c]	1040.60	1040.60	1040.60	
Run-On (mm/yr)	0.00	0.00	0.00	
Other Inputs (mm/yr)	0.00	0.00	0.00	
TOTAL INPUTS (mm/yr)	1040.60	1040.60	1040.60	
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	439.54	832.48	474.91	
Net Surplus (mm/yr)	439.54	832.48	474.91	
Evapotranspiration (mm/yr)	601.06	208.12	565.69	
Infiltration (mm/yr) [d]	175.82	332.99	189.96	
Rooftop Infiltration (mm/yr)	n/a	0.00	0.00	
Total Infiltration (mm/yr)	175.82	332.99	189.96	
Runoff (Pervious)	263.72	n/a	239.99	
Runoff (Impervious) [d]	n/a	499.49	44.95	
Total Runoff (mm/yr)	263.72	499.49	284.94	
TOTAL OUTPUTS (mm/yr)	1040.60	1040.60	1040.60	
Difference (Inputs-Outputs)	0.00	0.00	0.00	

Inputs (Volumes)			
Precipitation (m^3/yr)	10605.80	1048.92	11654.72
Run-On (m^3/yr)	0.00	0.00	0.00
Other Inputs (m^3/yr)	0.00	0.00	0.00
TOTAL INPUTS (m^3/yr)	10605.80	1048.92	11654.72

Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	4479.80	839.14	5318.94
Net Surplus (m^3/yr)	4479.80	839.14	5318.94
Evapotranspiration (m^3/yr)	6125.99	209.78	6335.78
Infiltration (m^3/yr)	1791.92	335.66	2127.58
Rooftop Infiltration (m^3/yr)	n/a	0.00	0.00
Total Infiltration (m^3/yr)	1791.92	335.66	2127.58
Runoff Pervious Areas (m^3/yr)	2687.88	n/a	2687.88
Runoff Impervious Areas (m^3/yr)	n/a	503.48	503.48
Total Runoff (m^3/yr)	2687.88	503.48	3191.37
TOTAL OUTPUTS (m^3/yr)	10605.80	1048.92	11654.72
Difference (Inputs-Outputs)	0.00	0.00	0.00

a- from MOECC (2003)

b- Evaporation assumed to be 20% of precipitation

c- from Canadian Climate Centre Normals (1981-2010)

d- assumes Roadways discharge to ground surface, allowing potential to infiltrate

Table C: Post-Development Water Balance (no Mitigation)

	Grass/ Trees	Built/ Paved	Total	
Inputs (per Unit Area)				
Total Area (m2)	4144.00	7056.00	11200.00	
Pervious Area (m2)	4144.00		4144.00	***37.00%***
Impervious Area (m2)		7056.00	7056.00	***63.00%***
Infiltration Factors				
Topography [a]	0.17	0.17	--	
Soil [a]	0.14	0.14	--	
Land Cover [a]	0.11	0.11	--	
MOECC Infiltration Factor	0.42	n/a	--	
Actual Infiltration Factor	0.42	n/a	--	
Run-Off Coefficient	0.58	1.00	--	
Runoff from Impervious Surfaces [b]	n/a	0.80	--	
Precipitation (mm/yr) [c]	1040.60	1040.60	1040.60	
Run-On (mm/yr)	0.00	0.00	0.00	
Other Inputs (mm/yr)	0.00	0.00	0.00	
TOTAL INPUTS (mm/yr)	1040.60	1040.60	1040.60	
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	439.54	832.48	687.09	
Net Surplus (mm/yr)	439.54	832.48	687.09	
Evapotranspiration (mm/yr)	601.06	208.12	353.51	
Infiltration (mm/yr) [d]	184.61	0.00	68.30	
Rooftop Infiltration (mm/yr)	n/a	0.00	0.00	
Total Infiltration (mm/yr)	184.61	0.00	68.30	
Runoff (Pervious)	254.93	n/a	94.33	
Runoff (Impervious) [e]	n/a	832.48	524.46	
Total Runoff (mm/yr)	254.93	832.48	618.79	
TOTAL OUTPUTS (mm/yr)	1040.60	1040.60	1040.60	
Difference (Inputs-Outputs)	0.00	0.00	0.00	

Inputs (Volumes)			
Precipitation (m^3/yr)	4312.25	7342.47	11654.72
Run-On (m^3/yr)	0.00	0.00	0.00
Other Inputs (m^3/yr)	0.00	0.00	0.00
TOTAL INPUTS (m^3/yr)	4312.25	7342.47	11654.72

Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	1821.46	5873.98	7695.44
Net Surplus (m^3/yr)	1821.46	5873.98	7695.44
Evapotranspiration (m^3/yr)	2490.79	1468.49	3959.28
Infiltration (m^3/yr)	765.01	0.00	765.01
Rooftop Infiltration (m^3/yr)	n/a	0.00	0.00
Total Infiltration (m^3/yr)	765.01	0.00	765.01
Runoff Pervious Areas (m^3/yr)	1056.45	n/a	1056.45
Runoff Impervious Areas* (m^3/yr)	n/a	5873.98	5873.98
Total Runoff (m^3/yr)	1056.45	5873.98	6930.42
TOTAL OUTPUTS (m^3/yr)	4312.25	7342.47	11654.72
Difference (Inputs-Outputs)	0.00	0.00	0.00

a- from MOECC (2003)

b- Evaporation assumed to be 20% of precipitation

c- from Canadian Climate Centre Normals (1981-2010)

d- assumes stormwater is collected and routed to SWM pond, no infiltration

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Table D: Post-Development Water Balance with Mitigation Measures

	Grass/ Trees	Built/ Paved	Total	
Inputs (per Unit Area)				
Total Area (m2)	4144.00	7056.00	11200.00	
Pervious Area (m2)	4144.00		4144	***39.20%***
Impervious Area (m2)		7056.00	7056	***60.80%***
Rooftop/Parking Infiltration Area (m2)		1500		**13.39%** of total area
Infiltration Factors				
Topography [a]	0.17	0.17	--	
Soil [a]	0.14	0.14	--	
Land Cover [a]	0.11	0.11	--	
MOECC Infiltration Factor	0.42	n/a	--	
Actual Infiltration Factor	0.42	n/a	--	
Run-Off Coefficient	0.58	1.00	--	
Runoff from Impervious Surfaces [b]	n/a	0.80	--	
Precipitation (mm/yr) [c]	1040.60	1040.60	1040.60	
Run-On (mm/yr)	0.00	0.00	0.00	
Other Inputs (mm/yr)	0.00	0.00	0.00	
TOTAL INPUTS (mm/yr)	1040.60	1040.60	1040.60	
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	439.54	832.48	678.31	adjusted for rooftop infiltration
Net Surplus (mm/yr)	439.54	832.48	678.31	adjusted for rooftop infiltration
Evapotranspiration (mm/yr)	601.06	208.12	362.15	
Infiltration (mm/yr)	184.61	0.00	72.37	
Rooftop Infiltration (mm/yr)[d]	n/a	750.00	100.45	from MTE Consultants Inc.
Total Infiltration (mm/yr)	184.61	750.00	172.81	
Runoff (Pervious) (mm/yr)	254.93	n/a	99.93	
Runoff (Impervious) (mm/yr)[e]	n/a	832.48	405.70	adjusted for runoff directed to infiltration gallery
Rooftop Infiltration Runoff (mm/yr)[f]	n/a	0.00	0.00	from MTE Consultants Inc.
Total Runoff (mm/yr)	254.93	832.48	505.64	
TOTAL OUTPUTS (mm/yr)	1040.60	1040.60	1040.60	
Difference (Inputs-Outputs)	0.00	0.00	0.00	
Inputs (Volumes)				
Precipitation (m^3/yr)	4312.2464	7342.4736	11654.72	
Run-On (m^3/yr)	0.00	0.00	0.00	
Other Inputs (m^3/yr)	0.00	0.00	0.00	
TOTAL INPUTS (m^3/yr)	4312.2464	7342.4736	11654.72	
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	1821.458	5873.9789	7695.4369	
Net Surplus (m^3/yr)	1821.458	5873.9789	7695.4369	
Evapotranspiration (m^3/yr)	2490.7884	1468.49	3959.2831	
Infiltration (m^3/yr)	765.01	0.00	765.01	
Rooftop Infiltration (m^3/yr)	n/a	1125.00	1125.00	
Total Infiltration (m^3/yr)	765.01	1125.00	1890.01	
Runoff Pervious Areas (m^3/yr)	1056.45	n/a	1056.45	
Runoff Impervious Areas (m^3/yr)	n/a	4748.98	4748.98	
Rooftop Infiltration Runoff (m^3/yr)	n/a	0.00	0.00	
Total Runoff (m^3/yr)	1056.45	4748.98	5805.4245	
TOTAL OUTPUTS (m^3/yr)	4312.2464	7342.47	11654.72	
Difference (Inputs-Outputs)	0.00	0.00	0.00	

Table E: Water Balance Summary

	Pre- Development	Post-Development	Change (Pre-Post)	Post-Development with Mitigation	Change (Pre-Post with Mitigation)
Inputs (Volumes)					
Precipitation (m^3/yr)	1040.60	1040.60	0.00	1040.60	0.00
Run-On (m^3/yr)	0	0	0.00	0	0.00
Other Inputs (m^3/yr)	0	0	0.00	0	0.00
TOTAL INPUTS (m^3/yr)	1040.60	1040.60	0.00	1040.60	0.00
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	5318.94	7695.44	2376.49	7695.44	2376.49
Net Surplus (m^3/yr)	5318.94	7695.44	2376.49	7695.44	2376.49
Evapotranspiration (m^3/yr)	6335.78	3959.28	-2376.49	3959.28	-2376.49
Infiltration (m^3/yr)	2127.58	765.01	-1362.56	765.01	-1362.56
Rooftop Infiltration (m^3/yr)	0.00	0.00	0.00	1125.00	1125.00
Total Infiltration (m^3/yr)	2127.58	765.01	-1362.56	1890.01	-237.56
Runoff Pervious Areas (m^3/yr)	2687.88	1056.45	-1631.44	1056.45	-1631.44
Runoff Impervious Areas (m^3/yr)	503.48	5873.98	5370.49	4748.98	4245.49
Total Runoff (m^3/yr)	3191.37	6930.42	3739.06	5805.42	2614.06
TOTAL OUTPUTS (m^3/yr)	11654.72	11654.72	0.00	11654.72	0.00

NOTES

Infiltration output for Infiltration Galleries applies only to the Infiltration Gallery catchment area. The Runoff Total Outputs for have been adjusted to correctly reflect the total water balance.

a- from MOECC (2003)
b- Evaporation assumed to be 20% of precipitation
c- from Canadian Climate Centre Normals (1981-2010)
d- MTE Consultants Inc. SWM Brief indicates 1,125 m^3/yr infiltration from a 1,500 m^2 catchment area
e- Precipitation not collected will discharge to stormwater management pond, with no infiltration
f- MTE Consultants Inc. SWM Brief indicates 100% of collected runoff will be infiltrated, with 0% loss

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