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Structural Steel

March 29, 2021

File No. **1-18-0438-56**
Brampton Office

Condeland Engineering Limited

350 Creditstone Road, Unit 200
Concord, Ontario, L4K 3Z2

Attention: Mr. Robert P. DeAngelis, P. Eng
Mr. Jonathan Kapitanchuk, B.Eng

**RE: GROUNDWATER SEEPAGE ASSESSMENT - PROPOSED
SANITARY SEWER OUTFALL ALONG CONFEDERATION STREET
AND MAIN STREET, GLEN WILLIAMS, ONTARIO**

Dear Mr. Robert,

Terraprobe Inc. is pleased to provide **Condeland Engineering Ltd.** with the groundwater seepage assessment in support of construction of entry and exit shafts to facilitate the trenchless construction of an external sanitary conveyance sewer under the Credit River to connect to the existing Glen William Pumping Station located to the east of the Credit River.

If you have any questions or concerns please do not hesitate to contact the undersigned.

Yours truly,

Terraprobe Inc.

Usman Arshad, M.Eng., P.Eng., PMP.
Project Manager

Samuel Oyedokun, P.Eng., PMP., QP_{ESA}
Associate/ Sr. Project Manager

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1.0 INTRODUCTION

Terraprobe Inc. is pleased to provide **Condeland Engineering Ltd.** with the groundwater seepage assessment in support of construction of entry and exit shafts to facilitate the trenchless construction of an external sanitary conveyance sewer under the Credit River to connect to the existing Glen William Pumping Station located to the east of the Credit River. The study area location is shown in **Figure 1**.

A summary of the work program conducted includes the following:

- **Review of available background information:** This included a review of the results of previous investigation completed by DS Consultants Ltd. and external sanitary sewer plan & profile provided by the client.
- **Assessment of short term (during construction) groundwater discharge volumes:** Assessed the groundwater discharge volumes and requirements for Environmental Activity and Sector Registry (EASR) or Permit-to-Take-Water (PTTW) for short term (during construction) groundwater control using the finite element analysis.

2.0 REVIEW OF PREVIOUS STUDY

DS Consultants Ltd. completed a preliminary hydrogeological investigation of the Site in July, 2020 “*Preliminary Hydrogeological Investigation Glen Williams Estates Part of Lot 21, Concession 9, Halton Hills, Ontario, Project No. 19-025-100*, dated: July 9, 2020” in support of the proposed residential development for the land located part of Lot 21, Concession 9 in Halton Hills, Ontario which includes includes thirty-two (32) lots each with one (1) level of basement. As a part of this investigation, twelve (12) boreholes (19-1 to 19-12) were advanced within the property area to depths ranging from 1.8 to 9.7 metres below ground surface.

The study also included the hydrogeological assessment of the external sanitary sewer outfall along the Confederation Street and Main Street. For this purpose, four (4) monitoring wells (19-13 to 19-16) were installed in October 2019 with screen depths ranging from 6.1 to 14.1 mbgs (Elev. 214.7 - 223.0 masl). The borehole locations and sub surface profiles completed by DS Consultants Ltd. are provided in **Appendix A**. The review of the hydrogeological assessment indicated the following:

- Based on the stratigraphic profile at boreholes 19-13 to 19-16, a surficial topsoil layer, ranging in thickness from 75 to 400 mm, was encountered at all borehole locations underlain by fill material consisting of sandy silt, sand and sand and gravel which extended to depths of 1.5 to 2.3 m (Elev. 226.4 - 226.5 masl). The earth fill is underlain by native soils consisting of cohesionless deposits of silt, sandy silt to silty sand, and gravelly sand to sandy gravel. Shale bedrock (Queenston Formation) was found underneath the native materials at depths ranging from 8.2 to 10.7 m (Elev. 218.1 - 219.7 masl) in boreholes 19-15 and 19-16.
- Based on the groundwater level monitoring data from November 2019 to March 2020, the groundwater elevation varies from Elev. 228.12 masl in January 2020 at monitoring well 19-13 to Elev. 229.17 masl (0.42 m above ground surface) in March 2020 at monitoring well 19-15.
- Based on the single well response tests (SWRTs), the hydraulic conductivity of sand and gravel unit ranges from order of magnitude of 10^{-5} m/s to 10^{-6} m/s, 10^{-6} m/s to 10^{-7} m/s for the silt unit and from 10^{-6} m/s to 10^{-8} m/s for the shale formation.

- Based on the groundwater analysis, it is understood that the groundwater quality at the Site exceeded the Region of Halton Sanitary and Storm Sewer Discharge guidelines for trace metals and Total Suspended Solids (TSS). The reported results for the surface water quality also exceeded the Provincial Water Quality Objectives (PWQO) for Phosphorous, E. coli and Total Aluminum.

3.0 SHORT TERM GROUNDWATER CONTROL REQUIREMENTS (DURING CONSTRUCTION)

3.1 Site Visit

Terraprobe conducted a site visit on March 8, 2021 to further confirm the static water levels at monitoring wells 19-15 and 19-16 for the dewatering analysis. The monitoring well 19-16 couldn't be accessed during the site visit. However, the groundwater level observation at monitoring well 19-15 indicates the static water level at Elev. 227.8 masl (0.94 mbgs), and does not indicate artesian conditions at the Site.

3.2 Groundwater Extraction

Based on the "External Sanitary Sewer Plan and Profile" provided in **Appendix B**, sanitary sewer design sheet and email correspondence with the client, it is proposed to construct two (2) 5.0 m x 5.0 m entry and exit shafts with a depth of 7.9 m (Elev. 220.85 masl) i.e., 1 m below the invert elevation of SAN MH 21A (Elev. 221.85 masl). The finite element analysis was conducted utilizing computer software (Slide 7.014, developed by Rocscience Inc.) to estimate the short term (during construction) dewatering requirements as provided below.

The hydraulic parametrization of the generalized numerical model is based on the findings of the preliminary hydrogeological investigation completed by DS Consultants Ltd as indicated above. The stratigraphy of the conceptual model is based on the boreholes 19-15 and 19-16. The following considerations were made for the analysis:

- Design water level at Elev. 227.8 masl (0.94 mbgs) to account for the highest observed water table elevation based on monitoring well 19-15;
- Hydraulic conductivity of 10^{-6} m/s for the earth fill, 10^{-5} m/s for sand and gravel and 10^{-6} m/s for the underlying shale formation;
- Water tight shoring system along the excavation perimeter precluding horizontal groundwater flow in the excavation; and
- Safety factor of 1.5 on the groundwater flow with the inclusion of 40 mm design rainfall event.

This indicates that the excavations to the proposed structures will extend below the prevailing groundwater table and require dewatering. For the excavations extending below the prevailing groundwater level the native soils must be dewatered a minimum of 1.0 m below the bottom of the excavation (dewatering target) to preserve the in-situ integrity of the native soils during construction dewatering activities.

The short term (during construction) groundwater control requirement is estimated to be on the order of 12,667 \pm L/day. A 50% safety factor (1.5) on the groundwater inflow volume yields 19,000 \pm L/day. An incidental 40 mm precipitation requires an additional dewatering requirement of 1,000 L/day for the entire excavation. As

such, the short term (during construction) dewatering requirement for the construction of a single shaft is calculated as follows:

$$Q = 19,000 \text{ L/day} + 1,000 \text{ L/day}$$

$$Q = 20,000 \text{ L/day}$$

As such, the total dewatering requirement for the construction of both shafts is calculated as 40,000 L/day considering if both shafts are constructed at a same time. The results of the finite element analysis for the above assessment are provided in **Appendix C**.

Should the shoring system/methodology and the construction procedure differ from the above noted assumptions, Terraprobe should be retained to revise the groundwater seepage assessment.

3.3 Zone of Influence (ZOI)

The conceptual Zone of Influence (ZOI) for dewatering, also known as Radius of Influence (R_0) with respect to anticipated maximum drawdown required, was calculated based on the estimated groundwater taking rate and the average hydraulic conductivity of the unit from which the groundwater will be taken. As the excavation works will be advanced using a water tight shoring system, the zone of influence will be limited to the excavation box. However, based on the numerical simulation approximately 3.0 m of zone of influence is estimated.

3.4 Permit Requirements

The MECP regulates construction water takings over 50,000 L/day and less than 400,000 L/day to obtain an Environmental Activity Sector Registry (EASR) Posting with the MECP prior to any construction dewatering activities. Based on the estimated dewatering volumes, an Environmental Activity Sector Registry (EASR) Posting from the MECP prior to dewatering activities for the proposed works will **not** be required.

3.5 Groundwater Discharge

As indicated earlier in Section 2.0, the baseline groundwater quality and surface water quality exceeded the Region of Halton Sanitary and Storm Sewer Discharge guidelines and Provincial Water Quality Objectives (PWQO), respectively. The nearest water body is Credit River which is located in the close proximity of the Site. Any groundwater that will be taken from the site should be discharged (if required) into the City's sewer systems and not into any natural water body. Any required approvals should be obtained from the conservation authorities if the extracted groundwater is discharged to local surface water body. As such, the quality of groundwater discharge will have to conform to the applicable standards which includes the Provincial Water Quality Objectives (PWQO).

Terraprobe recommends to collect a total of two (2) samples from the monitoring wells 19-15 and/or 19-16 before the commencement of construction activities to establish a baseline water quality of the study area. The collected samples will be analyzed for the following guidelines: Region of Halton Sewer Use By-Law and Provincial Water Quality Objectives (PWQO). This will further include the recommendations related to discharge options and pre-treatment, if required.

3.6 Impact on Local Wells

Based on the nature of the proposed structures to be constructed and estimated zone influence in response to the dewatering activities, it is unlikely that impacts from the proposed shafts excavations will affect local water resources within the vicinity of the Site.

4.0 PROPOSED MITIGATION MEASURES AND MONITORING PLAN

The monitoring requirements will consist of the following:

- Visual monitoring of groundwater discharge on a daily basis. The discharge should be monitored to ensure that there is no evidence of sediment, fines, or deleterious materials in the discharge water.
- Monitoring of discharge volumes using a continuous recording flow meter. The total volume of discharge should be recorded on a daily basis.
- Monitoring of site activities. A log of site activities and any significant events which may affect the volume or quality of discharge should be maintained. This should include the following:
 - Description of the general depth and extent of excavations.
 - Noting of the duration and intensity of rainfall events.
 - Records of discharge durations and volumes.
 - Noting of any unusual activities which may affect quality or volume of groundwater discharge.

5.0 CLOSURE

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

Yours truly,

Terraprobe Inc.



Usman Arshad, M.Eng., P.Eng., PMP.
Project Manager



Samuel Oyedokun, P.Eng., PMP., QP_{ESA}
Associate/ Sr. Project Manager



Dr. Giorgio Garofalo, P.Geo., QP_{ESA}
Sr. Hydrogeologist/Sr. Project Manager



Attachments:

Figure 1: Site Location Plan

Appendix A: Borehole/Monitoring well locations and Cross Sections (Reference: DS Consultants Ltd.)

Appendix B: Proposed Drawings

Appendix C: Short Term Finite Element Analysis



LIMITATIONS OF LIABILITY

This report was prepared at the request of, and for the exclusive use of **Condeland Engineering Limited**, and its affiliates (“the Intended User”) is intended to provide an assessment of the hydrogeological conditions of the property located at, **West Half Lot 21, Concession 9 (Esquesing), Glen Williams, Ontario** (the Site). No one other than the Intended User has the right to use and rely on the work without first obtaining the written authorization of Terraprobe Inc. and Condeland Engineering Limited.

Terraprobe Inc. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work. 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. Terraprobe Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The assessment should not be considered a comprehensive audit that eliminates all risks of encountering hydrogeological problems. The information presented in this report is based on information collected during the completion of the hydrogeological study by Terraprobe Inc. It was based on the conditions on the Site at the time of the hydrogeological study by a review of historical information and field investigation to assess the hydrogeological conditions of the Site, as reported herein.

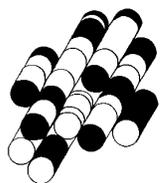
There is no warranty expressed or implied by this report regarding the hydrogeological conditions for the Site. Professional judgement was exercised in gathering and analysing information collected by reviewing previous reports, data provided by government and are open to public and field work investigation. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

In the event that during future work new information regarding the hydrogeological conditions of the Site is encountered, or in the event that the outstanding responses from the regulatory agencies indicate outstanding issues on file with respect to the Site, Terraprobe Inc. should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.

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FIGURES

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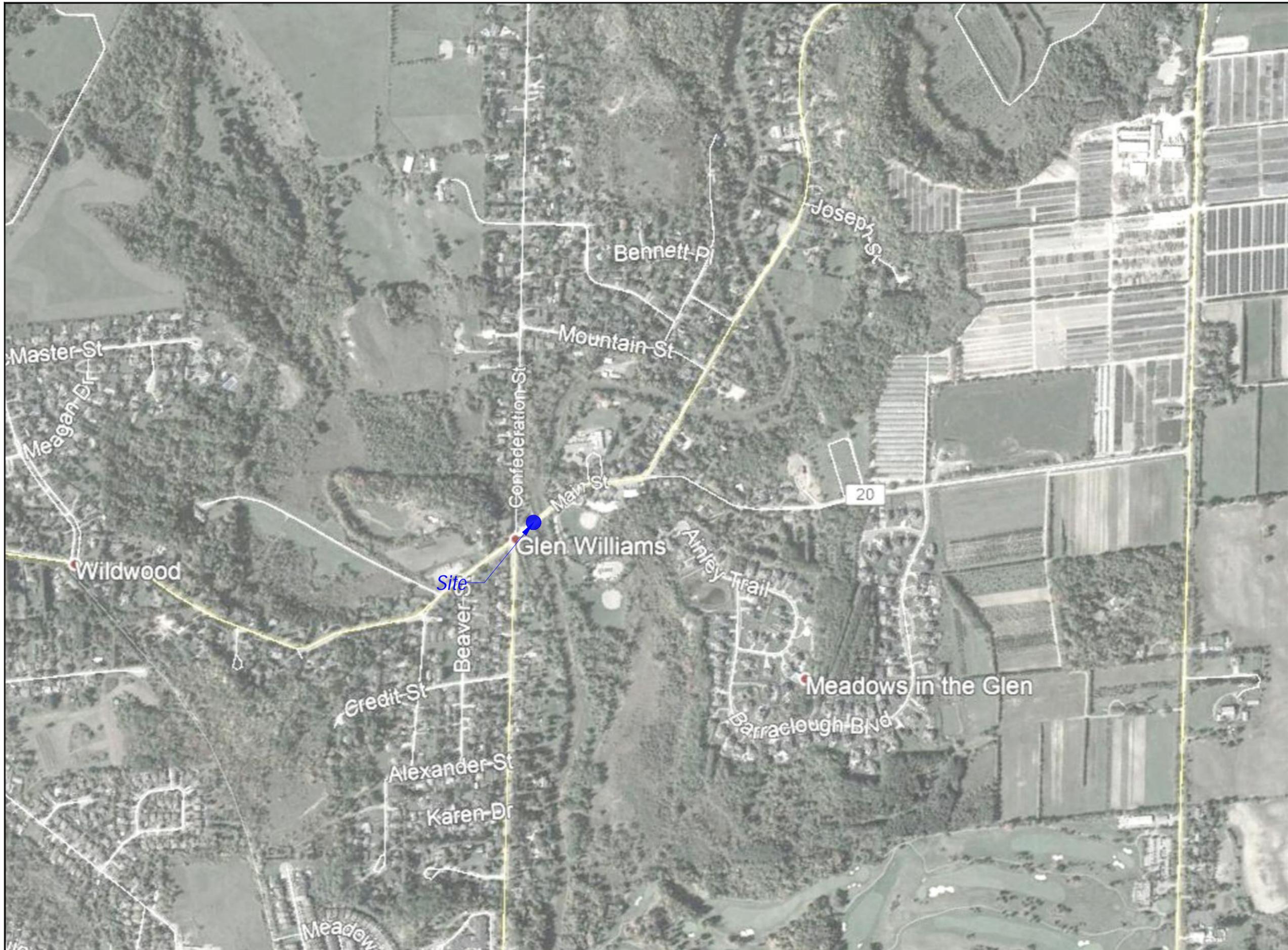




Reference:
 Google Earth Pro 2018

Notes:

Legend:



Project Title:
 Groundwater Seepage Assessment

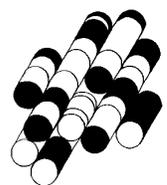
Site Location:
 Confederation Street and Main Street,
 Glen Williams, Ontario

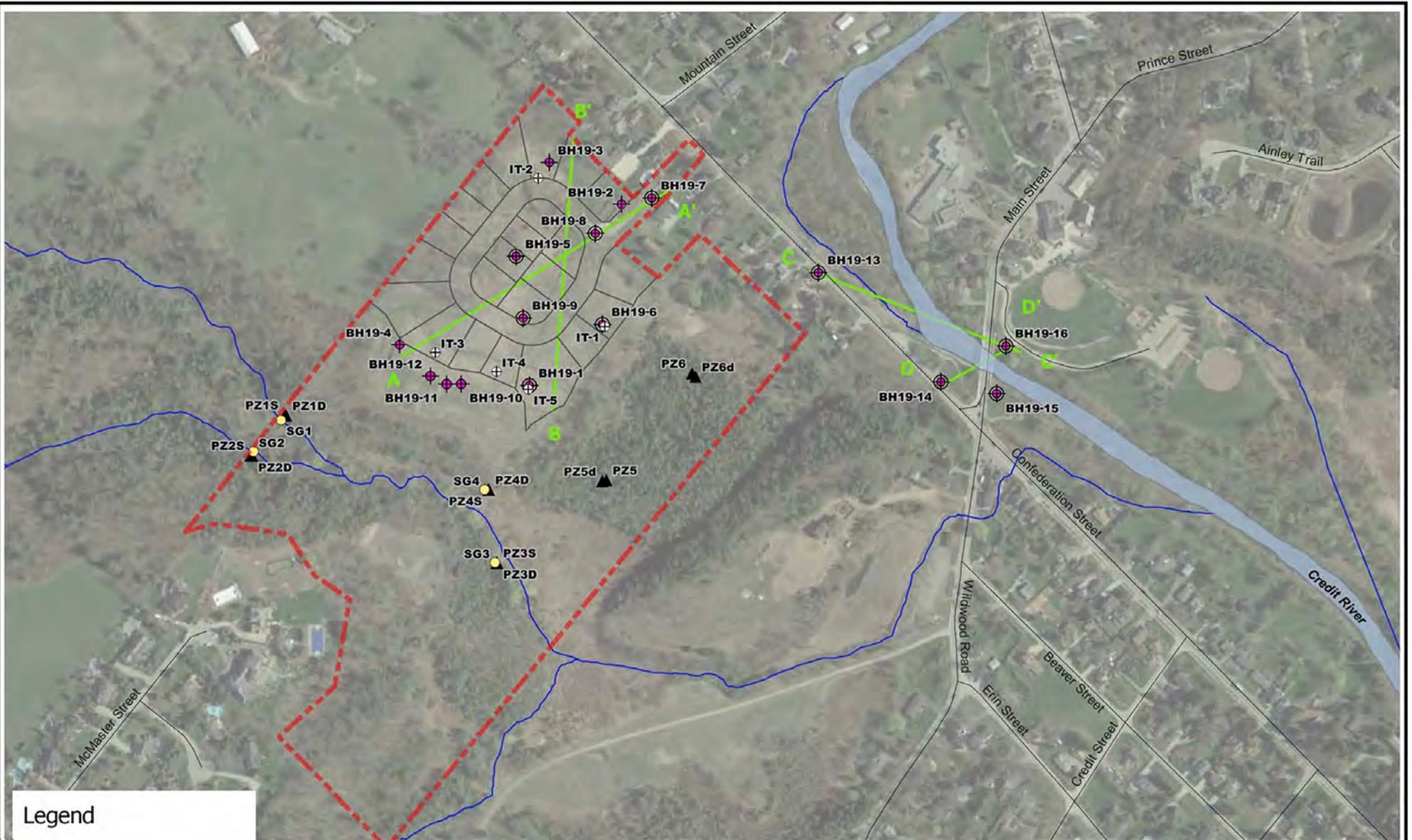
Figure Title:
 SITE LOCATION

Designed By: UA	File No.: 1-18-0438-56
Drawn By: JB	Scale: As Shown
Reviewed By: SO	Figure No.: 1
Date: March 2021	

APPENDIX A

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Legend

- - - Approx Site Boundary
- ◆ Borehole
- ⊗ Monitoring Well
- ⊕ Infiltration Test
- ▲ Piezometer
- Staff Gauge
- Cross Section



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 6221 Highway 7, UNIT 16
 Vaughan, Ontario L4H 0K8
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 www.dsconsultants.ca

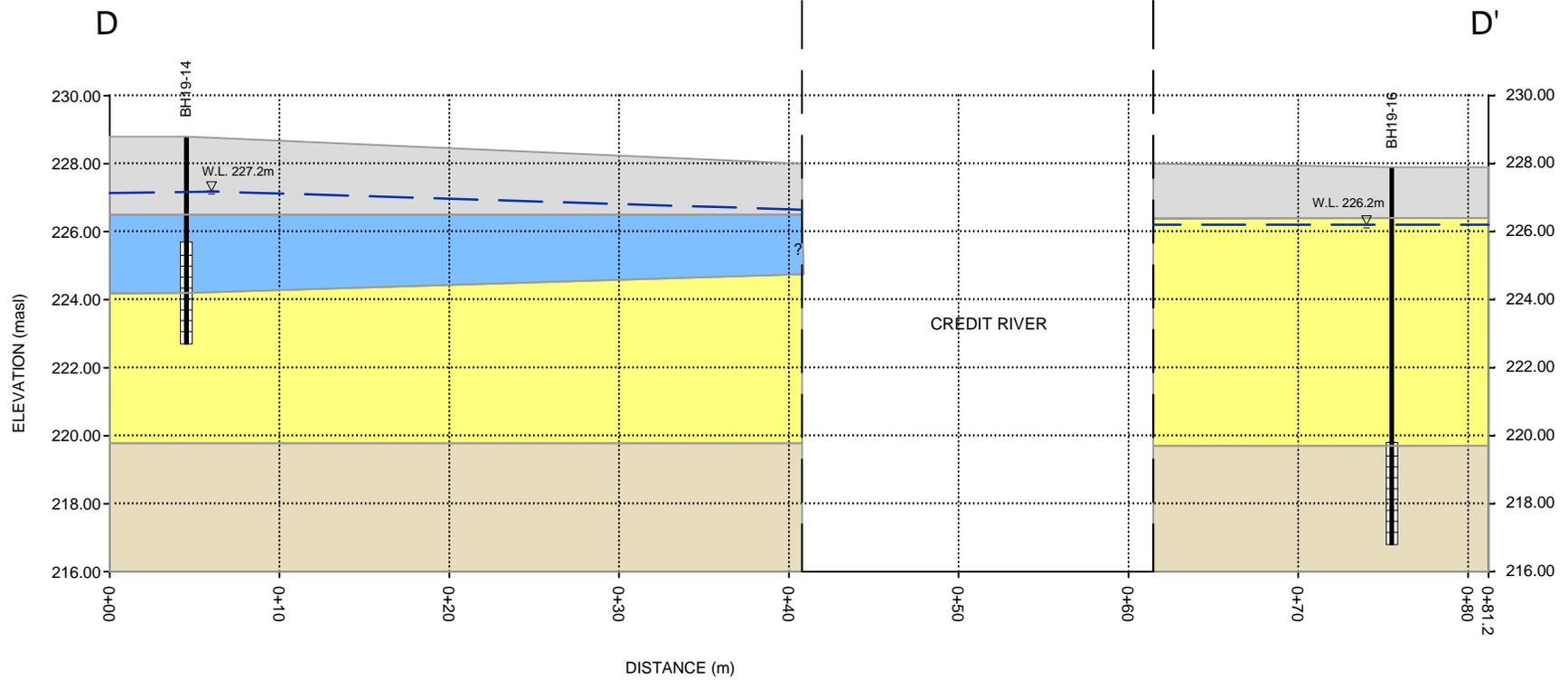
Client:
 Glen Williams Estates Inc..

Project: HYDROGEOLOGICAL INVESTIGATION
 Part of Lot 21, Concession 9, Town of Halton Hills, ON

Title: **BOREHOLE AND MONITORING LOCATIONS**



Size: 8.5 x 11	Approved By: S.W	Drawn By: M.Z.	Date: July 2020
Rev: 0	Scale: As Shown	Project No.: 19-025-100	Figure No.: 3
Image/Map Source: Google Satellite Image			



Horizontal Scale: 1:600
Vertical Scale: 1:300

--- Groundwater Level
(Nov 21 2019)



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www.dsconsultants.ca

Project: HYROGEOLOGICAL INVESTIGATION
Part of Lot 21, Concession 9, Town of Halton Hills, ON

Title: **GEOLOGICAL CROSS SECTION D-D'**

Client:
DTS LTD.

Size:
8.5 x 11

Approved By:
S.W

Drawn By:
S.Y

Date:
July 2020

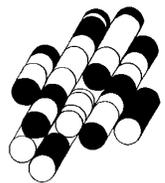
Rev. Scale:
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Project No:
19-025-100

Figure No.
5D

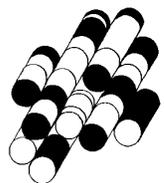
APPENDIX B

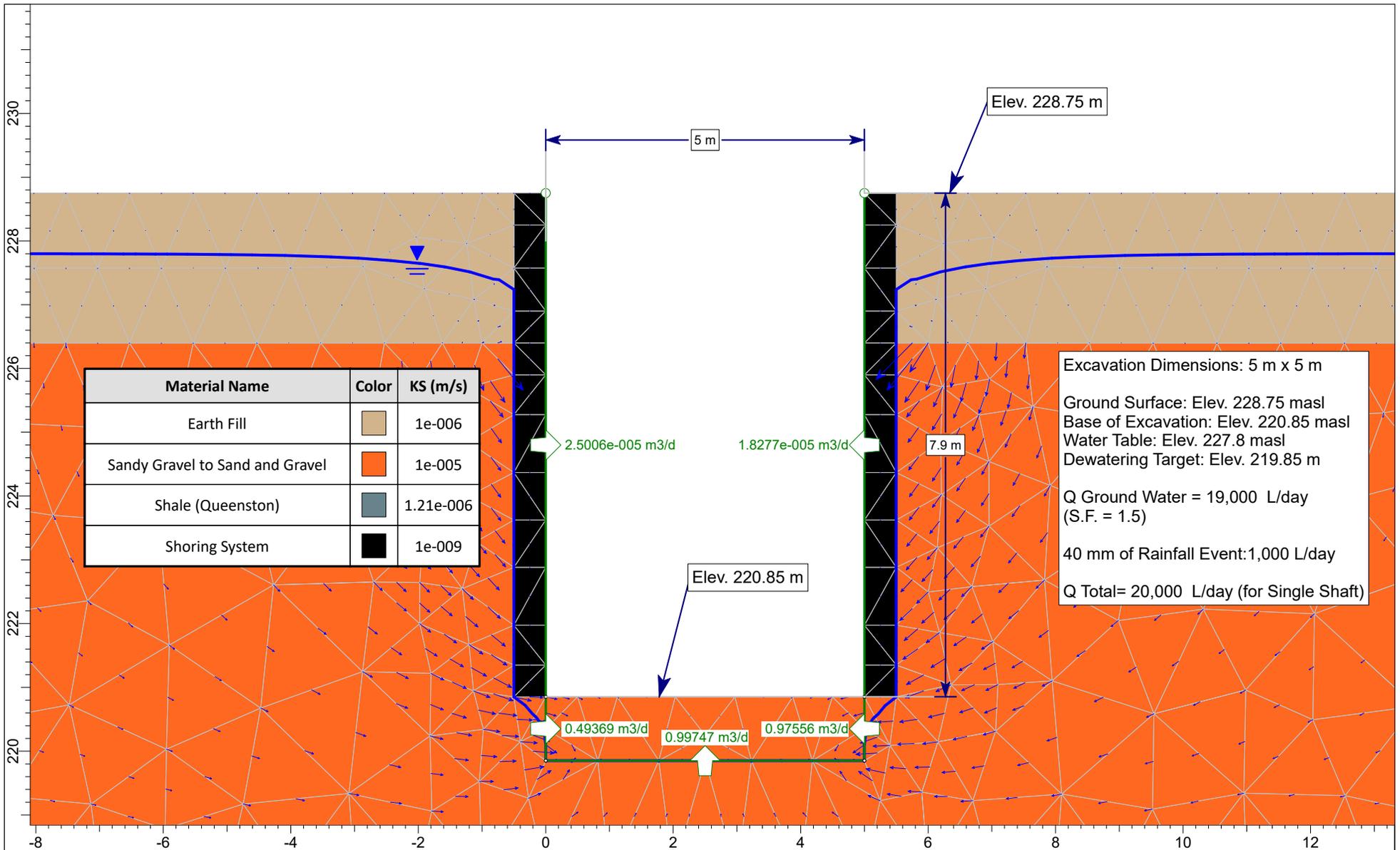
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APPENDIX C

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 <p>Terraprobe Consulting Geotechnical & Environmental Engineering Construction Materials Inspection & Testing</p>	Notes Refer to Hydrogeological Report for factual information supporting this analysis.	Project 1-18-0438-56 External Sanitary Sewer			
		Analysis Dewatering Assessment , Short Term , Impermeable Shoring			
		Date 2021-03-12	Scale 1:84	File 1-18-0438-56.sldm	
		By UA	Company Terraprobe Inc.		