

**HYDROGEOLOGICAL ASSESSMENT
REPORT**

271 MAIN STREET DEVELOPMENT

**VILLAGE OF DUNDALK
TOWNSHIP OF SOUTHGATE
GREY COUNTY**

PREPARED FOR:

271 MAIN STREET EAST INC.

PREPARED BY:

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1.0 Introduction

C.F. Crozier and Associates Inc. (Crozier) was retained by 271 Main Street East Inc. (Developer) to complete a Hydrogeological Assessment Report for the proposed development of a townhouse complex inclusive of a drive aisle located at 271 Main Street East (the Subject Property) in the Village of Dundalk, within the Township of Southgate (Township) and Grey County (County), Ontario. The Study Area is considered to be the Subject Property and a 500 m buffer around the Site Boundary.

This Hydrogeological Assessment has been prepared in support of the Site Plan Approval (SPA) and Zoning By-Law Amendment (ZBA) submissions as required by the Township and the Grand River Conservation Authority (GRCA). The report characterizes the hydrogeological regime of the property and describes the seasonal high groundwater elevation on-site.

Through a review of the source water protection conditions on the Subject Property and the results of the field investigation, a discussion of the potential impacts to groundwater resources will be explored as well as an analysis of the requirement for short-term/long-term dewatering on-site. Additionally, further commentary on best management practices (BMP) and potential mitigation measures will be provided to help guide future design considerations.

1.1 Site Description

The Subject Property covers an area of approximately 0.26 ha and currently consists of vacant land, sparse coniferous trees, and overgrown vegetation. A large open excavation also exists in the central portion of the Subject Property, likely a remnant from the demolition of the previous structural feature. The property is designated as a Residential Area Type 3 per the Township of Southgate Official Plan, located in a fully serviced urban settlement area. It is bounded by Main Street (County Road 9) to the north, a funeral home to the east, and single-family homes to the west and south. Please refer to **Figure 1** for a Site Location Plan.

The Subject Property is located within the jurisdiction of the Grand River Conservation Authority (GRCA). Through a review of the GRCA regulation mapping, the Subject Property is outside of the regulation limit of the two constructed municipal drains which are tributaries of the James Foley Drain.

Based on the proposed Site Plan completed by Orchard Design Studio Inc. dated April 2024, the elements envisioned for the proposed development include:

- Twenty-four (24) stacked townhouses (0.13 ha) consisting of Blocks A and B;
- Full perimeter sidewalks and individual unit driveways;
- A deep collection waste system;
- Snow storage area; and,
- A 6 m drive aisle.

Currently, no significant underground structures are proposed on the Subject Property. Townhomes will not include basements and in-ground services are planned to be shallow, with the exception of the Sanitary sewers, which will connect to the existing municipal sewers at a depth of approximately 514.28 metres above sea level (masl). Please refer to **Figure 6** for 271 Main Street Site Plan.

2.0 Drinking Water Source Protection

The Subject Property is located within the Grand River Source Protection Area which is authorized to act under the legislated powers of Ontario's Clean Water Act (2006). The Grand River Source Protection Plan (GRSPP) is a document that sets out policies to protect sources of municipal drinking water against existing and future drinking water threats.

The Source Protection Plan applies a Vulnerability Score / Threats-Based Approach in which the product of two crucial pieces of information (vulnerability and circumstance) are combined to determine if a specific area and incorporated activity will be considered a Low, Moderate, or Significant Drinking Water Threat (LDWT, MDWT, and SDWT).

Related to the Drinking Water Threat classification, the Clean Water Act (2006) employs various levels of policy tools ranging from "Softer" tools such as Education and Outreach to "Part IV Powers" such as Restrictive Land Uses (S. 59), Risk Management Plans (S. 58), and Prohibition (S. 57). In general, only SDWTs incur the application of "Part IV Powers."

2.1 Vulnerability Score / Threats-Based Approach

In general, there are five types of vulnerable areas where activities may incur risks to drinking water sources. These areas are assigned vulnerability index scores ranging from 0 to 10 where the score is derived from numerous factors related to the physical setting. The four primary types of vulnerable areas include: Wellhead Protection Areas (WHPA), Intake Protection Zones (IPZ), Highly Vulnerable Aquifers (HVA), and Significant Groundwater Recharge Areas (SGRA). Additionally, Event Based Areas (EBA) are delineated to address threats to systems drawing water from larger surface water bodies where the vulnerability scores are generally low.

Activities incurring threats to drinking water sources through impacts to quality and quantity within the region's Source Protection Plan are evaluated based on a hazard rating, also ranging from 0 to 10, and organized into Main and Subcategories.

Main Categories within the GRSPP jurisdiction include:

1. The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage.
3. The application of agricultural source material to land.
4. The storage of agricultural source material.
5. The management of agricultural source material.
6. The application of non-agricultural source material to land.
7. The handling and storage of non-agricultural source material.
8. The application of commercial fertilizer to land.
9. The handling and storage of commercial fertilizer.

10. The application of pesticide to land.
11. The handling and storage of pesticide.
12. The application of road salt.
13. The handling and storage of road salt.
14. The storage of snow.
15. The handling and storage of fuel.
16. The handling and storage of a dense non-aqueous phase liquid.
17. The handling and storage of an organic solvent.
18. The management of runoff that contains chemicals used in the de-icing of aircraft.
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.
20. An activity that reduces the recharge of an aquifer.
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.
22. The establishment and operation of a liquid hydrocarbon pipeline

Please note that Threats 19 and 20 are considered to be directly related to water quantity and the maintenance of water budgets.

The Source Protection Information Atlas provides a corresponding matrix which specifies under what circumstances or Subcategory each activity can be a Low, Moderate, or Significant Drinking Water Threat within a vulnerable area. SDWTs typically incur the activation of policy tools either through mitigation of impacts by applying Restrictive Land Uses and Risk Management Plans or prevention of future impacts through Prohibition.

2.2 Current Conditions

Based on review of the Ministry of the Environment, Conservation, and Parks (MECP) Source Protection Information Atlas online mapping tool, the Subject Property does not overlie an HVA or an EBA, but the entirety of the Site Area is located within a Wellhead Protection Area C (WHPA-C) with a score of 2. The Subject Property is also located within an SGRA and an Intake Protection Zone 3 (IPZ-3), with corresponding scores of 4.

2.3 Development Considerations

It should be noted that areas under WHPA-C with a score of 2 incur SDWTs if the following activities are conducted on-site.

- The handling and storage of a dense non-aqueous phase liquid.

This is considered a threat under the following circumstances in any quantity:

- The below grade handling of a DNAPL in relation to its storage.
- The handling of a DNAPL at or above grade, in relation to its storage.

In general, residential uses do not typically pose SDWTs which trigger Source Protection Policies. Through a review of the proposed land uses, the circumstances noted above are not predicted to occur through the development of 271 Main Street. Therefore, while potential SDWTs were considered, no mandated policies are required to mitigate potential issues.

Additionally, though the Subject Property are inclusive of an SGRA and IPZ-3, the associated vulnerability scores did not classify either zone as having Low, Moderate, or Significant Risks. However, Best Management Practices (BMPs) should be employed on site.

Source Protection considerations that should be noted and mitigated where possible include:

- The application of road salt.
- The handling and storage of road salt.
- The storage of snow.

Potential mitigation strategies should explore reducing the amount of contaminated runoff from infiltrating back into the soil. This could include using groundwater friendly road treatments in lieu of road salt, or providing a near impervious surface for the snow storage in which melted runoff is directed into the storm water infrastructure.

Water Threats associated with proposed activities on the Subject Property should be reviewed with the municipality's Risk Management Official (RMO) to ensure that proper policy instruments are considered.

Source Protection Mapping for the property can be referenced in **Appendix A**.

3.0 Physical Setting

The following sections describe the local and regional geology of the Subject Property, including the physiography, topography, and drainage of the area.

3.1 Surficial and Bedrock Geology

3.1.1 Regional Context

According to Ontario Geological Survey (OGS) mapping, the surficial materials of the Subject Property are mapped as till consisting of stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain. Within the greater Study Area, scattered areas of glaciofluvial deposits consisting of river deposits and delta topset facies exist. OGS mapping shows the bedrock in the area to be a part of the Guelph Formation which consists of a cream to buff to tan to tan-brown to brown; finely to medium crystalline; thinly to thickly bedded, moderately to very fossiliferous, saccharoidal dolostone.

The Study Area is also located within an “area of potential karst” according to OGS mapping. Karst is a landform feature formed by the dissolution of carbonate bedrock by water. In areas of thin or absent overburden material, exposures of dolostone and limestone are subjected to weathering and dissolution, causing karstic features such as caves, cervices, springs, sinkholes, and smaller karren features such as vugs and fractures. The nearest occurrence of “known karst” to the site is located approximately 8.9 km northeast of the Subject Property. On the Subject Property and the surrounding area, overburden thickness is observed to be approximately between 29.45 m to 31.98 m. Since overburden thickness is greater than 1 m thick around the area of the Site, significant karst formation on the property is not anticipated. Please note that a formal investigation for the presence of karst features on the property has not been completed and is outside the scope of this report.

Please refer to **Figure 2** for the Bedrock Geology and **Figure 3** for the Surficial Geology.

3.1.2 Local Conditions

Detailed subsurface investigations have been completed at different properties surrounding the Subject Property. According to the Township of Southgate and Grey County online archives, an investigation was completed by Sirati & Partners Consultants Ltd. in 2016 at a site approximately 0.9 km to the west of the Subject Property. The investigation revealed that the site was underlain by water bearing cohesionless soils. The cohesionless soil strata was found to be composed of silt, sandy silt, silty sand, sand, and gravel overlying till. Another investigation located approximately 1.4 km to the northeast of the Site Area was completed by Soil Engineers Ltd. in 2016. The investigation found that beneath a layer of topsoil, the native soils consisted of sandy silt, silty fine sand, silt sand till, silty clay till, and gravelly sand.

OGS Mapping and MECP Well Records align with the findings of both reviewed geotechnical investigations. Based on local well records, the anticipated surficial soils on the site are clay and stones, sandy gravel, and sandy silt till. Likewise, OGS Mapping identifies surficial materials as till consisting of stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain.

Full reports by Sirati & Partners Consultants Ltd. and Soil Engineers Ltd. are provided as supporting documentation and can be found as **Appendix B**.

3.2 **Physiography, Topography & Drainage**

3.2.1 Regional Context

The Site is located within the Dundalk Till Plain Physiographic region according to Chapman and Putnam (1984). The Dundalk Till Plain is a plain that slopes to the basins of Georgian Bay, Lake Huron and Lake Ontario. It is characterized by swamps or bogs and by poorly drained depressions. North and west of Dundalk, some low drumlins swells appear in the Dundalk Till Plain with their long axes oriented southeastward and some in the west.

According to Conservation Halton Mapping, the Site is located within the McNabb Drainage Works – Grand River Watershed. Surface water flow follows natural topography gently sloping in the southern direction where it drains into the Grand River tributaries ultimately reaching Lake Ontario.

3.2.2 Local Conditions

Based on a review of topography survey completed by Schaeffer Dzaldov Purcell Ltd. on December 5, 2023, for the Subject Property, the topography of the Site is relatively flat ranging from approximately 517 meters above sea level (masl) to 519 masl, generally sloping from the east to the west towards Main Street East.

At the time of preparation of this Report, a large excavation existed in the central portion of the site. Based on the location, depth and shape of the excavation, it is believed that this depression may be responsible for collecting local runoff and prematurely reintroducing it into the groundwater.

Please refer to **Figure 4** for the Physiography.

4.0 Hydrogeology

4.1 MECP Well Records

A review of MECP Well Record Database identified thirty-three (33) well records within a 500-meter radius of the Site Area. Well record logs indicated that many of the wells were used for domestic supply, and commercial/industrial supply. Many of the wells were reported to be abandoned. A full summary table is attached as **Appendix C**. A summary of the key points from the well records is as follows:

- Of the 33 wells, 11 are abandoned or not in use, 16 are for domestic use, 3 are used for commercial/industrial purposes, 1 is used for monitoring/observation, 1 is used for a public service, and 1 was not specified.
- The majority of the wells were screened within the bedrock aquifer, with only 1 well being screened within the overburden aquifer. Primary subsurface geology includes topsoil, clay, gravel, sand, hardpan, and limestone.
- Of the well records that indicated depth of the well, depths ranged from 4.5 meters below ground surface (mbgs) to 96.2 mbgs, with an average depth of 47.5 mbgs.
- Of the wells that included pumping rate information, the quantities ranged from 15.9 liters per minute (lpm) to 1320 lpm, with an average quantity of 116.1 lpm.
- All of the well records that reported on groundwater quality reported "Fresh" or "Clear" conditions.
- The reported static water levels ranged from 3.96 mbgs to 16.5 mbgs, with an average static water level of 8.00 mbgs. Based on the location of the wells, higher static water levels were found to occur north of the Site Area, and lower static water levels were found to occur south of the Site Area. Based on these findings, groundwater flow in the region of the site is expected to flow towards the south.

Please see **Figure 5** for the Study Area's Well Location Plan.

4.2 Groundwater Properties

The Grand River Source Protection Area Approved Assessment Report completed in 2021 was referenced for the following groundwater properties on the Subject Property. The Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region also completed an assessment report of the Saugeen Valley Source Protection Area, which evaluated the groundwater properties adjacent to the Study Area. While the Subject Property is located just outside the Saugeen Valley Source Protection Area, the majority of Dundalk is located within this Source Protection Area, therefore this study was also referenced for the groundwater properties.

4.2.1 Regional Context

According to the Grand River Assessment Report, potential drinking water quality issues of raw and treated production well water quality data were reviewed from 2004 to 2017. The raw water quality data was compared to the Ontario Drinking Water Quality Standards (ODWQS) to identify any parameters approaching or exceeding a standard.

A review of the data for the Dundalk Well Supply System did not identify any issues with the drinking water sources. No parameters analyzed exceeded a drinking water standard or showed signs of an increasing trend.

According to the Dundalk Waterworks Annual Report from 2023, there was one adverse test result noted on March 13, 2023. The Township received adverse sodium from Wells D3 and D4 at levels of 28.9 mg/L and 26.6 mg/L, respectively. These are in exceedance of the aesthetic guidelines and can impact users with high sodium levels. Accordingly, the health unit was notified, and a sodium fact sheet was sent out with residents' water bills.

Additionally, the system was tested for total coliform, E. Coli, and samples with heterotrophic plate counts (HPC) in both raw and treated samples. Total coliform was noted in three (3) of the 156 raw samples yet was not identified in the treated samples. Levels of E. Coli and HPC were not seen during testing.

Overall, the groundwater in Dundalk is considered to be of good quality.

4.2.2 Local Conditions

A hydrogeological study and groundwater monitoring program was completed by Soil Engineers Ltd. in 2016 for a site located approximately 1.4 km north-east of the Subject Property.

Groundwater samples were completed two monitoring wells on-site and were compared against the ODWQS. The tested parameters, save for Total Hardness (CaCO_3), met the respective ODWQS limits. It should be noted that the ODWQS limits for hardness represent an aesthetic objective for groundwater and can be treated domestically using a water softener.

4.2.3 Groundwater Flow

According to the Saugeen Valley Assessment Report, the groundwater flow within the bedrock radiates away from the Dundalk area and flows generally west to southwest towards Lake Huron and north towards Georgian Bay.

The overburden aquifer's utility is not presently known, due to the lack of reliable well records in the area. The aquifer has static water levels located very close to the ground surface that may have an impact on the placement of septic systems and foundations. The aquifer is considered to be of good quality and quantity, with some local wells yielding up to 120 L/min. Shallow groundwater flow is perceived to generally follow topography. In the area of the Subject Property, it is believed that groundwater flows move generally to the south and south east to two tributaries.

4.3 Hydrostratigraphy

According to the Saugeen Valley Source Protection Area and Grand River Assessment Reports, there are three major aquifer units noted on the Subject Property. The Dundalk Aquifer consists of gravel and sand deposits that range in thickness of 7-15 m. It is overlain by 18 m of a till-like deposit where sand and gravel deposits are located at the surface. The aquifer has both confined and unconfined portions. According to the Grand River Assessment Report, the Dundalk Aquifer is underlain by a bedrock aquifer. The uppermost bedrock formations are Guelph and Gasport and are estimated to be 88 m thick, forming the active aquifer system which supplies the Dundalk municipal wells.

5.0 Field Work

5.1 Monitoring Well Installation

On November 27, 2023, Green Geotechnical Limited (Green) completed a field investigation consisting of drilling and sampling of four (4) exploratory boreholes, two of which were outfitted with monitoring wells (MW23-1 and MW23-2). The borings were drilled by a licenced MECP well contractor organized by Green using a track mounted drill rig and power auger.

The purpose of this drilling program was in accordance with a geotechnical and hydrogeological field investigation. Continued monitoring was completed to establish hydrogeological conditions across the Subject Property and to assess the potential requirement for construction dewatering and/or long-term dewatering.

Key monitoring well construction details can be found in **Table 1**. Full borehole records and monitoring well construction logs can be found in **Appendix D**.

Table 1: 2023 Monitoring Well Construction Details

Monitoring Well	Ground Elevation (masl)	Well Depth (mbgl)	Screened Interval (masl)	Primary Formation
MW23-1	518.42	6.1	512.32 – 515.42	Silty Sand and Sandy Silt
MW23-2	518.76	6.1	512.66 – 515.76	Silty Sand and Sandy Silt

The two monitoring wells were drilled to a depth of 6.1 mbgl. Accordingly, the wells were installed between 512 – 516 masl. The primary noted formations encountered included silty sand and sandy silt.

6.0 Results

The following sections outline the results of the investigation at the time of this report. Note that groundwater monitoring is ongoing, and this report will be updated as additional results are obtained.

6.1 Groundwater Monitoring

Following the installation of the wells in 2023, manual groundwater measurements were collected using an electronic water level meter and automatic level loggers were deployed in select wells across the Site. The water level loggers were set to measure water levels on an hourly basis to collect a more comprehensive dataset for a greater understanding of the shallow groundwater system. Please see **Figure 6** for the location of the two monitoring wells in the context of the proposed site plan.

6.2 Groundwater Levels

Following the installation and development of the wells, periodic measurements were collected. At the time of this report, two (2) manual groundwater readings have been collected to date and are summarized in **Table 2** below. Note that groundwater monitoring is ongoing on the property and additional results can be provided following additional monitoring.

Table 2: Groundwater Levels (2023/2024)

Monitoring Well	Ground Elevation (masl)	Groundwater Level (mbgl)	
		2023-12-05	2024-03-13
MW23-1/BH3	518.42	3.42	1.44
MW23-2/BH2	518.76	2.88	2.52

Based on manual water level measurements, the seasonal high groundwater elevations noted were 1.44 mbgl.

6.2.1 Seasonally High Groundwater

A summary of recorded data through the deployed loggers is provided in **Table 3** below. Seasonally recorded maximums and minimums are provided.

Table 3: Water Level Range (mbgl)

Monitoring Well	Seasonally Recorded Max		Seasonally Recorded Minimum	
	Date	W/L	Date	W/L
MW23-1	2023-12-01	3.42	2024-03-01	1.19
MW23-2	2024-01-10	3.00	2024-03-01	2.22

Hydrographs were also developed for the two monitoring wells and the groundwater elevations were reviewed. Seasonal highs of 1.19 mbgl and 2.22 mbgl for MW23-1 and MW23-2, respectively, were noted on March 1, 2024. At the time of this report, monitoring has been completed from December 1, 2023 to March 13, 2024. Throughout this time, lows were noted in December for both monitoring wells, and each well showed a moderate response to precipitation events. Please refer to **Appendix E** for hydrographs displaying continuous groundwater level data collected through automatic loggers.

Data generated through a compilation of manual measurements in 2023 and 2024 has been used to provide the Crozier design team with conservative seasonal groundwater highs. Groundwater level measurements are still ongoing, though it is believed that the seasonally high point has been captured. Should any impacting updates be determined prior to the end of the monitoring period, detailed design will be advised accordingly.

6.3 Groundwater Flow Direction

Based on manual measurements collected in 2023/2024, there is a discrepancy in the groundwater flow direction. Initial measurements indicate that the groundwater flows from the southern portion of the Site towards Main Street East, yet measurements taken in March 2024 indicate that the gradient has reversed.

Based on the presence of the deep excavation in the immediate vicinity of MW23-2, it is likely that the initial recharge of this location following development was much faster. Therefore, following installation an accentuated lag time in the recharge of MW23-1 appears to have lasted approximately 10 days. This lag in recharge relative to MW23-2 is responsible for the initial discrepancy.

Stabilized water levels indicate that groundwater in fact flows in the direction from MW23-1 to MW23-2 and is believed to generally flow offsite to the South.

Future manual groundwater levels will provide more insight into the groundwater gradient on the Subject Property.

7.0 Design Considerations

7.1 Groundwater Conditions

Groundwater levels have ranged from 1.19 mbgl to 3.42 mbgl or 517.23 masl to 515 masl, respectively. Given that the aquifer units noted during geotechnical investigation were primarily moderately permeable soils, water seepage is expected during excavation.

According to the Township of Southgate Municipal Servicing Standards, 0.6 m of separation is required between the underside of all the footings and the seasonally high groundwater elevation. A footing depth of 2 ft (0.6 m) was assumed as there are no basements for the proposed development. Within a footing depth of 0.6 m and a required separation of 0.6 m from the seasonally high elevations, it is anticipated that short-term dewatering during construction for the purposes of excavation will be required and that long-term dewatering may be required for any structure permanently installed at an elevation below the measured groundwater table. It is recommended that a pre-construction dewatering assessment be undertaken prior to breaking ground to ensure that sufficient pumping capacity can be provided on the Site during construction works. It is advised that seepage at or near the groundwater levels should be handled adequately using a filtered sump pump placed at the base of the excavation for most of the site.

7.2 Dewatering Considerations

If the proposed building footings are to be extended below the reported seasonally high groundwater conditions, it can be expected that short-term and/or long-term groundwater dewatering will be required. If construction volumes are expected to fall between 50,000 L/day and 400,000 L/day, registration with the MECP Environmental Activity Sector Register is required. If construction dewatering volumes are to exceed 50,000 L/day post-construction, an additional

Permit to Take Water will be required for the groundwater discharge. Local permitting will also likely be required prior to any groundwater discharge to municipal infrastructure.

8.0 Conclusions

At the time of this report, Crozier is prepared to make the following conclusions:

- The soils in the Study Area are primarily sandy silt, silty fine sand, silt sand till, silty clay till, and gravelly sand. The Study Area sits atop a bedrock aquifer comprised of dolostone, interpreted to be encountered at a depth of approximately 29.45 m to 31.98 m.
- Groundwater levels have been observed to be 1.19 mbgl to 3.42 mbgl or at elevations of 517.23 masl to 515 masl, respectively.
- Due to the high groundwater levels recorded to date, it is anticipated that active construction dewatering and long-term dewatering will be required if excavations are extended to below an elevation of 517-518 masl. Dewatering volumes should be evaluated once final floor elevations are determined for the proposed developments planned.
- This report and its findings are advised to be preliminary and should not be used for final design purposes.
- In consideration of Drinking Water Source Protection, due to the presence of the WHPA-C with a vulnerability score of 2, the following activities should be considered prohibited on the Subject Property:
 - The below grade handling of a DNAPL in relation to its storage.
 - The handling of a DNAPL at or above grade, in relation to its storage.
- In consideration of Drinking Water Source Protection, potential mitigation strategies should explore reducing the amount of contaminated runoff from infiltrating back into the soil. This could include using groundwater friendly road treatments in lieu of road salt, or providing a near impervious surface for the snow storage in which melted runoff is directed into the storm water infrastructure.
- Groundwater dewatering during construction should be addressed using pumps that can be placed within open excavations.
- Should footings and/or foundations extend within 0.6 m of the seasonally high groundwater, it is recommended that subdrains be included and directed to outlet to municipal storm services.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.



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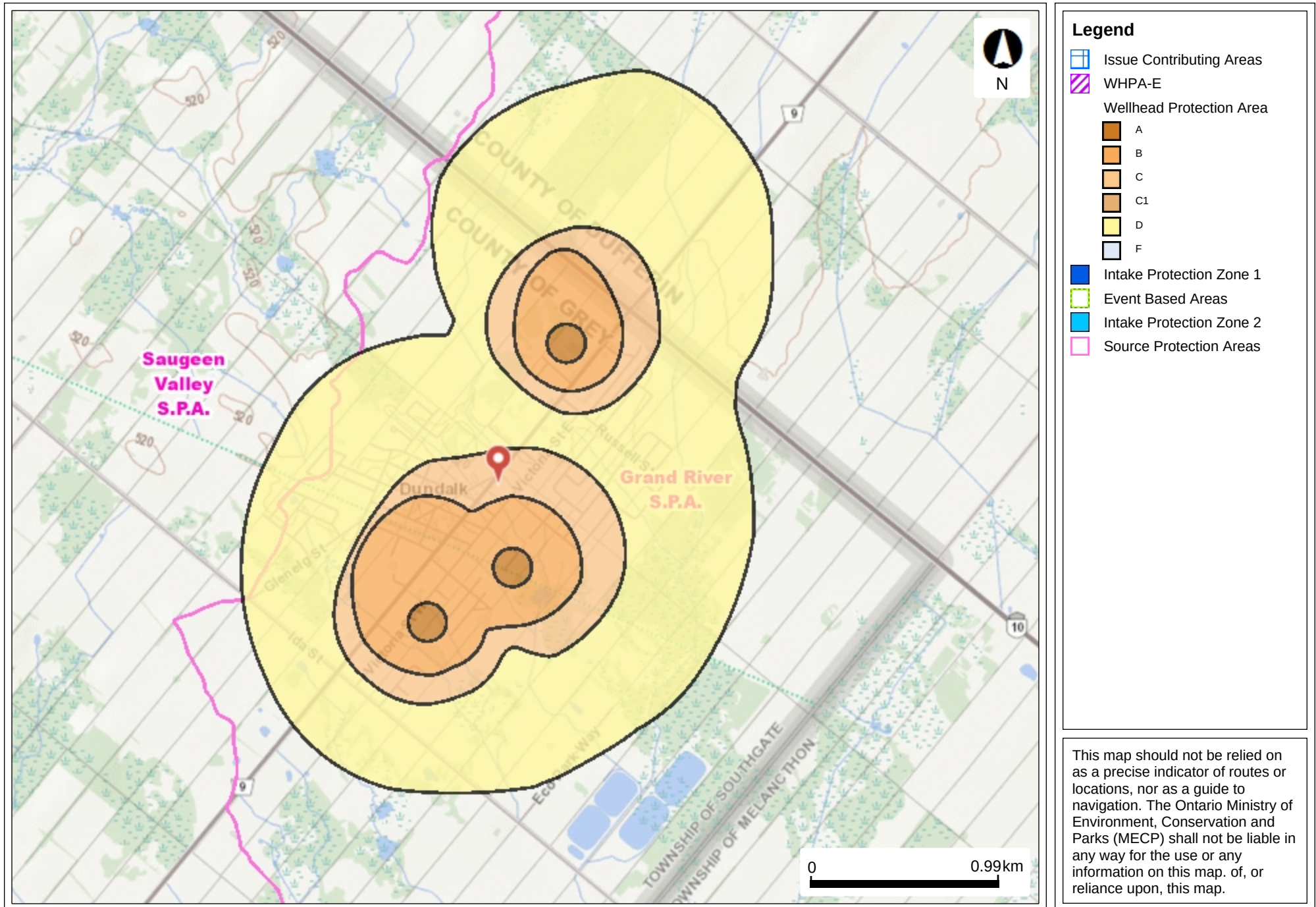
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APPENDIX A

Source Protection Mapping

Source Protection Mapping - 271 Main Street East, Dundalk



This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

APPENDIX B

Background Documents



global environmental solutions

2358737 Ontario Inc.

**Environmental Impact Study
Glenelg Residential Subdivision
231 Glenelg Street, Dundalk Ontario**

**March 2020
SLR Project No.: 209.40385.00000**



ENVIRONMENTAL IMPACT STUDY
GLENELG RESIDENTIAL SUBDIVISION
231 GLENELG STREET, DUNDALK ON
SLR Project No.: 209.40385.00000

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Terrestrial Ecologist

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. was retained by 2358737 Ontario Inc. to undertake an Environmental Impact Study (EIS) in support of an Official Plan Amendment, Zoning By-law Amendment and Draft Plan of Subdivision on lands legally described as Part of Lot 227 and 228 Range 2 West of Toronto and Sydenham Road Proton in the Community of Dundalk, Southlake Township in Grey County Ontario.

1.1 Study Area

The subject property is located at 231 Glenelg Street in the Community of Dundalk (Figure 1). The property is largely agricultural and includes a residence and amenity areas with adjacent land designations that include hazard lands, industrial and neighbourhood areas (Map 1, Township of Southgate Official Plan). The residential core of the community occurs to the east and south of the property with agriculture being the main land use to the north and west. The property also falls within the jurisdiction of two Conservation Authorities: Grand River Conservation Authority (GRCA) and Saugeen Valley Conservation Authority (SVCA).

1.2 Goals and Objectives

The goal of the EIS is to demonstrate that the proposed development complies with the requirements of the Township of Southgate and Grey County Official Plans, the GRCA and SVCA.

The objectives include the following:

- Document the natural features and functions of the site and adjacent lands and demonstrate that the proposed development will not create an unacceptable impact to the natural heritage features and areas identified within the Official Plans of the Township of Southgate and Grey County; and,
- Provide recommendations and mitigation measures to ensure the protection of adjacent natural features in the context of applicable legislation, including the Provincial Policy Statement (PPS, 2014), the City's Official Plan and Ontario Regulation 150/06 and 169/06 administered by the GRCA and SVCA respectively and associated policies.

2.0 PLANNING CONTEXT

Development on the site is subject to a number of federal, provincial and local environmental Acts, regulations and policies which provide direction and guidance regarding proposed changes in land use and the protection of natural heritage features and functions. The following instruments provide the applicable natural heritage regulatory framework that applies to the subject lands which include:

- Provincial Policy Statement (PPS, 2014);
- Grey County Official Plan;
- Township of Southgate Official Plan;
- Grand River Conservation Authority (GRCA) Ontario Regulation 150/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses;

- Saugeen Valley Conservation Authority (SVCA) Ontario Regulation 169/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses;
- Endangered Species Act (ESA, 2007); and,
- Migratory Birds Convention Act (MBCA, 1994).

Although the property straddles the jurisdictional boundary of two conservation authorities, GRCA will be the lead commenting and coordinating agency as agreed with SVCA.

3.0 METHODOLOGY

Existing conditions on the property were determined through a literature review and desktop analysis of secondary source material from the Ministry of Natural Resources and Forestry (MNRF) and the Natural Heritage Information Centre (NHIC) database combined with field investigations to assess and delineate the natural heritage features and functions within and adjacent to the study area. Additional information with respect to fisheries, wildlife and Species at Risk (SAR) were obtained through targeted surveys and field reconnaissance. This information was used to develop the description of the natural environment and to identify potential impacts related to proposed land use changes.

The following table (Table 1) provides a summary of site visits and field tasks completed. The wetland boundary was staked by SLR and GRCA on June 21, 2018.

Table 1. Summary of Field Investigations

Date	Task Description	Weather Conditions ₁
April 22, 2016	Identification of key natural heritage features	
June 16, 2016	Vegetation investigation (ELC)	Sunny/Beaufort:1-2/Temp: 25°C
June 23, 2016	Breeding Bird Survey #1	Sunny/Beaufort:1-2/Temp: 14°C Time 05:30-10:00
April 13, 2017	Amphibian Breeding Survey #1	Partly cloudy/Beaufort:0/Temp: 5°C Time 21:00-22:00
May 21, 2017	Amphibian Breeding Survey #2	Light rain/Beaufort:0/Temp: 14°C Time 21:30-22:50
June 7, 2017	Breeding Bird Survey #2	Sunny/Beaufort:0/Temp: 18°C Time 05:30-10:00
June 19, 2017	Site Reconnaissance	Sunny/Beaufort:2/Temp: 22°C
June 26, 2017	Breeding Bird Survey #3	Sunny/beaufort:0/Temp: 14°C Time 05:30-10:00
November 14, 2017	Site visit to establish preliminary wetland boundary	Sunny/Beaufort:2/Temp: 5°C
April 26, 2018	Mark wetland boundary in advance of site visit with GRCA/SVCA, Headwater Drainage Feature (HDF) evaluation	Sunny, Beaufort 1-2, Air temperature 5°C at 10:00
May 25, 2018	Confirm field conditions, HDF evaluation	Sunny, Beaufort 1-2, Air temperature 25°C at 16:00

Date	Task Description	Weather Conditions ¹
June 21, 2018	Wetland boundary staking with GRCA/SVCA	Sunny/Beaufort:0/Temp: 25°C
July 24, 2018	HDF evaluation	Sunny, Beaufort 1, Air temperature 24°C at 15:00
September 7, 2018	Assess potential effects of SWM pond discharge	Sunny, Beaufort 1-2, Air temperature 22°C
¹ The Beaufort Wind Scale is a tool used to estimate wind conditions. [0] Air calm, smoke rises vertically [1] Light air movement, smoke drifts, [2] Wind felt on face, leaves rustle [3] Leaves and small twigs in continual motion, wind extends light flags [4] Wind raises dust, loose paper, moves small branches [5] Small trees begin to sway, white crested wavelets form on inland waters [6] Large branches in motion		

3.1 Hydrogeology

Hydrogeological investigations are currently in progress. The objectives of the study include characterization of the geological setting and to determine the relationship of the groundwater interactions and maintenance of surface water features. A draft report will be provided under a separate cover.

3.2 Aquatic Habitat Assessment

The Natural Heritage Information Centre (NHIC) and the Fisheries and Oceans Canada Distribution Maps for Fish and Mussel Species at Risk were consulted for occurrences of federally (COSEWIC) and provincially (COSSARO) designated aquatic Species at Risk and Provincially Rare Species (S1-S3) within the subject lands. GRCA was contacted to obtain fish and fish habitat information for headwater drainage feature on the subject property.

The objective of field investigations was to identify, map, and describe the existing aquatic habitat and evaluate the Headwater Drainage Features (HDF). Observations were made by walking the entire on-site length of the HDF. The on-site HDF was evaluated using the Rapid Method provided in the Evaluation, Classification and Management of Headwater Drainage Features Guideline (TRCA and CVC, 2014). This approach is appropriate for low sensitivity sites and documents the HDF form and flow conditions, riparian vegetation and site features that are important components of habitat.

3.3 Vegetation

Aerial photography, soils mapping, contour mapping and Land Information Ontario data were used to delineate vegetation communities according to principles of the Ecological Land Classification (ELC) for Southern Ontario: First Approximation and its Application (Lee et. al., 1998). Site investigations were undertaken in April, June and November to inventory plant species, refine the ecological classification, and obtain soil samples. The wetland boundary was staked by SLR and GRCA on June 21, 2018 and surveyed. The classification was completed to the most detailed level in the hierarchy to reflect the differences within the vegetation communities that relate to species composition, architecture and ecosystem function.

3.4 Wildlife and Wildlife Habitat

Evidence of wildlife presence was determined from direct sightings, and indirectly from such indicators as calls, nests, tracks, scat, browse and burrows during all field investigations.

To better refine habitat communities for wildlife surveys the property was divided into units following the ecological land classification. Wildlife activity roughly follows differences in vegetation height and structure, and proximity of water resources, therefore the units reflect these characteristics. Unit 1 is the swamp thicket. Unit 2 is the treed deciduous swamp surrounding the thicket to the southwest and north and the woodland in the south west corner of the property. Agricultural and residential lands that comprise the majority of the property were included in Unit 3.

3.4.1 Breeding Bird Surveys

Breeding bird surveys were undertaken within the recognized surveying window in Ontario for breeding birds (typically June and early July). Surveys followed standard methodologies and conditions established by the Ontario Breeding Bird Atlas (OBBA) (i.e. between 05:30 and 10:00, low winds, no precipitation and suitable temperatures). Breeding evidence was recorded for each wildlife unit and evaluated as possible, probably or confirmed (e.g. singing male, pair observed or adult carrying food) in accordance with the standard protocols. Given the land use, the transect method suggested by MNR for evaluating habitat use by Bobolink and Eastern Meadowlark was not utilized. Instead, wandering transects within each Unit 1 and 2 and peripheral edge of Unit 3 (where grassland/ meadow occurred) were utilized. This allowed for optional listening and viewing while leaving potential nesting areas undisturbed. Where SAR birds were observed information including sex, behaviour and interaction with other SAR and non-SAR birds were recorded.

3.4.2 Amphibian Surveys

Amphibian surveys were undertaken to review the potential of the hazard lands and associated wetland features on the property and adjacent lands to support breeding amphibians. Three surveys were completed in April, May and early June following Marsh Monitoring Program standards. Surveys followed the basic principles that include: undertaking at least 15 days between each survey beginning one half hour after sunset, ending by midnight on evenings with little wind and minimum night air temperatures (5°C, 10°C, and 17°C). Survey times were coordinated with several other ecologists throughout Southern Ontario via an email circulation used to assist surveyors in targeting the prime breeding window for early and late breeders targeting Western Chorus Frog (*Pseudacris triseriata*). As climate change has the potential to shift the incidence of calling amphibians, it is increasingly important to coordinate surveys based on weather conditions and seasonal trends. Calling evidence was recorded on a scale of L0-L3 and interpreted as follows:

- L0 – No calling;
- L1 – Individuals can be accurately counted, calls do not overlap;
- L2 – Some calls simultaneous, number of individuals can be estimated; and,
- L3 – Full chorus, calls overlap, individuals cannot be estimated.

3.5 Species of Conservation Concern

For the purpose of this EIS, species that are designated federally, provincially and which are of regional or local interest (e.g. rare to the watershed or municipality) are collectively identified as Species of Conservation Concern. Species protected under the *ESA, 2007* are also included in this category. A habitat based approach was applied to evaluate the potential for Species of Conservation Concern to occur within the property and adjacent lands in conjunction with the

desktop review and inquiry with the MNRF and NHIC database. The information obtained through this exercise was confirmed through site investigations and targeted surveys.

3.6 Significant Wildlife Habitat

The criteria provided in the MNRF Significant Wildlife Habitat Technical Guide (SWHTG) and updated Ecoregion Criterion Schedules 6E (MNRF, 2012) for significant wildlife habitat (SWH) were reviewed. Anthropogenic features do not qualify as SWH and therefore were not assessed. The potential for candidate SWH is limited given the context of the subject property (residential, agricultural lands)

4.0 EXISTING CONDITIONS

4.1 Geology, Hydrology and Soils

Dundalk Island, a topographic high in southern Ontario, is characterized by a drumlinized sandy silt till plain where peat-dominated wetlands occur in the areas between the drumlins (Chapman and Putnam, 1984). The property lies largely to the south of the drumlins, but fluting maintains the rolling aspect and mineral wetland occurs in the depression. The till is stone-poor, sandy silt to silty sand-textured till with glaciofluvial deposits underlying the wetlands (Surficial Geology of Southern Ontario, 2010). Soil samples reflect a “plough layer” created by agriculture over silty sands.

The property is crossed by the watershed divide between a tributary to the Grand River and the Saugeen River. The wetland on site is the headwater to both systems, shifting in response to the volume of rain that falls in the area. The Melancthon Wetland Complex #1 Provincially Significant Wetland occurs downstream to the southeast, while the Ventry or Riverview Locally Significant Wetlands occur in the Saugeen watershed to the southeast.

The groundwater table is high (0.8 to 1.5m below surface) (Sirati & Partners Consultants Ltd., 2017). The agricultural lands have been tile drained and discharge at the edge of the meadow marsh in the north-central part of the property.

4.2 Aquatic Environment

A constructed channelized drain was found within a meadow marsh deciduous swamp identified in the study area west of the proposed development (Figure 1). Flow conditions were observed early and late spring and mid-summer in conjunction with other visits such as wetland staking and vegetation surveys to record hydrological conditions during wet and dry seasons (Table 2).

Table 2: Channel Conditions through Meadow Marsh and Deciduous Swamp

Date of Observation	Observations	Representative Photos
April 26, 2018	• Water gently flowing to northwest through deciduous swamp • Standing water in meadow marsh (photo)	
May 25, 2018	• Standing water in channel through swamp; no discernible flow	
July 24, 2018	• Standing water only in deeper sections of channel extending through meadow marsh and swamp	

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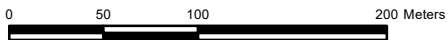


LEGEND

- Property Boundary
- Tile Drain Outlet
- Drain
- Staked Dripline (Schaeffer Dzaldov Bennett Ltd., Staked June 25, 2018)
- Wetland and Dripline Buffer (10m)
- Grasshopper Sparrow (CUM)(2017)
- CUM1-1 Put Into Agricultural Production in 2018

Ecological Land Classification

Red-osier Dogwood Mineral Swamp Thicket	SWT2-5
Reed-canary Grass Mineral Meadow Marsh	MAM2-2
Poplar Mineral Deciduous Swamp	SWD4-3
Fresh-Moist White Cedar Coniferous Forest	FOC4-1
Fresh-Moist Sugar Maple – lowland Ash Deciduous Forest	FOD6-1
Fresh Mineral Cultural Meadow	CUM1-1
Agricultural Lands	AGR
Residential Campus	RES



SCALE: 1:4,000
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 17N

NOTES

This map is for conceptual purposes only and should not be used for navigational purposes.

Basedata: Digiglobe, (Oct 22, 2014)

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EXISTING CONDITIONS

September 26, 2018	Rev	0.0	Figure No.
Project No.	209.40385.00000		1



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

No GRCA or MNRF fish collection records were found for the site. A review of fisheries distribution maps (Fisheries and Oceans Canada) and screening of provincial sources (MNRF, SARO List, NHIC) did not identify fish and mussel Species at Risk in the study area. This is consistent with observations on the property.

According to the headwater drainage feature evaluation (TRCA and CVC 2014), the feature is considered to support important hydrologic function because it contains standing water in a wetland environment in mid-summer. Fish habitat is classified as contributing function limited to providing allochthonous transport to downstream habitat owing to intermittent flow.

4.3 Vegetation

The vegetation communities are mapped on a 2014 aerial photo. At the time of field studies in the spring and summer of 2017, the residential house fronting on to Glenelg Street was the remaining structure on site. The vegetation mapping reflects the conditions as of the summer of 2017.

The northeast side of the property is agricultural consisting of cultural meadow and active agriculture. The natural areas occur on the southwestern portion of the property consisting of wetlands and small patches of remnant forests near the residence to the west of the property. The vegetation communities that occur on the subject lands include:

1. Red-osier Dogwood Mineral Swamp Thicket (SWT2-5)
2. Reed-canary Grass Mineral Meadow Marsh (MAM2-2)
3. Poplar Mineral Deciduous Swamp (SWD4-3)
4. Fresh-Moist White Cedar Coniferous Forest (FOC4-1)
5. Fresh-Moist Sugar Maple – lowland Ash Deciduous Forest (FOD6-1)
6. Fresh Mineral Cultural Meadow (CUM1-1)
7. Agricultural Lands

Vegetation communities and their respective locations within the subject property are provided on Figure 1. An inventory of plants observed during field investigations was also completed and is provided in Appendix A.

The following describes the vegetation communities observed on the subject lands.

4.3.1 Red-osier Dogwood Mineral Swamp Thicket (SWT2-5)

The shrub dominated community occurs west of the agricultural lands on the southern half of the property and may have been cleared for farming in the past. In dry years this area could have been ploughed as evidenced by the presence of cool season forage grasses such as Timothy (*Phleum pratense*) and Kentucky Fescue (*Lolium arundinaceum*). If that is true, the attempt was abandoned in subsequent wet years and the area is now dominated by Red-osier Dogwood (*Cornus sericea*) in association with Pussy Willow (*Salix discolor*), Shining Willow (*Salix lucida*) and Bebb's Willow (*Salix bebbiana*). Balsam Poplar (*Populus balsamifera*) occurs occasionally. The understory includes Reed-canary Grass (*Phalaris arundinacea*), Fox Sedge (*Carex vulpinoidea*) and Fowl Bluegrass (*Poa palustris*).

Balsam Groundsel (*Packera paupercula*) was observed in an opening in the thicket found in moist areas including fens. The soil in this area is not marly nor is it peat as one could expect

from a condition of groundwater discharge. It represents a borderline condition where groundwater table rises and falls maintaining moist to wet conditions that are difficult to drain.

4.3.2 Reed-canary Grass Mineral Meadow Marsh (MAM2-2)

This community occurs in a narrow band adjacent to the channelized drain and expanding to the northwest corner of the property. The outlet of the tile drain is located in the extreme north end of this community. It is dominated by Reed-canary Grass with several species of sedge (*Carex retrosa*, *C. vulpinoidea*, *C. gracillima*, *C. lacustris*, *C. flava*), Broad-leaved Water Plantain (*Alisma subcordatum*) and Narrow-leaved Cattail (*Typha angustifolia*). Species that intermix include Purple-stemmed Aster (*Symphotrichum puniceus*) and Marsh Bedstraw (*Galium palustris*). Occasional trees and shrubs occur throughout.

Of note is the occurrence of Yellow Sedge (*Carex flava*) that similar to the Balsam Groundsel, is a species that may be indicative of near fen-like conditions.

4.3.3 Poplar Mineral Deciduous Swamp (SWD4-3) modified by Black Ash and Cedar

This treed unit occurs on the west side of the property, surrounding the thicket swamp and interspersed by the meadow marsh. Although dominated by Balsam Poplar, there are elements that include Black Ash (*Fraxinus nigra*) and Swamp Maple (*Acer xfreemanii*) that speaks to past disturbance. Eastern White Cedar (*Thuja occidentalis*) occurs sporadically, and White Spruce (*Picea glauca*) occupy slightly drier knolls. The shrub layer includes Red-osier Dogwood and Alderleaf Buckthorn (*Entropis alnifolia*), the latter being another element of these near-fen conditions. Ground flora includes Dwarf Raspberry (*Rubus pubescens*), Fowl Bluegrass and Broad-leaved Water-plantain.

4.3.4 Fresh-Moist White Cedar Coniferous Forest (FOC4-1)

This is a small unit at the interface of the deciduous forest and the thicket and treed deciduous swamp to the north. The canopy of this community is closed and dense eliminating light, and therefore the ground flora is absent. It is dominated by Eastern White Cedar with occasionally occurring Sugar Maple (*Acer saccharum*) and Trembling Aspen (*Populus tremuloides*).

4.3.5 Fresh-Moist Sugar Maple – Lowland Ash Deciduous Forest (FOD6-1)

Sugar Maple dominates the canopy with frequent occurrences of White Ash (*Fraxinus americana*) and Trembling Aspen. The understory is sparse and largely Chokecherry (*Prunus virginiana*). The ground flora is patchy and includes Graceful Sedge, Virginia Strawberry (*Fragaria virginiana*) and False Solomon's Seal (*Maianthemum racemosum*).

4.3.6 Fresh Mineral Cultural Meadow (CUM1-1)

Areas of pasture occurred within the former horse-ring and on the north eastern and south-central parts of the property near the former residence. These cultural meadows are populated with largely non-native species and reflect their use as grazing for farm animals and landscape features. Grass is the dominant vegetation and includes Timothy Grass (*Phleum pratense*), Smooth Brome (*Bromus inermis*), Orchard Grass (*Dactylis glomerata*), Kentucky Fescue (*Lolium arundinaceum*), Tall Buttercup (*Ranunculus repens*), Bird's-foot Trefoil (*Lotus corniculatus*) and Oxeye Daisy (*Leucanthemum vulgare*).

4.3.7 Agricultural Lands

The north east portion of the site consists of a field of rotating annual row crops such as wheat and soybean. In 2018 cultivation was expanded to include the cultural meadows by the tenant farmer.

4.3.8 Residential Campus

The two-storey dwelling, associated gardens, landscape plantings and mowed lawn remains occupied on Glenelg Street.

4.3.9 Floristics

All of the species documented on the property are common and secure in Ontario. Approximately 27% of the inventory is non-native (30% is average for southern Ontario) although this number approaches 90% if the cultural meadows are evaluated separately. The relatively low incidence of non-native species in the wetlands speaks to relatively stable conditions in spite of historical disturbance.

Of note is the small number of species (Balsam Groundsel, Yellow Sedge, Alderleaf Buckthorn) that indicate that the site tends toward a fen, although no strong fen indicators were observed. This is an effect of the rise and fall of the shallow groundwater table.

4.4 Wildlife

Formal surveys were undertaken for birds and amphibians during the time at one of their most vulnerable life cycle stages: breeding. It is at this time that they are anchored to breeding activity (nests, breeding ponds) that they migrate from when breeding is complete. These species inform the functions of landscape feature in terms of diversity, species richness and the importance of the underlying vegetation and water resources that support wildlife habitat. The wildlife units that were sampled, together with stations for amphibian calling counts are illustrated on Figure 3.

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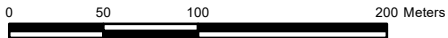


LEGEND

- Property Boundary
- Amphibian Survey Stations (2017)
- Tile Drain Outlet
- Drain
- Staked Dripline (Schaeffer Dzaldov Bennett Ltd., Staked June 25, 2018)
- Wetland and Dripline Buffer (10m)
- Grasshopper Sparrow (CUM)(2017)
- Wildlife Units (Breeding Birds)(2017)
- CUM1-1 Put Into Agricultural Production in 2018

Ecological Land Classification

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WILDLIFE SURVEY LOCATIONS

September 26, 2018	Rev	0.0	Figure No.
Project No.	209.40385.00000		2



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.4.1 Breeding Birds (General)

The breeding bird survey in the spring of 2016 and 2017 documented 42 species (Appendix B) on the subject property. Of these, evidence of breeding on the property was recorded for 33 species. The remaining were species with wide ranges that were observed flying over for which there is no breeding habitat (e.g., Herring Gull), or that were not in appropriate habitat (e.g., Northern Harrier).

They represent distinct groupings associated with the available habitat.

The majority of the species recorded are urban tolerant and typical of cultural and agricultural landscapes (e.g. American Goldfinch, American Robin). These species are tolerant to disturbances within the landscape and able to adapt to changing environments.

Woodland species such as Hairy Woodpecker, Pileated Woodpecker, Northern Flicker and Red-eyed Vireo were documented in the woodland. It speaks to the small size of the woodland that no other wood warblers were observed.

Species such as Savannah Sparrow, Grasshopper Sparrow and Bobolink and Eastern Meadowlark are characteristic of open grasslands and were associated with the cultural meadows on and surrounding the subject property.

Field Sparrow, despite its name, favours edges and thickets, together with Indigo Bunting, Gray Catbird and Song Sparrow, both at upland and wetland sites. The cross-over to wetland conditions is indicated by the presence of Alder Flycatcher, Yellow Warbler and Common Yellowthroat.

4.4.2 Amphibian Breeding Habitat

Amphibian breeding habitat is limited to the western portion of the property consistent with the wetlands. Four locations were surveyed at the edges of the thicket swamp and treed swamp, and also at the meadow marsh south of Glenelg (Figure 2).

- 1A: Pond inside horse-ring;
- 1B: Glenelg Street at southeast wetland;
- 2: Glenelg Street at woodland;
- 3: Glenelg Street at treed swamp;
- 4A: Ida Street in northwest corner; and,
- 4B at interface with cultivated lands.

Results for points 4A and 4B were combined as the calling was evenly distributed throughout the north end of the wetland.

The woodland adjacent to the house to the west of the property had been mapped in Land Information Ontario as a cartographic wetland. No amphibians were calling on either survey and the vegetation is all upland therefore the area has been classified as a forest.

Surveys at a small pond inside the historical horse-ring were negative: no frogs or turtles were recorded.

The lack of permanent standing water is evident in that no Green Frogs (*Lithobates clamitans*) were recorded. Breeding habitat appears to be limited to species that require ephemeral wetlands.

The most concentrated populations are associated with the treed deciduous swamp that extends south to Glenelg to the west of the property, and in the northern meadow marsh. The occurrence of Western Chorus Frog was limited to this corner at Ida Street. Spring Peepers were heard incidentally during the day in a pool in approximately the middle of the property (see photographs), but no Western Chorus Frogs were calling. As this species can be censused during the day due to its inclination to call in greater numbers diurnally, it is with confidence that we locate the important breeding site for Western Chorus Frogs in the northwest.

Table 3: Amphibian Survey Results

Survey Dates	Station	Common Name	Scientific Name	Calling Level	Count
April 13, 2017 Weather: Partly cloudy Beaufort:0 Temp: 5°C Time 21:00-22:00	1B	Spring Peeper Wood Frog	<i>Pseudacris crucifer</i> <i>Lithobates sylvaticus</i>	L2 L1	9 5
	2	No calling; no water. This area had been mapped in background documents in error as wetland.			
	3	Spring Peeper Wood Frog	<i>Pseudacris crucifer</i> <i>Lithobates sylvaticus</i>	L3 L2	chorus 10
	4A and 4B	Spring Peeper Wood Frog Western Chorus Frog Northern Leopard Frog	<i>Pseudacris crucifer</i> <i>Lithobates sylvaticus</i> <i>Pseudacris triseriata</i> <i>Lithobates pipiens</i>	L3 L3 L2 L1	chorus chorus 15 1
May 21, 2017 Weather: Light rain Beaufort:0 Temp; 14°C Time 21:30-22:50	1B	Spring Peeper Wood Frog	<i>Pseudacris crucifer</i> <i>Lithobates sylvaticus</i>	L3 L1	chorus 2
	2	No calling - Dry			
	3	Spring Peeper Gray Treefrog American Toad	<i>Pseudacris crucifer</i> <i>Hyla versicolor</i> <i>Anaxyrus americanus</i>	L2 L3 L1	5 chorus 1
	4A and 4B	Spring Peeper Wood Frog Western Chorus Frog Northern Leopard Frog	<i>Pseudacris crucifer</i> <i>Lithobates sylvaticus</i> <i>Pseudacris triseriata</i> <i>Lithobates pipiens</i>	L2 L2 L2 L1	15 7 7 5

4.4.3 Miscellaneous Wildlife

4.4.3.1 Mammals

Evidence of White-tailed Deer (*Odocoileus virginianus*) (tracks, browse) was observed at many places on the subject property. A doe and fawn were observed on 23 June 2016 in the deciduous swamp.

Other mammal sitings include Eastern Chipmunk (*Tamias striatus*), Northern Raccoon (*Procyon lotor*) and Red Fox (*Vulpes vulpes*). A dead Wild Boar (*Sus scrofa*) was observed in the northwest corner of the thicket swamp. This is likely an escape from production in the neighbourhood, but as this species has the potential to naturalize and become a serious pest, it was worthy of mention.

A dead Eastern Gartersnake (*Thamnophis sirtalis*) was observed on Glenelg Road, and reported by the former owners to occur on site.

Digger Crayfish (*Fallicambarus fodiens*) chimneys were noted along the wetland boundary extending up to 5 metres into the agricultural fields.

4.4.4 Species of Conservation Interest and Significant Wildlife Habitat

The background screening identified potential species that could occur on and adjacent to the subject lands. The list in Table 3 was scoped to include species for which suitable habitat is present and excluded those for which no habitat opportunities occur on site or are historical in nature (i.e. greater than 40 years). The scoped review below includes a summary of relevance to the proposed application.

Table 4. Species of Conservation Concern Screening

Common Name	Scientific Name	Designation ⁴	Habitat Affinities Present Within or Adjacent to site
<i>Mammals</i>			
¹ Tri- Coloured Bat	<i>Perimyotis subflavus</i>	Endangered ESA regulated	Marginal – Mature trees present
¹ Little Brown	<i>Myotis lucifugus</i>	Endangered ESA regulated	Yes – Suitable trees and structures present
¹ Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Endangered ESA regulated	Low / None – Lacks forested habitats, only some mature trees are present
¹ Eastern Small-footed Bat	<i>Myotis leibii</i>	Endangered ESA regulated	No – Typically found in areas where rock structure occurs (e.g. escarpment, alvars, quarries)
<i>Avifauna</i>			
¹ Barn Swallow	<i>Hirundo rustica</i>	Threatened	Foraging habitat – observed in 2016 survey.
¹ Chimney Swift	<i>Chaetura pelagica</i>	Threatened	No – chimney is capped. None were observed during field investigations.
¹ Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	Special Concern	Yes - Hazard lands
^{1, 2} Eastern Meadowlark	<i>Sturnella magna</i>	Threatened	Yes - Suitable habitat on adjacent lands
^{1, 2} Bobolink	<i>Dolichonyx oryzivorus</i>	Threatened	Yes - Suitable habitat on adjacent lands
¹ Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Special Concern	Yes – observed on site
<i>Reptiles/Amphibians</i>			
¹ Western Chorus Frog	<i>Pseudacris triseriata</i>	Threatened	Yes - Hazard lands
<i>Vegetation</i>			
¹ Butternut	<i>Juglans cinerea</i>	Endangered ESA Regulated	Not observed during field investigations.
<i>Other</i>			
¹ Monarch	<i>Danaus plexippus</i>	Special Concern	Yes – milkweed observed on site

Source: (1) MNRF, SARO List, SLR expertise; (2) NHIC (2017)

Designation Status

Provincial Status - Species at Risk in Ontario list maintained by the Ontario Ministry of Natural Resources and Forestry, O.Reg. 230/08. Endangered Species Act Regulation OMNR S.O. 2007, Chapter 6. Schedules 1 thru 5.4. O. Reg. 242/08.

Regional or Local

Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC). S3 [Vulnerable] Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

Of the species identified above, the following are relevant to the site and proposed application:

- Bats (Little Brown Myotis, Northern Myotis, and Tri-coloured Bat);
- Butternut;
- Barn Swallow;
- Red-headed Woodpecker
- Bobolink, Eastern Meadowlark, Grasshopper Sparrow; and,
- Monarch Butterfly.

4.4.4.1 Bats

The swamp and wetland features provide opportunities for foraging and possible roosting for bats. Snag trees or trees with extensive leaf canopies may be used by bats (not just SAR). With Northern Myotis and Tri-coloured bats, woodlands are preferred as they provide the micro climates necessary for rearing young (proximity to water or ephemeral pools, swamps, understory structure providing feeding opportunity) while Little Myotis in Ontario has generally been restricted to anthropogenic structures.

The designation of Endangered is due to the presence of White Nose Syndrome with agencies concerned primarily for maternity roost sites (not individual day roosts). Within the property it is possible for trees and potentially the existing dwelling to be utilized by individuals as roosts. However, the woodland is not extensive and unlikely to contribute to roosting habitat for Northern Myotis or Tri-coloured bat. Their presence is expected to be associated with foraging. If suitable attic conditions are present within the house, it could be used by Little Brown Bats. However, the surrounding farms and the natural corridor likely provide more extensive habitat. Current direction from MNRF regarding SAR bats is evolving. On similar projects MNRF has requested that tree removal be avoided during periods of critical life stages. Typically, avoid tree removal from April to September when bats are most susceptible. No hibernation habitat is present on site. Any removal of building structures will require MNRF consultation and it is recommended that MNRF be consulted to confirm the avoidance window approach.

4.4.4.2 Butternut.

Suitable habitat for Butternut occurs in the hazard lands on the western portion of the site. No Butternut trees were observed on the subject lands or within 6 metres of the property during site investigations.

Survey Limitations

While every effort was used to detect the presence of Butternut on the property by visual examination, seedlings are difficult to detect due to visibility restrictions. Furthermore, seed dispersal (squirrels) may occur and seeds may remain dormant for prolonged periods. Thus

seedlings may occur in the future, especially if a parent tree occurs in the proximity to the subject property. To date there is no evidence of occurrence.

4.4.4.3 Barn Swallow

Barn Swallow were observed foraging over the pasture and agricultural lands. No nests were observed on the residential building. Nesting opportunities occur in the surrounding properties.

4.4.4.4 Red-headed Woodpecker

Mature trees and forest occur in the hazard lands that provide suitable habitat for the species including availability of cavities. This species was not recorded during 2016 and 2017 breeding bird surveys.

4.4.4.5 Bobolink, Eastern Meadowlark, Grasshopper Sparrow

Bobolink and Eastern Meadowlark, both Threatened species, were observed along the property boundaries and adjacent lands. The cultural meadow was heavily grazed by farm animals making the habitat not suitable for these species for nesting. Individuals observed are incidental and are utilizing the fence line as a perch for singing and the property as foraging opportunity and are likely breeding on adjacent lands.

Grasshopper Sparrows, Special Concern, were observed on the property utilizing the areas adjacent to the track. The habitat in this area provides suitable grass height and areas of bare ground. Evidence for nesting is confirmed as possible as these birds were observed in the appropriate habitat during the breeding season during all three surveys. However, this species is sensitive to habitat size, and on the property the fragment is approximately 0.2 ha. It is believed that this occurrence is a consequence of the grassland that extends to the northeast where larger areas persist with suitable vegetation.

4.4.4.6 Monarch

The host plant for Monarch, Common Milkweed (*Asclepias syriaca*), was observed sporadically on the site. One Monarch was observed in flight during the site investigations late in 2018, a year in which record numbers of Monarchs have emerged in Ontario. The potential for the site to be productive for Monarch was determined to be low due to the large area of cultivation and low numbers of Common Milkweed providing limited feeding opportunities for egg laying and forage for the caterpillar stage of the life cycle.

4.5 Significant Wildlife Habitat

Habitats as outlined within the SWHTG include *Seasonal Concentrations of Wildlife*, *Rare Vegetation Communities*, *Specialized Habitat for Wildlife [excludes Endangered and Threatened Species]*, and *Animal Movement Corridors*. Criteria for Ecoregion 6E provide more detailed descriptions. The following candidate SWH features on the site were identified: Amphibian Breeding Habitat (Wetlands), Open Country Bird Breeding Habitat (Grasshopper Sparrow and Savannah Sparrow), Terrestrial Crayfish and Special Concern Species Habitat (Grasshopper Sparrow, Eastern Wood-peewee).

4.5.1 Amphibian Breeding Habitat (Wetlands)

Amphibian surveys confirmed the presence of 3 species listed in the Significant Wildlife Habitat Guidelines by MNRF (2002). The threshold for designation is:

2 or more of the listed frog/toad species with at least 20 individuals (adults or eggs masses) or 2 or more of the listed frog/toad species with Call Level Codes of 3

The data indicate that the treed swamp (SWD4-3)/meadow marsh (MAM2-3) is borderline SWH since both Spring Peeper and Gray Treefrog were recorded as a full chorus, but not on the same evening. Due to fluctuations in populations, an additional year of monitoring would provide greater certainty if necessary.

4.5.2 Open Country Bird Breeding Habitat (Grasshopper Sparrow and Savannah Sparrow)

Breeding bird surveys confirmed the presence of 2 species listed in the Significant Wildlife Habitat Guidelines by MNRF (2002). The threshold for designation includes a minimum area of >30ha not including active farming. Suitable habitat is marginal for Grasshopper Sparrow and measures 2.6 ha, which is below the threshold. Therefore, SWH for these species is not identified on the subject lands. Special Concern Species Habitat (Grasshopper Sparrow, Eastern Wood-pewee)

Breeding bird surveys confirmed the presence of 2 species listed under the Endangered Species Act, 2007 whose habitat may qualify as SWH as per the Significant Wildlife Habitat Guidelines by MNRF (2002). They include the Grasshopper Sparrow discussed above, a grassland specialist, and Eastern Wood-pewee, a forest bird. The habitat for both of these species is small.

4.5.3 Terrestrial Crayfish

Site investigation confirmed the presence of Chimney or Digger Crayfish listed in the Significant Wildlife Habitat Guidelines by MNRF (2002). The chimneys were observed in lands currently under cultivation, and not in the ELC ecosites identified although “moist terrestrial sites” is mentioned. The SWH is limited to the area of meadow marsh or swamp, therefore the Poplar Mineral Deciduous Swamp (SWD4-3), Red-osier Dogwood Mineral Swamp Thicket (SWT2-5) and Reed-canary Grass Mineral Meadow Marsh (MAM2-2) constitutes candidate SWH, although no chimneys were observed due to the dense vegetation obscuring the chimneys.

4.6 Corridors and Wildlife Linkages

Although the wetlands on the property provide important wildlife functions, they are virtually isolated by development to the southeast and east, and by agriculture to the north and west. “Significant Woodland” abuts the southern boundary of the subject property on the south side of Glenelg Street as mapped in Appendix B of the Grey County Official Plan (OP). There is also a wetland associated with the woodland where calling amphibians were observed. The hazard lands mapped in the Southgate Township OP and County’s OP will be protected and the connection to the adjacent significant woodland and wetland maintained.

5.0 SIGNIFICANCE AND SENSITIVITY

5.1 Aquatic Environment

Although the aquatic environment provides low fish habitat function, the headwater drainage feature evaluation (TRCA and CVC 2014) recommends protection based on hydrological function associated with the channelized drainage feature that occurs within the meadow marsh and deciduous swamp along the west side of the study area.

The wetland along the south side of Glenelg Street immediately south of proposed development was examined. Robust vegetation and some dry preferential pathways for water flow were noted but no fish habitat was observed in the feature.

5.2 Significant Woodlands

The Grey County Official Plan designates the woodland south of Glenelg Street as significant based on its location within a settlement area, and its size. The woodland north of Glenelg is not designated as significant. As described, much of the “woodland” mapped on the property is Poplar Mineral Deciduous Swamp with small patches of coniferous and deciduous forest.

There are no species of the flora that are rare or uncommon according to the Natural Heritage Information Centre.

5.3 Wetlands

Three types of wetland comprise the large unit on the west side of the subject lands. The unit is identified in the Grey County Natural Heritage System Study (2017) but they have not been evaluated. The Melancthon Provincially Significant wetland occurs some distance to the southeast however the wetlands do not appear to discharge to the south, and are therefore hydrologically isolated from that complex. Identified wetland complexes to the west and south are not provincially significant. Therefore, the applicable policy framework consists of the two Official Plans and the two conservation authority regulations.

They are maintained by a combination of surface water contributions (precipitation, runoff from lands to the east) and a fluctuating groundwater table. The latter is weakly indicated by the presence of Balsam Groundsel, Yellow Sedge and Alderleaf Buckthorn together with the Digger Crayfish. It will be important to maintain groundwater recharge and to ensure that sufficient water collects to support the amphibian breeding pools.

Note that the terrain is relatively flat and the wetland water is slow to discharge. When it does, the direction is generally to the north where the water level remaining in the wetland will be controlled by the elevation of the outlet. These wetlands generally dry out in summer except for the area around the drainage ditch where the excavation may have intersected the water table. The water volume in spring is a result of the spring freshette, controlled by outlet and subject to variations in climate. Volumes in excess of the storage capacity of the wetland will decant. In other words, the excess water flows through the system, while the ephemeral breeding pools are maintained, and dry out through a combination of infiltration and evaporation. This mechanism makes the pools less sensitive to variation in water supply.

5.4 Wildlife

The community of birds, amphibians and mammals observed on the site are generally secure in Ontario and common in rural agricultural landscapes. Those that are designated as species of conservation concern are discussed in the following section.

5.5 SAR and SWH

Candidate SWH identified on site includes:

- The treed swamp (SWD4-3)/meadow marsh (MAM2-3);
- Special Concern Species Habitat (Grasshopper Sparrow, Eastern Wood-pewee); and,
- Terrestrial Crayfish.

The Reed-canary Grass Mineral Meadow Marsh and Poplar Mineral Deciduous Swamp are likely SWH for amphibian breeding, and together with the Reed-canary Grass Mineral Meadow Marsh likely provide habitat for Digger Crayfish as well. The habitat for the latter within the agricultural fields is excluded from designation, but will be protected within the 10m buffer to the wetland as a precautionary approach. Advice published in 2005 concluded that while “never locally common there are many occurrences of this species in southern Ontario” (Environment Canada 2005). To date neither the provincial nor federal government has listed the species beyond noting its sensitivity to development.

With respect to SAR Endangered and Threatened Species, although individuals were observed visiting the site, breeding was not confirmed except for Western Chorus Frog. This species is listed as Threatened both provincially and federally. Both the species and its habitat is protected under the Endangered Species Act, 2007. Any removal of habitat is subject to discussion with the Ministry of Environment, Conservation and Parks and a permit and commitment to creating an overall benefit to the species may be required.

5.6 Corridors and Wildlife Linkage

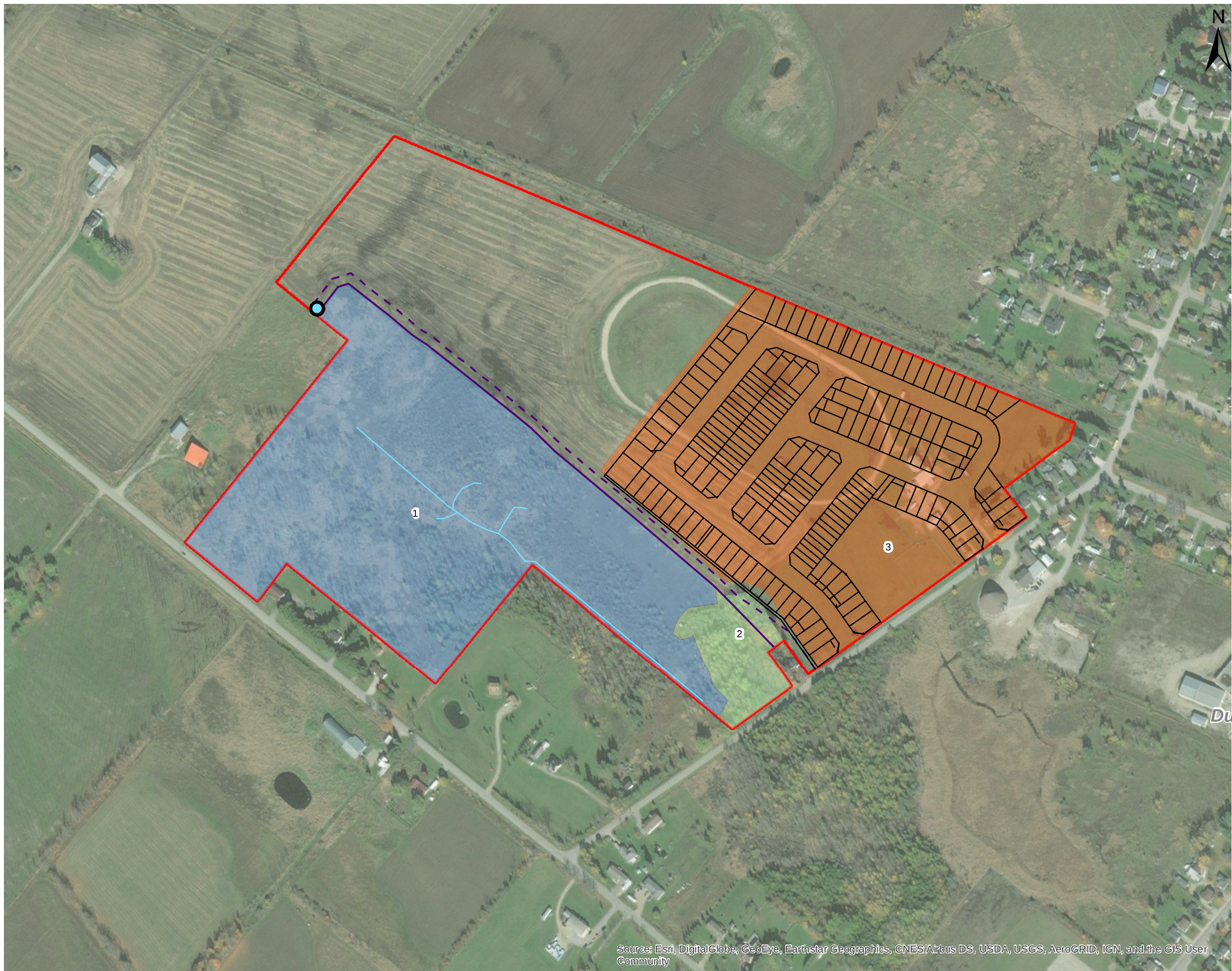
The linkage across Glenelg Street is the most important connection adjacent to the study area through the Fresh-Moist Sugar Maple – lowland Ash Deciduous Forest.

6.0 DESCRIPTION OF THE DEVELOPMENT

The overall property is 33.3 ha with 14.6 ha included in this draft plan. The development proposed for the subject property includes a Low Density Residential Plan consisting of 118 single detached lots and 65 townhouse units when fully built out. **Figure 3** illustrates the concept plan prepared by MHBC, showing the storm water management area, mix of housing units, walkways, open space, setbacks, park and other features. The Open Feature includes the forest, thicket swamp, portions of the meadow marsh and deciduous swamp and a channelized drain, protected from the proposed development.

Approximately 8.5 ha of the overall property drains south and the remaining 24.8 ha drains to the west. Surface water currently flowing from 4 ha of land to the wetland along the west side of the property will be diverted south via the storm water management system. Proposed stormwater discharge is to the wetland south of Glenelg Street with treatment to MOECC enhanced protection level.

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LEGEND

- Property Boundary
- Tile Drain Outlet
- Site Plan (MHBC, Mar 24, 2020)
- Drain
- Staked Dripline (Schaeffer Dzaldov Bennett Ltd., Staked June 25, 2018)
- Wetland and Dripline Buffer (10m)
- 1: Wetland
- 2: Woodland
- 3: Development Envelope

0 50 100 200 Meters

SCALE: 1:4,000
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 17N

NOTES

This map is for conceptual purposes only and should not be used for navigational purposes.

Basedata: Digiglobe, (Oct 22, 2014)

FLATO DEVELOPMENT INC.

GLENELG DEVELOPMENT

DRAFT PLAN OVERLAY

March 25, 2020	Rev 0.0	Figure No.
Project No.	209.40385.00000	3



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

7.0 IMPACT ASSESSMENT

The development has been located to protect most of the natural features (Figure 3). No wetlands will be removed, and the mid-wetland drain will remain intact. The primary potential source of impact to ecosystem functions is the anticipated change in the distribution of surface water and the potential for groundwater drawdown.

7.1 Aquatic Environment

Protection is provided to the intermittently flowing channelized drain within the meadow marsh and deciduous swamp by the buffer along the western limit of development, thus minimizing potential effects from the proposed development.

Post development peak storm water flows will be controlled to pre-development conditions, thus protecting channelized features. In addition, storm water management design of 80% removal efficiency for total suspended solids will provide enhanced protection (Crozier 2018, MOECP standard).

No fish habitat occurs in the wetland on the south side of Glenelg Street. The vegetation is dominated by Narrow-leaved Cattail (*Typha angustifolia*) and Reed-canary Grass (*Phalaris arundinacea*), both of which are robust and tolerant of urban discharge conditions. Absence of fish habitat and the nature of the vegetation make this wetland a good candidate receptor for stormwater discharge from the proposed development.

7.2 Vegetation

There will be no wetland removed as a result of the draft plan. The draft plan encroaches slightly into the edge of the woodland.

The soils are silty sands that permit some infiltration. Grades on the plan are anticipated to be 2%. On the basis that runoff will have an opportunity to infiltrate, and the low grade allows the water to remain in the backyards due to the low velocity of runoff, the buffer to the wetland required for water quality can be reduced to 10 m. The wildlife inventories did not record any sensitive species breeding close to the edge of the swamp, therefore there is not a requirement to provide wider buffers to protect wildlife function, especially as the draft plan anticipates that backyards will abut the buffer.

In order to maintain a straight edge to the draft plan, and in view of the disturbed edge of the woodland, half of which is a hedgerow beside the neighbouring house and driveway, the plan will likely remove a few trees, totalling 14 m². A 10 m buffer is proposed adjacent to the property line that will protect the trees on the neighbouring property.

In order to enhance the water quality improvement function of the buffer, they will be ecologically restored using a native meadow seed mix that will provide suitable water quality control. The buffers should be allowed to naturally revegetate.

It is expected that the hydrogeology report will demonstrate a minimal drawdown effect with respect to the groundwater table associated with the wetland. The Functional Servicing Report (Crozier 2018) anticipates that water that currently reaches the wetland through sheet flow will now be diverted through the subdivision to be discharged south of Glenelg Street.

The draft plan area, including wetland and woodland (future Open Space) totals 14.6 ha. The Open Space block, including buffers, totals 3.3 ha. Of the remaining approximately 11 ha, about 4 ha (~27%) of runoff will be redirected to the south. That is to say that about 7.5 ha will continue to discharge as per pre-construction conditions.

This diversion of water runoff could be important if it resulted in desiccation of the soils and a failure to maintain wetland conditions. However, most of the plants in the wetland are those that are tolerant of drier conditions and are called facultative wetland species. These are species that are routinely found in upland sites about 30% of the time. The wet conditions on the property are maintained by a combination of groundwater and surface water supply. The presence of the three near-fen plants and Digger Crayfish indicates that groundwater plays an important role and the surface water a lesser one in maintaining wetland conditions. The important function is the trapping of the spring freshette that creates suitable amphibian breeding habitat for several species of frogs and the toad including a Threatened species. This habitat will be maintained through a combination of relatively flat grades in the wetland and the invert of the outlet. Note that a drainage channel excavated in the middle of the wetland failed to drain it. The spring freshette will continue to fill the wetland, with excess decanting to the north as in the current condition.

As a precautionary measure, the runoff from the roofs and backyards adjacent to the wetland should be directed toward the wetland.

Stormwater from the proposed development will discharge to the wetland immediately south across Glenelg Street. The biodiversity in the wetland south of Glenelg Street is poor, an indicator of high nutrient levels. The dominant vegetation (a non-native cattail and Reed-canary Grass) is robust and common associated with stormwater discharge. This vegetation will provide enhanced protection in terms of water quality and quantity control if implemented as described in the Functional Servicing Report (Crozier 2018).

There will be no negative impact on the significant woodland south of Glenelg Street as a result of the proposed development.

7.3 Wildlife

Wildlife habitat occurs on the property in the form of residential/agricultural areas, grasslands, woodland and thicket. The latter two will be removed by the proposed development, however the species associated with residential and agricultural lands will return to the neighbourhood following construction. The grasslands are small and biodiversity is low in those areas, and they will be permanently removed. See the discussion below regarding the SAR recorded from that location.

All of the wetlands and most of the woodland will remain with the implementation of the Plan. The 10 m buffer to these features captures the chimneys produced by the Digger Crayfish, therefore it is expected that the population will not be affected. It is expected that the hydrogeology report will demonstrate a minimal drawdown effect with respect to the groundwater table associated with the wetland. The 10 m buffer will be naturalized and function to increase the size of these natural areas to the advantage of wildlife.

7.4 Species at Risk and Significant Wildlife Habitat

Western Chorus Frog is the only Threatened species breeding in the northern wetland. It's habitat will be maintained through mitigation that addresses infiltration of groundwater. The 10 m buffer will provide water quality improvements for runoff directed to the feature from the backyards.

The grasslands and agricultural verges provide foraging habitat for four listed species: Monarch (Endangered), Barn Swallow Bobolink, and Eastern Meadowlark (both Threatened). MNRF/MECP will be contacted with respect to appropriate compliance with the Endangered Species Act, 2007, if any. Similarly, the Ministry will be contacted to confirm that timing windows can be used to mitigate the presence of *Myotis* sp. using any trees removed and the residence.

Two species of Special Concern are considered to be breeding on the property: Grasshopper Sparrow and Eastern Wood-pewee. This habitat is also considered to be Significant Wildlife Habitat in the context of the PPS.

The habitat for the Grasshopper Sparrow is very small, and the occurrence is likely an artefact of the surrounding grasslands. Within a settlement area, this species will not persist. Suitable habitat will be provided in the buffers, however in aerial extent they will be too small to support the species. It is expected that the population will be maintained in the pastures in the surrounding countryside, outside the designated settlement area.

Habitat for the Eastern Wood-pewee is limited to the forest and treed swamp. These areas will be enhanced through the application of buffers. The species is expected to remain on site.

7.5 Summary of Impact Analysis

Table 5 provides a synopsis of the key features and/or functions that occur on the site together with the potential impact that could be created by the proposed draft plan, and the recommended mitigation.

Table 5. Summary of Impacts and Recommended Mitigation

Feature/Function	Sensitivity	Mitigation
Wetland	Desiccation through groundwater drawdown and diversion of surface water runoff; Changes in water quality discharged to the wetland	The hydrogeology report will provide mitigation to prevent a drawdown associated with the installation of services, or a blockage of groundwater flow to the wetland. No further mitigation is required. Surface water will be diverted away from the wetland (~27%), however the critical amphibian breeding functions will still occur since they are maintained by spring freshette that is retained

Feature/Function	Sensitivity	Mitigation
		behind the invert of the outlet. Water quality impairment is not an issue since all water originating on the subdivision will be directed south of Glenelg St. The area of the woodland (forest) and wetland will be enhanced through the addition of 10 m buffers that will be planted in native meadow and allowed to naturalize.
Wildlife Habitat	Habitat removal consisting of agricultural fields and pasture.	Wildlife habitat will be maintained in the Open Space block that has been enlarged through the application of buffers. An array of urban tolerant wildlife will continue to occur on the property.
Species of Conservation Concern - Special Concern Species Habitat - Grasshopper Sparrow - Eastern Wood-pewee - Western Chorus Frog	Habitat removal consisting of agricultural fields and pasture.	The habitat for the Grasshopper Sparrow will persist in the surrounding countryside; habitat within the draft plan is too small to support the species. Wetland and forest will be enhanced through the application of buffers. Western Chorus Frog habitat will be maintained through mitigation that maintains the wetlands.
Species of Conservation Concern SAR Bats	Removal of roosting opportunities	Timing of tree and residence removal to avoid the window of active bat roosting, typically from April to September.

8.0 POLICY CONFORMITY

The following section describes policies relevant to the natural environment and describes how the natural heritage features identified within this EIS have been addressed. Policy conformity is summarized in **Table 6**.

Table 6. Summary of Policy Conformity

Policy	Conformity	Rationale
Provincial Policy Statement	In compliance	• No PSW or ANSI identified on subject property or adjacent land • No woodlands occur within the subject property site that would qualify as candidate features for evaluation • Fish habitat contributes allochthonous transport to downstream habitat • Sensitive features associated with the wetlands and the woodland will remain on the landscape • The 10 m buffer to the features captures the chimneys produced by the Digger Crayfish • We anticipate the hydrogeology report will demonstrate a minimal drawdown effect with respect to the groundwater table associated with the wetland • Habitat for threatened species identified on the subject property will be protected
Grey County Official Plan	In compliance	• Proposed development located in primary settlement area, Schedule A, Map 2 • Approximately 14 m² of the woodland to the west will be removed, however this woodland is not considered significant (Map 3, Grey County Natural Heritage System) • Proposed development will be set back 10 m from the woodland on the adjacent land
Township of Southgate Official Plan	Not applicable	• The plan shows no significant natural environment features on or adjacent to the proposed development • Proposed development will be set back 10 m from the wetland; there will be minimal encroachment into the woodland and application of 10 m from the woodland on the adjacent land
Ontario Regulation 150/06 (GRCA) and 169/06 (SVCA)	In compliance	• Proposed development set back 10m from wetland identified along west side of subject property • No interference with the wetland is anticipated • Outlet of stormwater south of Glenelg Street will comply with MOE/MECP requirements

Policy	Conformity	Rationale
Endangered Species Act (ESA, 2007)	In compliance with MNRF/MECP follow-up	Foraging and natural roosting habitat for bats will be maintained within the wetland and the woodland. Breeding habitat and summer refuge for Western Chorus Frog will be maintained in the wetland. Foraging habitat for Bobolink, Eastern Meadowlark and Grasshopper Sparrow will be affected by the development. Consultation with MNRF regarding the potential for bat roosting in the residence and further discussion of the effects to foraging habitat for SAR birds will occur consistent with MNRF/MECP protocol.
Migratory Birds Convention Act (MBCA, 1994)	Compliance anticipated	Vegetation clearing will not occur within the breeding bird period provided under Environment Canada guidance for periods of highest nesting probability (i.e. cannot occur generally between April 1st and August 31st).

9.0 CONCLUSIONS AND RECOMMENDATIONS

The subject lands are located within lands currently in agricultural land use. The proposal does not anticipate creation of impacts to fish or fish habitat and provisions have been made for the management of the terrestrial linkage associated with the wetlands and woodland to minimize the impacts on connectivity and corridor function.

We recommend that best management practices be in place with respect to sediment and erosion control, vegetation clearing and construction timing windows and stabilization of disturbed soils. The analysis of the natural heritage features and functions associated with proposed draft plan indicate that the proposed community within the Southgate Official Plan can proceed within the context of provincial and regional policies to protect essential natural heritage function and species at risk within the landscape in the long term. Thus the draft plan is supportable from a natural heritage system perspective.

9.1 Recommendations

The following operational constraints and mitigation strategies are recommended for use during the construction phase of this project for the protection of natural heritage features and functions on and adjacent to the subject lands:

- Recommendations as outlined in the accompanying application documents (i.e. Geotechnical Investigation reports and or Hydrogeology reports are to be respected);
- Permanent post and rail wire or chain-link fence is recommended along the limits of proposed buffers. This fencing should be sturdy beyond the typical rebar and sediment fabric fence. Prior to the commencement of construction, the limits of protection areas (buffers) are to be delineated and fenced to avoid inadvertent intrusion of machinery or other activities such as stockpiling of materials. Temporary sediment control fencing can be attached to the fencing and must be maintained and remain in place until final grading and landscaping has been completed.
- Grading limits are to respect minimum root protection zones for trees along the woodland and where present along the wetland edge. Minimum protection of the root zone is measured the base of the tree to the tree's dripline. Earthworks/ grading, stockpiling of material etc. is to be directed away from protection areas. Final site grading and design is to ensure these areas are not encroached upon unless approved by the Township and GRCA where minor grading intrusions may be necessary (e.g. to match grades),
- Vegetation removals associated with construction related activities are to be minimized. Additional tree hording/ fencing may be required in consultation with the GRCA to prevent intrusion and stockpiling of materials into adjacent forests and swamps.
- Stockpiling of materials should be kept away from adjacent natural features; no fill should be placed in and around the wetland communities;
- Exposed soils should be re-vegetated as soon as possible with native seed mixes to reduce erosion. If stabilization is not possible by plantings, then other appropriate erosion controls (e.g. coir mats) should be applied in the interim;
- It is the responsibility of the proponent to ensure that the works are in conformity with the Migratory Bird Convention Act and Endangered Species Act, 2007 in that no migratory

bird(s) or SAR species will be harassed, harmed, killed or nests / habitats destroyed by the proposed work. The recommended avoidance window (where vegetation removal should be avoided) is from April 1 to August 31st. No avoidance window absolves the proponent or their contractors from contriving the MBCA or ESA. If a nest, egg, fledging or SAR species is encountered work must stop and the appropriate agency (e.g. Environment Canada and Climate Change) be consulted for advice.

- Restoration of the buffer is proposed. This is to be seeded with native species meadow mix (suitable for this growing region and soils). Native Milkweed (*Asclepias* sp.) should be incorporated into any buffer planting seed mix and where possible other natural areas on the property. The area is to be maintained as a maintenance free area for pollinators and edge bird species using GRCA/SVCA specification and guidelines;
- To protect wildlife in general, no animals are to be knowingly harmed. If wildlife is encountered during construction, work must stop and animals be allowed to disperse on their own. If necessary, the GRCA/SVCA or MNRF should be contacted for advice;
- Construction monitoring by an ecologist/arborist and certified inspector of sediment and erosion control (CISEC) is recommended as a part of a monitoring program to be developed with the GRCA/SVCA. This may include (but not limited to): photographic records, periodic SEC inspection reports and inspection of protected limits to ensure no encroachment and other mitigation measures are implemented.
- All outdoor lighting (including any new street lighting and external lighting on buildings) should be directed towards the ground and away from the natural areas.

In addition to these recommendations, the following requirements as provided through consultation with the Town, GRCA and MNRF pertain specifically to future land use planning, design and construction activities associated with the subject property:

- A permit from GRCA will be required as the subject property is regulated by Ontario Regulation 150/06;
- Prior to removing the house, consultation with MNRF under ESA, 2007 regarding bats must be completed.
- Compensation for the removal of foraging habitat for Bobolink, Eastern Meadowlark and Barn Swallow habitat will be determined through consultation with the MNRF in accordance with ESA policies;

Note: Species at Risk Information is accurate and up to date as of this report (September 2018). New species designation's under Ontario Regulation 230/08 (Species at Risk in Ontario List) occur periodically. It is the owner's responsibility to ensure that species and habitats regulated under *Endangered Species Act* (2007) or those described under other policies (i.e. the *Migratory Bird Convention Act*, *Fish and Wildlife Conservation Act*) are protected.

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11.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for 2358737 Ontario Inc., hereafter referred to as the "Client". The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. It is intended for the sole and exclusive use of Client. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion.

Information contained within this report may have been provided to SLR from third party sources. This information may not have been verified by a third party and/or updated since the date of issuance of the external report and cannot be warranted by SLR. SLR is entitled to rely on the accuracy and completeness of the information provided from third party sources and no obligation to update such information.

Nothing in this report is intended to constitute or provide a legal opinion. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to related environmental regulatory authorities or persons for review and comment purposes.

APPENDIX A
Botanical Inventory

2358737 Ontario Inc.
Glenelg Residential Subdivision
SLR Project No.: 209.40385

Common Name	Scientific Name	SRank ¹	SARA ²	SARO ³	MAM2-2	SWD4-3	SWT2-5	FOC4-1	FOD6-1	CUM1-1
Alderleaf Buckthorn	<i>Rhamnus alnifolia</i>	S5				x				
Alsike Clover	<i>Trifolium hybridum</i>	SNA								x
Alternate-leaf Dogwood	<i>Cornus alternifolia</i>	S5							x	
American Elm	<i>Ulmus americana</i>	S5				x				
American Larch	<i>Larix laricina</i>	S5				x		x		
Bald Spikerush	<i>Eleocharis erythropoda</i>	S5			x					
Balsam Groundsel	<i>Packera paupercula</i>	S5			x					
Balsam Poplar	<i>Populus balsamifera</i>	S5				x				
Bebb's Willow	<i>Salix bebbiana</i>	S5				x	x			
Bird's-foot Trefoil	<i>Lotus corniculatus</i>	SNA								x
Black Ash	<i>Fraxinus nigra</i>	S5				x				
Bracken Fern	<i>Pteridium aquilinum</i>	S5						x	x	
Broad-leaved Water-plantain	<i>Alisma subcordatum</i>	S5			x					
Choke Cherry	<i>Prunus virginiana</i>	S5							x	
Climbing Nightshade	<i>Solanum dulcamara</i>	SNA			x	x	x			
Colt's Foot	<i>Tussilago farfara</i>	SNA								x
Common Apple	<i>Malus pumila</i>	SNA							x	
Common Burdock	<i>Arctium minus</i>	SNA								x
Common Dandelion	<i>Taraxacum officinale</i>	SNA						x	x	x
Common Milkweed	<i>Asclepias syriaca</i>	S5								x
Crack Willow	<i>Salix euxina</i>	SNA							x	
Dwarf Raspberry	<i>Rubus pubescens</i>	S5				x				
European Mountain-ash	<i>Sorbus aucuparia</i>	SNA							x	
False Solomon's seal	<i>Maianthemum racemosum</i>	S5							x	
Field Horsetail	<i>Equisetum arvense</i>	S5			x	x	x			
Fowl Bluegrass	<i>Poa palustris</i>	S5			x					
Fowl Mannagrass	<i>Glyceria striata</i>	S5			x	x	x			
Fox sedge	<i>Carex vulpinoidea</i>	S5			x					
Fringed Loosestrife	<i>Lysimachia ciliata</i>	S5				x				
Graceful sedge	<i>Carex gracillima</i>	S5			x	x			x	
Grass-leaved Goldenrod	<i>Euthamia graminifolia</i>	S5			x					
Gray-stemmed Goldenrod	<i>Solidago nemoralis</i>	S5			x					x
Green Ash	<i>Fraxinus pennsylvanica</i>	S4				x	x			
Hawthorn species	<i>Crataegus species</i>	--							x	
Kentucky Bluegrass	<i>Poa pratensis</i>	S5								x
Kentucky Fescue	<i>Lolium arundinaceum</i>	SNA					x			x
Lake-bank sedge	<i>Carex lacustris</i>	S5			x	x				
Manitoba Maple	<i>Acer negundo</i>	S5				x	x	x	x	x

Common Name	Scientific Name	SRank ¹	SARA ²	SARO ³	MAM2-2	SWD4-3	SWT2-5	FOC4-1	FOD6-1	CUM1-1
Marsh Bedstraw	<i>Galium palustre</i>	S5			x		x			
Michaux's sedge	<i>Carex michauxiana</i>	S5?			x					
Narrow-leaved Cattail	<i>Typha angustifolia</i>	S5			x					
Narrow-leaved Meadow-sweet	<i>Spiraea alba</i>	S5			x		x			
Norway Spruce	<i>Picea abies</i>	SNA						x	x	
Old-field Cinquefoil	<i>Potentilla simplex</i>	S5								x
Orchard Grass	<i>Dactylis glomerata</i>	SNA								x
Oxeye Daisy	<i>Leucanthemum vulgare</i>	SNA								x
Panicled Aster	<i>Symphyotrichum lanceolatus</i>	S5			x		x			
Purple-stemmed Aster	<i>Symphyotrichum puniceus</i>	S5			x					
Pussy Willow	<i>Salix discolor</i>	S5					x			
Red-osier Dogwood	<i>Cornus sericea</i>	S5			x	x	x	x	x	
Reed Canary Grass	<i>Phalaris arundinacea</i>	S5			x	x	x			x
Retorse sedge	<i>Carex retrorsa</i>	S5			x					
Shining Willow	<i>Salix lucida</i>	S5				x	x			
Silver/Fremans Maple	<i>Acer x freemanii</i>	SNA				x				
Silverweed	<i>Potentilla anserina</i>	S5								x
Smooth Brome	<i>Bromus inermis</i>	SNA								x
Soft Rush	<i>Juncus effusus</i>	S5			x					
Soft-stemmed Bulrush	<i>Schoenoplectus tabernaemontani</i>	S5			x					
Spotted Jewelweed	<i>Impatiens capensis</i>	S5			x					
Spotted Joe-pye Weed	<i>Eupatorium maculatum</i>	S5			x		x			
Strict Blue-eyed-grass	<i>Sisyrinchium montanum</i>	S5								x
Sugar Maple	<i>Acer saccharum</i>	S5							x	
Tall Buttercup	<i>Ranunculus acris</i>	SNA								x
Tall Fescue	<i>Lolium arundinadium</i>	SNA								x
Tall Goldenrod	<i>Solidago altissima</i>	S5			x					x
Timothy	<i>Phleum pratense</i>	SNA			x		x			x
Trembling Aspen	<i>Populus tremuloides</i>	S5				x			x	
Virginia Strawberry	<i>Fragaria virginiana</i>	S5							x	x
White Ash	<i>Fraxinus americana</i>	S5							x	
White Cedar	<i>Thuja occidentalis</i>	S5				x		x		
White Spruce	<i>Picea glauca</i>	S5						x		
Wild Carrot	<i>Daucus carota</i>	SNA					x			x
Wild Mock-cucumber	<i>Echinocystis lobata</i>	S5								x
Woolgrass Bulrush	<i>Scirpus atrovirens</i>	S5			x		x			
Woolly Burdock	<i>Arctium tomentosum</i>	SNA								x
Yellow sedge	<i>Carex flava</i>	S5			x					

¹S-Ranks - Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario.

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

SX Apparently extirpated from Ontario, with little likelihood of rediscovery. Typically not seen in the province for many decades, despite searches at known historic sites.

SNA (Formally SE) Exotic; not believed to be a native component of Ontario's flora.

²SARA - Species at Risk Act (S.C. 2002, c. 29) Act current to 2018-08-19 and last amended on 2018-05-30.

³SARO - ONTARIO REGULATION 230/08 under the Endangered Species Act, 2007 species at risk in Ontario list. Act current to 2018-08-21. COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

EXT Extinct - A species that no longer exists.

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern (formerly vulnerable) - A species that may become a threatened or an endangered species because

of a combination of biological characteristics and identified threats.

NAR Not At Risk - A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

DD Data Deficient (formerly Indeterminate) - Available information is insufficient to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction.

APPENDIX B
Wildlife Observations

2358737 Ontario Inc.
Glenelg Residential Subdivision
SLR Project No.: 209.40385

Common Name	Scientific Name	SRank ¹	SARA ² COSEWIC Designation then Schedule	SARO ³	Highest Breeding Evidence Observed ⁴	SWT/SWD/MAM (Wildlife Unit 1)	Woodland (Wildlife Unit 2)	Agricultural Lands (Wildlife Unit 3)	Comments
Avifauna									
Alder Flycatcher	<i>Empidonax alnorum</i>	S5B,SZN			AE	x			Only observed in 2017 surveys
American Crow	<i>Corvus brachyrhynchos</i>	S5B,SZN			H	x	x	x	
American Goldfinch	<i>Carduelis tristis</i>	S5B,SZN			FY	x		x	
American Redstart	<i>Setophaga ruticilla</i>	S5B,SZN			S	x			Female observed during 2017 survey only
American Robin	<i>Turdus migratorius</i>	S5B,SZN			FY	x	x	x	Observed foraging in agricultural lands
Barn Swallow	<i>Hirundo rustica</i>	S5B,SZN	THR SCH 1 THR	THR	H			x	Observed foraging throughout property
Black-capped Chickadee	<i>Poecile atricapillus</i>	S5			A	x			
Blue Jay	<i>Cyanocitta cristata</i>	S5			S	x		x	
Bobolink	<i>Dolichonyx oryzivorus</i>	S4B,SZN	THR SCH 1 THR	THR	XX	x			Observed on adjacent lands northwest of the property limits singing on the fence post
Canada Goose	<i>Branta canadensis</i>	S5B,SZN			FY			x	Foraging and resting in agricultural lands
Chipping Sparrow	<i>Spizella passerina</i>	S5B,SZN			H			x	Only observed during 2016 surveys
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	S5B,SZN			H			x	Only observed during 2016 surveys
Common Grackle	<i>Quiscalus quiscula</i>	S5B,SZN			S	x		x	
Common Yellowthroat	<i>Geothlypis trichas</i>	S5B,SZN			DD	x			Only observed during 2017 surveys
Eastern Kingbird	<i>Tyrannus tyrannus</i>	S5B,SZN			H			x	Observed utilizing agricultral edges for foraging opportunities
Eastern Meadowlark	<i>Sturnella magna</i>	S5B,SZN	THR SCH 1 THR	THR	FY			x	Femal observed in small grassy area within property, and perched on post of horse ring. One male observed perched and calling from fench post in small area within property near north property line; other birds were heard calling from the northeast on adjacent lands.
Eastern Phoebe	<i>Sayornis phoebe</i>	S5B,SZN						x	
European Starling	<i>Sturnus vulgaris</i>	SE			P			x	
Field Sparrow	<i>Spizella pusilla</i>	S5B,SZN			H			x	Only observed in 2016 surveys
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	S4B,SZN	SC SCH 1 SCH	SC	H			x	
Gray Catbird	<i>Dumetella carolinensis</i>	S5B,SZN			H	x		x	
Great Egret	<i>Casmerodius albus</i>	S2B,SZN			X			x	Observed as a flyover
Hairy Woodpecker	<i>Dryobates villosus</i>	S5			S		x		
Herring Gull	<i>Larus argentatus</i>	S5B,S5N			X			x	
House Wren	<i>Troglodytes aedon</i>	S5B,SZN			P	x		x	
Indigo Bunting	<i>Passerina cyanea</i>	S5B,SZN			T			x	Only observed during 2016 surveys
Killdeer	<i>Charadrius vociferus</i>	S5B,SZN			FY			x	
Mourning Dove	<i>Zenaida macroura</i>	S5B,SZN			FY	x		x	
Northern Cardinal	<i>Cardinalis cardinalis</i>	S5			S	x			Only observed during 2017 surveys

Common Name	Scientific Name	SRank ¹	SARA ² COSEWIC Designation then Schedule	SARO ³	Highest Breeding Evidence Observed ⁴	SWT/SWD/MAM (Wildlife Unit 1)	Woodland (Wildlife Unit 2)	Agricultural Lands (Wildlife Unit 3)	Comments
Northern Flicker	<i>Colaptes auratus</i>	S5B,SZN			S	x			
Northern Harrier	<i>Circus hudsonius</i>	S4B			H			x	
Pileated Woodpecker	<i>Dryocopus pileatus</i>	S4S5			H	x			Observed foraging in larger trees in hazard lands
Red-eyed Vireo	<i>Vireo olivaceus</i>	S5B,SZN			H		x	x	Only observed during 2017 surveys
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	S5B,SZN			P	x		x	
Ring-billed Gull	<i>Larus delawarensis</i>	S5B,SZN			XX			x	Observed in agricultural lands and flying overhead
Rock Dove	<i>Columba livia</i>	SE			H			x	
Savannah Sparrow	<i>Passerculus sandwichensis</i>	S5B,SZN			S	x		x	
Song Sparrow	<i>Melospiza melodia</i>	S5B,SZN			FY	x		x	
Swamp Sparrow	<i>Melospiza georgiana</i>	S5B,SZN				x			
Turkey Vulture	<i>Cathartes aura</i>	S5B			X			x	
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	S5B			S		x		
Yellow Warbler	<i>Dendroica petechia</i>	S5B,SZN			S	x			Only observed during 2017 surveys
Wild Turkey	<i>Meleagris gallopavo</i>	S5			X			x	
Amphians / Reptiles									
American Toad	<i>Anaxyrus americanus</i>	S5				x		x	
Western Chorus Frog	<i>Pseudacris maculata</i>	S3	THR SCH 1 THR			x			
Gray Treefrog	<i>Dryophytes versicolor</i>	S5				x			
Northern Leopard Frog	<i>Lithobates pipiens</i>	S5				x			
Snapping Turtle	<i>Chelydra serpentina</i>	S3	SC SCH 1 SC	SC		x			
Spring Peeper	<i>Pseudacris crucifer</i>	S5				x		x	Small wetland pocket at Glenelg Street on south side (Wildlife Unit 3); Spread throughout the unit (Wildlife Unit 1)
Wood Frog	<i>Lithobates sylvaticus</i>	S5				x		x	Small wetland pocket at Glenelg Street on south side (Wildlife Unit 3); Spread throughout the unit (Wildlife Unit 1)
Mammals / Other									
Chimney Crayfish	<i>Cambarus diogenes</i>	S4				x			Several Chimneys within the edge of fields
Eastern Chipmunk	<i>Tamias striatus</i>	S5				x	x	x	
Monarch	<i>Danaus plexippus</i>	S2N,S4B	END SCH 1 SC	SC		x		x	
Raccoon	<i>Procyon lotor</i>	S5				x	x	x	
Red Fox	<i>Vulpes vulpes</i>					x	x	x	
Two-spotted Bumble Bee	<i>Bombus bimaculatus</i>	S5				x		x	
White-tailed Deer	<i>Odocoileus virginianus</i>	S5				x	x	x	

Common Name	Scientific Name	SRank ¹	SARA ² COSEWIC Designation then Schedule	SARO ³	Highest Breeding Evidence Observed ⁴	SWT/SWD/MAM (Wildlife Unit 1)	Woodland (Wildlife Unit 2)	Agricultural Lands (Wildlife Unit 3)	Comments
Wild Boar	<i>Sus scrofa</i>	NA	NA	NA		x			Carcass

¹**S-Ranks** - Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario.

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

SX Apparently extirpated from Ontario, with little likelihood of rediscovery. Typically not seen in the province for many decades, despite searches at known historic sites.

SNA (Formally SE) Exotic; not believed to be a native component of Ontario's flora.

²**SARA** - Species at Risk Act (S.C. 2002, c. 29) Act current to 2018-07-05 and last amended on 2018-05-30.

³**SARO** - ONTARIO REGULATION 230/08 under the Endangered Species Act, 2007 species at risk in Ontario list. Act current to 2018-08-01. COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

EXT Extinct - A species that no longer exists.

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern (formerly vulnerable) - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

NAR Not At Risk - A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

DD Data Deficient (formerly Indeterminate) - Available information is insufficient to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction.

* - Species on Schedule 1 of Species At Risk Act (SARA)

⁴**Highest Breeding Evidence Ontario Breeding Bird Atlas: Breeding Evidence Codes**

X - Present **XX** - Heard but not expected to be breeding (e.g. using habitat - foraging)

POSSIBLE

H - *Species observed in its breeding season in suitable nesting habitat.*

S - *Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season.*

PROBABLE

P - Pair observed in suitable nesting habitat in nesting season

T - Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two days, a week or more apart, at the same place

D - Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulations

V - Visiting probably nest site

A - Agitated behaviour or anxiety calls of an adult

B - Brood patch on adult female or cloacal protuberance on adult males

N - Nest building or excavation of nest hole

CONFIRMED

DD - Distraction display or injury feigning **CF** - Adult carrying food for young **NE** - Nest containing eggs

NY - Nest with young seen or heard **NU** - Used nest or egg shells found (occupied or laid within the period of the survey) **FY** - Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight

AE - Adult leaving or entering nest sites in circumstances indicating occupied nest **FS** - Adult carrying fecal sac

APPENDIX C
Representative Site Photographs

2358737 Ontario Inc.
Glenelg Residential Subdivision
SLR Project No.: 209.40385

Swamp Thicket (Wetland) and Woodland



Photograph 1. Overview wetland areas (SWT, view south west towards hazard lands also providing Spring Peeper habitat (November 14, 2017).



Photograph 2. Wetland Staking edge of feature (June 2018).



Photograph 3. Drainage feature within swamp thicket (April 2018).



Photograph 4. Chimney Crayfish within wetland along edge (June, 2018).



Photograph 5. Carcass of wild bore (exotic escape) found within SWT unit (April 2018).



Photograph 6. Cedar dominated Woodland abutting wetland features (June 2016).

Agricultural and Cultural Meadow



Photograph 7. Overview of agricultural lands, view south west towards hazard lands (June 2016).



Photograph 8. Pasture - grass dominant species composition providing foraging opportunities for Eastern Meadowlark (June 2016).



Photograph 9. Debris pile within pasture (June 2016).



Photograph 10. Soy fields encompassing the majority of the property (June 2016).



Photograph 11. Plowed agricultural fields. View across fields east to west towards the wetland community (background) (June 7, 2017).



Photograph 12. Overview of site from Glenelg Street. Note Woodland and wetland in background and crop in foreground (September 2018).

Aquatic Features



Photograph 13. Tile outlet mostly northerly limits of the property (May 2018).



Photograph 14. Spring Freshet of drainage feature. Representative of how the channels are braided and difficult to define (April 2018).



Photograph 15. Channelized drainage within swamp thicket along west property limits (May, 2018).



Photograph 16. Beaver evidence in channelized drainage



Photograph 17. Channelized drain with isolated standing pools (July, 2018)



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**A REPORT TO
FLATO DUNDALK MEADOWS INC.**

**HYDROGEOLOGICAL STUDY AND GROUNDWATER MONITORING
PROPOSED RESIDENTIAL DEVELOPMENT**

772146 HIGHWAY 10

TOWNSHIP OF SOUTHGATE (COMMUNITY OF DUNDALK)

REFERENCE NO. 1506-W067

FEBRUARY 2016

DISTRIBUTION

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This report was prepared by Soil Engineers Ltd. for the account of Flato Developments Inc., and for review by its designated agents, financial institutions and government agencies, and can be used for development approval purposes by the Township of Southgate (Dundalk) and their peer reviewer who may rely on the results of the report. The material in it reflects the judgement of Narjes Alijani, M.Sc., P.Geo., and Gavin O'Brien, M.Sc., P.Geo. Any use which a Third Party makes of this report and/or any reliance on decisions to be made based on it is the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

One must understand that the mandate of Soil Engineers Ltd. is to obtain readily available current and past information pertinent to the subject site for a Hydrogeological Study only. No other warranty or representation, expressed or implied, as to the accuracy of the information is included or intended by this assessment. Site conditions are not static and this report documents site conditions observed at the time of the site reconnaissance.



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1.0 **EXECUTIVE SUMMARY**

Soil Engineers Ltd. conducted a hydrogeological study at a parcel of land located on the west side of Highway 10, about 400 m south of Main Street, in the Township of Southgate (Dundalk), in support of a proposed residential development. The findings show that the groundwater level ranges from El. 511.90 to El. 516.92 masl. Moderate seepage is expected during excavation, and dewatering is anticipated to lower the groundwater to facilitate safe, stable conditions for underground services construction. The dewatering flow rate could reach an approximate daily maximum of 82.47 m³/day which increases to a maximum of 247.43 m³/day by applying 3x safety factor. If the dewatering flows exceed 50,000 litres per day (1/day), a Permit to Take Water (PTTW) will be required from the Ministry of the Environment and Climate Change (MOECC) to facilitate the construction dewatering program.

The subject site lies within the physiographic region of Southern Ontario known as the Dundalk Till plain, where the area is underlain by Catfish Creek Till deposits consisting of sandy silt to silt matrix, strongly calcareous and moderately stony.

The subject site is located within the Grand River Watershed and Upper Grand River sub-watershed. Tributaries of Grand River traverse southwesterly across the subject site, and a wetland and associated wooded area are located at the south/southwest boundary of the proposed development site. Records indicate this area includes both provincial and non-classified wetland. Construction of underground services for the proposed development is expected to temporarily affect shallow groundwater flow patterns. It is recommended that trench plugs be installed in underground service



trenches to mitigate potential impact to shallow groundwater flow and maintain long-term groundwater levels in the area since the groundwater contributes to the Forest/Wetland Areas that border the south and southwest sides of the site.

The groundwater quality meets the Drinking Water Quality Standards (DWQS) with the exception of total Hardness (as CaCO_3), and the surface water quality meets the provincial quality objectives (PWQO).



2.0 **INTRODUCTION**

2.1 **Project Description**

In accordance with authorization dated June 9, 2015, from Mr. Shakir Rehmatullah, President, of Flato Developments Inc., Soil Engineers Ltd. (SEL) has performed a hydrogeological study and groundwater monitoring program. The subject site is located on the west side of Highway 10, about 400 m southwest of Main Street, in the Township of Southgate (community of Dundalk). The location of the site is shown on Drawing No. 1.

Surrounding land use includes residential and agricultural properties to the northeast and northwest, wetland and wooded areas to the southeast and southwest, as shown on Drawing No. 1.

The purpose of this study is to summarize the findings of the field study and the associated groundwater monitoring and hydraulic testing, to provide a description and characterization of the hydro-geostratigraphy for the site and surrounding area, and to assess the site's groundwater function relative to the adjacent natural heritage feature located south and southwest of the subject site. The study provides preliminary recommendations for dewatering needs prior to the detailed design. It should be noted that a hydrogeological study report is a required supporting document for a Category 3 Permit to Take Water (PTTW) application if anticipated dewatering flows to lower the groundwater table exceed 400,000 L/day.



2.2 **Project Objectives**

The major objectives of this Hydrogeological Study Report are as follows:

1. Establish the local hydrogeological setting of the site and surrounding area;
2. Interpret shallow groundwater flow and runoff patterns;
3. Identify zones of higher groundwater yield as potential sources of ongoing shallow groundwater seepage;
4. Characterize the hydraulic conductivity (K) for groundwater-bearing soil strata;
5. Prepare an interpreted hydrostratigraphic cross-section for the subject site;
6. Estimate the anticipated dewatering flows that may be required to lower the water table to facilitate construction;
7. Estimate the anticipated zone of influence associated with construction dewatering, if required;
8. Assess baseline groundwater and surface water quality;
9. Monitor and measure the flow rate for the watercourse features that cross the subject site;
10. Conduct a seasonal groundwater level monitoring program;
11. Evaluate potential impacts to groundwater receptors within the anticipated zone of influence of the proposed development lands;
12. Assess the groundwater function of the subject site relative to the nearby wooded area and associated wetland, and for the maintenance of these features following development.



2.3 **Scope of Work**

The scope of work for the current Hydrogeological Study is summarized below:

1. Clearance of underground services, drilling of seven (7) boreholes within the development footprint, and installation of monitoring wells at the borehole locations, with shallow nested wells installed at three (3) of the seven (7) monitoring well locations.
2. Well development and performance of Single Well Response Tests (SWRTs) at the monitoring wells to estimate the hydraulic conductivity (K) for groundwater-bearing subsoil at the depths of the well screens
3. Reviewing and plotting of Ministry of Environment and Climate Change (MOECC) water well records within 500 m of the proposed residential development site;
4. Assessing the baseline groundwater and surface water quality;
5. Seasonal monitoring and measuring of the flow rate for the watercourses that cross the subject site; instrumentation of the three (3) deep nested wells with data loggers to continuously record seasonal groundwater fluctuation.
6. Conducting a seasonal groundwater level monitoring program;
7. Describing the geological and hydrogeological setting for the study area;
8. Review of the findings of the concurrent geotechnical investigation, along with available engineering development plans and profiles. Preliminary calculation of expected dewatering flows necessary to lower groundwater level to facilitate excavation and construction and;
9. Determining the groundwater and surface water function of the site relative to the support of the nearby natural heritage areas.



3.0 **METHODOLOGY**

3.1 **Borehole Advancement and Monitoring Well Installation**

The borehole drilling and monitoring well construction were performed during the period from July 6 to July 9, 2015, consisting of seven (7) boreholes with a monitoring well installed in each of the boreholes. At three (3) locations, a shallow, nested well was installed adjacent to the deeper well. The locations of the boreholes/monitoring wells are shown on Drawing No. 2.

The drilling and monitoring well installation were completed by DBW Drilling Limited, a licensed water well contractor. The boreholes were drilled using flight-augers, with the field work being supervised and the findings recorded by a geotechnical technician who logged the soil strata changes and collected representative samples for soil classification. Detailed descriptions of the encountered subsurface conditions are presented on the Borehole and Monitoring Well Logs, Figures 1 to 10, inclusive.

The monitoring wells were constructed using 50-mm diameter PVC riser pipe and screens, and installed in accordance with Ontario Regulation (O. Reg.) 903. All the monitoring wells were provided with monument-type, steel protective casings.

The UTM coordinates and ground surface elevations at the borehole/monitoring well locations, together with the well details, are given in Table 3-1.

**Table 3-1 - Monitoring Well Installation Details**

Well ID	Installation Date	East	North	Ground El. (masl)	BH Depth (mbgs)	Screen Interval (mbgs)	Casing Dia. (mm)
BH/MW 101	July 9, 2015	549321.2	4890927.6	514.9	6.9	3.4-6.4	50
BH/MW 102	July 8, 2015	549511.8	4891186.9	518.8	7.0	3.4-6.4	50
BH/MW 103D	July 7, 2015	549712.8	4891449.6	515.4	3.4	1.9-3.4	50
BH/MW 103S	July 7, 2015	549714.9	4891449.4	515.2	2.1	0.6-2.1	50
BH/MW 104	July 7, 2015	549821.3	4891453.1	516.24	6.9	3.4-6.4	50
BH/MW 105	July 6, 2015	550112.8	4891417.6	516.4	7.0	3.4-6.4	50
BH/MW 106 D	July 6, 2015	549760.9	4891122.4	513.2	6.9	3.4-6.4	50
BH/MW 106 S	July 6, 2015	549760.8	4891124.4	513.2	3.0	1.5-3.0	50
BH/MW 107 D	July 8, 2015	549555.5	4890878.7	513.5	6.9	3.4-6.4	50
BH/MW 107 S	July 8, 2015	549554.9	4890879.4	513.6	3.0	1.5-3.0	50

3.2 Groundwater Monitoring

The groundwater level in the monitoring wells was measured manually on August 24, September 19 and October 9, 2015, to record the depths to the static groundwater table.

Seasonal groundwater monitoring (one year) is ongoing at the site, and the results will be presented under separate cover. The groundwater level in the monitoring wells was measured on three occasions during 2015. Data loggers were installed at BH/MW 103D, BH/MW 106D and BH/MW 107D to continuously record the fluctuation of the groundwater table.



3.3 **Mapping of Ontario Water Well Records**

SEL reviewed the MOECC Water Well Records (WWRs) for registered wells located on the subject site and within 500 m from the site boundaries. The records indicate twenty-two (22) wells are located within the study area. The well locations are shown on Drawing No. 3, and the Ontario WWRs reviewed for this study are listed in Appendix 'A'.

3.4 **Monitoring Well Development and Single Well Response Tests**

BH/MWs 101, 102, 103D, 104, 105, 106D, 107D underwent development to prepare the wells for single well response tests (SWRT) to estimate hydraulic conductivity (K) for soil strata at the depths of the well screens. Well development involved the purging and removal of several casing volumes of groundwater from each well to remove remnants of clay, silt and other debris introduced into the wells during construction, and to induce the flow of fresh formation groundwater into the well screens thereby improving the transmissivity of the formation at the well screen depths.

The K values, derived from the SWRT, provide an indication of the groundwater yield capacity for the groundwater bearing strata, and can be used to estimate the flow of groundwater through granular water-bearing soil strata.

The SWRT involves the placement of a slug of known volume into the well, below the water table, to displace the groundwater level upward. The rate at which the water level recovers to static conditions (falling head) is tracked using either a data logger/pressure transducer and/or manually using a water level tape. The rate at which the



water table recovers to static conditions is used to estimate the K value for the water-bearing formation at the well screen depth. BH/MWs 101, 102, 103D, 104, 105, 106D, 107D underwent SWRT on August 27, 2015, and the results are provided in Appendix 'B'.

3.5 **Surface Water Flow Rate Measurement**

The flow rate for the two watercourses on the subject site was measured on December 22, 2015. A 'Current Velocity Stream Discharge Indicator, Model 3000' was used for flow rate measurements.

A seasonal flow rate measurement program is ongoing at the subject site, and the results will be presented under separate cover.

3.6 **Previous Report and Concurrent Report**

Soil Engineers Ltd. conducted a preliminary geotechnical investigation for the subject site. The findings were presented in the report noted below, which was reviewed in preparation of this hydrogeological study:

"Preliminary Geotechnical Investigation, Property Acquisition for Proposed Residential Development, 772146 Highway 10, Township of Southgate (Dundalk)", Reference No. 1412-S073E, dated February 9, 2015.



3.7 **Groundwater and Surface Water Quality Assessment**

BH/MWs 101 and 103D underwent sampling for analysis to characterize the baseline groundwater quality for evaluation against the Drinking Water Quality Standards (DWQS). In addition two (2) surface water samples were submitted for analysis to characterize the baseline surface water quality for evaluation against the Provincial Water Quality Objectives (PWQO).

The monitoring wells were purged of a minimum of 3 casing volumes of groundwater prior to sample collection. The groundwater sampling was carried out in accordance with the protocol for evaluation based on the DWQS, and the surface water sampling was conducted in accordance with the protocol for evaluation based on the PWQO. Upon sampling, all bottles were placed in ice and packed in a cooler at about 4° C for shipment to the analytical laboratory. Sample analysis was performed by AGAT Laboratories, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). The results of the analysis are provided in Appendix 'C'.



4.0 **REGIONAL AND LOCAL SETTING**

4.1 **Regional Geology**

The subject site lies within the physiographic region of Southern Ontario known as the Dundalk Till plain. Low drumlinoidal oval-shaped hills appear with their long axes oriented southeastward at areas north and west of Dundalk. The main part of the area is a fluted till plain; the flutings run southeastward, and the surface appears planed but is scored by shallow troughs which are barely perceptible to the eye. The plain is characterized by swamps or bogs and by poorly drained depressions. Generally, throughout the Dundalk plain on the lower slopes and in the hollows, except where there is muck or peat, the soils are mapped as Parkhill silt loam and Brookston silt loam. These silts have very dark humified surface soils which may vary from six to twelve inches in depth, and are underlain by grey horizons which are light brownish grey with olive mottling and exhibit a sticky consistency. These areas are usually too wet for cultivation and if cleared are devoted to pasture (Chapman and Putnam, 1984).

Based on a surface geological map provided by Ontario Geological Survey (OGS), the subject site is located near the boundary of Elma Till and Catfish Till deposits, with the site situated on Catfish Creek Till deposits, consisting of sandy silt to silt matrix, which is strongly calcareous, and moderately stony. Organic deposits are located northeast and southeast of the subject site. There is a record of an oil and gas well about 3.5 km southeast of the subject site. The depth of this well is 6.26 mbgs. It should be noted there is a record of bedrock outcrop about 5.2 km southwest of the subject site. Drawing No. 4, reproduced from OGS mapping, illustrates the quaternary surface soil geology for the area. The bedrock elevation ranges from 495.3 to 502.9 masl, and the bedrock consists of sandstone, shale, dolostone and siltstone of the Guelph formation



which was deposited during the lower to middle Silurian epoch (Bedrock Geology of Ontario, 1993). The approximate depth to the top of bedrock is expected to be about 12 to 20 m.

4.2 **Physical Topography**

Based on the elevations recorded at the borehole and monitoring well locations, and a review of a topographic map for the surrounding area, the topography of the subject site shows a gentle decline in relief to the southwest, toward one of the tributaries of Grand River. The elevation relief across the subject site is about 5 m; Drawing No. 5 shows the mapped topographic contours for the site and surrounding area.

4.3 **Watershed Setting**

The subject site is located within the Grand River Watershed and Upper Grand River sub-watershed. The Grand River watershed is the largest watershed in southern Ontario, stretching 280 km from Dundalk in the north to Port Maitland on Lake Erie in the south. This watershed covers an area of almost 7,000 km². The outstanding heritage of this watershed (7000 square kilometers) has been recognized by the designation of the Grand River as a Canadian Heritage River. The major tributaries of the Grand River include the Conestogo and Nith Rivers, draining the western half of the watershed; and the Speed and Eramosa which drain the northeast. Several smaller tributaries drain the southern half of the watershed. The largest of these include the Fairchild, Whiteman's and McKenzie Creeks. In addition, the Grand River watershed includes sub-watersheds such as the Conestogo, Nith and Speed Rivers; Upper, Central, Lower and Central Lower Grand River; Lower Creek, Mill Creek and Whitemans Creek sub-watersheds (Grand River Conservation Authority). Drawing



No. 6 shows the location of the subject site within the Grand River watershed and Upper Grand River sub-watershed.

4.4 **Local Surface Water and Natural Features**

Records show wooded areas around the subject site, with the nearest wooded area adjacent to the southeast boundary of the site. Minor areas along the southeast boundary of the site are wooded, and a treeline is shown in the central portion of the site.

The records show wetlands, provincial and non-classified, within the wooded areas south and west of the subject site. Provincial and non-classified wetlands are identified within the wooded area southeast of the site, and a non-classified wetland is identified within a wooded area 160 m west of the site.

Tributaries of Grand River cross the subject site, flowing in a southwest direction.

The location of the site and noted natural features are shown on Drawing No. 7.



5.0 **SOIL LITHOLOGY**

This study has disclosed that beneath a layer of topsoil, the native soils consist of sandy silt, silty fine sand, silty sand till, silty clay till and gravelly sand. A Key Plan and the interpreted geological cross-sections along southwest-to-northeast transect are presented on Drawing Nos. 8-1 and 8-2.

5.1 **Topsoil** (All Boreholes and Monitoring Wells)

A dark brown layer of topsoil, 25 to 38 cm thick, was found at the ground surface throughout the site.

5.2 **Sandy Silt** (BH/MWs 101, 103D, 104 and 107D)

The sandy silt was found immediately beneath the topsoil. The sandy silt is brown in colour, and the water content ranges from 16% to 25%, indicating it is in a very moist to saturated condition. The thickness of the sandy silt unit ranges from 0.3 to 1.25 m. Grain size analyses were performed on two (2) samples, and the gradations are plotted on Figure 11.

5.3 **Silty Fine Sand** (BH/MW 102)

The silty fine sand was found immediately beneath the topsoil. The silty fine sand is brown in colour, and the water content is 15%, indicating it is in a very moist condition. The thickness of the silty fine sand unit is 0.4 m.



5.4 **Silty Sand Till** (BH/MWs 101, 102 and 107D)

The silty sand till was found beneath the sandy silt and silty fine sand. The silty sand till is brown in colour and the moisture content ranges from 9% to 12%, indicating that it is in a moist condition. The thickness of the silt layer ranges from 0.7 to 1.4 m. A grain size analysis was performed on one (1) sample, and the gradation is plotted on Figure 12.

5.5 **Silty Clay Till** (All Boreholes and Monitoring Wells)

The silty clay till is predominant in the revealed stratigraphy, and extends to the investigated depth at all borehole/monitoring well locations. At BH/MWs 101 and 102, the silty clay till occurs at two depths in the revealed stratigraphy. The upper layer occurs beneath a silty sand till stratum, and is 0.7 m and 0.8 m thick at BH/MWs 101 and 102, respectively.

The silty clay till is brown, and the moisture content of the till samples ranges from 5% to 24%, showing that it is in a damp to saturated condition. The high moisture content was found for the till immediately below the topsoil.

5.6 **Gravelly Sand** (BH/MWs 101 and 102)

The gravelly sand was found as an interbedded unit within the silty clay till unit. The gravelly sand is brown, and the moisture content ranges from 5% to 8% indicating it is in a moist condition. The thickness of the layer ranges from 0.5 to 1.6 m. A grain size analysis was performed on one (1) sample, and the gradation plotted on Figure 13.



6.0 **GROUNDWATER STUDY**

6.1 **Review of Previous and Concurrent Reports**

Soil Engineers Ltd. carried out a preliminary geotechnical investigation for the subject site, and the findings were presented in the report noted below, which was reviewed in preparation of this hydrogeological study:

“Preliminary Geotechnical Investigation, Property Acquisition for Proposed Residential Development, 772146 Highway 10, Township of Southgate (Dondalk)”, Reference No. 1412-S073E, dated February 9, 2015.

6.2 **Review of Ontario Water Well Records**

The MOECC water well records for the study area and properties within a 500 m radius of the boundaries of the subject site were reviewed.

The locations of the wells, based on the UTM coordinates given in the records, are shown on Drawing No 3, with a summary of the reviewed records provided in Appendix ‘A’. The records indicate that twenty-two (22) wells are located within the 500 m study area relative to the subject site. Review of the first status of wells indicates that thirteen (13) water wells are registered as domestic wells, two (2) as livestock wells, two (2) as test hole wells, one (1) as a commercial well, with three (3) records indicating unidentified usage.

Reviewing the final status of wells shows that seventeen (17) water wells are registered as water supply wells, two (2) as test holes, one (1) as an abandoned or other, and two (2) wells are identified with unknown usage.



There is a record of an existing water supply well in the southwest part of the subject site. The static water level given in the record for this well is 10.68 mbgs. It is recommended that the on-site domestic well be decommissioned prior to site development, if discovered during future earth work.

6.3 **Groundwater Monitoring**

The groundwater level was measured in all the monitoring wells to record the fluctuation of the groundwater table beneath the site during the period from August 24 to October 9, 2015. The depths and elevations of the measured water levels are given in Table 6-1.

Table 6-1 - Water Level Measurements

Well ID		August 24, 2015	September 19, 2015	October 9, 2015	Average
BH/MW 101	mbgs	0.7	0.36	0.85	0.64
	masl	514.22	514.56	514.07	514.28
BH/MW 102	mbgs	1.75	1.9	2	1.88
	masl	517.05	516.90	516.80	516.92
BH/MW 103 D*	mbgs	0.76	0.61	0.86	0.74
	masl	514.62	514.77	514.52	514.64
BH/MW 103 S**	mbgs	0.76	0.62	0.9	0.76
	masl	514.47	514.61	514.33	514.47
BH/MW 104	mbgs	0.1	0.33	0.74	0.39
	masl	516.14	515.91	515.50	515.85
BH/MW 105	mbgs	1.2	1.02	1.42	1.21
	masl	515.23	515.41	515.01	515.22
BH/MW 106 D	mbgs	1.32	1.15	1.37	1.28
	masl	511.87	512.04	511.82	511.91
BH/MW 106 S	mbgs	1.36	1.21	1.41	1.33
	masl	511.87	512.02	512.82	511.90
BH/MW 107 D	mbgs	0.77	0.53	0.99	0.76
	masl	512.77	513.01	512.55	512.78
BH/MW 107 S	mbgs	0.76	0.51	0.93	0.73
	masl	512.79	513.04	512.62	512.81

Notes:

mbgs -- metres below ground surface

* -- Deep nested well

masl -- metres above sea level

** -- Shallow nested well



As shown above, the groundwater levels recorded at the monitoring wells, with the exceptions of BH/MWs 102 and 104, exhibited an ascending trend during the period from August 24 to September 19, 2015, followed by a downward trend from September 19 to October 9, 2015. At BH/MWs 102 and 104, the groundwater level exhibited a descending trend over the monitoring period. The greatest fluctuation was observed at BH/MW 104, with a 0.64 m decrease for the shallow groundwater level elevation over the study period. The least fluctuation of the groundwater level elevation was observed at BH/MW 103 D, which is installed beside the easterly watercourse. The fluctuation is partly related to the seasonal conditions and rainfall received during the study period.

As a means to study the connection between surface water flowing in the creeks and the shallow groundwater aquifer, nested deep and shallow wells were installed at three (3) locations, BH/MWs 103, 106 and 107.

A review of the measured groundwater levels over the monitoring period shows that at BH/MW 106, minimal difference was observed between the groundwater levels in the deep and shallow wells, suggesting a minor upward vertical gradient and groundwater discharge conditions. At BH/MW 103, the average groundwater level over the monitoring period is about 17 cm higher in the deep well, indicating that the groundwater discharges into the easterly creek. At BH/MW 107, no significant difference was observed in the groundwater levels at the deep and shallow wells on October 24 and September 19, while on October 9, 2015, the groundwater level in the deep well was 6 cm lower than in the shallow well. These observations suggest that the surface water is neither recharging the shallow aquifer nor receiving water from the shallow aquifer. It should be noted that the groundwater conditions will vary over the course of a year based on precipitation and seasonal effects.

The groundwater level measurements were used to interpret the horizontal flow pattern for shallow groundwater across the site, which is illustrated on Drawing No.10.



The above-described groundwater conditions were observed during the summer and fall periods for the ongoing seasonal groundwater monitoring program at the subject site.

The results of the seasonal monitoring program, including hydrographs for the automated monitoring wells, will be provided under separate cover.

6.4 **Surface water Flow Rate Measurement**

Two tributaries of Grand River traverse the subject site, merging south of the site and flow to the south/southwest. Surface water flow rates were measured on December 22, 2015, at the locations shown on Drawing No. 9. Flow rates were measured at stations upgradient and downgradient from the watercourses. The results are summarized in Table 6-2.

Table 6-2 - Flow Rate Measurements Summary

Station ID	Flow Rate (L/s)	Description
C-1U	79.5	East Creek, Upgradient
C-1D	81.5	East Creek, Downgradient
C-2U	21.0	West Creek, Upgradient
C-2D	30.6	West Creek, Downgradient

As shown above, the flow rates are slower at the upstream stations than at the downstream stations. The results also show that the flow rates for the east watercourse are greater than the flow rates for the west watercourse. The results of the seasonal monitoring program (groundwater levels and surface water flow measurement), together with discussion and recommendations, will be presented under separate cover at the conclusion of the program.

It should be noted that a flow monitoring program is ongoing at the subject site, and the results will be presented under separate cover.



6.5 Single Well Response Test

MWs 101, 102, 103D, 104, 105, 106D and 107D underwent single well response tests (SWRT) to assess the hydraulic conductivity (K) for shallow saturated aquifer soils at the depths of the well screens. The results of the SWRT are presented in Appendix 'B', with a summary of the findings shown in Table 6-2.

Table 6-2 - Summary of SWRT Results

Well ID	Ground El. (masl)	BH Depth (mbgs)	Screen Depth (mbgs)	Screen Interval (mbgs)	Screened Soil Strata	Hydraulic Conductivity (K) (m/sec)
BH/MW 101	514.92	6.9	6.4	3.4-6.4	Gravelly Sand and Silty Clay, Till	1.5×10^{-6}
BH/MW 102	518.80	7.0	6.4	3.4-6.4	Silty Clay, Till	5.8×10^{-7}
BH/MW 103D	515.38	3.4	3.4	1.9-3.4	Silty Clay, Till	9.8×10^{-7}
BH/MW 104	516.24	6.9	6.4	3.4-6.4	Silty Clay, Till	1.2×10^{-7}
BH/MW 105	516.43	7.0	6.4	3.4-6.4	Silty Clay, Till	5.3×10^{-8}
BH/MW 106D	513.19	6.9	6.4	3.4-6.4	Silty Clay, Till	1.3×10^{-7}
BH/MW 107D	513.54	6.9	6.4	3.4-6.4	Silty Clay, Till	2.6×10^{-7}

The results of the SWRT indicate the hydraulic conductivity for the groundwater-bearing silty clay till ranges from 5.3×10^{-8} to 9.8×10^{-7} m/sec, with the seepage rates for silty clay till unit anticipated to be low to moderate. The hydraulic conductivity for the gravelly sand overlying the silty clay till layers is 1.5×10^{-6} m/sec, with moderate groundwater seepage rates expected for the gravelly sand unit.

6.6 Shallow Groundwater Flow Pattern

The review of the groundwater levels measured at BH/MWs 101, 102, 103D, 104, 105 D, 106 D and 107 D suggests that it flows in a southeasterly direction, toward one of the Grand River tributaries. The interpreted shallow groundwater flow pattern for the undeveloped site area is shown on Drawing No. 10.



7.0 **GROUNDWATER CONTROL DURING CONSTRUCTION**

The estimated hydraulic conductivity (K) values suggest that low to moderate groundwater seepage may be encountered in excavations below the groundwater table. To provide safe, dry and stable conditions for excavation for underground servicing, the water table will need to be lowered. Preliminary estimates for construction dewatering flow required to locally lower the water table, based on the K test results, are discussed in the following sections.

7.1 **Groundwater Construction Dewatering Rates**

Development plans showing the invert elevation and servicing depths were not available at the time of this report preparation. However, the proposed development will consist of residences with basements. Therefore, and an excavation depth of $3.0 \pm$ m was considered for the preliminary dewatering calculations. To facilitate excavation and construction in dry and stable subsoil conditions, it is proposed that the water table be lowered to depth of $4.0 \pm$ mbgs, which is about 1.0 m below the lowest proposed excavation depth.

The findings of the hydrogeological studies show that the subsoils extending to depths of $4.0 \pm$ m from the ground surface at borehole/monitoring well locations consist primarily of sandy silt, silty sand till, silty clay till, gravelly sand and silty fine sand.

7.2 **Management of Dewatering Effluent**

The dewatering rate at the site, assuming a 100 m length of active open trench, could reach an approximate daily maximum of $82.47 \text{ m}^3/\text{day}$; however, this may occur only at the beginning of the dewatering process. By applying 3x safety factor, the



dewatering rate could reach an approximate daily maximum of 247.43 m³/day. It is anticipated that, following the lowering of the localized water table, groundwater seepage removed via dewatering from the open trench excavation will be a fraction of the above estimate since much of the groundwater in the proposed development area will have been removed from local storage.

Once the required plans and profiles are prepared and available for review, the dewatering needs for the site should be re-evaluated.

7.3 **Groundwater Control Methodology**

Moderate groundwater seepage is anticipated in open excavations below the water table, and may be controllable by pumping from sumps, or if necessary, well points can be employed to lower water table if trenching encounters unstable subsoils which cannot be controlled by pumping from sumps. The final design for the dewatering system will be the responsibility of the construction contractors.

7.4 **Mitigation of Potential Impacts Associated with Dewatering**

The zone of the influence for dewatering could reach a maximum of 0.8 m from the conceptual dewatering areas. Watercourses and wooded areas are present within the zone of influence of the conceptual dewatering area. In addition, there is a record of water supply well located within the zone of influence of the dewatering (well ID 14 on Drawing No. 3). The static water level for this well is 10.68 mbgs, which is lower than the excavation depth for development; although no significant interference is anticipated, it is recommended that the well be decommissioned prior to construction, if encountered.



7.5 **Ground Settlement**

Potential ground settlement associated with dewatering should be assessed by a geotechnical engineer prior to construction.

7.6 **Groundwater Function for the Subject Site**

Two watercourses traverse north-to-south/southwest across the site. Given the shallow, relatively permeable sandy silt, silty sand till and silty fine sand deposits at the site, infiltrated precipitation may discharge to feed the local watercourses when the water table is high during the spring. Further, based on the interpreted shallow groundwater and runoff flow patterns, the subject site is located hydraulically upgradient from the wetland and forest feature located at the south boundary. The above-mentioned features likely maintain the high groundwater level elevations exhibited at the site, particularly at the south portion of the site.

In order to maintain the wetland and watercourses, safeguards are recommended for underground service trenches, such as installation of clay collars or trench plugs, to mitigate permanent lowering of the local water table flowing site development. Alternatively, engineered fill soil can be used to raise the site elevations prior to servicing and construction of houses. With the anticipated raising of site grades prior to development, it is recommended that clean runoff generated from the developed impervious surfaces should be directed to the south and southeast to maintain the wetland and forest features adjacent to the south limits of the site.



7.7 Low Impact Development Storm Water Management

Given the presence of the sandy silt, silty sand till and silty fine sand deposits across the site, opportunities may exist for the infiltration of storm water to the subsurface at the developed site. This will be confirmed by the findings of the seasonal groundwater monitoring program. Implementation of a soakaway pit and/or dry well may be feasible as a means to recharge groundwater to the subsurface following development. Alternatively, runoff can be re-directed to maintain wetland and woodlot areas by means of a grass swale or similar LID technology.

7.8 Groundwater Quality

Groundwater samples were collected from two monitoring wells; BH/MWs 101 and 103D, on December 22, 2015, and submitted for analysis for evaluation against the Drinking Water Quality Standards (DWQS). The Certificates of Analysis for the water quality sampling and analysis program are included in Appendix 'C'. Drawing No. 10 shows the groundwater sampling locations.

The tested parameters, with the exception of Total Hardness (as CaCO_3), meet the respective DWQS limits. The result and permissible standard for the exceeding parameters are given in Table 7-1.

Table 7-1 - Summary of Water Quality Exceedances

Well ID Parameter	BH/MW 101 (mg/L)	BH/MW 103D (mg/L)	DWQS limits (mg/L)
Total Hardness (as CaCO_3)	252	283	80-100



The above results shows that the groundwater at BH/MWs 101 and 103D is hard (>150 mg/L as CaCO_3). Table 7-2 shows the hardness level for the groundwater samples, and classifies the groundwater based on the hardness level.

Table 7-2 - Groundwater Hardness

Total Hardness (mg/L) (as CaCO_3)		Hardness Classification (mg/L) (as CaCO_3)	Description
BH/MW 101	BH/MW 103D		
252	283	150-300	Hard

Note: adopted from Table 2.12, pg. 92, Water Quality, G. Tchobanoglous, E. Schroeder, 1987

It should be noted that the DWQS limits for hardness represent an aesthetic objective for groundwater, and the groundwater can be pre-treated using a softener for domestic well water usage.

The results for Aluminium and Manganese are significantly higher at BH/MW 103 in comparison with BH/MW 101. In addition, the values for Sulphate and Potassium are marginally lower at BH/MW 103 in comparison with BH/MW 101. This may be partially related to the watercourse which flows close to the BH/MW 103D location.

7.9 Surface Water Quality

Surface water samples were collected from two existing watercourses which flow north-to-south/southeast across the subject site. The samples were collected on December 22, 2015 from downstream locations, shown on Drawing No. 10, and submitted for analysis for evaluation against the Provincial Quality Objectives (PWQO). The Certificates of Analysis for the water quality sampling and analysis program are included in Appendix 'C'.



The results meet the respective PWQO limits. There is no criteria for Total hardness based on the PWQO guidelines; however, the results are similar to those of the groundwater samples and are within the 150 - 300 mg/L range.



8.0 **CONCLUSION**

1. The subject site is located on the Dundalk Till plain where surficial soils underlying the site consist of Catfish Creek Till deposits, comprised of sandy silt to silt matrix, strongly calcareous, and moderately stony.
2. The surface topography of the site exhibits a gentle decline in relief to the southwest, toward one of the tributaries of the Grand River.
3. The subject site is located within the Grand River Watershed and Upper Grand River sub-watershed with tributaries of Grand River traversing the subject site, flowing south/southeasterly.
4. Wetland and associated wooded area are located on the adjacent land southeast of the subject site. The records show that the area includes both provincial and non-classified wetland features.
5. The findings of the subsurface studies revealed that beneath a layer of topsoil, the native soils underlying the subject site consist of sandy silt, silty fine sand, silty sand till, silty clay till and gravelly sand.
6. The groundwater levels ranges from El. 511.90 to 516.92 masl.
7. The single well response tests yielded estimated K values of 5.3×10^{-8} to 9.8×10^{-7} m/sec for the silty till, and 1.5×10^{-6} m/sec for the gravelly sand overlying silty clay till layers at the depths of the well screen, suggesting that moderate groundwater seepage rates can be expected in open excavations bellow the water table.
8. Shallow groundwater flows southeasterly, toward one of the tributaries of the Grand River.
9. The dewatering flow rate to facilitate underground servicing and construction of the development could reach an approximate daily maximum of 82.47 m³/day; by applying 3x safety factor, the dewatering rate could reach an approximate daily maximum of 247.43 m³/day.



10. The anticipated zone of influence for a dewatering array to lower the water table to facilitate underground services construction is 8.9 m. Watercourses and wooded area lie within the zone for influence of the conceptual dewatering array. In addition, well records indicate that a water supply well is located within the zone of influence for dewatering area.
11. In order to maintain the wetland and watercourses, safeguards are recommended for underground service trenches, such as construction clay collars or trench plugs, to mitigate permanent lowering of the local water table following site development. Alternatively, engineered fill soil can be placed to raise the grade at the site prior to servicing and construction of houses.
12. In order to maintain the natural feature located on the adjacent land southwest of the subject site, it is recommended that clean runoff generated from the developed impervious surfaces (such as roofs) be directed to the south and southeast portions of the site.
13. The water quality test results show that the shallow groundwater is hard.
14. The findings of the ongoing seasonal groundwater monitoring can be used in assessing site grading requirements when the seasonal information becomes available.
15. Once the required plans and profiles are prepared and available for review, the dewatering needs for the site should be re-evaluated.

SOIL ENGINEERS LTD.


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Gavin O'Brien, M.Sc., P.Geo.
NA/GO:dd





9.0 **REFERENCES**

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FIGURES 1 to 13

BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION GRAPHS

REFERENCE NO. 1506-W067

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS Auger sample
CS Chunk sample
DO Drive open (split spoon)
DS Denison type sample
FS Foil sample
RC Rock core (with size and percentage recovery)
ST Slotted tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash sample

SOIL DESCRIPTION

Cohesionless Soils:

<u>'N' (blows/ft)</u>	<u>Relative Density</u>
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Undrained Shear
Strength (ksf)

less than 0.25
0.25 to 0.50
0.50 to 1.0
1.0 to 2.0
2.0 to 4.0
over 4.0

'N' (blows/ft)

0 to 2	very soft
2 to 4	soft
4 to 8	firm
8 to 16	stiff
16 to 32	very stiff
over 32	hard

Consistency

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

□ Compression test in laboratory

WH Sampler advanced by static weight
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
NP No penetration

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg

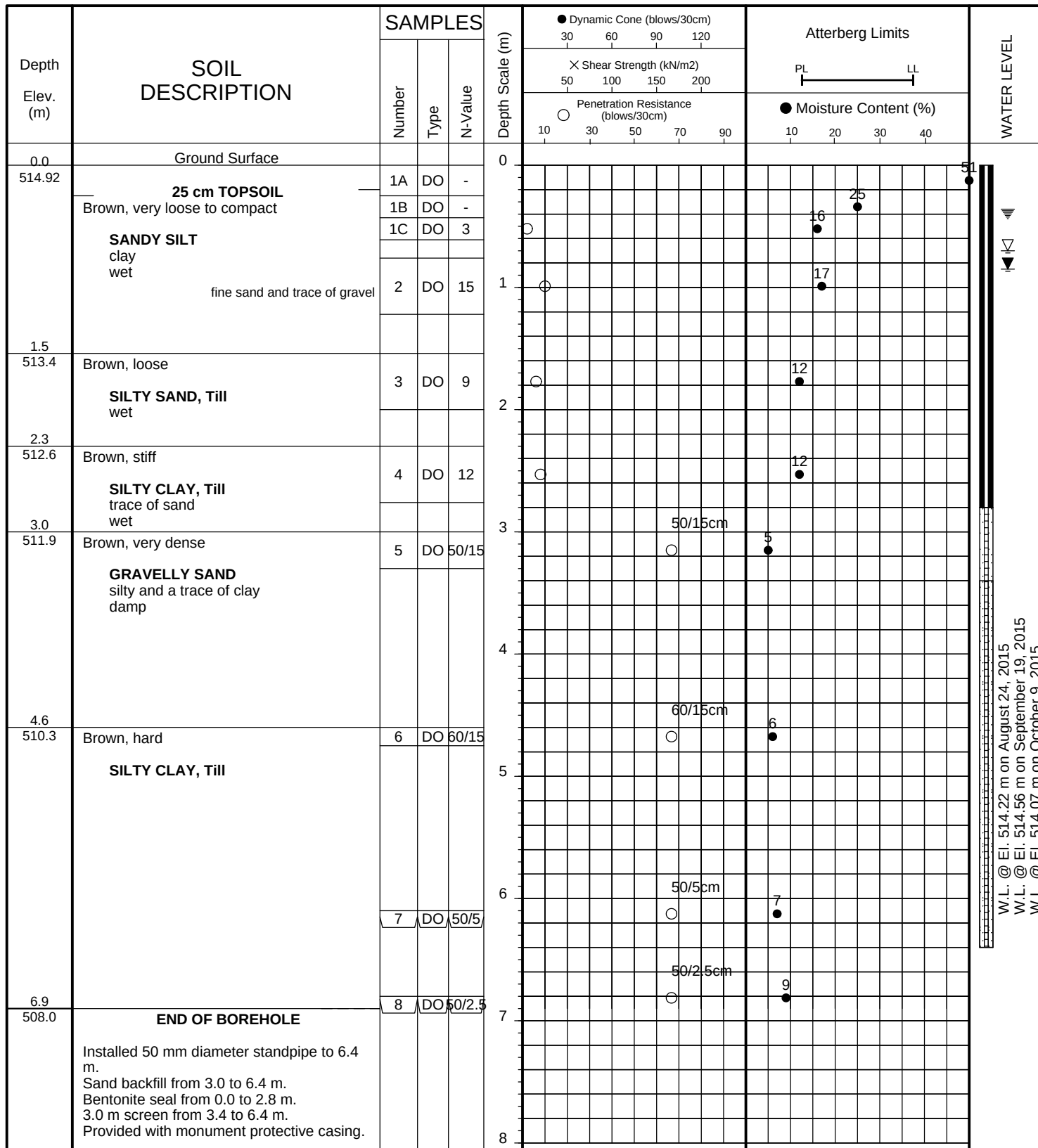
1 inch = 25.4 mm
1ksf = 47.88 kPa

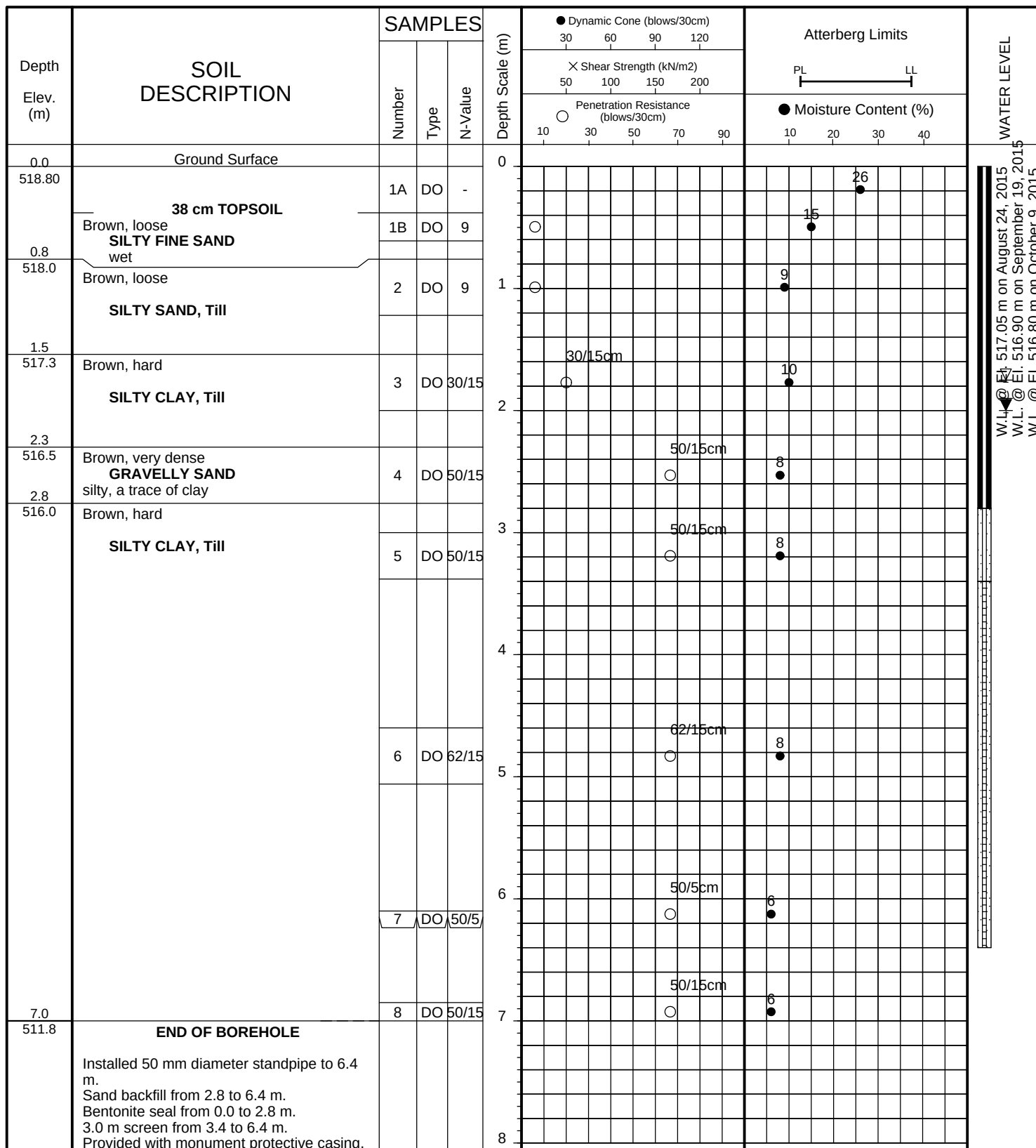


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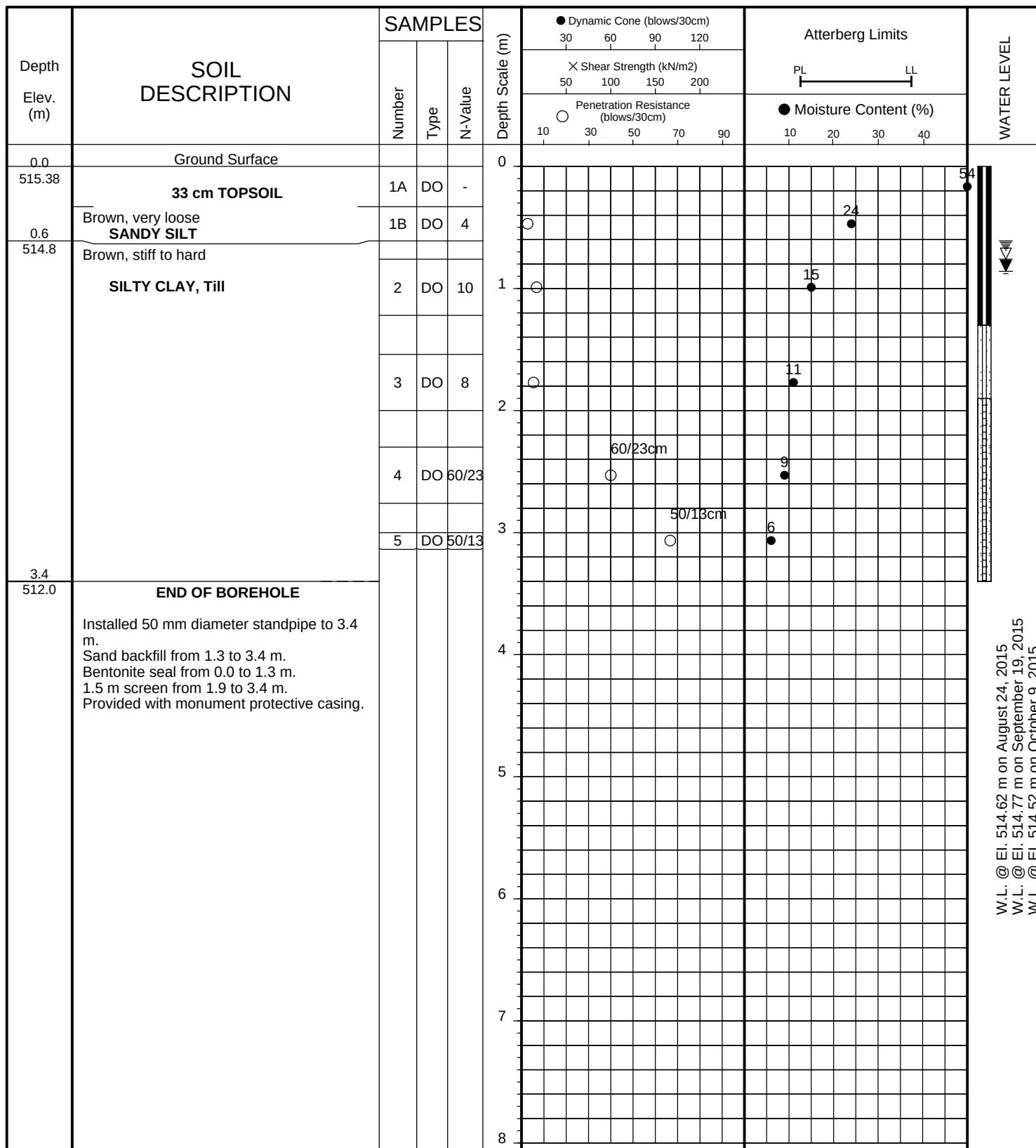
JOB NO: 1506-W067 **LOG OF BOREHOLE NO: BH/MW 103 D** **FIGURE NO: 3**

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 7, 2015



Soil Engineers Ltd.

LOG OF BOREHOLE NO: BH/MW 103 S *FIGURE NO: 4*

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

DATE: July 7, 2015

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES			Depth Scale (m)	Atterberg Limits		WATER LEVEL
		Number	Type	N-Value		● Dynamic Cone (blows/30cm) X Shear Strength (kN/m2) ○ Penetration Resistance (blows/30cm)	PL ————— LL ● Moisture Content (%)	
0.0	Ground Surface				0			
515.23	33 cm TOPSOIL							
0.6	Brown, very loose SANDY SILT							
514.6	Brown, stiff to hard SILTY CLAY, Till				1			
2.1					2			
513.1	END OF BOREHOLE				3			
	Installed 50 mm diameter standpipe to 2.1 m. Sand backfill from 0.2 to 2.1 m. Bentonite seal from 0.0 to 0.2 m. 1.5 m screen from 0.6 to 2.1 m. Provided with monument protective casing.				4			
					5			
					6			
					7			
					8			

W.L. @ El. 514.47 m on August 24, 2015
W.L. @ El. 514.61 m on September 19, 2015
W.L. @ El. 514.33 m on October 9, 2015



Soil Engineers Ltd.

JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 104

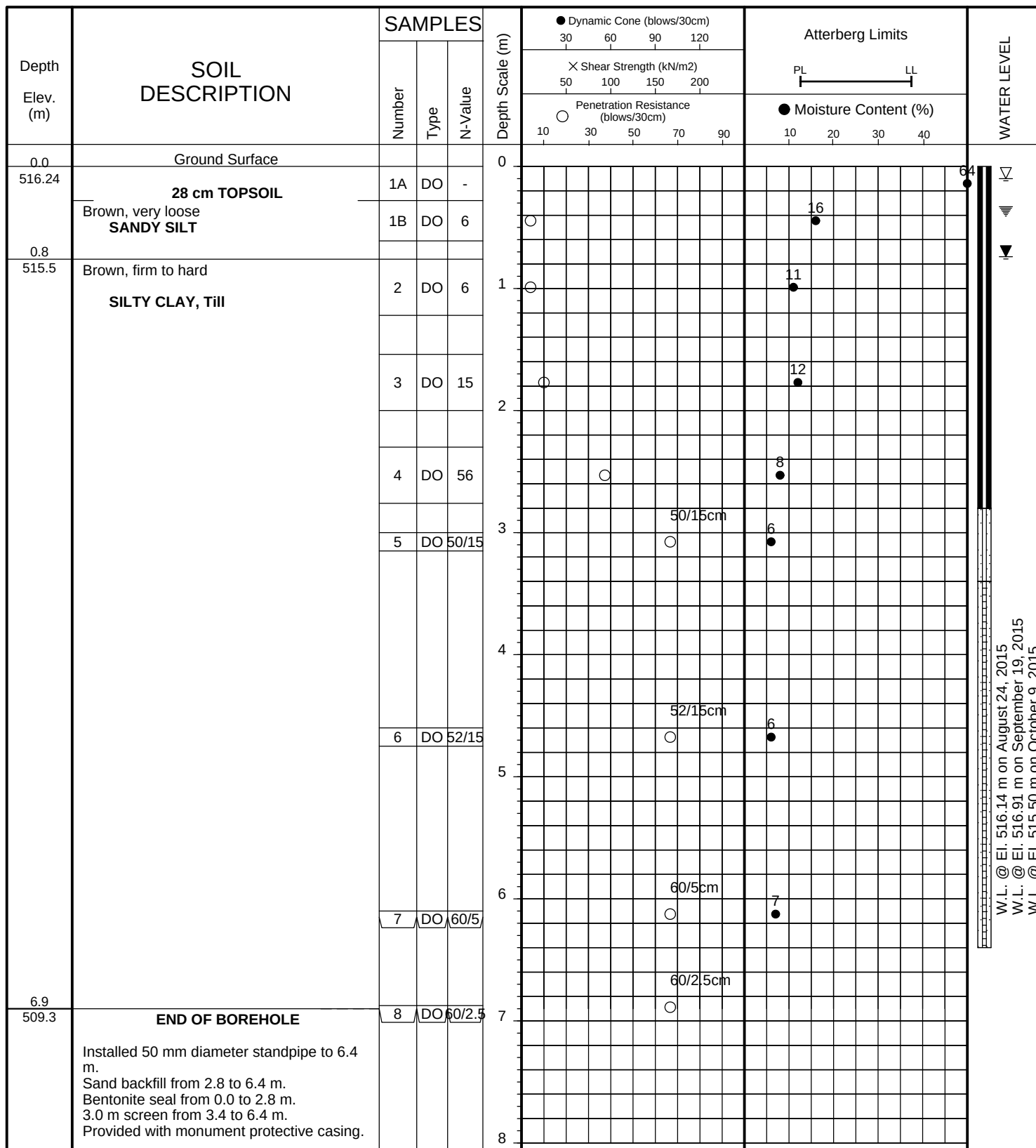
FIGURE NO: 5

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 7, 2015



Soil Engineers Ltd.

JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 105

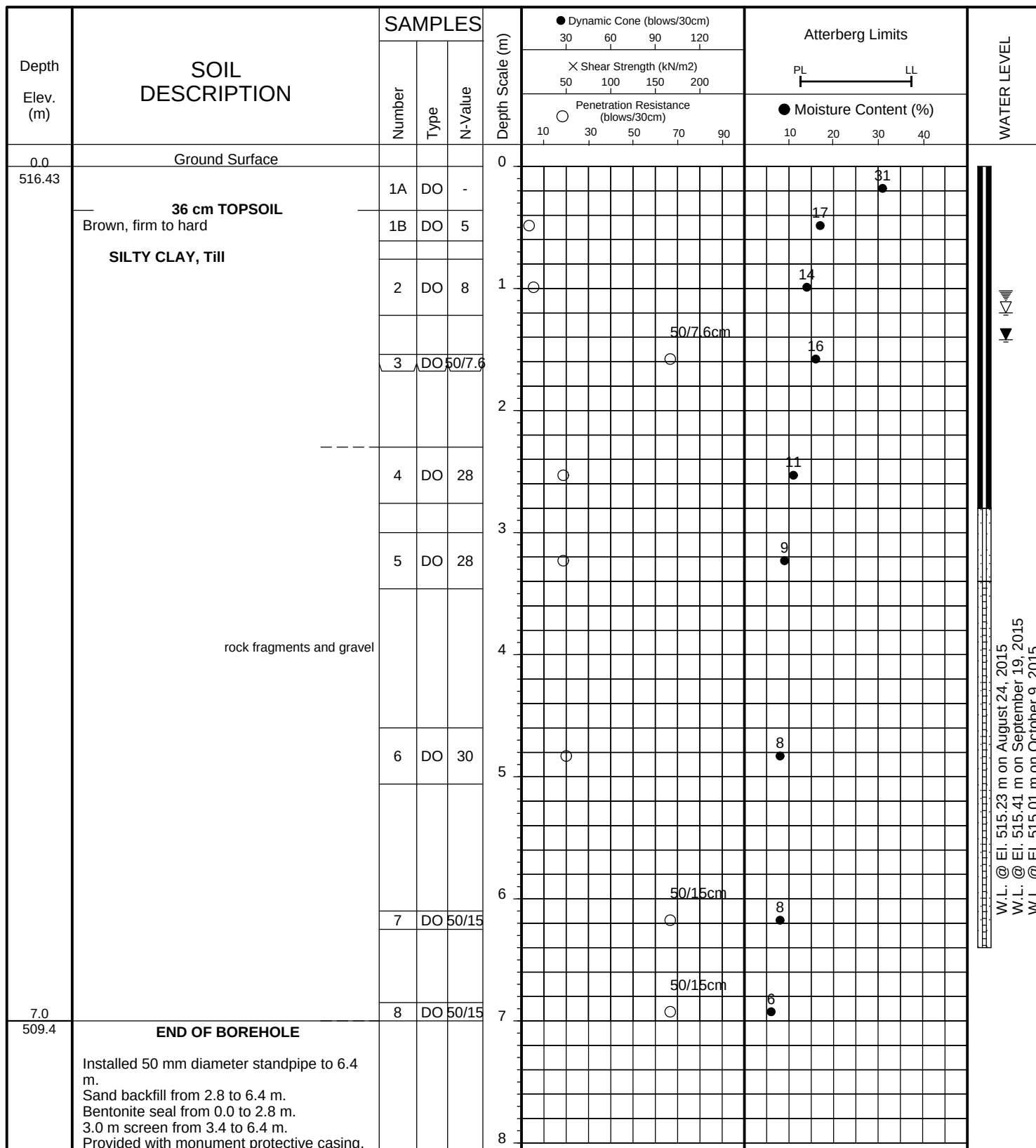
FIGURE NO: 6

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 6, 2015



Soil Engineers Ltd.

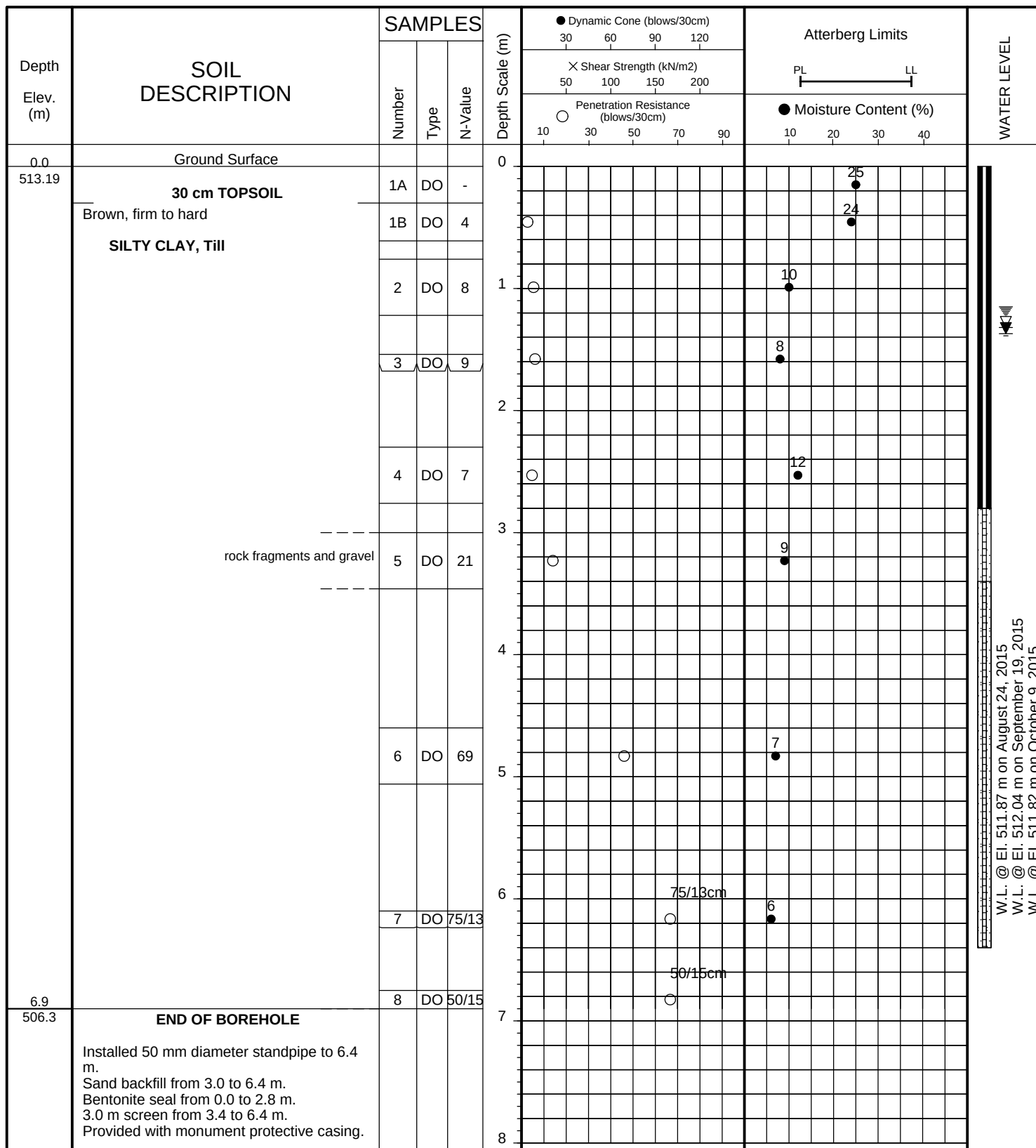
JOB NO: 1506-W067 **LOG OF BOREHOLE NO: BH/MW 106 D** **FIGURE NO: 7**

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 6, 2015



Soil Engineers Ltd.

LOG OF BOREHOLE NO: BH/MW 106 S *FIGURE NO: 8*

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

DATE: July 6, 2015

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES			Depth Scale (m)	Atterberg Limits		WATER LEVEL
		Number	Type	N-Value		● Dynamic Cone (blows/30cm) 30 60 90 120 X Shear Strength (kN/m2) 50 100 150 200 ○ Penetration Resistance (blows/30cm) 10 30 50 70 90	PL LL ● Moisture Content (%) 10 20 30 40	
0.0	Ground Surface				0			
513.23	30 cm TOPSOIL Brown, firm to hard SILTY CLAY, Till				1			
					2			
					3			
3.0	END OF BOREHOLE				4			
510.2	Installed 50 mm diameter standpipe to 3.0 m. Sand backfill from 0.91 to 3.0 m. Bentonite seal from 0.0 to 0.91 m. 1.5 m screen from 1.5 to 3.0 m. Provided with monument protective casing.				5			
					6			
					7			
					8			

W.L. @ El. 511.87 m on August 24, 2015
W.L. @ El. 512.02 m on September 19, 2015
W.L. @ El. 511.82 m on October 9, 2015



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JOB NO: 1506-W067

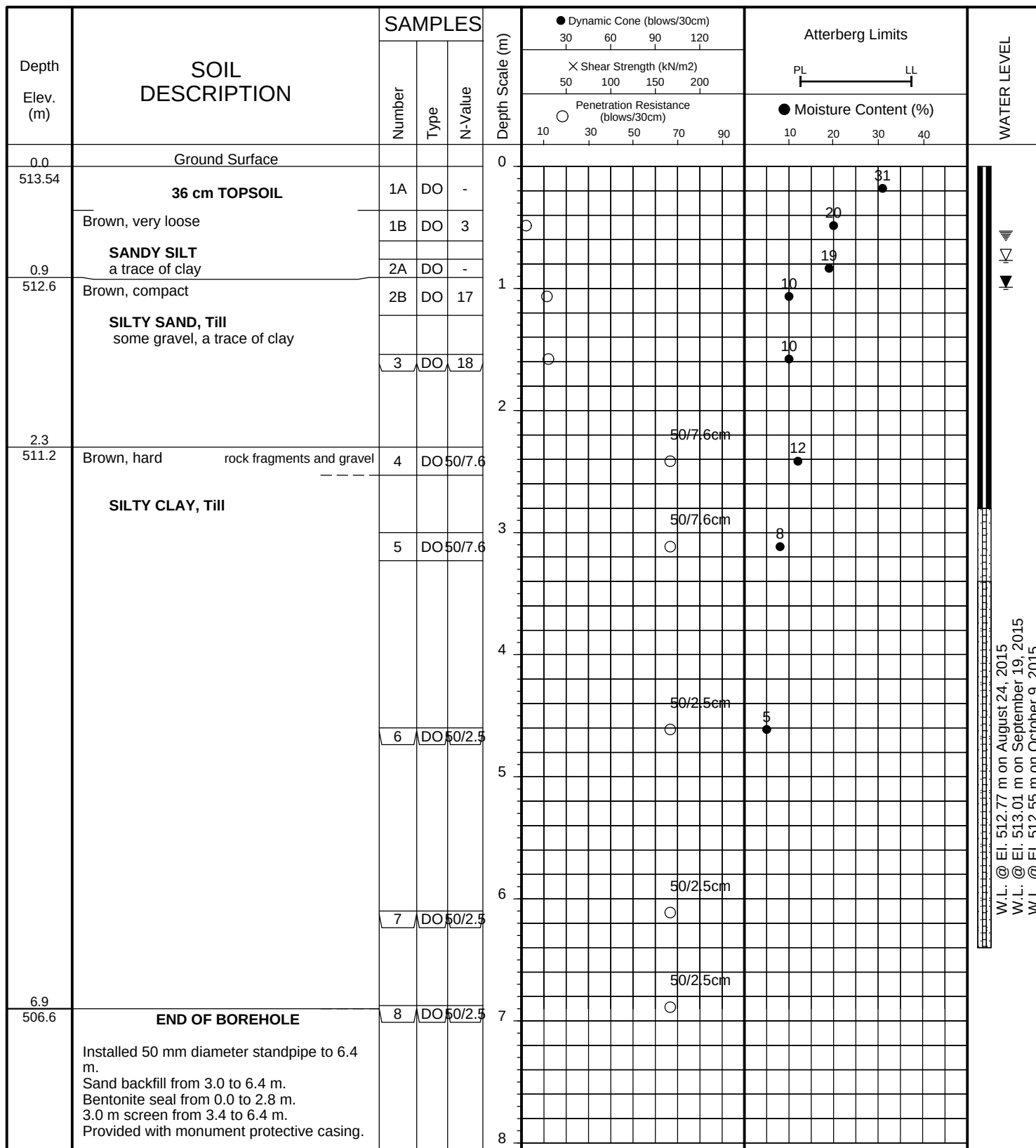
LOG OF BOREHOLE NO: BH/MW 107 D FIGURE NO: 9

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 8, 2015



Soil Engineers Ltd.

JOB NO: 1506-W067 **LOG OF BOREHOLE NO: BH/MW 107 S** **FIGURE NO: 10**

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 8, 2015

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES			Depth Scale (m)	● Dynamic Cone (blows/30cm) 30 60 90 120 X Shear Strength (kN/m ²) 50 100 150 200 ○ Penetration Resistance (blows/30cm) 10 30 50 70 90		Atterberg Limits PL ——— LL ● Moisture Content (%) 10 20 30 40		WATER LEVEL
		Number	Type	N-Value						
0.0	Ground Surface				0					
513.55	36 cm TOPSOIL									
	Brown, very loose SANDY SILT a trace of clay									
0.9					1					
512.6	Brown, compact SILTY SAND, Till some gravel, a trace of clay									
2.3					2					
511.3	Brown, hard rock fragments and gravel SILTY CLAY, Till									
3.0					3					
510.6	END OF BOREHOLE									W.L. @ El. 512.79 m on August 24, 2015 W.L. @ El. 513.04 m on September 19, 2015 W.L. @ El. 512.62 m on October 9, 2015
	Installed 50 mm diameter standpipe to 3.0 m. Sand backfill from 0.91 to 3.0 m. Bentonite seal from 0.0 to 0.91 m. 1.5 m screen from 1.5 to 3.0 m. Provided with monument protective casing.									
					4					
					5					
					6					
					7					
					8					



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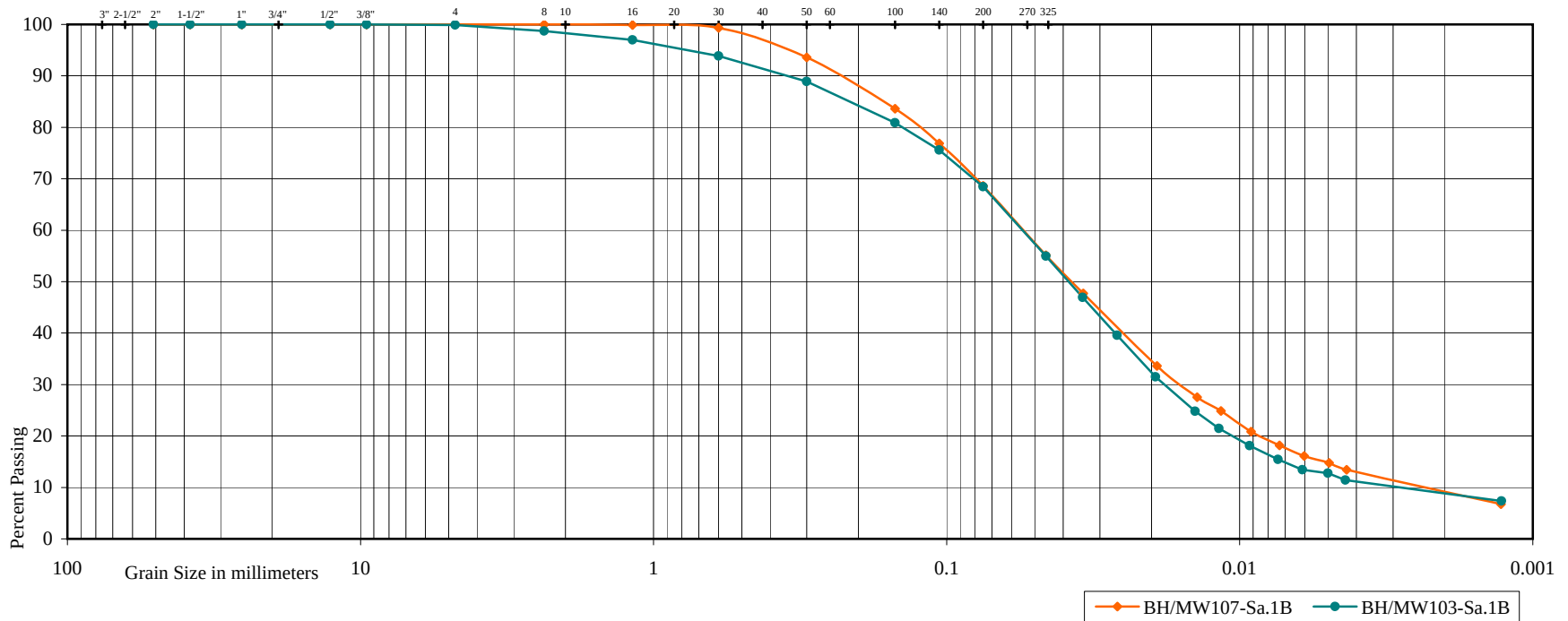


U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL			SAND				SILT	CLAY
COARSE		FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND				SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		



Project: Proposed Residential Development

Location: 772146 Highway 10, Township of Southgate (Community of Dundalk)

Borehole No: 107 103

Sample No: 1B 1B

Depth (m): 0.5 0.5

Elevation (m): 513.04 514.88

Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

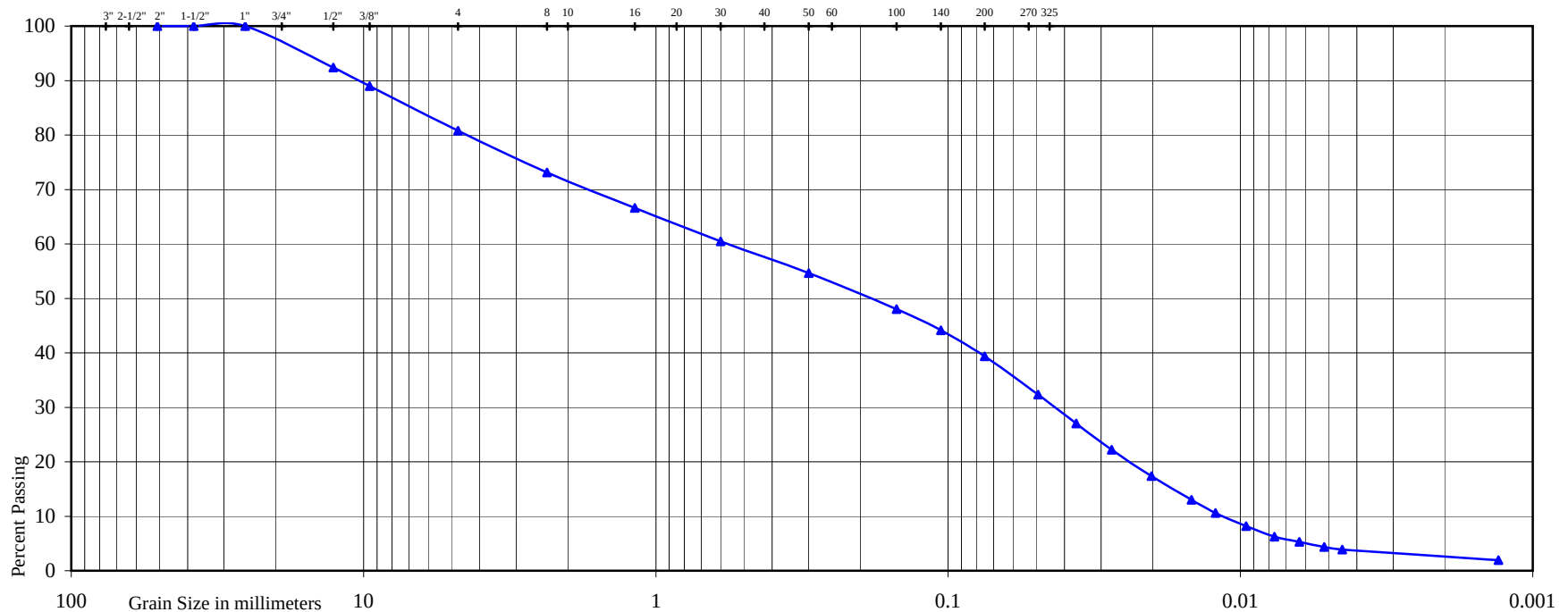


U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Residential Development

Location: 772146 Highway 10, Township of Southgate (Community of Dundalk)

Borehole No: 107

Sample No: 2B

Depth (m): 1.1

Elevation (m): 512.44

Classification of Sample [& Group Symbol]: SILTY SAND TILL, some gravel, a trace of clay

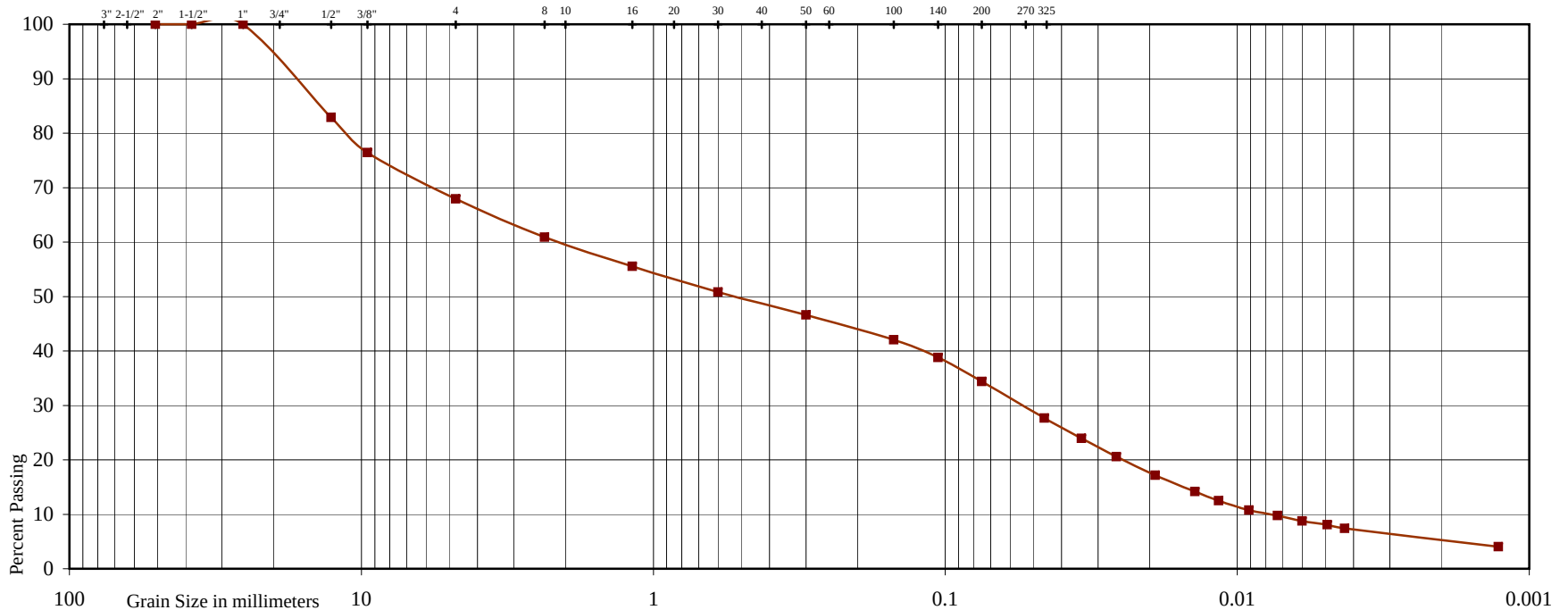


U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL			SAND				SILT	CLAY
COARSE		FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Residential Development

Location: 772146 Highway 10, Township of Southgate (Community of Dundalk)

Borehole No: 102

Sample No: 4

Depth (m): 2.5

Elevation (m): 515.5

Classification of Sample [& Group Symbol]: GRAVELLY SAND, silty, a trace of clay



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

DRAWINGS

REFERENCE NO. 1506-W067



- Approximate Boundary of Subject Site
- Principal Highway
- Major Road
- Local Road
- ▶ Watercourse
- Railway



Title: Site Location Plan

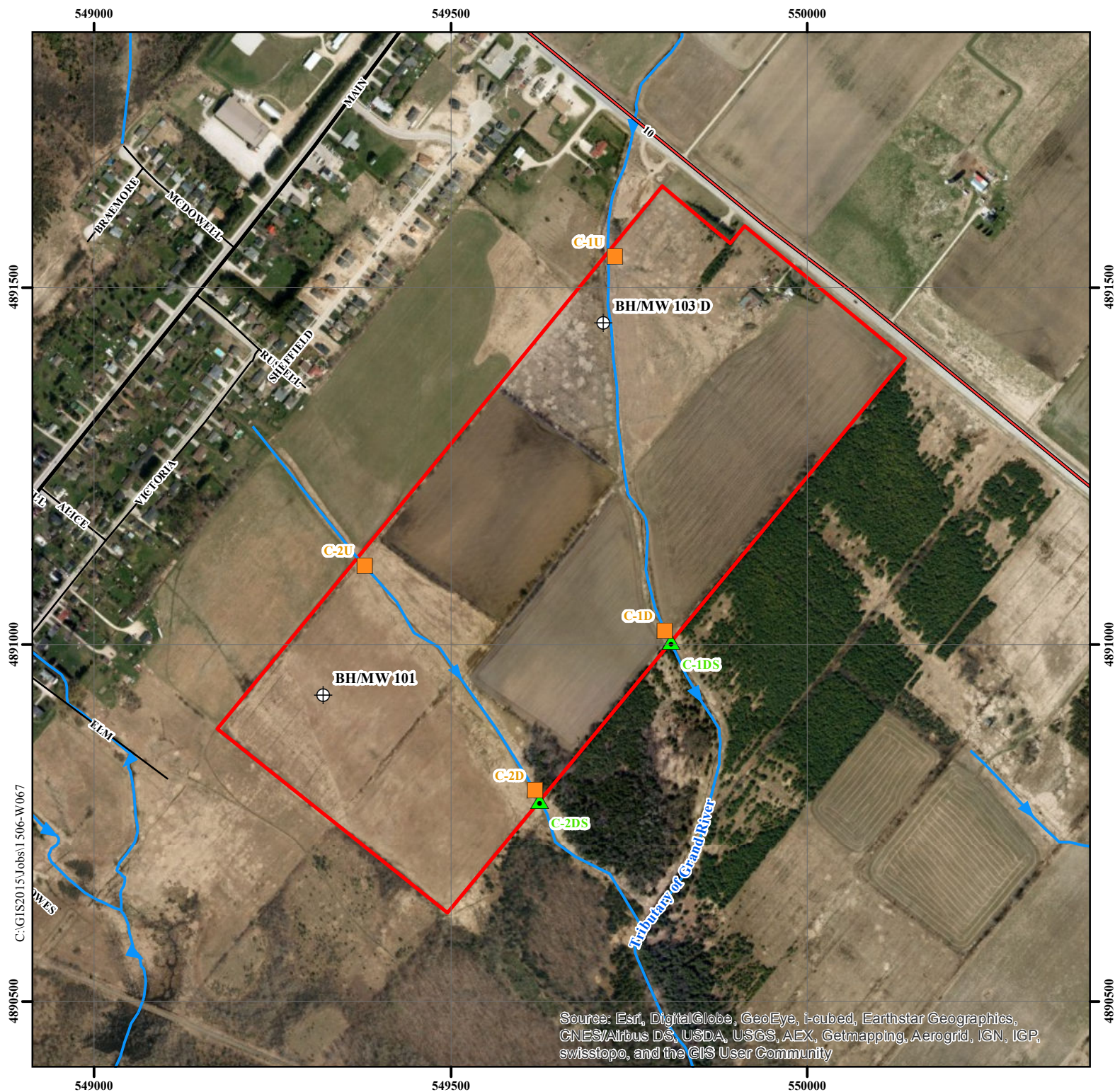
Project:
Hydrogeological Study and
Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 15, 2015

Scale:
0 80 160 320 480 640
Metres

Drawing No. 1





N

- Approximate Boundary of Subject site
- Groundwater Sampling Location
- Flow Rate Measurement Station
- Surface Water Sampling Location
- Principal Highway
- Major Road
- Local Road
- Watercourse



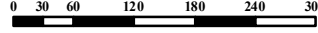
Soil Engineers Ltd.

Title: Water Sampling Location and Flow Rate Measurement Station Plan

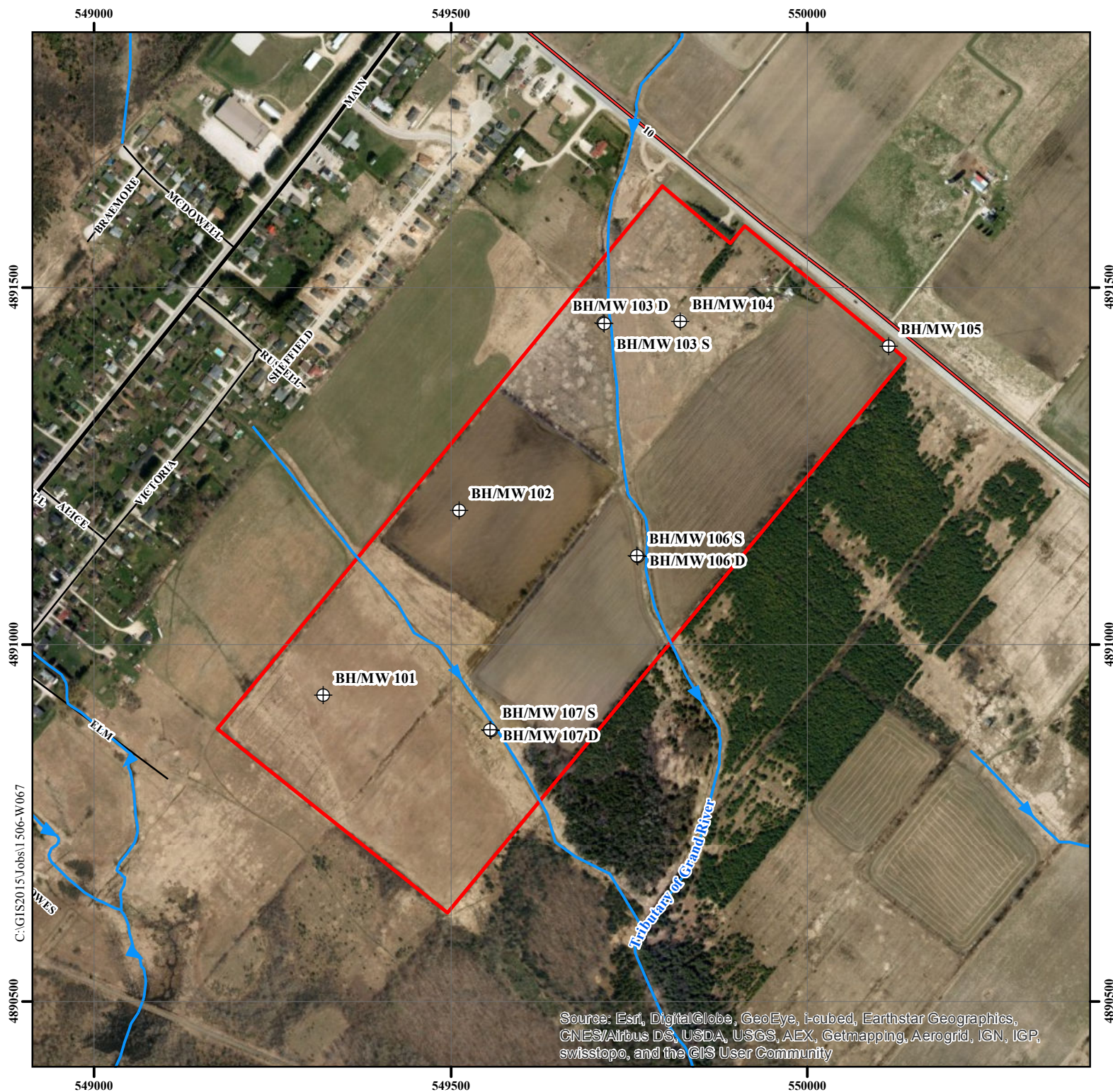
Project:
 Hydrogeological Study and Groundwater Monitoring
 Proposed Residential Development
 772146 Highway 10
 Township of Southgate
 (Community of Dundalk)

Reference No. 1506-W067

Date: July 22, 2015

Scale:

 0 30 60 120 180 240 300
 Metres

Drawing No. 10



- Approximate Boundary of Subject site
- Borehole and Monitoring Well Location
- Principal Highway
- Major Road
- Local Road
- Watercourse



Title: Borehole and Monitoring Well Location Plan

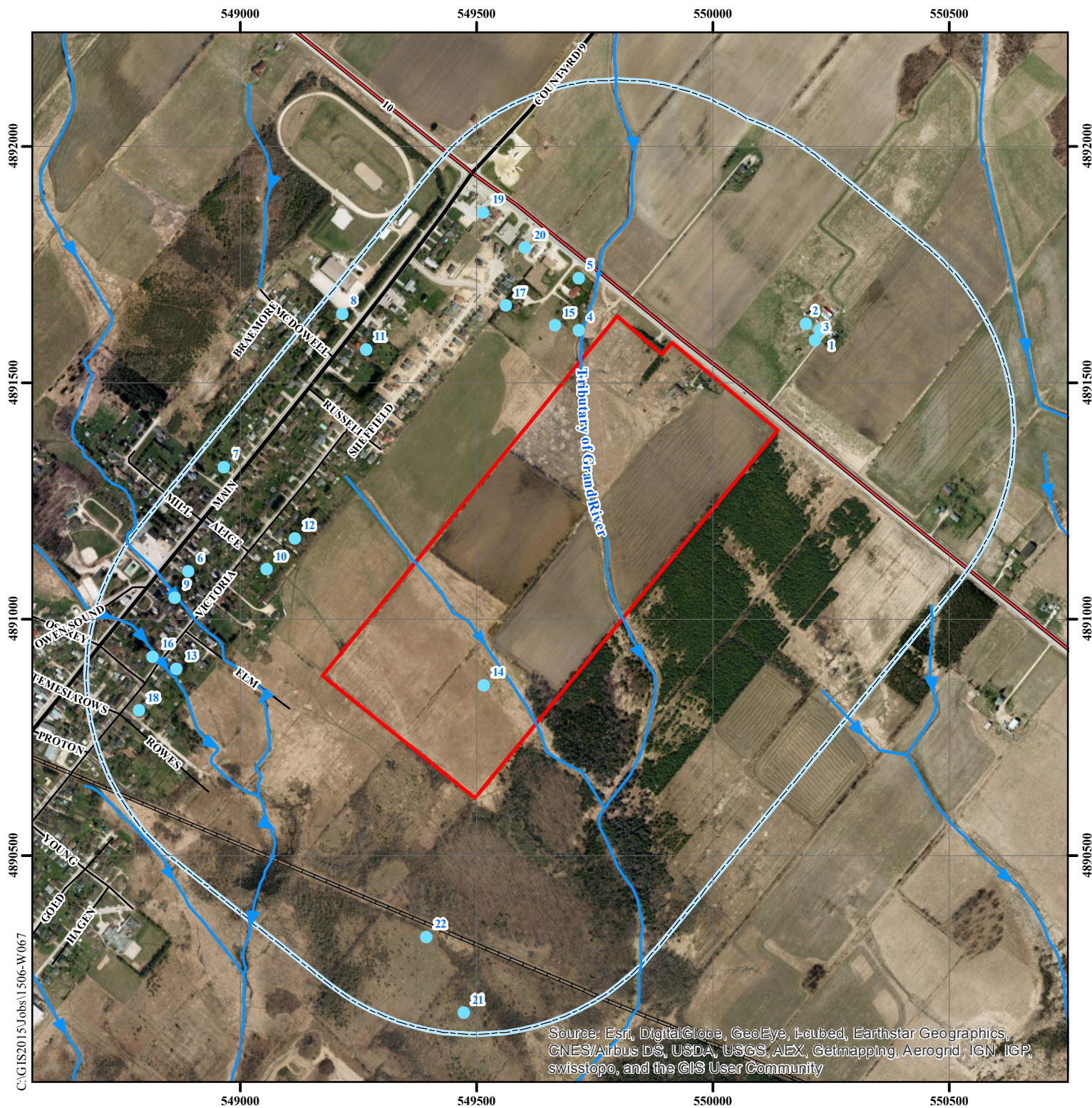
Project:
Hydrogeological Study and
Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 22, 2015

Scale:
30003060120180240
Metres

Drawing No. 2



-  Approximate 500 metres from Subject Site Boundary
-  Approximate Boundary of Subject Site
-  Well Locations from MOECC Well Records
-  Principal Highway
-  Major Road
-  Local Road
-  Watercourse
-  Railway



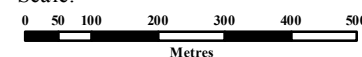
Title: MOECC Well Location Plan

Project:
Hydrogeological Study and
Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

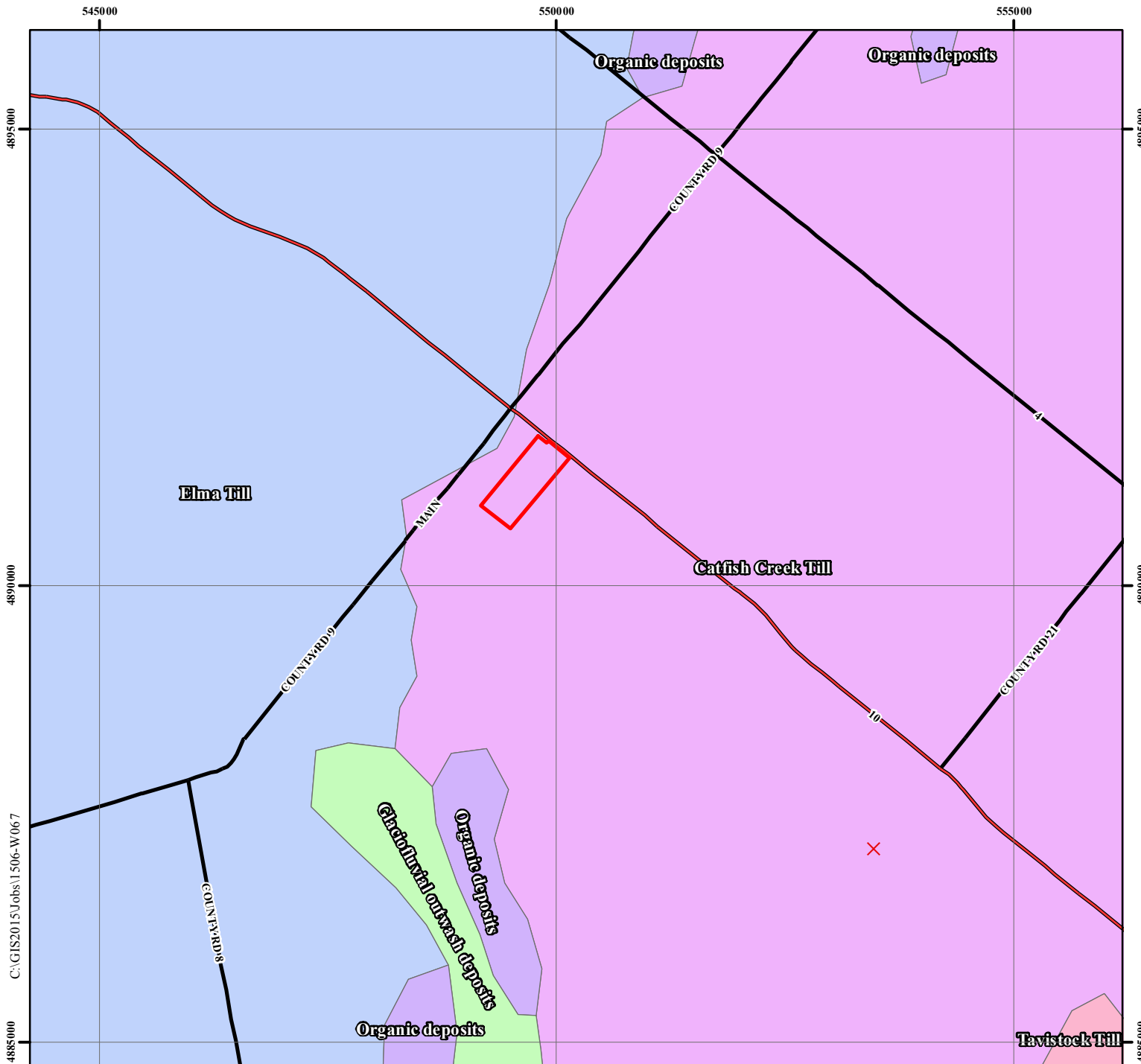
Reference No. 1506-W067

Date: July 15, 2015

Scale:



Drawing No. 3



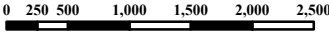
Source: Ontario Geological Survey, 1997,
Surface Geology of Ontario; Ontario Geological Survey,
Miscellaneous Released-Data 0014

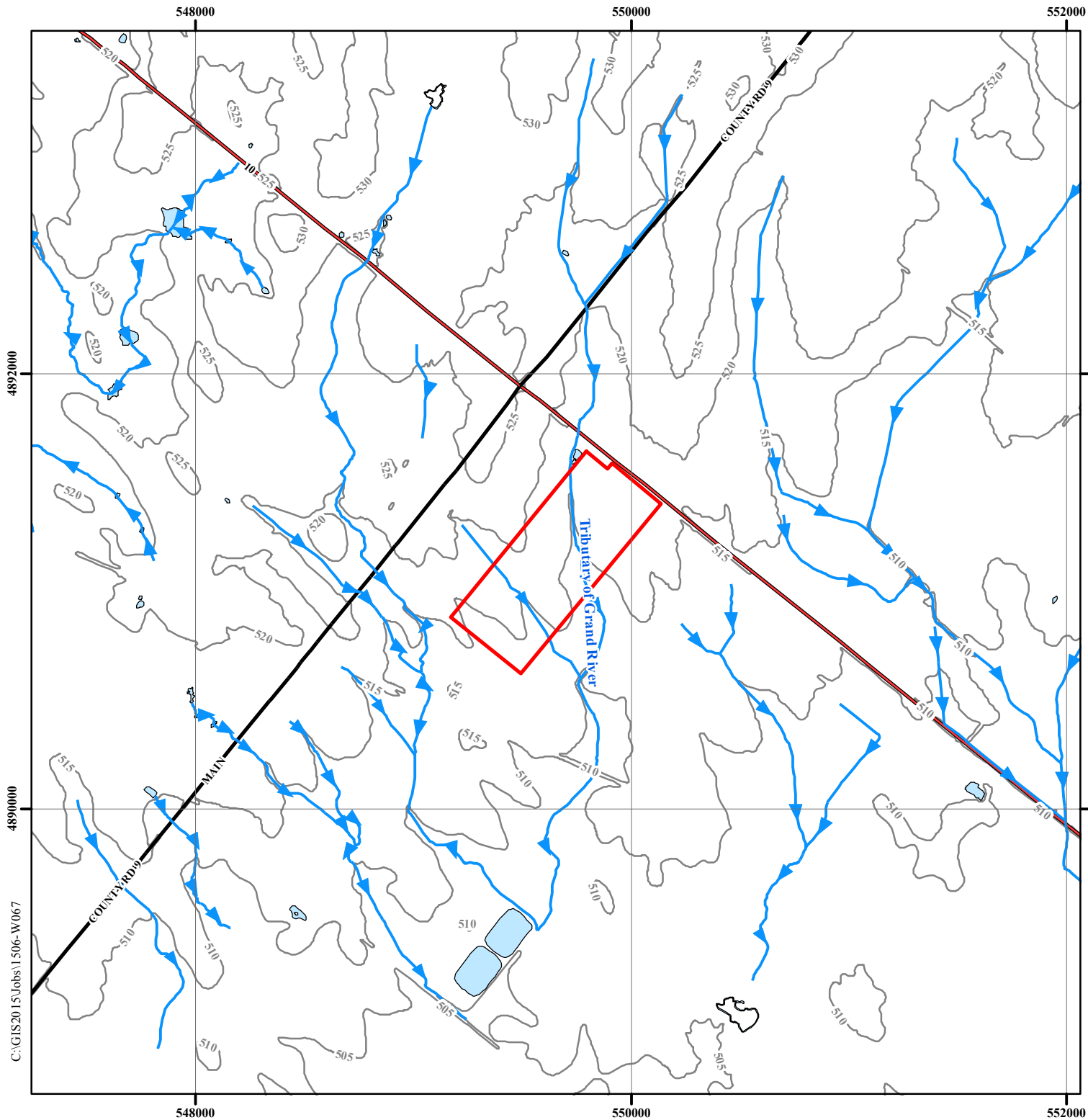
Source: Oak Ridges Moraine, Ontario Ministry of Natural Resources and Forestry
© Queen's Printer for Ontario

Source: Wetland, Ontario Ministry of Natural Resources and Forestry
© Queen's Printer for Ontario, 2012

Source: Water Course, Ontario Ministry of Natural Resources and Forestry
© Queen's Printer for Ontario

Source: Water Body, Ontario Ministry of Natural Resources and Forestry
© Queen's Printer for Ontario

	
	Approximate Boundary of Subject Site
	Bedrock Outcrops
	Catfish Creek Till Material: sandy silt to silt matrix, strongly calcareous, moderately stony to stony
	Elma Till Material: sandy silt to silt matrix, clayey silt along southern margin, moderately stony, strongly calcareous
	Organic deposits material: peat, muck and marl
	Glaciofluvial outwash deposits Material: gravel and sand, includes proglacial river and deltaic deposits
	Tavistock Till Material: sandy silt to silt matrix, silty clay matrix in south and in north, moderate to high carbonate content, clast content decreases from moderate to poor northward
	Principal Highway
	Major Road
 Soil Engineers Ltd.	
Title: Quaternary and Surface Geology Map	
Project: Hydrogeological Study and Groundwater Monitoring Proposed Residential Development 772146 Highway 10 Township of Southgate (Community of Dundalk)	
Reference No. 1506-W067	
Date: July 15, 2015	
Scale: 	
Drawing No. 4	



-  Approximate Boundary of Subject Site
-  Water Body
-  Topographic Contour (masl)
-  Watercourse
-  Principal Highway
-  Major Road



Title: Topographic Map

Project:
Hydrogeological Study and
Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

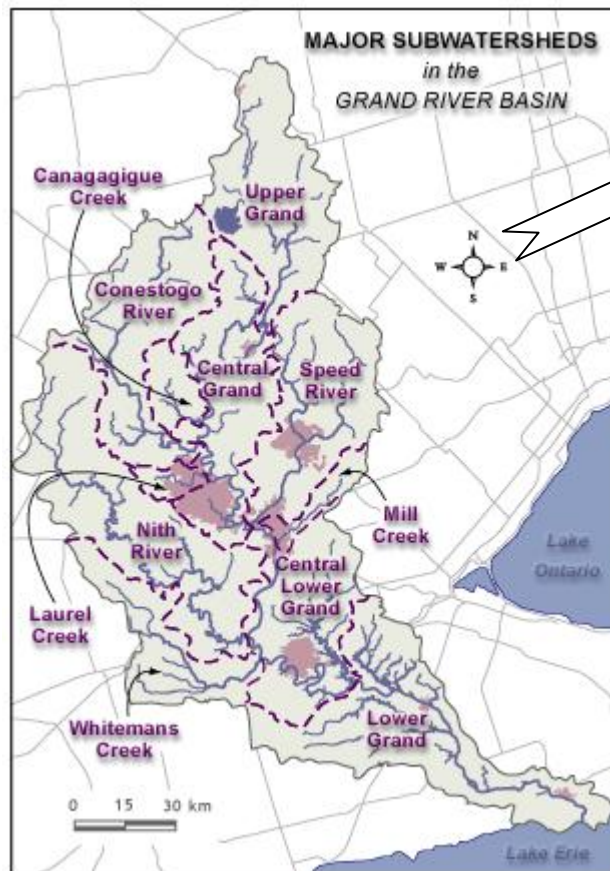
Reference No. 1506-W067

Date: July 15, 2015

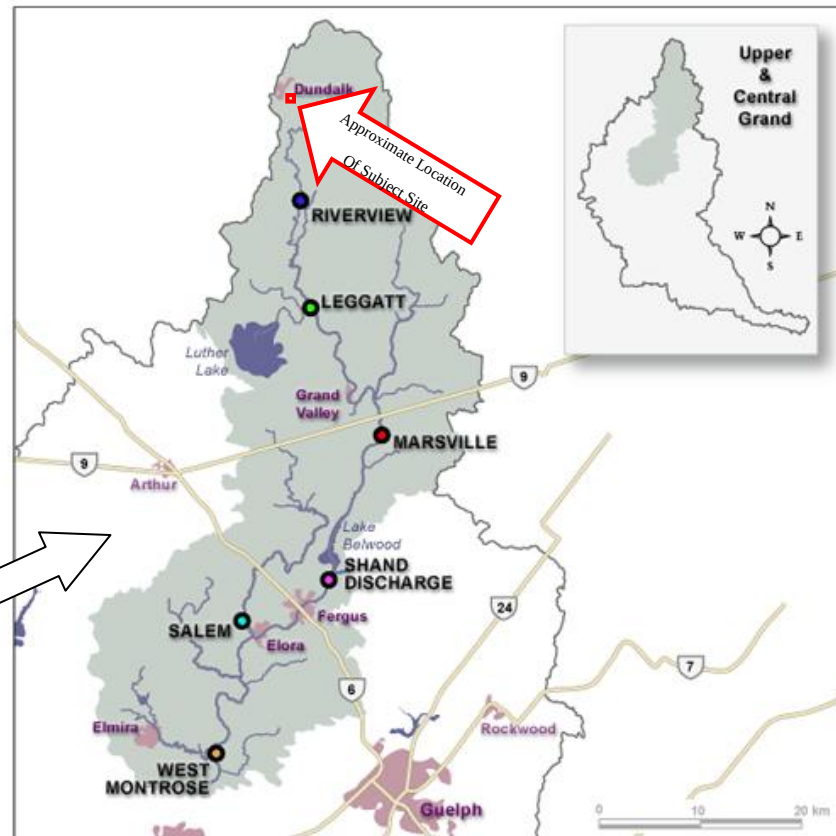
Scale:
0 125 250 500 750 1,000
Metres

Drawing No. 5

Source: Contour, Ontario Ministry of Natural Resources
©Queen's Printer for Ontario, 2012
Source: Water Course, Ontario Ministry of Natural Resources
©Queen's Printer for Ontario, 2012
Source: Water Body, Ontario Ministry of Natural Resources
©Queen's Printer for Ontario, 2012



Source: Grand River Conservation Authority



 Approximate Location of Subject Site



Title
Watershed and Sub-watershed Map

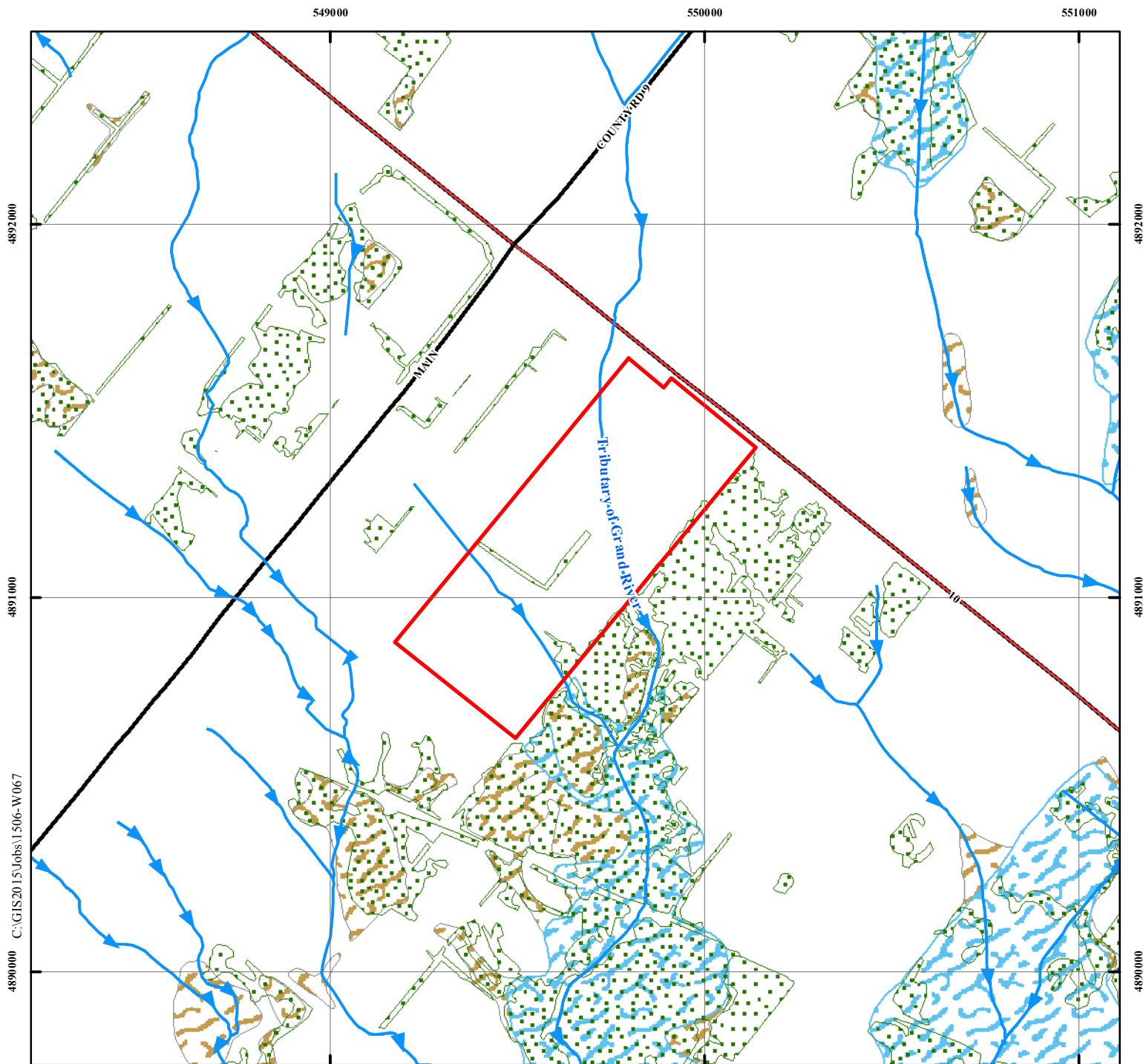
Project
Limited Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No.
1506-W067

Date
July 16, 2015

Scale
See maps

Drawing No. 6





	Approximate Boundary of Subject Site
	Watercourse
	Wooded Area
	Wetland (classified as Provincial)
	Wetland (non-classified)
	Principal Highway
	Major Road

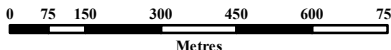

Soil Engineers Ltd.

Title: Natural Features and Protection Area Plan

Project:
 Hydrogeological Study and Groundwater Monitoring
 Proposed Residential Development
 772146 Highway 10
 Township of Southgate
 (Community of Dundalk)

Reference No. 1506-W067

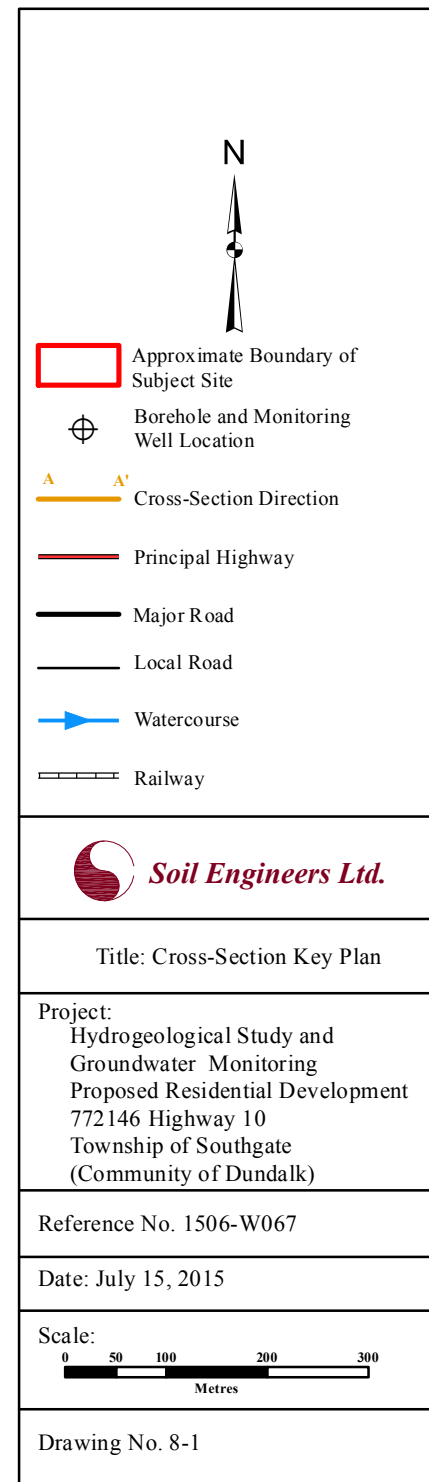
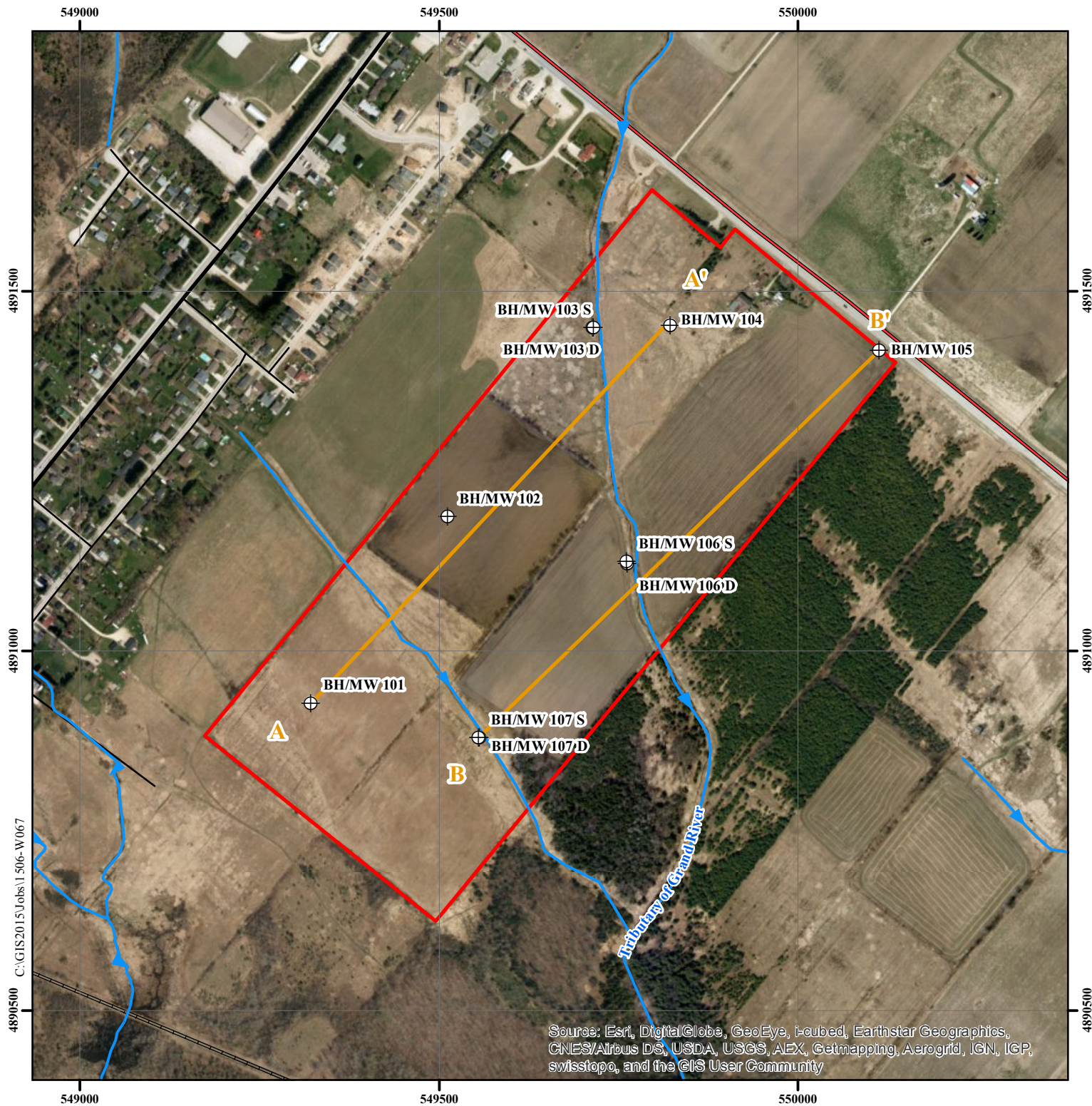
Date: July 15, 2015

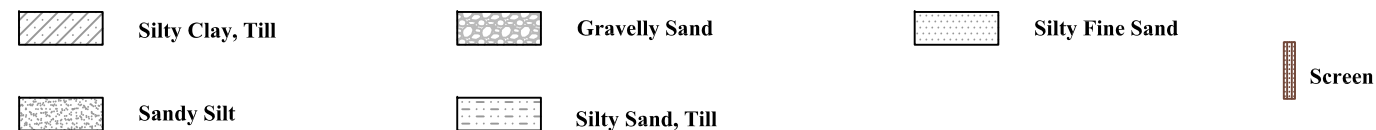
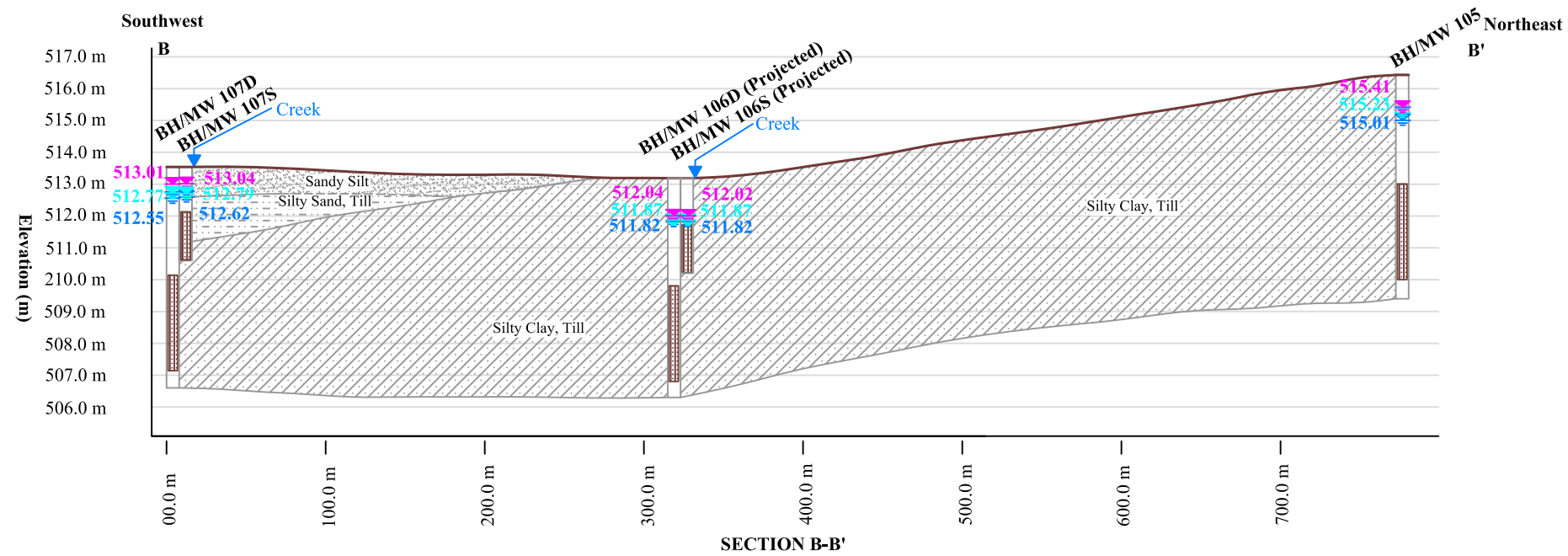
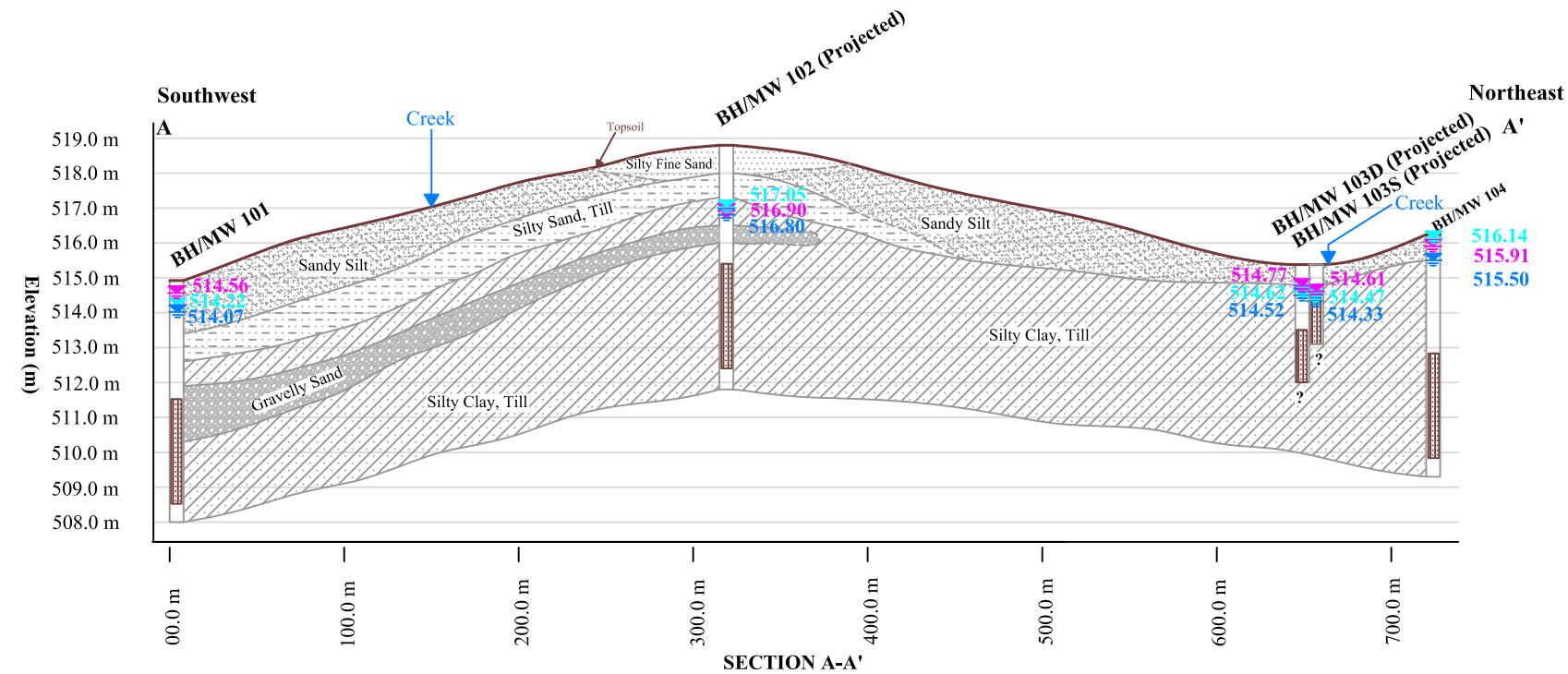
Scale:


Drawing No. 7

Contains information licensed under the Open Government Licence – Ontario, 2014.
 Includes information: Provincial Park, Conservation Reserve, Area of Natural and Scientific Interest,
 Wetland, Niagara Escarpment Protection Area, Oak Ridges Moraine Conservation and Wilderness Areas

Source: Water Course, Ontario Ministry of Natural Resources and Forestry
 ©Queen's Printer for Ontario
 Source: Water Body, Ontario Ministry of Natural Resources and Forestry
 ©Queen's Printer for Ontario

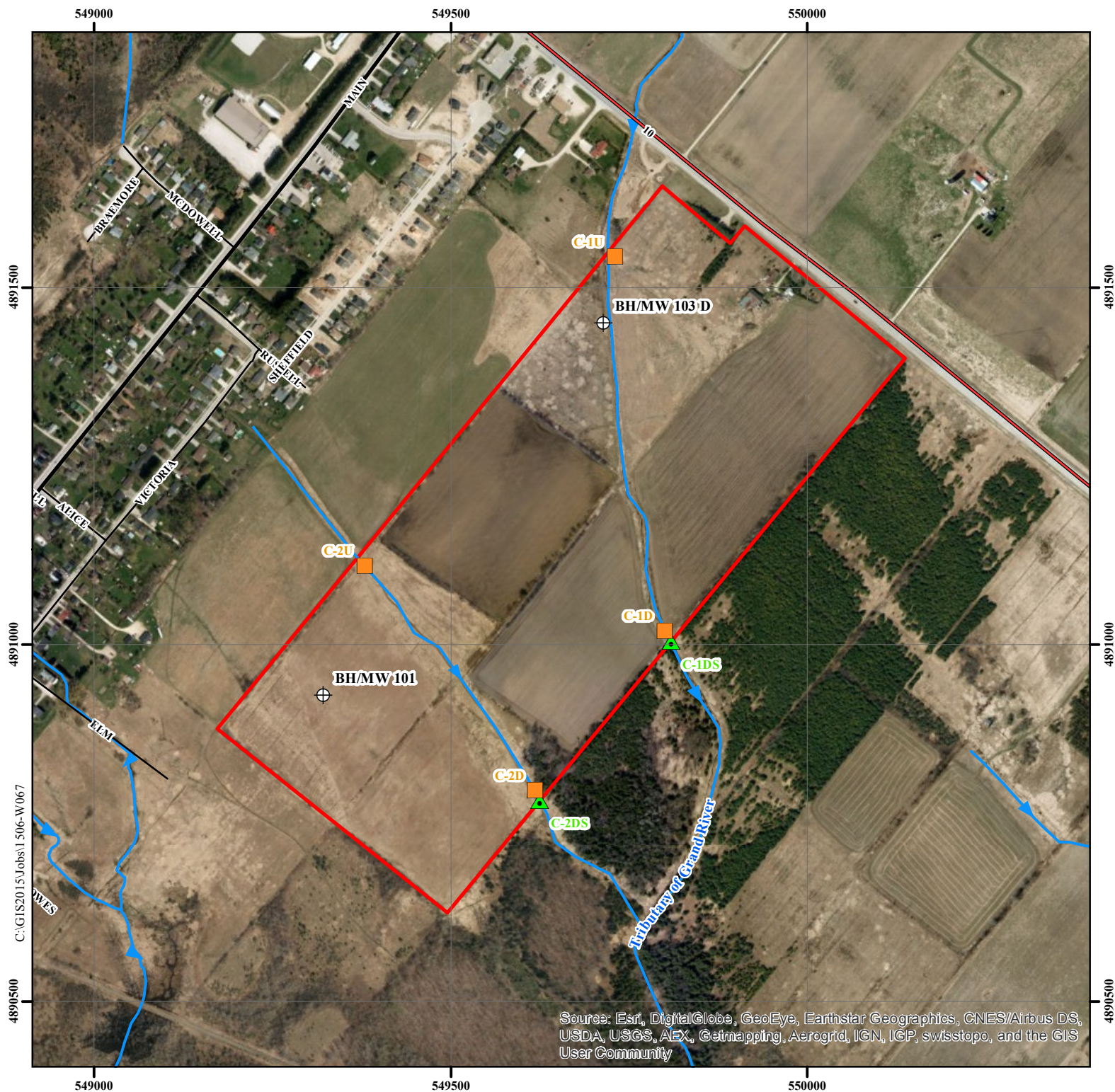




Title: Geological Cross-Sections (A-A' and B-B')

Project: Proposed Single Lot Residential Development
772146 Highway 10, Township of Southgate (Community of Dundalk)

Reference No: 1507-W067	Date: August, 2015	Scale: V 1:200	Scale: H 1:4000	Drawing No. 8-2
----------------------------	-----------------------	-------------------	--------------------	--------------------





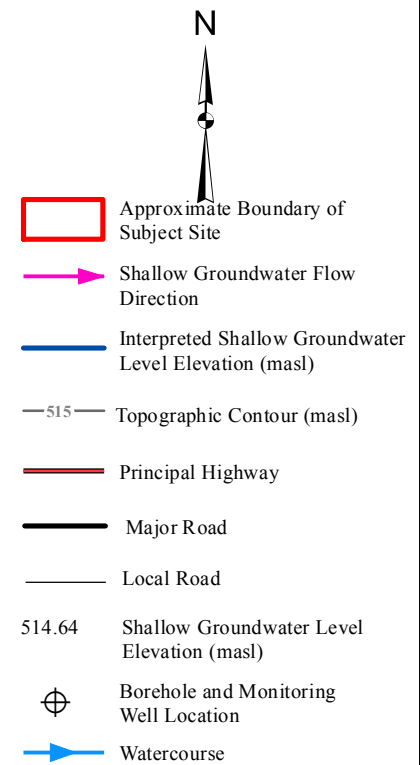
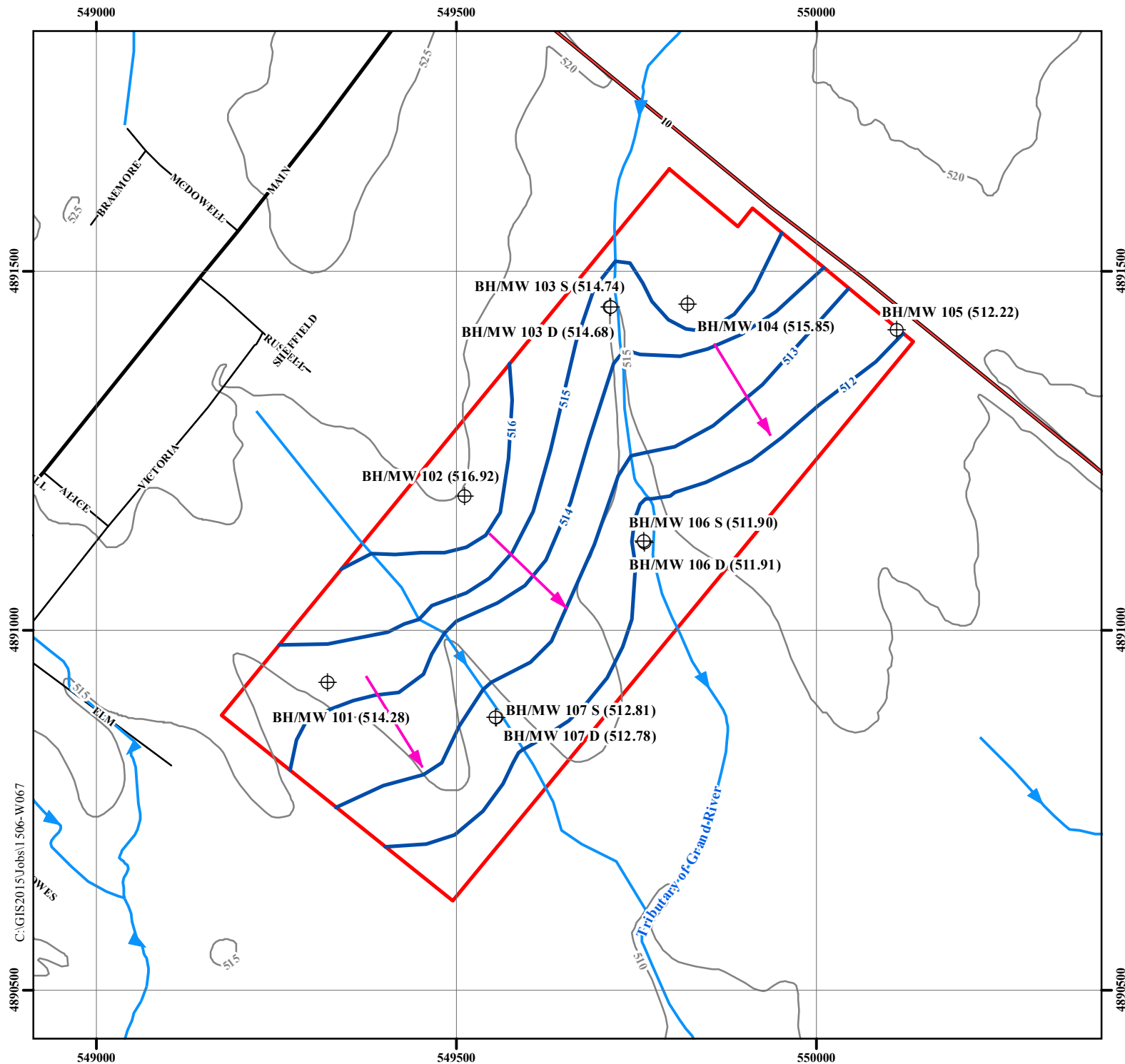
N

	Approximate Boundary of Subject site
	Groundwater Sampling Location
	Flow Rate Measurement Station
	Surface Water Sampling Location
	Principal Highway
	Major Road
	Local Road
	Watercourse



Soil Engineers Ltd.

Title: Water Sampling Location and Flow Rate Measurement Station Plan	
Project: Hydrogeological Study and Groundwater Monitoring Proposed Residential Development 772146 Highway 10 Township of Southgate (Community of Dundalk)	
Reference No. 1506-W067	
Date: July 22, 2015	
Scale:  0 30 60 120 180 240 300 Metres	
Drawing No. 9	



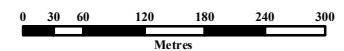
Title: Shallow Groundwater
Flow Pattern Plan

Project:
Hydrogeological Study and
Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 15, 2015

Scale:



Drawing No. 10



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

APPENDIX 'A'

MOECC WATER WELL RECORDS SUMMARY

REFERENCE NO. 1506-W067

Ontario Water Well Records

WELL ID	MOECC WWR ID*	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**
				Final Status	First Use			
1	1701081	Cable Tool	36.58	Water Supply	Livestock	3.05	—	—
2	1700353	Cable Tool	29.26	Water Supply	Livestock	12.20	—	—
3	1701258	Cable Tool	36.58	Water Supply	Domestic	9.15	—	—
4	2504108	Cable Tool	28.96	Water Supply	Domestic	3.66	—	—
5	2502008	Cable Tool	28.04	Water Supply	Commerical	3.05	—	—
6	2500878	Cable Tool	48.46	Water Supply	Domestic	4.88	—	—
7	2500880	Cable Tool	71.63	Water Supply	Domestic	8.85	—	—
8	2500881	Cable Tool	47.85	Water Supply	Domestic	3.05	—	—
9	2500884	Cable Tool	48.46	Water Supply	Domestic	5.80	—	—
10	2500887	Cable Tool	47.85	Water Supply	Domestic	4.88	—	—
11	2500890	Cable Tool	42.06	Water Supply	Livestock	11.59	—	—
12	2500891	Cable Tool	49.99	Water Supply	Domestic	6.10	—	—
13	2500894	Cable Tool	46.63	Water Supply	Domestic	5.49	—	—
14	2500896	Cable Tool	26.52	Water Supply	Domestic	10.68	—	—
15	2508694	Rotary (Convent.)	28.04	Water Supply	Domestic	1.83	—	—
16	2507815	Cable Tool	32.00	Water Supply	Domestic	11.90	—	—
17	2516239	Rotary (Convent.)	40.23	Water Supply	Domestic	10.37	—	—
18	2516756	—	—	Abandoned-Other	—	—	—	—
19	7151338	Boring	3.90	Test Hole	Test Hole	—	0.90	3.90
20	7175260	Rotary (Convent.)	4.27	Test Hole	Test Hole	—	4.27	1.22
21	7241221	—	—	—	—	—	—	—
22	7241222	—	—	—	—	—	—	—

*MOECC WWID: Ministry of Environment and Climate Change Water Well Records Identification

**metres below ground surface



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

APPENDIX 'B'

RESULTS OF SINGLE WELL RESPONSE TESTS

REFERENCE NO. 1506-W067

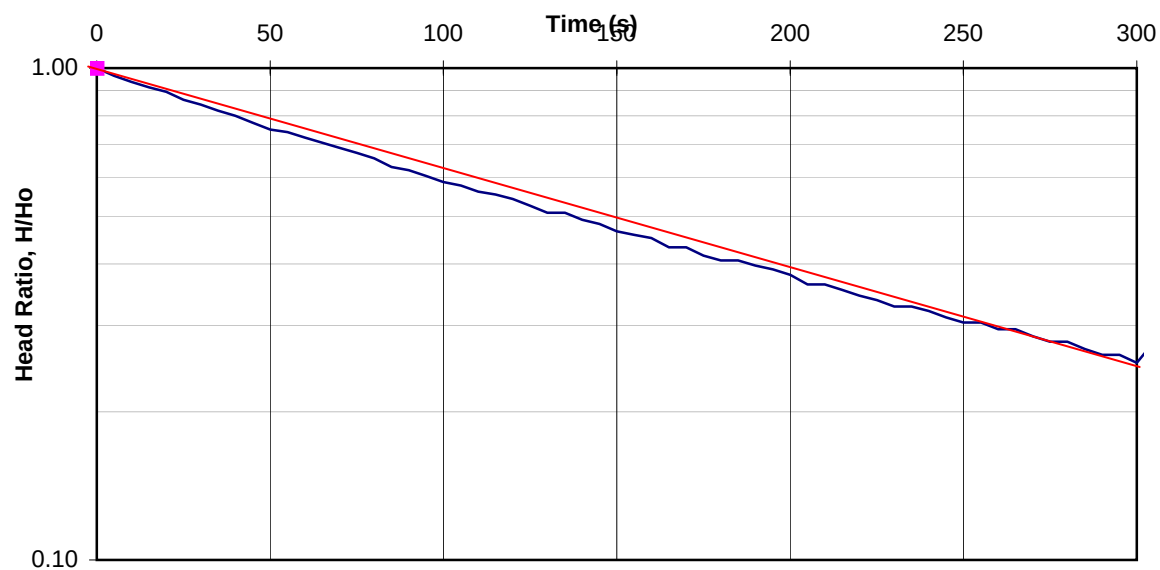
Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 101
 Ground level: 514.92 m
 Screen top level: 511.52 m
 Screen bottom level: 508.52 m
 Test El. (at midpoint of screen): 510.02 m
 Test depth (at midpoint of screen): 4.9 m
 Screen length L= 3 m
 Diameter of undisturbed portion $c \ 2R=$ 0.22 m
 Standpipe diameter $2r=$ 0.05 m
 Initial unbalanced head $H_o=$ -0.421 m
 Initial water depth 0.43 m
 Aquifer material: **Silty Clay Till and Gravelly Sand**
 $2 \times 3.14 \times L$
 Shape factor $F= \frac{3.14 \times r^2}{\ln(L/R)} = 5.701815 \text{ m}$

Permeability $K= \frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)

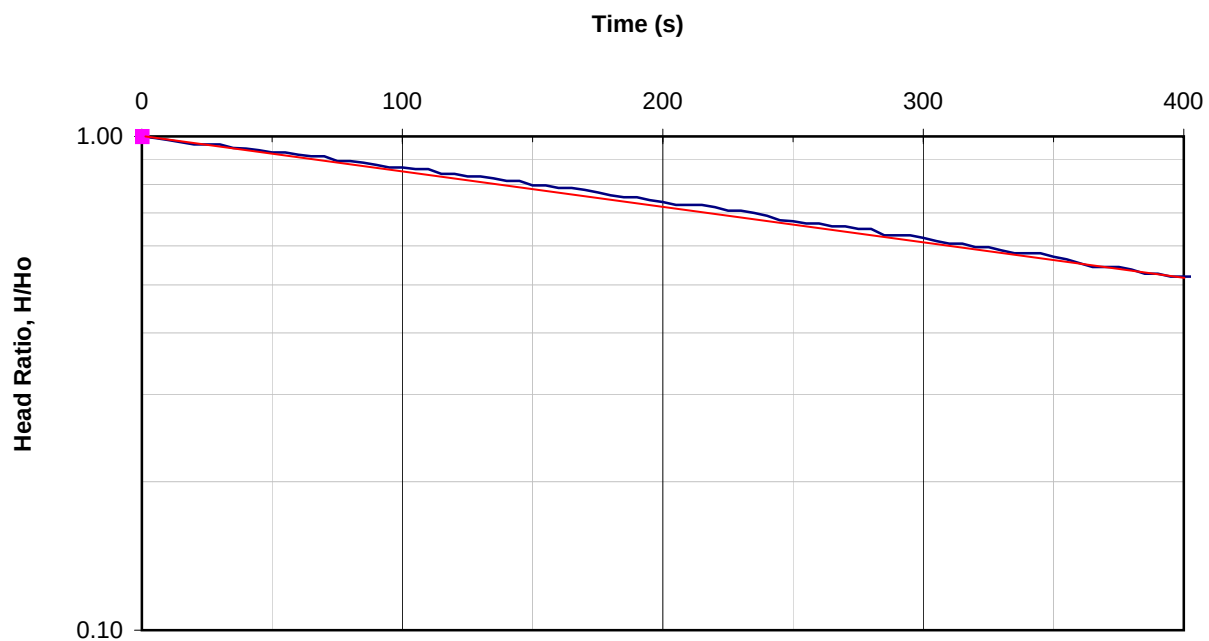
$$\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.00434316$$

$$K= \begin{matrix} 1.5E-04 \text{ cm/s} \\ 1.5E-06 \text{ m/s} \end{matrix}$$



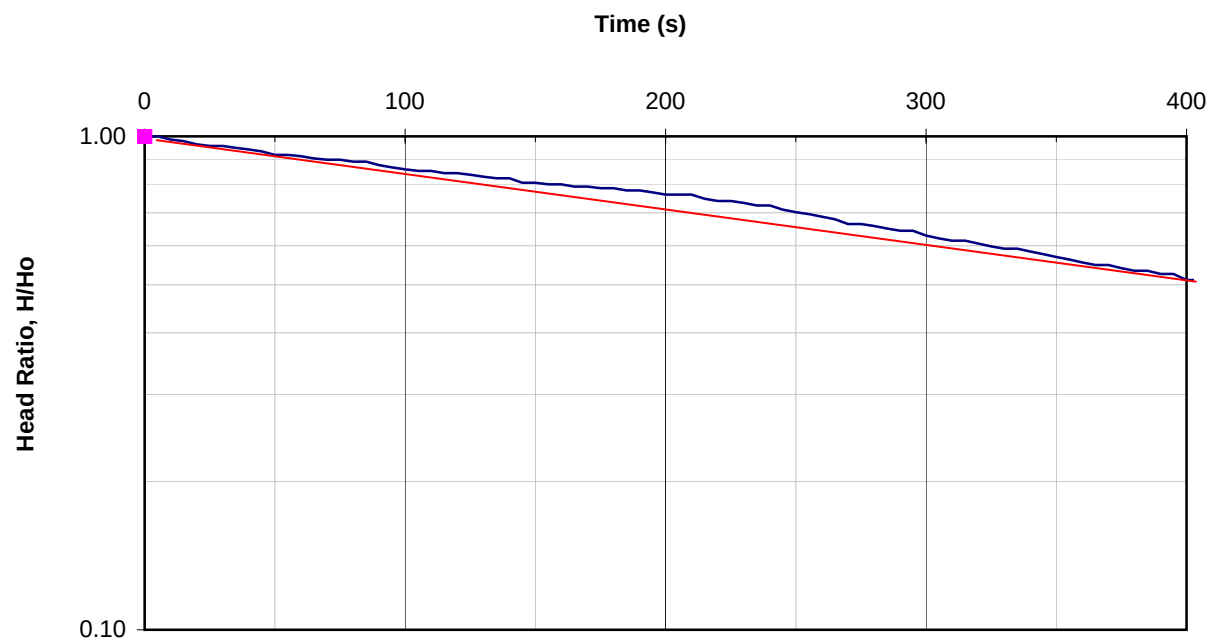
Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 102
 Ground level: 518.80 m
 Screen top level: 515.40 m
 Screen bottom level: 512.40 m
 Test El. (at midpoint of screen): 513.9 m
 Test depth (at midpoint of screen): 4.9 m
 Screen length L= 3 m
 Diameter of undisturbed portion c 2R= 0.22 m
 Standpipe diameter 2r= 0.05 m
 Initial unbalanced head Ho= -0.417 m
 Initial water depth 2.37 m
 Aquifer material: **Silty Clay, Till**
 2 x 3.14 x L
 Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 5.701815 m
 Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)
 $\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.001679069$
 K= **5.8E-05 cm/s**
5.8E-07 m/s



Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 103 D
 Ground level: 515.38 m
 Screen top level: 513.48 m
 Screen bottom level: 511.98 m
 Test El. (at midpoint of screen): 512.73 m
 Test depth (at midpoint of screen): 2.65 m
 Screen length L= 1.5 m
 Diameter of undisturbed portion c 2R= 0.22 m
 Standpipe diameter 2r= 0.05 m
 Initial unbalanced head Ho= -0.483 m
 Initial water depth 0.56 m
 Aquifer material: **Silty Clay Till**
 2 x 3.14 x L
 Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 3.607239 m
 Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)
 $\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.001801004$
 K= **9.8E-05 cm/s**
9.8E-07 m/s



Falling Head Test (Slug Test)

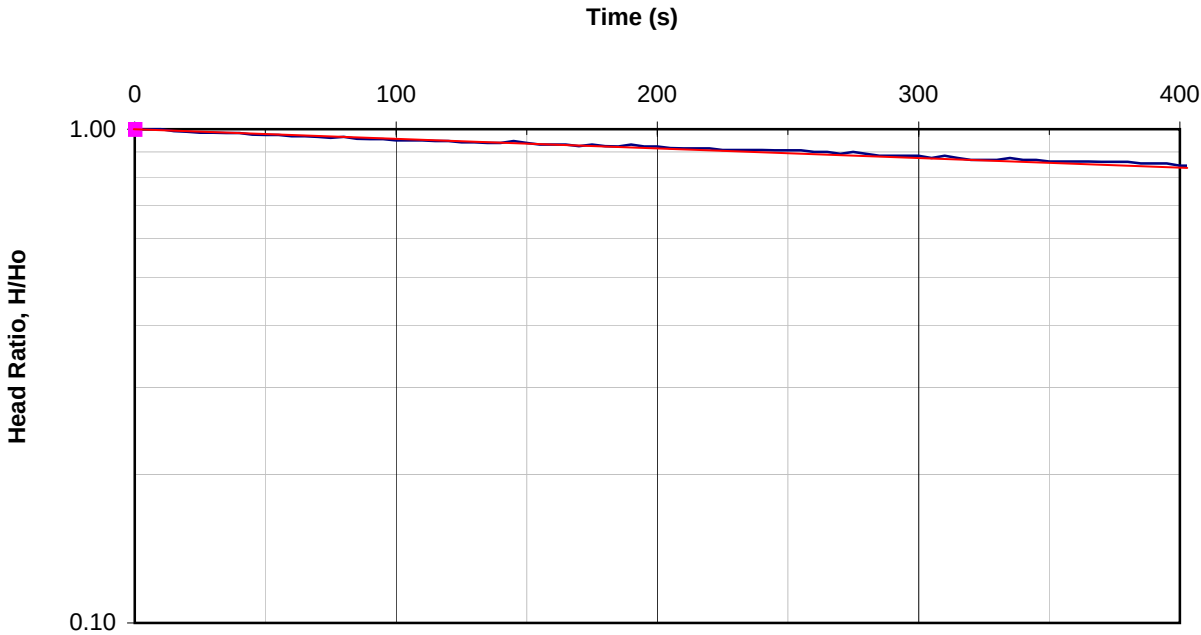
Test Date: 27-Aug-15
Piezometer/Well No.: BH/MW 104
Ground level: 516.24 m
Screen top level: 512.84 m
Screen bottom level: 509.84 m
Test El. (at midpoint of screen): 511.34 m
Test depth (at midpoint of screen): 4.9 m
Screen length L= 3 m

Diameter of undisturbed portion c 2R= 0.22 m
Standpipe diameter 2r= 0.05 m
Initial unbalanced head Ho= -0.487 m
Initial water depth 0.19 m
Aquifer material: **Silty Clay Till**
2 x 3.14 x L
Shape factor F= ----- = 5.701815 m
ln(L/R)

Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)}$ x ln (H1/H2) (Bouwer and Rice Method)

 $\frac{\ln (H_1/H_2)}{(t_2 - t_1)}$ = 0.000345109

K= **1.2E-05 cm/s**
1.2E-07 m/s

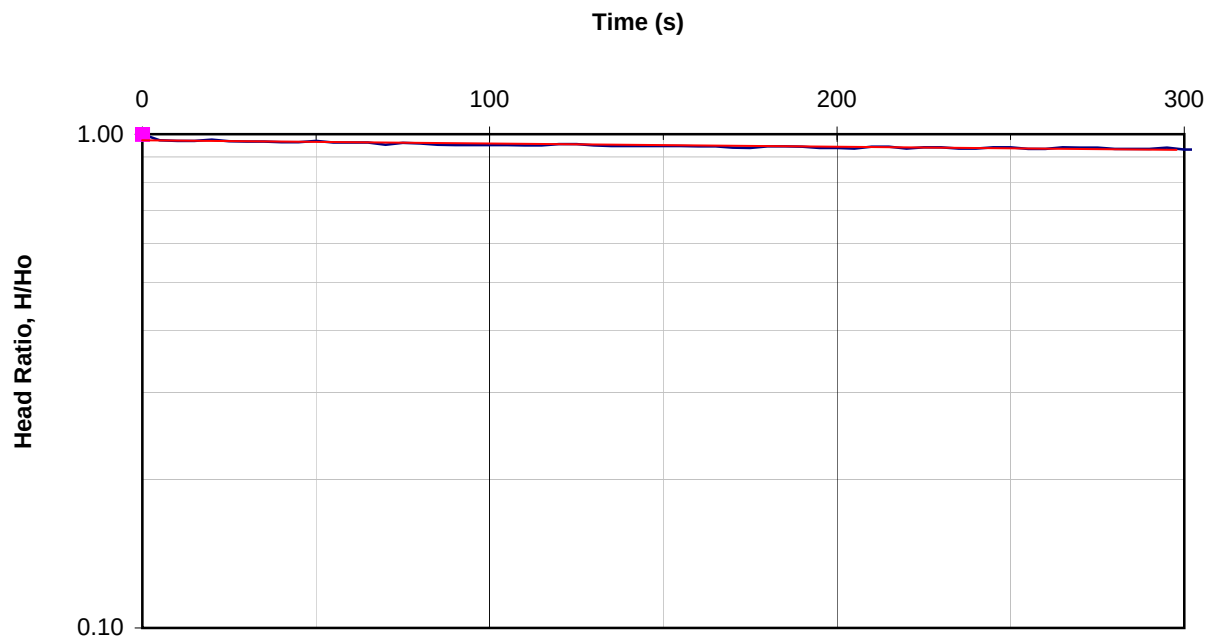


Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 105
 Ground level: 516.43 m
 Screen top level: 513.03 m
 Screen bottom level: 510.03 m
 Test El. (at midpoint of screen): 511.53 m
 Test depth (at midpoint of screen): 4.9 m
 Screen length L= 3 m
 Diameter of undisturbed portion c 2R= 0.22 m
 Standpipe diameter 2r= 0.05 m
 Initial unbalanced head Ho= -0.526 m
 Initial water depth 1.01 m
 Aquifer material: **Silty Clay Till**
 2 x 3.14 x L
 Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 5.701815 m
 Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)

$$\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.000154104$$

 K= **5.3E-06 cm/s**
5.3E-08 m/s

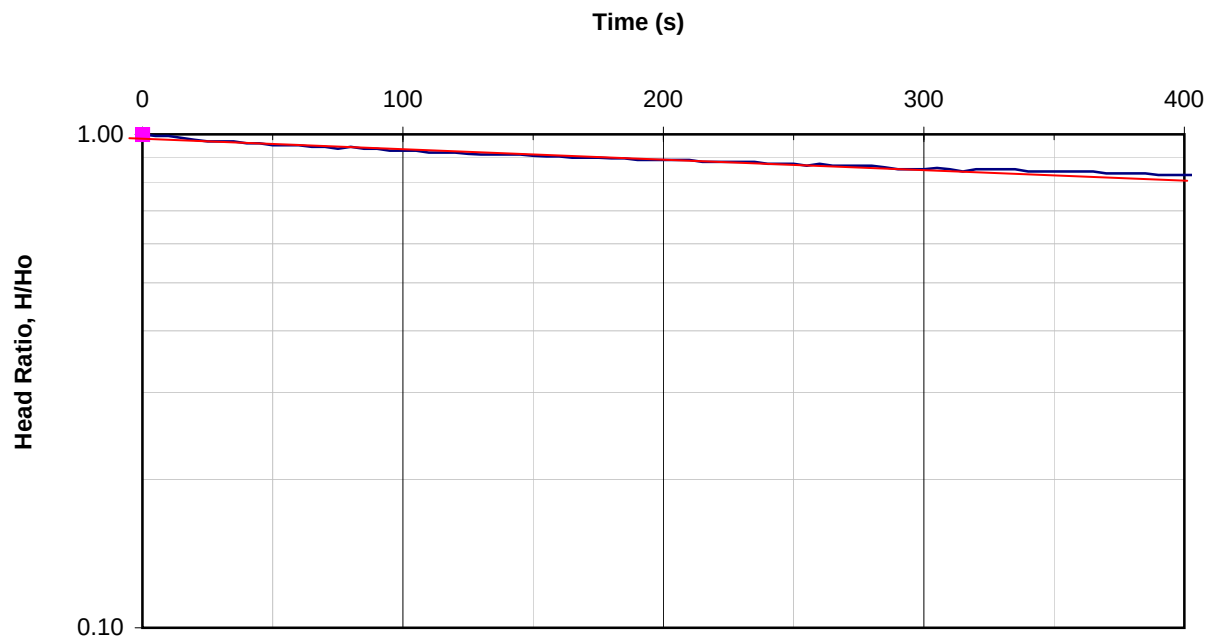


Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 106 D
 Ground level: 513.19 m
 Screen top level: 509.79 m
 Screen bottom level: 506.79 m
 Test El. (at midpoint of screen): 508.29 m
 Test depth (at midpoint of screen): 4.9 m
 Screen length L= 3 m
 Diameter of undisturbed portion c 2R= 0.22 m
 Standpipe diameter 2r= 0.05 m
 Initial unbalanced head Ho= -0.491 m
 Initial water depth 2.06 m
 Aquifer material: **Silty Clay Till**
 2 x 3.14 x L
 Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 5.701815 m
 Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)

$$\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.000373548$$

 K= **1.3E-05 cm/s**
1.3E-07 m/s

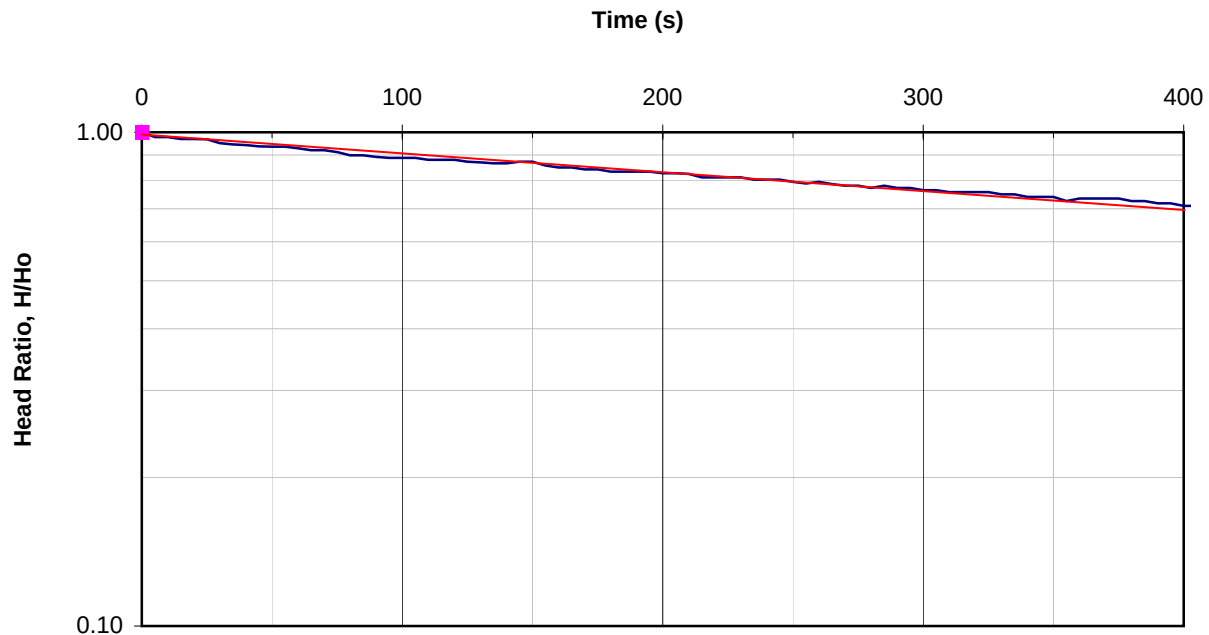


Falling Head Test (Slug Test)

Test Date: 27-Aug-15
 Piezometer/Well No.: BH/MW 107D
 Ground level: 513.54 m
 Screen top level: 510.14 m
 Screen bottom level: 507.14 m
 Test El. (at midpoint of screen): 508.64 m
 Test depth (at midpoint of screen): 4.9 m
 Screen length L= 3 m
 Diameter of undisturbed portion c 2R= 0.22 m
 Standpipe diameter 2r= 0.05 m
 Initial unbalanced head Ho= -0.489 m
 Initial water depth 0.56 m
 Aquifer material: **Silty Clay Till**
 2 x 3.14 x L
 Shape factor F= $\frac{2 \times 3.14 \times L}{\ln(L/R)}$ = 5.701815 m
 Permeability K= $\frac{3.14 \times r^2}{F \times (t_2 - t_1)} \times \ln(H_1/H_2)$ (Bouwer and Rice Method)

$$\frac{\ln(H_1/H_2)}{(t_2 - t_1)} = 0.000748919$$

 K= **2.6E-05 cm/s**
2.6E-07 m/s





Soil Engineers Ltd.

CONSULTING ENGINEERS

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TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 440-2040	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

APPENDIX 'C'

WATER QUALITY CERTIFICATES OF ANALYSIS

REFERENCE NO. 1506-W067

**CLIENT NAME: SOIL ENGINEERS LIMITED
100 NUGGET AVENUE
TORONTO, ON M1S3A7
(416) 754-8515**

ATTENTION TO: Gavin O'Brein

PROJECT: 1506-W067

AGAT WORK ORDER: 15T055697

**WATER ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab
Supervisor**

DATE REPORTED: Jan 11, 2016

PAGES (INCLUDING COVER): 9

VERSION*: 2

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

***NOTES**

VERSION 2: January 11, 2016: Upon client's request, CoA was updated to include sulphate, Calcium, Potassium, pH, electrical conductivity and hardness

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Full Metals Scan incl. Hg (Water)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

Parameter	Unit	SAMPLE DESCRIPTION:		MW 101	MW 103
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
		G / S	RDL	7310703	7310713
Aluminum	mg/L	0.1	0.004	0.006	0.015
Antimony	mg/L	0.006	0.001	<0.001	<0.001
Arsenic	mg/L	0.025	0.001	<0.001	<0.001
Barium	mg/L	1	0.002	0.035	0.028
Beryllium	mg/L		0.001	<0.001	<0.001
Bismuth	mg/L		0.002	<0.002	<0.002
Boron	mg/L	5	0.01	0.01	<0.01
Cadmium	mg/L	0.005	0.001	<0.001	<0.001
Chromium	mg/L	0.05	0.002	<0.002	<0.002
Cobalt	mg/L		0.001	<0.001	<0.001
Copper	mg/L	1	0.002	<0.002	<0.002
Iron	mg/L	0.3	0.01	<0.01	<0.01
Lead	mg/L	0.01	0.001	<0.001	<0.001
Manganese	mg/L	0.05	0.002	0.016	0.045
Dissolved Mercury	mg/L		0.0001	<0.0001	<0.0001
Molybdenum	mg/L		0.001	0.001	<0.001
Nickel	mg/L		0.003	<0.003	<0.003
Phosphorus	mg/L		0.05	<0.05	<0.05
Selenium	mg/L	0.01	0.004	<0.004	<0.004
Silver	mg/L		0.001	<0.001	<0.001
Strontium	mg/L		0.005	0.140	0.100
Tin	mg/L		0.002	<0.002	<0.002
Titanium	mg/L		0.001	<0.001	<0.001
Thallium	mg/L		0.001	<0.001	<0.001
Uranium	mg/L	0.02	0.001	<0.001	<0.001
Vanadium	mg/L		0.001	<0.001	<0.001
Zinc	mg/L	5	0.005	<0.005	<0.005

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)

Certified By:



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

		SAMPLE DESCRIPTION:		MW 101	MW 103
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
Parameter	Unit	G / S	RDL	7310703	7310713
Electrical Conductivity	uS/cm		2	620	683
pH	pH Units	(6.5-8.5)	NA	8.03	7.94
Total Hardness (as CaCO ₃)	mg/L	(80-100)	0.5	252	283
Sulphate	mg/L	500	0.50	5.67	2.4
Calcium	mg/L		0.05	43.9	58.4
Potassium	mg/L		0.05	1.27	0.47

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)

7310703-7310713 Please note that the analysis for pH was conducted past the recommended hold time.

Certified By:

Elizabeth Potokowska



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

5835 COOPERS AVENUE
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<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

		SAMPLE DESCRIPTION:		MW 101	MW 103
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
Parameter	Unit	G / S	RDL	7310703	7310713
Chloride	mg/L	250	0.50	3.76	2.56
Nitrate as N	mg/L	10.0	0.25	<0.25	<0.25
Nitrite as N	mg/L	1.0	0.25	<0.25	<0.25
Ammonia as N	mg/L		0.02	<0.02	<0.02
Total Phosphorus	mg/L		0.02	0.02	0.02
Total Phosphorous, Dissolved	mg/L		0.02	0.02	<0.02

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O.Reg.169/03(mg/L)

Certified By:

Elizabeth Potokowska

CLIENT NAME: SOIL ENGINEERS LIMITED
100 NUGGET AVENUE
TORONTO, ON M1S3A7
(416) 754-8515

ATTENTION TO: Gavin O'Brein

PROJECT: 1506-W067

AGAT WORK ORDER: 15T055705

WATER ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab
Supervisor

DATE REPORTED: Jan 11, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 2

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

***NOTES**

VERSION 2: January 11, 2016: Upon client's request, CoA was updated to include sulphate, pH and hardness

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

5835 COOPERS AVENUE
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<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

		SAMPLE DESCRIPTION:		C-1DS	C-2DS
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
Parameter	Unit	G / S	RDL	7311455	7311492
pH	pH Units	6.5-8.5	NA	8.19	8.21
Total Hardness (as CaCO ₃)	mg/L		0.5	256	249
Sulphate	mg/L		0.20	11.5	6.32

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)
7311455-7311492 Please note that the analysis for pH was conducted past the recommended hold time.

Certified By:

Elizabeth Potokowska



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

5835 COOPERS AVENUE
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<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Inorganic Chemistry (Water)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

Parameter	Unit	SAMPLE DESCRIPTION:		C-1DS	C-2DS
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
		G / S	RDL	7311455	7311492
Chloride	mg/L		0.20	39.6	73.9
Nitrate as N	mg/L		0.10	2.82	0.18
Nitrite as N	mg/L		0.10	<0.10	<0.10
Total Phosphorus	mg/L	0.03	0.02	0.03	<0.02
Total Phosphorus, Dissolved	mg/L	0.03	0.02	<0.02	<0.02
Total Kjeldahl Nitrogen	mg/L		0.10	0.39	<0.10

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)
7311455-7311492 Please note that the analysis for Nitrate and Nitrite was conducted past the recommended hold time.

Certified By:

Elizabeth Potokowska



Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

PWQO - Metals Scan (incl. Hg)

DATE RECEIVED: 2015-12-23

DATE REPORTED: 2016-01-11

Parameter	Unit	SAMPLE DESCRIPTION:		C-1DS	C-2DS
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		12/22/2015	12/22/2015
		G / S	RDL	7311455	7311492
Aluminum-dissolved	mg/L	0.075	0.004	0.010	<0.004
Antimony	mg/L	0.020	0.003	<0.003	<0.003
Arsenic	mg/L	0.1	0.003	<0.003	<0.003
Barium	mg/L		0.002	0.022	0.017
Beryllium	mg/L	0.011	0.001	<0.001	<0.001
Boron	mg/L	0.20	0.01	0.01	<0.01
Cadmium	mg/L	0.0002	0.0001	<0.0001	<0.0001
Chromium	mg/L		0.003	<0.003	<0.003
Cobalt	mg/L	0.0009	0.0005	<0.0005	<0.0005
Copper	mg/L	0.005	0.002	<0.002	<0.002
Iron	mg/L	0.3	0.01	0.10	0.01
Lead	mg/L	0.005	0.001	<0.001	<0.001
Manganese	mg/L		0.002	0.017	0.005
Dissolved Mercury	mg/L	0.0002	0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.04	0.002	<0.002	<0.002
Nickel	mg/L	0.025	0.003	<0.003	<0.003
Selenium	mg/L	0.1	0.004	<0.004	<0.004
Silver	mg/L	0.0001	0.0001	<0.0001	<0.0001
Strontium	mg/L		0.005	0.082	0.089
Thallium	mg/L	0.0003	0.0003	<0.0003	<0.0003
Titanium	mg/L		0.002	0.004	<0.002
Tungsten	mg/L	0.03	0.010	<0.010	<0.010
Uranium	mg/L	0.005	0.002	<0.002	<0.002
Vanadium	mg/L	0.006	0.002	<0.002	<0.002
Zinc	mg/L	0.02	0.005	<0.005	<0.005
Zirconium	mg/L	0.004	0.004	<0.004	<0.004

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

Certified By:

Elizabeth Potokowska

Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

PROJECT: 1506-W067

SAMPLING SITE:

AGAT WORK ORDER: 15T055705

ATTENTION TO: Gavin O'Brein

SAMPLED BY:

Water Analysis															
RPT Date: Jan 11, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

PWQO - Metals Scan (incl. Hg)

Aluminum-dissolved	7310569		0.004	0.004	NA	< 0.004	100%	90%	110%	108%	90%	110%	108%	70%	130%
Antimony	7310540		<0.003	<0.003	NA	< 0.003	97%	90%	110%	99%	90%	110%	102%	70%	130%
Arsenic	7310540		<0.003	<0.003	NA	< 0.003	97%	90%	110%	104%	90%	110%	108%	70%	130%
Barium	7310540		0.074	0.074	0.0%	< 0.002	96%	90%	110%	102%	90%	110%	103%	70%	130%
Beryllium	7310540		<0.001	<0.001	NA	< 0.001	100%	90%	110%	105%	90%	110%	113%	70%	130%
Boron	7310540		0.03	0.03	NA	< 0.01	106%	90%	110%	108%	90%	110%	111%	70%	130%
Cadmium	7310540		<0.0001	<0.0001	NA	< 0.0001	97%	90%	110%	109%	90%	110%	110%	70%	130%
Chromium	7310540		<0.003	<0.003	NA	< 0.003	101%	90%	110%	105%	90%	110%	108%	70%	130%
Cobalt	7310540		0.0007	0.0006	NA	< 0.0005	100%	90%	110%	108%	90%	110%	107%	70%	130%
Copper	7310540		0.005	0.005	NA	< 0.002	99%	90%	110%	107%	90%	110%	106%	70%	130%
Iron	7310540		0.03	0.02	NA	< 0.01	104%	90%	110%	106%	90%	110%	100%	70%	130%
Lead	7310540		<0.001	<0.001	NA	< 0.001	94%	90%	110%	101%	90%	110%	100%	70%	130%
Manganese	7310540		0.229	0.227	0.9%	< 0.002	102%	90%	110%	107%	90%	110%	105%	70%	130%
Dissolved Mercury	7310793		<0.0001	<0.0001	NA	< 0.0001	106%	90%	110%	106%	90%	110%	112%	80%	120%
Molybdenum	7310540		0.008	0.008	NA	< 0.002	103%	90%	110%	106%	90%	110%	109%	70%	130%
Nickel	7310540		<0.003	<0.003	NA	< 0.003	100%	90%	110%	108%	90%	110%	106%	70%	130%
Selenium	7310540		<0.004	<0.004	NA	< 0.004	96%	90%	110%	103%	90%	110%	112%	70%	130%
Silver	7310540		<0.0001	<0.0001	NA	< 0.0001	98%	90%	110%	106%	90%	110%	109%	70%	130%
Strontium	7310540		1.42	1.44	1.4%	< 0.005	94%	90%	110%	101%	90%	110%	103%	70%	130%
Thallium	7310540		<0.0003	<0.0003	NA	< 0.0003	100%	90%	110%	110%	90%	110%	108%	70%	130%
Titanium	7310540		0.005	0.005	NA	< 0.002	104%	90%	110%	105%	90%	110%	105%	70%	130%
Tungsten	7310540		0.035	0.035	NA	< 0.010	103%	90%	110%	96%	90%	110%	98%	70%	130%
Uranium	7310540		0.005	0.005	NA	< 0.002	101%	90%	110%	105%	90%	110%	108%	70%	130%
Vanadium	7310540		<0.002	<0.002	NA	< 0.002	100%	90%	110%	108%	90%	110%	109%	70%	130%
Zinc	7310540		0.008	0.006	NA	< 0.005	101%	90%	110%	110%	90%	110%	116%	70%	130%
Zirconium	7310540		<0.004	<0.004	NA	< 0.004	99%	90%	110%	99%	90%	110%	100%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Inorganic Chemistry (Water)

Chloride	7310703		3.76	3.54	6.0%	< 0.10	105%	90%	110%	103%	90%	110%	104%	80%	120%
Nitrate as N	7310703		<0.25	<0.25	NA	< 0.05	93%	90%	110%	106%	90%	110%	105%	80%	120%
Nitrite as N	7310703		<0.25	<0.25	NA	< 0.05	NA	90%	110%	102%	90%	110%	106%	80%	120%
Total Phosphorus	7311455	7311455	0.03	0.03	NA	< 0.02	94%	90%	110%	98%	90%	110%	96%	80%	120%
Total Phosphorus, Dissolved	7311455	7311455	< 0.02	0.02	NA	< 0.02	92%	90%	110%	98%	90%	110%	98%	80%	120%
Total Kjeldahl Nitrogen	7312026		49.6	49.3	0.6%	< 0.10	103%	80%	120%	87%	80%	120%	88%	70%	130%

Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

PROJECT: 1506-W067

SAMPLING SITE:

AGAT WORK ORDER: 15T055705

ATTENTION TO: Gavin O'Brein

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jan 11, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: NA signifies Not Applicable.

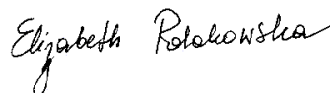
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Inorganic Chemistry (Water)

pH	7314449	7.90	7.83	0.9%	NA	100%	90%	110%	NA				NA		
Sulphate	7310703	5.67	5.54	2.3%	< 0.10	98%	90%	110%	97%	90%	110%	98%	80%	120%	

Comments: NA signifies Not Applicable.

Certified By:



Method Summary

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO ₃)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Total Phosphorus	INOR-93-6022	SM 4500-P B&E	SPECTROPHOTOMETER
Total Phosphorus, Dissolved	INOR-93-6022	SM 4500-P B&E	SPECTROPHOTOMETER
Total Kjeldahl Nitrogen	INOR-93-6048	QuikChem 10-107-06-2-I & SM 4500-Norg D	LACHAT FIA
Aluminum-dissolved	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Antimony	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Dissolved Mercury	MET-93-6100	EPA SW 846 7470 & 245.1	CVAAS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tungsten	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zirconium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS



AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Gavin O'Brein

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7310703	MW 101	O.Reg.169/03(mg/L)	Inorganic Chemistry (Water)	Total Hardness (as CaCO ₃)	(80-100)	252
7310713	MW 103	O.Reg.169/03(mg/L)	Inorganic Chemistry (Water)	Total Hardness (as CaCO ₃)	(80-100)	283

Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

PROJECT: 1506-W067

SAMPLING SITE:

AGAT WORK ORDER: 15T055697

ATTENTION TO: Gavin O'Brein

SAMPLED BY:

Water Analysis															
RPT Date: Jan 11, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Inorganic Chemistry (Water)

Chloride	7310703	7310703	3.76	3.54	6.0%	< 0.10	105%	90%	110%	103%	90%	110%	104%	80%	120%
Nitrate as N	7310703	7310703	<0.25	<0.25	NA	< 0.05	93%	90%	110%	106%	90%	110%	105%	80%	120%
Nitrite as N	7310703	7310703	<0.25	<0.25	NA	< 0.05	NA	90%	110%	102%	90%	110%	106%	80%	120%
Ammonia as N	7310593		0.53	0.52	1.9%	< 0.02	104%	90%	110%	99%	90%	110%	97%	80%	120%
Total Phosphorus	7310703	7310703	0.02	0.02	NA	< 0.02	105%	80%	120%	101%	90%	110%	101%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Full Metals Scan incl. Hg (Water)

Aluminum	7310540		0.090	0.085	5.7%	< 0.004	98%	90%	110%	106%	90%	110%	104%	70%	130%
Antimony	7310540		<0.001	<0.001	NA	< 0.001	97%	90%	110%	99%	90%	110%	102%	70%	130%
Arsenic	7310540		<0.001	<0.001	NA	< 0.001	97%	90%	110%	104%	90%	110%	108%	70%	130%
Barium	7310540		0.074	0.074	0.0%	< 0.002	96%	90%	110%	102%	90%	110%	103%	70%	130%
Beryllium	7310540		<0.001	<0.001	NA	< 0.001	100%	90%	110%	105%	90%	110%	113%	70%	130%
Bismuth	7310540		<0.002	<0.002	NA	< 0.002	96%	90%	110%	101%	90%	110%	100%	70%	130%
Boron	7310540		0.03	0.03	NA	< 0.01	106%	90%	110%	108%	90%	110%	111%	70%	130%
Cadmium	7310540		<0.001	<0.001	NA	< 0.001	97%	90%	110%	109%	90%	110%	110%	70%	130%
Chromium	7310540		<0.002	<0.002	NA	< 0.002	101%	90%	110%	105%	90%	110%	108%	70%	130%
Cobalt	7310540		<0.001	<0.001	NA	< 0.001	100%	90%	110%	108%	90%	110%	107%	70%	130%
Copper	7310540		0.005	0.005	NA	< 0.002	99%	90%	110%	107%	90%	110%	106%	70%	130%
Iron	7310540		0.03	0.02	NA	< 0.01	104%	90%	110%	106%	90%	110%	100%	70%	130%
Lead	7310540		<0.001	<0.001	NA	< 0.001	94%	90%	110%	101%	90%	110%	100%	70%	130%
Manganese	7310540		0.229	0.227	0.9%	< 0.002	102%	90%	110%	107%	90%	110%	105%	70%	130%
Dissolved Mercury	7310540		<0.0001	<0.0001	NA	< 0.0001	107%	90%	110%	108%	90%	110%	104%	80%	120%
Molybdenum	7310540		0.008	0.008	0.0%	< 0.001	103%	90%	110%	106%	90%	110%	109%	70%	130%
Nickel	7310540		<0.003	<0.003	NA	< 0.003	100%	90%	110%	108%	90%	110%	106%	70%	130%
Phosphorus	7310540		<0.05	<0.05	NA	< 0.05	101%	90%	110%	102%	90%	110%	111%	70%	130%
Selenium	7310540		<0.004	<0.004	NA	< 0.004	96%	90%	110%	103%	90%	110%	112%	70%	130%
Silver	7310540		<0.001	<0.001	NA	< 0.001	98%	90%	110%	106%	90%	110%	109%	70%	130%
Strontium	7310540		1.42	1.44	1.4%	< 0.005	94%	90%	110%	101%	90%	110%	103%	70%	130%
Tin	7310540		<0.002	<0.002	NA	< 0.002	102%	90%	110%	101%	90%	110%	103%	70%	130%
Titanium	7310540		0.005	0.005	0.0%	< 0.001	104%	90%	110%	105%	90%	110%	105%	70%	130%
Thallium	7310540		<0.001	<0.001	NA	< 0.001	100%	90%	110%	110%	90%	110%	108%	70%	130%
Uranium	7310540		0.005	0.005	0.0%	< 0.001	101%	90%	110%	105%	90%	110%	108%	70%	130%
Vanadium	7310540		0.002	0.002	NA	< 0.001	100%	90%	110%	108%	90%	110%	109%	70%	130%
Zinc	7310540		0.008	0.006	NA	< 0.005	101%	90%	110%	110%	90%	110%	116%	70%	130%

Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

PROJECT: 1506-W067

SAMPLING SITE:

AGAT WORK ORDER: 15T055697

ATTENTION TO: Gavin O'Brein

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jan 11, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: NA signifies Not Applicable.

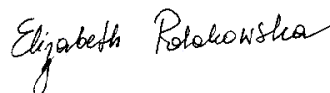
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Inorganic Chemistry (Water)

Electrical Conductivity	7314449		2700	2670	1.1%	< 2	100%	80%	120%	NA			NA		
pH	7314449		7.90	7.83	0.9%	NA	100%	90%	110%	NA			NA		
Sulphate	7310703	7310703	5.67	5.54	2.3%	< 0.10	98%	90%	110%	97%	90%	110%	98%	80%	120%
Calcium	7310703	7310703	43.9	49.1	11.2%	< 0.05	102%	90%	110%	105%	90%	110%	98%	70%	130%
Potassium	7310703	7310703	1.27	1.27	0.0%	< 0.05	95%	90%	110%	96%	90%	110%	95%	70%	130%

Comments: NA signifies Not Applicable.

Certified By:



Method Summary

CLIENT NAME: SOIL ENGINEERS LIMITED
AGAT WORK ORDER: 15T055697
PROJECT: 1506-W067
ATTENTION TO: Gavin O'Brein
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Aluminum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Antimony	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Bismuth	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Dissolved Mercury	MET-93-6100	EPA SW 846 7470 & 245.1	CVAAS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Phosphorus	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tin	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Total Hardness (as CaCO ₃)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH ₃ -F	LACHAT FIA
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA
Total Phosphorous, Dissolved	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P E	LACHAT FIA



5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Company: Boil Engineers Ltd.
Contact: Gavin
Address: 100 Nugget Ave
Toronto M1S 3A7
Phone: 416-754-8515 Fax: 416-754-8516
Reports to be sent to:
1. Email: gavin@boilengineers.tv.com
2. Email: navies@boilengineers.tv.com

Project: 1506-2067
Site Location: Dundalk
Sampled By: Kevin
AGAT Quote #: PO:

Bill To Same: Yes ☒ No ☐

Company: _____

Contact: _____

Address: _____

Email: _____

(Please check all applicable boxes.)

☐ Coarse

☐ Fine

Indicate One

Indicate One

☐ Yes ☒ No

☐ Yes ☒ No

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻
☐ C₂O₄²⁻ ☐ EC ☐ FOC ☐ NO₃/NO₂
☐ Total N ☐ Hg ☐ pH ☐ SAR
Nutrients: ☒ TP ☐ NH₃ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃/NO₂
Volatiles: ☐ VOC ☐ BTEX ☐ THM

[illegible]

Page _____ of _____

Nº: **T** 019834

APPENDIX C

MECP Well Records

MECP WATER WELL RECORDS									
Project Number: 2515-6796					Address: 271 Main Street East, Southgate				
Prepared by: KS					Date completed: 2023.07.28				
Well ID	Diameter (cm)	Depth (m)	Static Level (m)	Quantity (Lpm)	Quality	Materials	Aquifer ¹	Use	Date Completed
2500877	9.1	41.5	6.10	37.9	Fresh	Clay and boulders (0-8 ft), gravel (80-102 ft), rock (102-136 ft)	BR	Commercial	07/14/1953
2500878	10.2	48.5	4.88	18.9	Fresh	Hardpan and clay (0-102 ft), limestone (102-159 ft)	BR	Domestic	12/12/1953
2500879	10.2	50.3	8.23	18.9	Fresh	Clay and stones (0-110 ft), limestone (110-165 ft)	BR	Industrial	01/07/1954
2500880	10.2	71.6	8.84	15.9	Clear	Dug well (0-30 ft), stones and clay (30-108 ft), rock (108-116 ft), limestone (116-235 ft)	BR	Domestic	03/20/1954
2500883	15.2	44.2	6.10	18.9	Clear	Clay and stones (0-101 ft), limestone (101-145 ft)	BR	Commercial	12/18/1954
2500884	10.2	48.5	5.79	31.4	Clear	Dug well (0-20 ft), clay with stones (20-101 ft), limestone (101-159 ft)	BR	Domestic	02/02/1955
2500885	11.7	47.9	9.14	56.8	Fresh	Dug well (0-30 ft), clay and stones (30-102 ft), limestone (102-157 ft)	BR	Domestic	10/03/1955
2500886	10.2	47.9	6.10	31.4	Clear	Clay and stones (0-102 ft), limestone (102-157 ft)	BR	Domestic	12/19/1955
2500887	10.2	47.9	4.88	31.4	Clear	Clay and stones (0-109 ft), limestone (109-157 ft)	BR	Domestic	01/15/1956
2500889	9.1	42.7	6.10	56.8	Clear	Clay and stones (0-114 ft), limestone (114 - 140 ft)	BR	Domestic	07/20/1956
2500891	10.2	50	6.10	56.8	Clear	Clay and stones (0-108 ft), limestones (108-164 ft)	BR	Domestic	09/03/1956
2500892	10.2	48.2	3.96	56.8	Clear	Clay and boulders (0-108 ft), limestone (108 - 158 ft)	BR	Domestic	01/30/1957
2500893	11.4	41.1	10.67	37.9	Clear	Hard clay and stones (0-107 ft), grey rock (107-135 ft)	BR	Domestic	05/04/1957
2500894	11.4	46.6	5.49	37.9	Clear	Gravel (0-13 ft), hard clay and stones (13-96 ft), grey hard rock (96-153 ft)	BR	Domestic	07/19/1957
2500895	11.4	48.5	9.14	37.9	Clear	Hard clay and stones (0-108 ft), grey rock (108-159 ft)	BR	Domestic	08/14/1957
2500898	25.4	61.3	6.40	446.7	Clear	Sand (0-8 ft), gravel and hardpan (8-66 ft), sandy gravel (103 - 118 ft), limestone (118 - 201 ft)	BR	Public Service	04/05/1960
2503216	10.2	37.5	12.80	30.3	Fresh	Topsoil (0-2 ft), hard pan and stone (2-103 ft), hard rock (103 - 123 ft)	BR	Domestic	06/26/1970
2506029	10.2	33.2	11.58	26.5	Fresh	Topsoil (0-1 ft), sandy clay gravel (1027 ft), brown hardpan (27-100 ft), limestone (100-109 ft)	BR	Domestic	04/15/1977
2507815	12.7	32	11.89	45.4	Fresh	Topsoil (0-1 ft), clay and stones (1-28 ft), hardpan (28-96 ft), limestone (96-105 ft)	BR	Domestic	12/04/1982
2509109	15.2	55.8	16.46	22.7	Fresh	Topsoil (0-1 ft), clay and stones (1-53 ft), hardpan (53-100 ft), limestone (106-183 ft)	BR	Domestic	09/15/1987
2516288	12.7	4.5	N/A	N/A	N/A	Brown fill (0-1 ft), sandy silt till (1-4.5 ft)	OB	Observation	11/30/2004
2516363	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	04/22/2005
2516364	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	04/22/2005
2516756	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	10/12/2005
7140432	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	02/19/2010
7140447	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	02/07/2010
7141631	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	11/24/2009
7259065	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	08/20/2015
7281370	25.4	96.2	7.54	1320.0	Clear	Clay and stone (0-24.99 m), limestone (24.99-96.66m)	BR	Water Supply	02/01/2017
7300081	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	
7362026	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	06/03/2020
7362027	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	06/03/2020
7362030	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned	06/03/2020

Data Source: Ministry of the Environment, Conservation, and Parks, retrieved July 28, 2023.

1. OB = Overburden Aquifer, BR = Bedrock Aquifer

2.

APPENDIX D

Green Geotechnical Ltd. Geotechnical Investigation Report



GEOTECHNICAL INVESTIGATION REPORT

PROPOSED RESIDENTIAL SUBDIVISION,

271 MAIN STREET,

DUNDALK, ON;

PROJECT NUMBER: 23-115-01

CLIENT: 271 Main Street East Inc.

ATTENTION: Cale Barnes

DATE: April 30, 2024

PREPARED BY: Green Geotechnical Ltd.

576 Bryne Drive, Unit 'O'

Barrie, ON

L4N 9P6



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1.0 SITE AND PROJECT BACKGROUND

Green Geotechnical Ltd. (Green Geotechnical) was retained by 271 Main Street East Inc. to conduct a subsurface investigation and prepare a geotechnical design report for the proposed residential development at 271 Main Street East, in the community of Dundalk, in the Township of Southgate, Ontario. The site is located in a predominately commercial and residential area on the southeast side of Main Street East. A site location plan is provided as Figure 1. Currently the site is an approximately 0.65-acre vacant property with remnants of a demolished building and driveway.

Based on email communication dated August 2023 and the conceptual site plan, it is understood that the site will be developed to include the construction of 32 stacked townhome units with below-grade basements and a 6m wide drive aisle. It is assumed that the development is to be fully serviced municipally serviced to an urban standard.

At the time of this investigation, no conceptual grading or servicing plans were available. It is presumed that site grades will generally be near or slightly above their current elevations. Any regrading within the influence zones of building or settlement sensitive areas is anticipated to be done with the use of Engineered Fill.

This report encompasses the geotechnical investigation conducted for the Property to assess its geotechnical suitability for the proposed development. The field investigation consisted of advancing a total of four (4) exploratory boreholes (Boreholes 1 to 4) at the Property. The objective of the geotechnical investigation was to determine the prevailing subsurface soil and groundwater conditions, in order to provide geotechnical engineering recommendations for the design of the proposed building foundations, basement-slabs, lateral earth pressure and seismic design parameters, pavement design, and pipe bedding. In addition, comments are also included on the pertinent project construction aspects including excavation, backfill and groundwater control.

2.0 INVESTIGATION PROCEDURES AND METHODOLOGY

The field investigation was conducted on November 27th, 2023, and consisted of drilling and sampling a total of four (4) exploratory boreholes (Boreholes 1 to 4) extending to termination depths ranging from approximately 6.3m to 6.6m below existing ground surface.

The boreholes were staked out in the field by Green Geotechnical based on the proposed development and existing site features. The approximate borehole locations are shown on the enclosed Borehole Location Plans as Figure 2A – Existing Conditions and Figure 2B – Proposed Conditions.

Various utility locates agencies (including a private locate company) were contacted by Green Geotechnical to clear the borehole locations prior to the commencement of the field investigation.



The ground surface elevations at the borehole locations were surveyed by Green Geotechnical. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T). It should be noted that the elevations provided on the Borehole Logs are approximate and provided only for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The borings were drilled by a specialist drilling contractor using a track mounted drill rig power auger and sampled at regular intervals with a conventional 50mm diameter split barrel sampler when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling, and testing) was observed full time and recorded by Green Geotechnical field staff, who logged the boring and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into plastic jars and transported to our geotechnical laboratory for detailed inspection and testing. The borehole samples were examined (tactile) in detail by a geotechnical engineer and classified according to visual and index properties. Geotechnical laboratory testing consisted of water content determination on all samples, and grain size analysis on two (2) selected soil samples. The measured natural water contents of individual samples and the results of the grain size analysis test are plotted on the enclosed borehole logs at respective sampling depths. The results of the grain size analyses are also summarized in Section 3.5 of this report and are appended in Appendix B.

Groundwater levels were observed in the open boreholes upon the completion of drilling. Monitoring wells were installed in two (2) boreholes to facilitate one (1) stabilized groundwater level reading by Green Geotechnical, which was taken on January 6th, 2024, and two (2) readings by Crozier on December 13th, 2024 and March 13th, 2024. The results of the groundwater level readings are enclosed on the borehole logs and summarized in Section 3.4 of this report.

3.0 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site. The borehole logs are enclosed in Appendix A.

It should be noted that the subsurface conditions are confirmed at the borehole locations only and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.



3.1 Topsoil

Surficial topsoil with a thickness of approximately 0.2m to 0.6m was encountered at the ground surface of all Boreholes. The topsoil was dark brown in colour.

Topsoil thicknesses provided in this report were obtained at the individual borehole locations, as measured through the collar of the open borehole. Thicknesses may vary between and beyond borehole locations and should not be used/relied upon for costing purposes.

3.2 Earth Fill

Earth fill comprised of a sandy silt, with trace to some gravel to cobbles, trace clay, and organic inclusions was encountered in Boreholes 1, 2, 3, and 4 underlying the surficial topsoil, with thicknesses ranging from approximately 0.4m to 1.3m. The earth fill zone was underlain by the native glacial till.

The Standard Penetration Test result (N-Values) obtained from the earth fill zone ranged from 4 to over 50 blows per 300mm of penetration, indicating a very loose to very dense relative density.

The in-situ moisture contents of the earth fill samples ranged from 4.6 to 37.2 percent by weight, indicating a generally moist to wet condition.

3.3 Silt Glacial Till

Native deposits of a sandy silt glacial till with some gravel to cobbles and occasional boulders, sand content ranging from sandy to and sand, and trace to some clay was encountered in Boreholes 1, 2, 3, and 4 underlying the Earth Fill layer and extended to the borehole termination depths of approximately 6.3m to 6.6m.

The Standard Penetration Test result (N-Values) obtained from this layer ranged from 11 to over 50 blows per 300 mm of penetration, indicating a generally compact to very dense relative density.

The in-situ moisture contents of the silt soil samples ranged from 5 to 35 percent by weight, indicating a generally moist to wet condition.

3.4 Groundwater

The depth of ground water and caving was measured in each of the boreholes immediately following the drilling. Water level measurements were made in the monitoring wells installed in Boreholes 2 and 3 on January 6th, 2024 by Green Geotechnical. Two more measurements were made by Crozier on December 13th, 2023, and March 13th, 2024. The ground water observations of all the boreholes are summarized as follows:



Borehole No.	Depth of Augering (m)	Depth to Cave (m)	Unstabilized Water Level (Depth/Elevation) (m)	Stabilized Water Level in well on December 13 th , 2023 (Depth/Elevation) (m)	Stabilized Water Level in well on January 6 th , 2024 (Depth/Elevation) (m)	Stabilized Water Level in well on March 13 th , 2024 (Depth/Elevation) (m)
1	6.1	5.5	Dry	N/A	N/A	N/A
2	6.1	Open	Dry	2.9 / 516.9	2.6 / 516.2	2.5 / 516.3
3	6.1	Open	Dry	3.4 / 515.0	1.6 / 516.8	1.4 / 517.0
4	6.1	Open	Dry	N/A	N/A	N/A

Groundwater levels will fluctuate seasonally and depending on the amount of surface runoff and precipitation.

3.5 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples, while grain size analysis was conducted on two selected soil samples (Borehole 2, Sample 4 and Borehole 4, Sample 4). The test results are listed on the enclosed Borehole Logs at the respective sampling depth.

The results (graphs) of the grain size analyses are appended and a summary of the results are as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1, Sample 4	2.3 – 2.8	29	24	34	13	GRAVELLY, SANDY SILT, some clay
Borehole 4, Sample 5	3.0 – 3.5	39	23	28	10	SILTY, SANDY GRAVEL, trace clay



4.0 GEOTECHNICAL ENGINEERING DESIGN

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by the owner and the design engineer. Contractor's bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards, and guidelines of practice. If there are any changes to the site development features or any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Green Geotechnical should be retained to review the implications of these changes with respect to the contents of this report.

Based on email communication dated August 2023 and the conceptual site plan, it is understood that the site will be developed to include the construction of 32 stacked townhome units with below-grade basements and a 6m wide drive aisle. It is assumed that the development is to be fully serviced municipally serviced to an urban standard.

At the time of this investigation, no conceptual grading or servicing plans were available. It is presumed that site grades will generally be near or slightly above their current elevations. Any regrading within the influence zones of building or settlement sensitive areas is anticipated to be done with the use of Engineered Fill.

4.1 Foundation Design Parameters

Based on the field investigation at this site, below the surficial topsoil and earth fill layers, the subsurface conditions at the location of the proposed structures predominantly consist of compact to very dense sandy silt to sand and silt glacial till soils. The undisturbed native site soils are suitable for the support of conventional spread footings, provided that all loose, caved, soft, or deleterious materials are removed, and excess water is pumped out prior to concrete placement. The surficial topsoil, earth fill zones, weathered/disturbed native soils or high organic soil areas and/or any other deleterious materials are not suitable to support building foundations.

The compact to very dense native soil conditions encountered will allow structure foundations placed directly on them to be designed with a maximum net geotechnical reaction of 150 kPa (SLS) and a factored geotechnical resistance of 225 kPa (ULS), subject to foundation inspection confirmation by Green Geotechnical. Greater capacity can be available at greater depths if required for specific components and can be assessed by Green Geotechnical on a case-by-case basis.



A minimum soil cover of 1.6m or equivalent insulation is recommended for frost protection to footings in exterior or unheated areas. Construction during cold weather should also ensure temporary frost protection of footing bases.

Native soils tend to weather rapidly and deteriorate on exposure to the atmosphere and surface water. The time between foundation excavation and concrete placement should be minimized as much as possible.

The minimum footing widths to be used in conjunction with the above recommended soil bearing pressures should be 0.5m for continuous footings and 0.9m for individual footings placed on native soils. The above recommended bearing capacities are based on estimated maximum total settlement of 25mm and differential settlement of 19mm.

It should also be noted that due to the variable conditions in the upper approximately 1 to 2m of the site, some downward stepping of footings should be anticipated in order to extend to competent soils. Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal, and with a grade change not exceeding 600mm.

Prior to placing foundation concrete, all excavated foundation subgrade soils should be cleaned of all deleterious materials such as topsoil, fill, softened or disturbed materials as well as any standing water. It is recommended that the foundations be inspected by Green Geotechnical in order to confirm the exposed soil conditions and recommended bearing capacities.

4.1.1 Foundations on Engineered Fill

At the time of this investigation, no conceptual grading or servicing plans were available. It is presumed that site grades will generally be near or slightly above their current elevations. Any regrading within the influence zones of building or settlement sensitive areas is anticipated to be done with the use of Engineered Fill.

The undisturbed native soils beneath the topsoil, weathered/disturbed zones, and earth fill are considered suitable for the support of Engineered Fill pads for supporting the building foundations. The Engineered Fill pads should extend at least 1m beyond any building footprint at underside of footing elevation and extend out at a 1:1 (horizontal to vertical) slope down to the native soils. Unless the foundations are constructed immediately on the Engineered Fill pad, the Engineered Fill should be built up at least an additional 1m in elevation to serve as a protective cap of the Engineered Fill at underside of footing level from the effects of weathering.

All deleterious or otherwise unsuitable materials such as topsoil, fill, softened or disturbed materials, as well as any standing water must be removed prior to the placement of Engineered Fill. These materials do not constitute an adequate subgrade for support of Engineered Fill. After any unsuitable materials are



removed, the exposed competent native soil subgrade must be inspected and approved by Green Geotechnical prior to placement of Engineered Fill. Engineered Fill placed to raise grades must consist of clean earth, free from any organic/topsoil or deleterious matter and must be placed in maximum 150mm thick lifts and compacted to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). Any Engineered Fill construction must be completed under full time supervision by Green Geotechnical to monitor extent, lift thickness, compaction, material quality and the like.

For Engineered Fill with a thickness of at least 0.5m constructed on a native subgrade approved by Green Geotechnical, the recommended maximum net geotechnical reaction may be 150kPa (SLS) and the maximum factored geotechnical resistance at Ultimate Limit State (ULS) is 225kPa.

Prior to placing foundation concrete, all Engineered Fill should be cleaned of all deleterious materials such as softened or disturbed materials as well as any standing water. It is required that the foundations placed on Engineered Fill be inspected by Green Geotechnical in order to confirm the exposed soil conditions and recommended bearing capacities.

The minimum footing widths to be used in conjunction with the above recommended soil bearing pressures should be 0.6m for continuous footings and 1.0m for individual footings placed on Engineered Fill. The above recommended bearing capacities are based on estimated maximum total settlement of 25mm and differential settlement of 19mm.

It should be noted that for structures placed on Engineered Fill, nominal reinforcing steel (rebar) at a minimum be placed in the foundations comprising two (2) continuous 15M bars in the strip footings, and two (2) continuous 15M bars at the top and bottom of the foundation walls be provided. Any column footing will require 15M bars spaced at 0.3m on centre, in each direction of the column. The reinforcing steel requirements of the structure are to be reviewed by a structural engineer.

A copy of “Engineered Fill Earthworks Specifications” is enclosed in Appendix E of this report for reference purposes. These specifications should be included in the earthworks contract.

4.2 Slab-on-Grade or Basement Floor Design Parameters

Groundwater levels recorded at this site were recorded at approximately ± 1.6 to ± 3.4 m below existing grades in December of 2023, January of 2024, and March of 2024. All finished floor surfaces are recommended to be at least 0.5m above the prevailing seasonally high groundwater level.

All non-structural earth fill and any other deleterious or unsuitable materials must be removed prior to placement of new fill for grade raise. These materials do not constitute an adequate subgrade for support of Engineered Fill. After any unsuitable materials are removed, the exposed soil subgrade must be inspected and approved by Green Geotechnical at the time of construction. Any structural fill placed to raise grades, must be placed in maximum 150mm thick lifts and compacted to at least 98 percent Standard



Proctor Maximum Dry Density (SPMDD). Conventional lightly loaded concrete slab-on-grade floors can be placed on the Engineered Fill. The vertical moduli of subgrade reaction for compacted fill soils at the site is 18,000 kPa/m.

It is necessary that building floor slabs be provided with a capillary moisture barrier and drainage layer. This is accomplished by placing the slab on a minimum 200mm layer of 19mm clear stone (OPSS.MUNI 1004) compacted by vibration to a dense state. The upper 50mm of the 200mm drainage layer may be replaced with 50mm of Granular A (OPSS.MUNI 1010) to provide a trafficable surface. The 19mm clear stone can be replaced in its entirety with Granular 'A' so long as a minimum 10mil poly-vapour barrier is used below the slab base. However, these do not replace the floor manufacturers' specific requirement(s) for a moisture and vapour barrier. A suitable non-woven geotextile filter (Terrafix 360R or equivalent approved by Green Geotechnical) must be installed (with a minimum 900mm overlap) below the capillary moisture break to properly filter the slab base from the subgrade. Otherwise, this could result in the loss of ground supporting the slab and clogging of the slab base.

All basement floors should be constructed at least 0.5m above the seasonally high-water level. Perimeter weeping drains (filtered) are recommended to be installed leading to positive outlets such as a sump pump in the basement. Normal basement damp proofing with Miradrain is recommended. Basement walls must be backfilled either with imported Granular "B" type backfill or drainage mediums as per the Ontario Building Code. The insitu soils are not considered to be suitable for reuse as backfill against basement walls unless damp proofing measures as specified in the Ontario Building Code are taken on foundation walls. A typical Basement Drainage Detail is provided in the attached Appendix C.

Where a basement level is within 1.0m of the water table, under-floor drains should be considered. Under floor drainage tiles should consist of placing rows of 100mm diameter perforated drainage pipe leading to a positive sump or outlet. It is recommended that the under-floor drain invert be placed at least 300mm below the underside of the floor slab. Drainage tiles should be placed in parallel rows 3m on centre in each direction. The drainage tile must be surrounded with 100mm of rounded clear stone, completely wrapped in filter fabric. It is essential that the clear stone is separated from the subgrade by using an approved geotextile fabric material (effective opening size of less than 130 microns). Typical Basement Drainage Details are provided in the attached Appendix C.

The basement drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation walls, in addition to keeping moisture out of the basement. The size and arrangement of the pump system and battery backup system should be designed to be adequate to accommodate the anticipated groundwater and storm event flows. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge



point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

Regardless of the approach to slab-on-grade floor construction, the floor slabs that are to have bonded floor finishes (such as tiles with adhesives) should be provided with a capillary moisture and vapour barrier and drainage layer. The floor manufacturers have specific requirements for moisture and vapour barrier; therefore, the floor designer/architect must ensure that a provision of appropriate moisture and vapour barrier conforming to specific floor finish product requirements is incorporated in the project specifications. Adequate testing must be carried out to ensure acceptable levels of moisture and relative humidity in the concrete slab prior to the installation of floor finish(es).

The under-slab vapour retarder specifications, selection and installation shall conform to ASTM E1745 and ASTM E1643. The moisture vapour measurement tests shall conform to RH: ASTM F2170, RH: ASTM F2420 and Calcium Chloride: ASTM F1869. The Surface Applied Moisture Vapour Barrier system shall meet the guidelines established in ASTM F3010-13.

4.3 Earthquake Design Parameters

The Ontario Building Code stipulates the methodology for earthquake design analysis. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

Under Ontario Regulation 88/19, the ministry amended Ontario's Building Code (O. Reg 332/12) to further harmonize Ontario's Building Code with the 2015 National Codes. These changes will help reduce red tape for businesses and remove barriers to interprovincial trade throughout the country. The amendments are based on code change proposals the ministry consulted in 2016 and 2017. The majority of the amendments came into effect on January 1, 2020, which includes structural sufficiency of buildings to withstand external forces and improve resilience.

Seismic hazard is defined in the Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2s, 0.5s, 1.0s and 2.0s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g., shear wave velocity (v_s), Standard Penetration Test (SPT) resistance, and undrained shear strength (s_u) in the top 30 meters of the site stratigraphy below the foundation level, as set out in the Ontario Building Code. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients F_a and F_v , respectively, used to modify the UHS to account for the effects of site-specific soil conditions.



Based on the above, it is recommended that the site designation for seismic analysis be **Site Class C**, as per the Ontario Building Code. It should be noted that the above site seismic designation is estimated on the basis of rational analysis of the undrained shear strength information obtained from the boreholes advanced at the site only up to about 6.6m depth below grade. Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to confirm the average shear wave velocity in the top 30m of the site stratigraphy. MASW testing often determines higher seismic site class ratings than those able to be determined from SPT testing, resulting in potential project cost savings.

The values of the site coefficient for design spectral acceleration at period T , $F(T)$, and of similar coefficients $F(PGA)$ and $F(PGV)$ shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I. using linear interpolation for intermediate values of PGA .

4.4 Lateral Earth Pressure Design Parameters

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Stratum/Parameter	γ	ϕ	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS.MUNI 1010)	21	32	0.31	0.47	3.25
Earth Fill	18	28	0.36	0.53	2.76
Silty Sand to Sand and Silt Glacial Till (compact to very dense)	20	32	0.31	0.47	3.25

where:

γ	=	bulk unit weight of soil (kN/m ³)
ϕ	=	internal angle of friction (degrees)
K_a	=	Rankine active earth pressure coefficient (dimensionless)
K_o	=	Rankine at-rest earth pressure coefficient (dimensionless)
K_p	=	Rankine passive earth pressure coefficient (dimensionless)

The above earth pressure parameters pertain to a horizontal grade condition behind a retaining structure. Values of earth pressure parameters for an inclined retained grade condition will vary.

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K[\gamma(h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$



where,	P	=	the horizontal pressure at depth, h (m)
	K	=	the earth pressure coefficient
	h_w	=	the depth below the groundwater level (m)
	γ	=	the bulk unit weight of soil, (kN/m ³)
	γ'	=	the submerged unit weight of the exterior soil, (γ - 9.8 kN/m ³)
	q	=	the surcharge loading (kPa)

The above equation pertains to a horizontal grade condition behind a retaining structure. Values of earth pressure against retaining structures for an inclined retained grade condition will vary.

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure, this equation can be simplified to:

$$P = K[\gamma h + q]$$

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan φ**) expressed as: **R = N tan φ**. This is an unfactored resistance. The factored resistance at ULS is **R_f = 0.8 N tan φ**.

4.5 Pavement Design

The pavement subgrade is expected to comprise of native undisturbed sandy silt to silt and sand glacial till or clean earth fill compacted to a minimum of 98% of SPMDD. The exposed subgrade should be shaped and graded with a typical 3% cross-fall, directed towards continuous subdrains with inverts at least 0.3m below subgrade level.

All topsoil, organic-rich, and otherwise deleterious material should be sub-excavated. The pavement subgrade should be assessed (proof rolled with a heavy rubber-tired vehicle, if deemed feasible by Green Geotechnical) and approved (no rutting or major deflections) by Green Geotechnical to ensure stability prior to the placement of the pavement granular courses. All unstable areas will require sub-excavation and re-compaction or increased thickness of granular subbase. It should be noted that the majority of the upper site soils are considered moderately to highly frost susceptible. Therefore, adequate subgrade drainage is recommended.

Based on the soil conditions encountered during our investigation, we recommend the following pavement structure for light duty (vehicle parking) and heavy-duty (fire route) traffic areas:



Pavement Structural Layers	Min. Thickness (mm)		Compaction Requirements
	Light Duty (Vehicle Parking) Traffic	Heavy Duty (Fire Route) Traffic	
Hot Mix Asphalt Surface Course, OPSS 1150 HL 3	40	50	as per OPSS 310
Hot Mix Asphalt Binder Course, OPSS 1150 HL 8	60	80	
Base Course, OPSS.MUNI 1010, Granular A or 19mm CRLS	150	150	100 percent of Standard Proctor Maximum Dry Density (SPMDD) (ASTM D698)
Subbase Course, OPSS.MUNI 1010, Granular B or 50mm CRLS	300	450	98 percent of Standard Proctor Maximum Dry Density (SPMDD) (ASTM D698)

The above design assumes that sub-drainage of the granular fill will be provided. This should consist of continuous subdrains leading to catch basins.

It should be reiterated that the subgrade soils are moderately to highly frost susceptible. The subdrains are considered a valuable protection against frost heave damage and subgrade softening particularly impacting the long-term performance of the pavement.

An adequate granular working surface would likely be required in order to minimize subgrade disturbance and protect its integrity in wet periods. The fill material may consist of granular type material with a moisture content within ± 2 percent of optimum moisture content. Fill materials should be placed and compacted in accordance with OPSS.MUNI 501 and the subgrade should be compacted to 98 percent of SPMDD.

The granular subbase and base fill materials should be compacted to a minimum of 98% and 100% of Standard Proctor Maximum Dry Density (SPMDD), respectively, placed in lifts of 150mm or less. Asphaltic concrete materials should be rolled and compacted as per OPSS 310 based on density testing. **Due to the susceptibility of the site soils to disturbance, care should be taken that construction occurs in the driest summer periods. If this is not possible, the granular subbase may require additional thickness, or the specific use of Granular B 'Type II.'**

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of 3 percent) to provide effective drainage toward subgrade drains. Grading adjacent to pavement areas should be designed to ensure that water is not allowed to pond



adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the driveway and drained into respective catch basins to facilitate drainage of the subgrade and the granular materials. The subdrain inverts should be maintained at least 0.3m below subgrade level. Continuous subdrains should also be provided for pavement areas along any curb-lines/sidewalks. Two lengths of subdrain stubs (each minimum 3m long) should be installed at each catch basin (refer to Appendix D - Pavement Drainage Details).

The granular base beneath the sidewalks and concrete walkways should be extended to provide continuous drainage paths outletting to the pavement curb-line or ditch subdrains to facilitate subgrade drainage and help minimize concrete slab heaving. The concrete surface sidewalk must be supported on a minimum of 1.6m thick non-frost susceptible material provided with a provision of a subdrain with a positive outlet to help minimize slab heave due to freezing weather conditions, or consideration should be given to install a frost slab in these areas.

The above pavement design thicknesses are considered adequate for design traffic. However, if the pavement construction occurs in wet or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular sub-base, base, or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

It should be noted that in addition to adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is required that regular inspection and testing by Green Geotechnical be conducted during the pavement construction to confirm material quality, stability, thickness, and to ensure adequate compaction.

4.6 Pipe Bedding

Trench bases are expected to consist primarily of native, undisturbed sandy silt to silt and sand glacial till soils, or clean earth fill compacted to a minimum of 98% of SPMDD. The native, undisturbed site soils as well as Engineered Fill will generally be suitable for support of underground services with conventional Class 'B' granular bedding. Additional granular bedding may be necessary for stabilization of wet trench bases or particularly soft areas. The granular bedding should consist of a well graded material such as



Granular 'A'. Excavation bases should be free of standing water prior to and during bedding and service placement.

Any soft, loose, or disturbed soils encountered as a result of groundwater seepage or construction traffic should be sub excavated and replaced with suitably compacted granular fill. Additionally, any loose or deleterious fill or organics encountered below proposed pipe inverts should be sub excavated and replaced with suitable compacted bedding material. Granular 'A' bedding material should be placed in thin lifts and compacted to a minimum of 95% of SPMDD. If HL8 coarse aggregate or 19mm clear stone is used this will require light tamping only. However, it should be cautioned that this HL8 aggregate or clear stone should not be used directly against native deposits unless a geotextile fabric is also considered as a complete wrap to prevent migration of fines into the bedding from the surrounding fine soil. Without proper filtering, this loss of ground could result in loss of support to the pipes and in possible future.

In areas where the soils become wet, unstable and dilatant (easily disturbed) such as saturated silts, clays and water bearing granular soils, careful construction techniques and dewatering should be followed. If the pipes are laid on disturbed, dilatant soil, significant post-construction settlements could occur after the trenches are backfilled. In such cases, disturbed soil must be removed. The bottom of wet trenches will have to be stabilized by dewatering. The placement of a thin layer of lean mix concrete or a 'mud slab' may be considered to prevent heaving of sensitive or easily disturbed sub-soils and prevent disturbance of sensitive sub-soils due to construction activity. If a 'mud slab' option is not used, then increasing the Class 'B' type bedding thickness in order to stabilize the subgrade soil is recommended.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Excavation and Backfill

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III – Excavations, Sections 222 through 242. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes, the site soils are classified as Type 3 soil above and Type 4 soil below the groundwater table.

Where workers must enter excavations advanced deeper than 1.2m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates safe slopes of excavation by soil type as follows:



Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

The subsurface soils can be removed by conventional excavation equipment. Larger size particles (cobbles and boulders) that are not specifically identified in the boreholes may be present in the native soils. The size and distribution of cobbles/boulders/obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. The risk and responsibility for the removal and disposal of cobbles/boulders/obstructions and appropriate use of equipment must be addressed in the contract documents for foundations, excavations and shoring contractors.

Structures such as existing buried foundations, previously backfilled excavations, existing old wells/cisterns, drainage tiles, boulders, rubble, etc. may also be present at the site. The presence of these structures if encountered, will likely affect construction methods and cost if they exist within proposed structure areas.

The surficial topsoil, earth fill, and native soil layers with amounts of organics should not be reused as backfill in settlement sensitive areas (beneath floor slabs, trench backfill and pavement areas). However, these materials may be stockpiled and reused for landscaping purposes.

Unsaturated native cohesionless soils which are free of organics, boulders, and deleterious inclusions, encountered above the groundwater table, are considered to be suitable for reuse as backfill, so long as moisture content levels are within 2 percent of the optimum moisture content level. Otherwise, consideration should be given to importing granular type fill to achieve adequate compaction in Engineered Fill and trench backfill activities, where use of the site's coarser grained soils is not feasible.

It should be noted that native soils excavated from below the prevailing groundwater level (if encountered) will likely be too wet to compact to required compaction specification.

The moisture content of the backfill soils should be within 2 percent of their optimum moisture content. Any soil material with in-situ moisture content higher than 2 percent of its optimum moisture content could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.



In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150mm thicknesses or less, and heavily compacted to a minimum of 95 percent SPMDD at a water content close to optimum. The soils encountered on the site will be best compacted with a heavy smooth drum (cohesionless) or sheep's-foot (cohesive) type roller. Imported granular type fill soils will be best compacted with a smooth-drum type roller.

It should be noted that the site soils vary greatly in their drainage properties and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that earthworks will be difficult during the wet periods (i.e., spring and fall) of the year and may result in increased earthwork costs.

5.2 Groundwater Control

Groundwater levels recorded at this site were recorded at approximately ± 1.4 to ± 3.4 m below existing grades in December of 2023, January of 2024, and March of 2024. Long term monitoring was beyond the scope of this investigation and the seasonal water table may fluctuate. Seepage at or near the groundwater levels should be handled adequately using filtered sump pumps placed at the base of the excavations for most of the site. More significant dewatering efforts will be required below the groundwater levels, and particularly in sandy/gravelly soil pockets.

Moderately permeable soils were encountered in the boreholes. These soils may yield varying amounts of groundwater seepage into the excavation depending upon the type of soil and the depth of excavation. The amount of water seepage is expected to increase with the depth of excavation. Groundwater control will be required for excavations extending into/or below the prevailing groundwater level, prior to and during the subsurface construction. Without positive groundwater control, the subgrade in wet permeable soils will become weak/disturbed and lose its integrity to support. Consideration should be given to install a skim coat of lean concrete (mud-slab) to preserve the subgrade integrity in these areas, and to provide a working platform, as deemed appropriate by the project geotechnical engineer during construction.

All finished floor surfaces are recommended to be at least 0.5m above the prevailing seasonally high groundwater level, which the proposed building is expected to comply with.

It should be noted that excavations carried through and below the water bearing soils will likely experience loosening and sloughing of the base and sides unless the groundwater level is lowered first to at least 1.0m below the bottom of the excavation.



5.3 Quality Control

The foundation installations must be reviewed in the field by Green Geotechnical, the geotechnical engineer, as they are constructed. The on-site review of the condition of the foundation subgrade as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code. If Green Geotechnical is not retained to carry out foundation evaluations during construction, then Green Geotechnical accepts no responsibility for the performance or non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice contained in this report.

The long-term performance of the pavement is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Green Geotechnical at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

The requirements for fill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density (SPMDD). In situ determinations of density during fill placement on site are required to demonstrate that the specified placement density is achieved. Green Geotechnical can provide sampling and testing services for the project as necessary, with our qualified technical staff.

Concrete will be specified in accordance with the requirements of CAN3 - CSA A23.1. Green Geotechnical maintains a concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

6.0 LIMITATIONS AND REPORT USE

6.1 Procedures

This subsurface investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Green Geotechnical and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Green Geotechnical.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Green



Geotechnical has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Green Geotechnical has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

6.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Green Geotechnical and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Green Geotechnical should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of 271 Main Street East Inc. and their retained design consultants and is not for use by others. This report is copyright of Green Geotechnical Inc., and no part of this report may be reproduced by any means, in any form, without the prior written permission of Green Geotechnical and 271 Main Street East Inc., who are the authorized users.

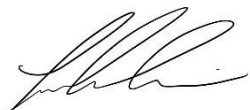
It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statutes, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.



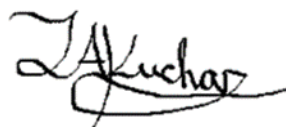
We trust this report meets your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Sincerely,

Green Geotechnical Ltd.



Luke Kim, E.I.T.
Project Coordinator



Tristan Kuchar, B.A.Sc., E.I.T.
Project Manager



Steven Green, P.Eng.
President



Enclosures: Figures and Appendices



FIGURES



Title:

Figure 1: SITE LOCATION PLAN

Client:

271 MAIN ST EAST INC.

Reference:

Map Data © 2023 Google Maps

Project:

271 MAIN STREET EAST, DUNDALK, ON

Drawn By:

NC

Reviewed By:

TK

Project Number:

23-115-02

Date:

FEB. 2024

GREEN
GEOTECHNICAL

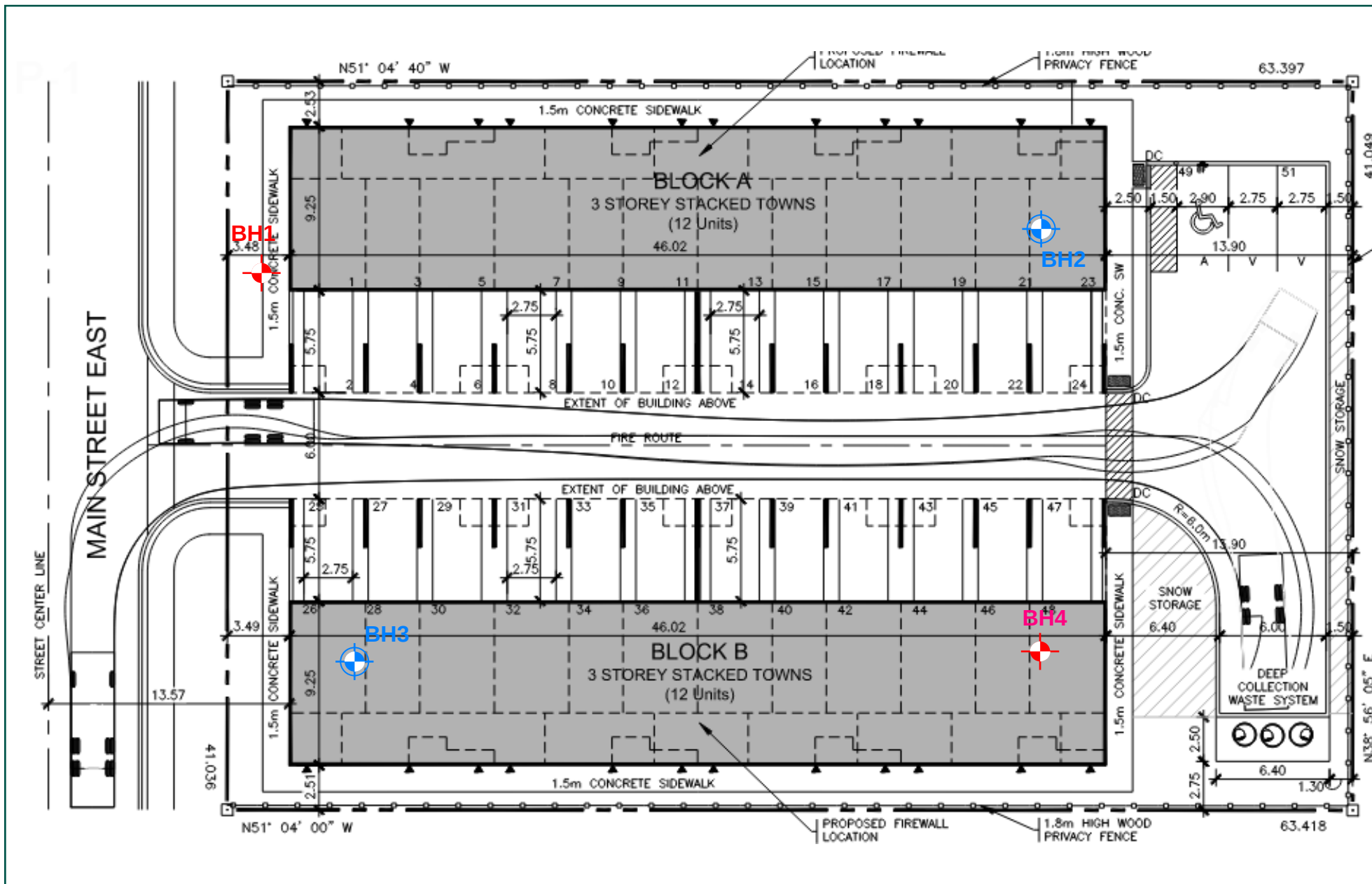
576 Bryne Drive, Unit 'O', Barrie, ON

705-503-9626

info@greengeo.ca



Title: FIGURE 2A: EXISTING BOREHOLE LAYOUT PLAN (Approximate)	Project: 271 MAIN STREET EAST, DUNDALK, ON		
Client: 271 MAIN ST EAST INC.	Drawn By: NC	Project Number: 23-115-02	 576 Bryne Drive, Unit 'O', Barrie, ON 705-503-9626 info@greengeo.ca
Reference: Map Data © 2024 Google Maps	Reviewed By: TK	Date: FEB. 2024	



Title: FIGURE 2B: PROPOSED BOREHOLE LAYOUT PLAN (Approximate)	Project: 271 MAIN STREET EAST, DUNDALK, ON		
Client: 271 MAIN ST EAST INC.	Drawn By: LK	Project Number: 23-115-02	576 Bryne Drive, Unit 'O', Barrie, ON 705-503-9626 info@greengeo.ca
Reference: "Site Plan," by Orchard Design Studios, dated April 29, 2024	Reviewed By: TK	Date: APR. 2024	

APPENDICIES



APPENDIX A

SYMBOLS and ABBREVIATIONS USED ON BOREHOLE LOGS

PROPORTIONAL TERMS

Term	Proportion
trace	0 to 10%
some	10 to 20%
-y or -ey	20 to 35%
and	>35%

MOISTURE DESCRIPTION

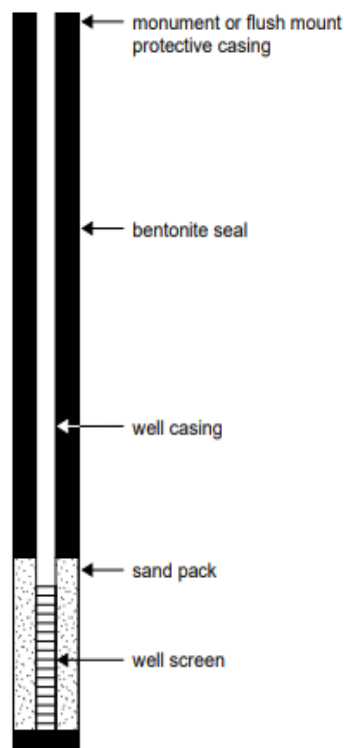
Term	Description
dry	No observable pore moisture
moist	Inferred pore moisture, no observable free water
wet	Weakened by moisture, free water on hands when handling

CONSISTENCY of COARSE-GRAINED SOILS

Consistency	Blow Count N
very loose	< 4
loose	4 to 10
compact	10 to 30
dense	30 to 50
very dense	> 50

Notes: SPT/DCPT 'N' values are 'raw' field blow counts, measured for 300 mm (12 inch) of penetration.

WELL LEGEND



CONSISTENCY of FINE-GRAINED SOILS

Consistency	Blow Count N	Undrained Shear Strength S_u (kPa)	
very soft	< 2	< 12	Easily exudes between fingers when squeezed
soft	2 to 4	12 to 25	Easily intended by fingers
firm	4 to 8	25 to 50	Can be intended by strong finger or thumb pressure
stiff	8 to 16	50 to 100	Cannot be intended by thumb pressure
very stiff	16 to 30	100 to 200	Can be intended by thumb nail
hard	> 30	> 200	Difficult to intend by thumb nail

ASTM STANDARDS

ASTM D1568 Standard Penetration Test (SPT) - Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760mm. The blows required to drive the split spoon 300mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

ASTM D1568 Cone Penetration Test (CPT) - Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm² Into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT) -

Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST) -

Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

SYMBOL	Description
AS	Auger Sample
CC	Continuous Core Sample
DC	Drill Cuttings
GS	Grab Sample
SS	SPT Spoon Sample
TS	Thin-walled / Shelby Sample
WS	Water Sample

SYMBOL	Description
▼	Measured in a piezometer or well
▽	Inferred water level based on observations during investigation

BOREHOLE LOG: BH1

Project: 271 Main Street East

Site Address: Dundalk, ON

Easting: 548800

Logged By: SO/NC

Northing: 4891044

Reviewed By: TK

Project No.: 23-115-01

Client: 271 Main St. East Inc.

Elevation: 518.6 m

Investigation Date: 2023-11-27

DEPTH	SOIL STRATIGRAPHY	SYMBOL	SAMPLES		STANDARD PENETRATION TEST (SPT)	NOTES/GRAIN SIZE (%)	MONITORING WELL	MOISTURE PLOT
			NO.	SYMBOLS				
					0 10 20 30 40 50			
Ground Surface at 518.6 m EL 518.6 m								
0	TOPSOIL 0.2 m EL 518.4 m		1	SS	6		No Data	
	FILL Sandy silt, trace to some gravel to cobbles, trace clay, trace organic inclusions, loose, moist, dark brown 0.6 m EL 518 m		2	SS	25			
1	SANDY SILT TO SAND AND SILT Some gravel to cobbles, occasional boulders, trace to some clay, compact, very dense, moist brown (GLACIAL TILL)		3	SS	11			
2			4	SS	36	Gr - 29%; Sa - 24%; Si - 34%; Cl - 13%		
3			5	SS	(61)			
4			6	SS	(REF)	N: 50/300mm		
5			7	SS	(90)			
6								
7	BH1 Terminated at 6.6 m 6.6 m EL 512 m							

Notes:

Borehole was dry and caved to 5.5 mbg upon completion of drilling.



BOREHOLE LOG: BH2

Project: 271 Main Street East

Site Address: Dundalk, ON

Easting: 548831

Logged By: SO/NC

Northing: 4891013

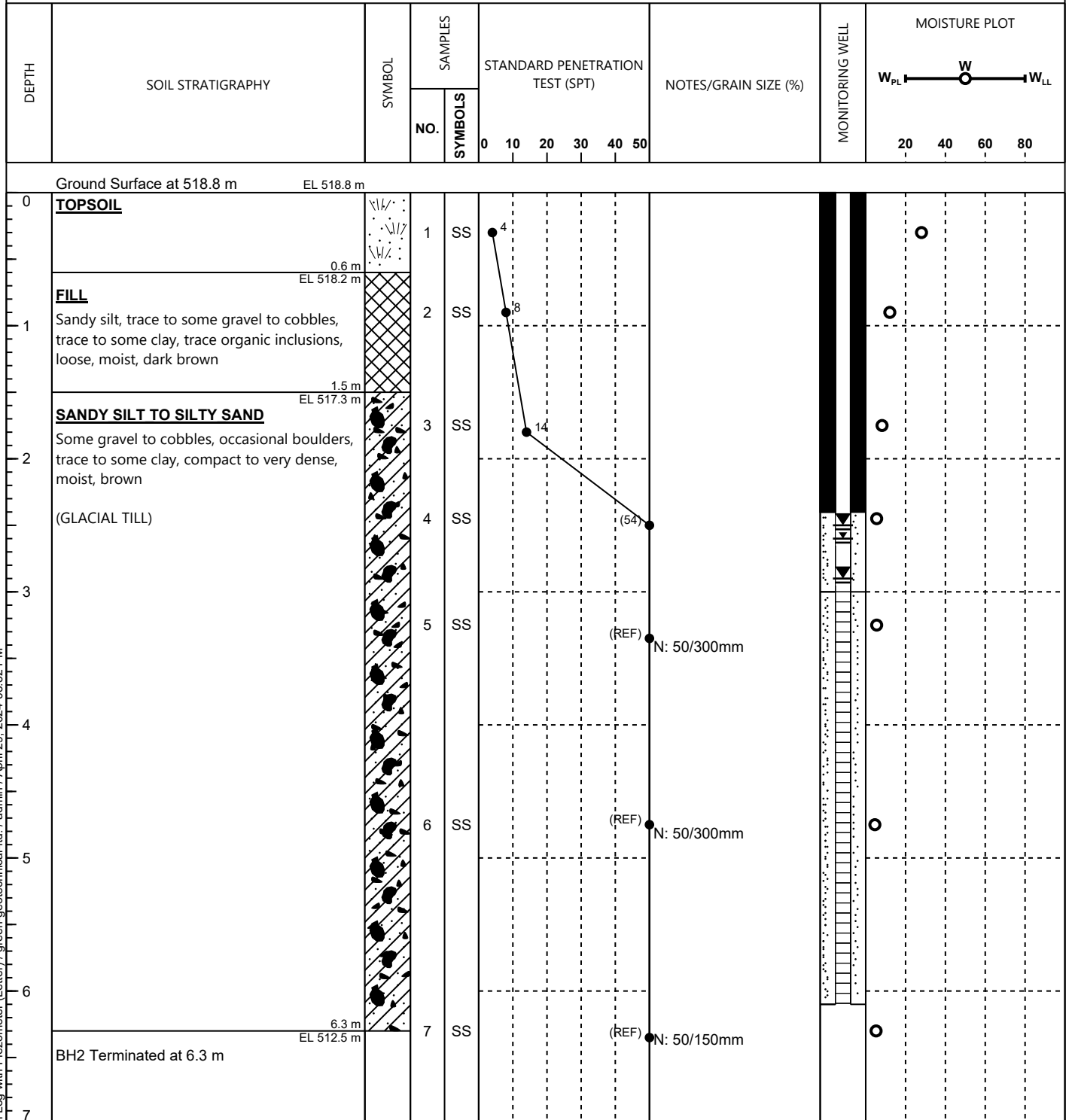
Reviewed By: TK

Project No.: 23-115-01

Client: 271 Main St. East Inc.

Elevation: 518.8 m

Investigation Date: 2023-11-27



Notes:

Borehole was dry and open upon completion of drilling. Stabilized water level measured at 2.6 mbg (elev. 516.2 m) on 01-06-24 by Green Geo. Stabilized water level measured at 2.9 mbg (elev 515.9 m) on 12-13-23 and 2.5 mbg (elev. 516.3 m) on 03-13-24 by Crozier.

BOREHOLE LOG: BH3

Project: 271 Main Street East

Site Address: Dundalk, ON

Easting: 548788

Logged By: SO/NC

Northing: 4891026

Reviewed By: TK

Project No.: 23-115-01

Client: 271 Main St. East Inc.

Elevation: 518.4 m

Investigation Date: 2023-11-27

DEPTH	SOIL STRATIGRAPHY	SYMBOL	SAMPLES		STANDARD PENETRATION TEST (SPT)	NOTES/GRAIN SIZE (%)	MONITORING WELL	MOISTURE PLOT
			NO.	SYMBOLS				
					0 10 20 30 40 50			
Ground Surface at 518.4 m EL 518.4 m								
0	TOPSOIL 0.2 m EL 518.2 m		1	SS	5			
	FILL Sandy silt, some gravel to cobbles, trace to some clay, trace organic inclusions, loose, moist, dark brown		2	SS	(REF)	N: 50/450mm		
1								
	1.5 m EL 516.9 m		3	SS	12			
	SANDY SILT TO SAND AND SILT Some gravel to cobbles and occasional boulders, some clay, compact to very dense, moist, brown (GLACIAL TILL)		4	SS	(57)			
2								
			5	SS	(REF)	N: 50/300mm		
3								
			6	SS	(REF)	N: 50/150mm		
4								
			7	SS	(REF)	N: 50/150mm		
5								
	6.3 m EL 512.1 m							
6	BH3 Terminated at 6.3 m							
7								



Notes:

Borehole was dry and open upon completion of drilling. Stabilized water level measured at 1.6 mbg (elev. 516.8 m) on 01-06-24 by Green Geo. Stabilized water level measured at 3.4 mbg (elev. 515.0 m) on 12-13-23 and 1.4 mbg (elev. 517.0 m) on 03-13-24 by Crozier.

BOREHOLE LOG: BH4

Project: 271 Main Street East

Site Address: Dundalk, ON

Easting: 548820

Logged By: SO/NC

Northing: 4891001

Reviewed By: TK

Project No.: 23-115-01

Client: 271 Main St. East Inc.

Elevation: 518.6 m

Investigation Date: 2023-11-27

DEPTH	SOIL STRATIGRAPHY	SYMBOL	SAMPLES		STANDARD PENETRATION TEST (SPT)	NOTES/GRAIN SIZE (%)	MONITORING WELL	MOISTURE PLOT
			NO.	SYMBOLS				
					0 10 20 30 40 50			
Ground Surface at 518.6 m EL 518.6 m								
0	TOPSOIL		1	SS	15		No Data	
	0.35 m EL 518.25 m							
	FILL		2	SS	17			
1	Sandy Silt, trace to some gravel to cobbles, trace clay, trace organic inclusions, loose, moist, dark brown							
	1.5 m EL 517.1 m							
	SANDY SILT TO SAND AND SILT,		3	SS	46			
2	Some gravel to cobbles, occasional boulders, trace to some clay, compact to very dense, moist, brown							
	(GLACIAL TILL)		4	SS	39			
3			5	SS	(REF)	Gr - 39%; Sa - 23%; Si - 28%; Cl - 10% N: 50/450mm		
4			6	SS	(56)			
5			7	SS	(83)			
6								
6.6 m EL 512 m	BH4 Terminated at 6.6 m							

Notes:

Borehole was dry and open upon completion of drilling.



APPENDIX B

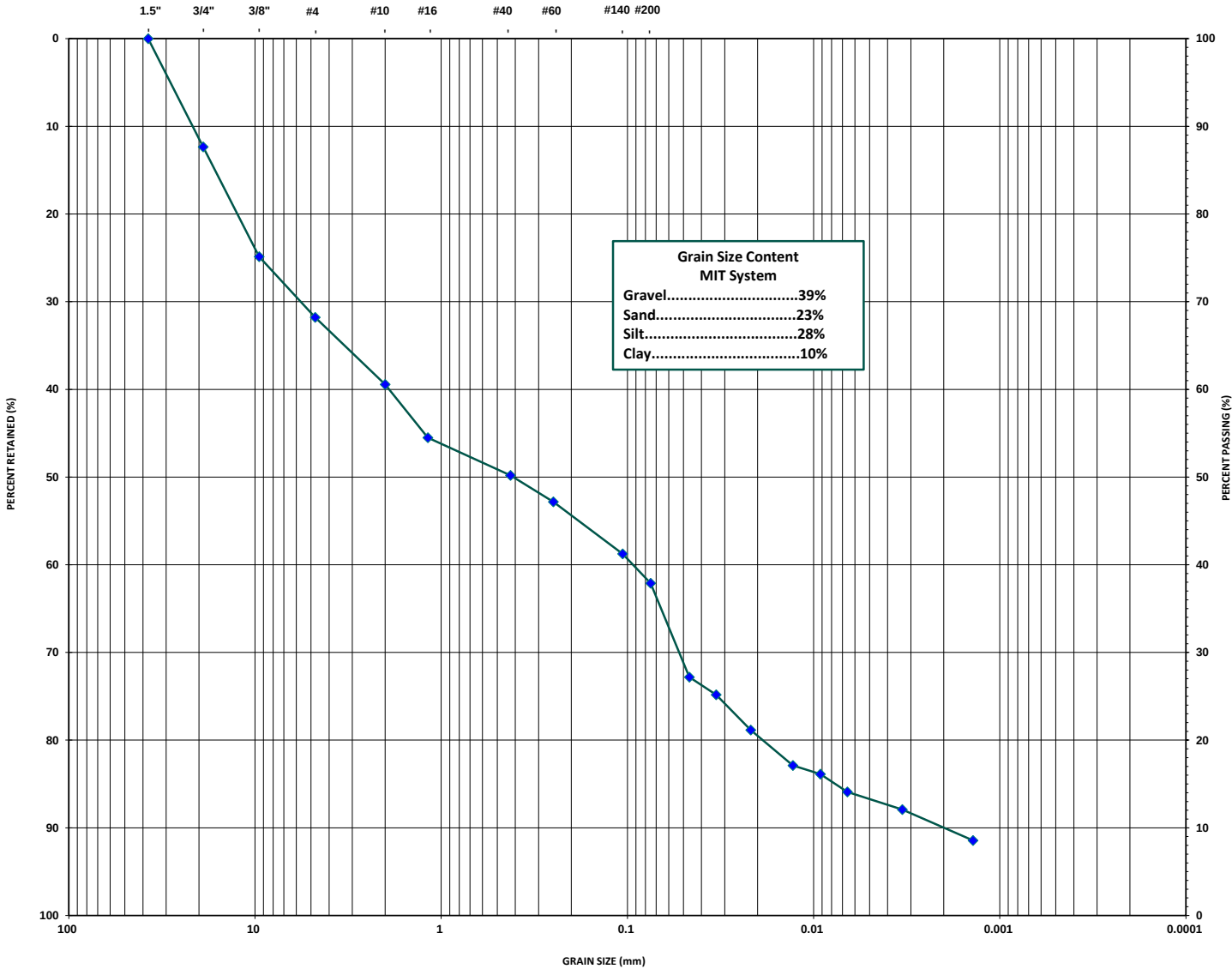


576 Bryne Drive, Unit 'O'
Barrie, ON
L4N 9P6

Hydrometer Analysis Form

Project Number:	23-115-01	Location:	Dundalk, ON	Project Name:	271 Main Street East
Sample Date:	November 27, 2023	Test Date:	January 11, 2023	Client Name:	271 Main Street East Inc.
Sample Description:	Silty, sandy gravel, trace clay	Lab Number:	118	Tested By:	NC
Sample Location:	N/A	Sample Depth:	10 to 11.5'	Sampled By:	NC
Borehole:	4	Sample Number:	5		
Estimated Septic T-Time:	N/A			Unified Soil Classification	SM

Grain Size Distribution
U.S. Standard Sieve Sizes



MIT System	Gravel			Coarse	Medium	Fine	Silt		Clay
				Sand					
Unified System	Coarse	Fine	Coarse	Medium	Fine	Silt and Clay			
	Gravel		Sand						

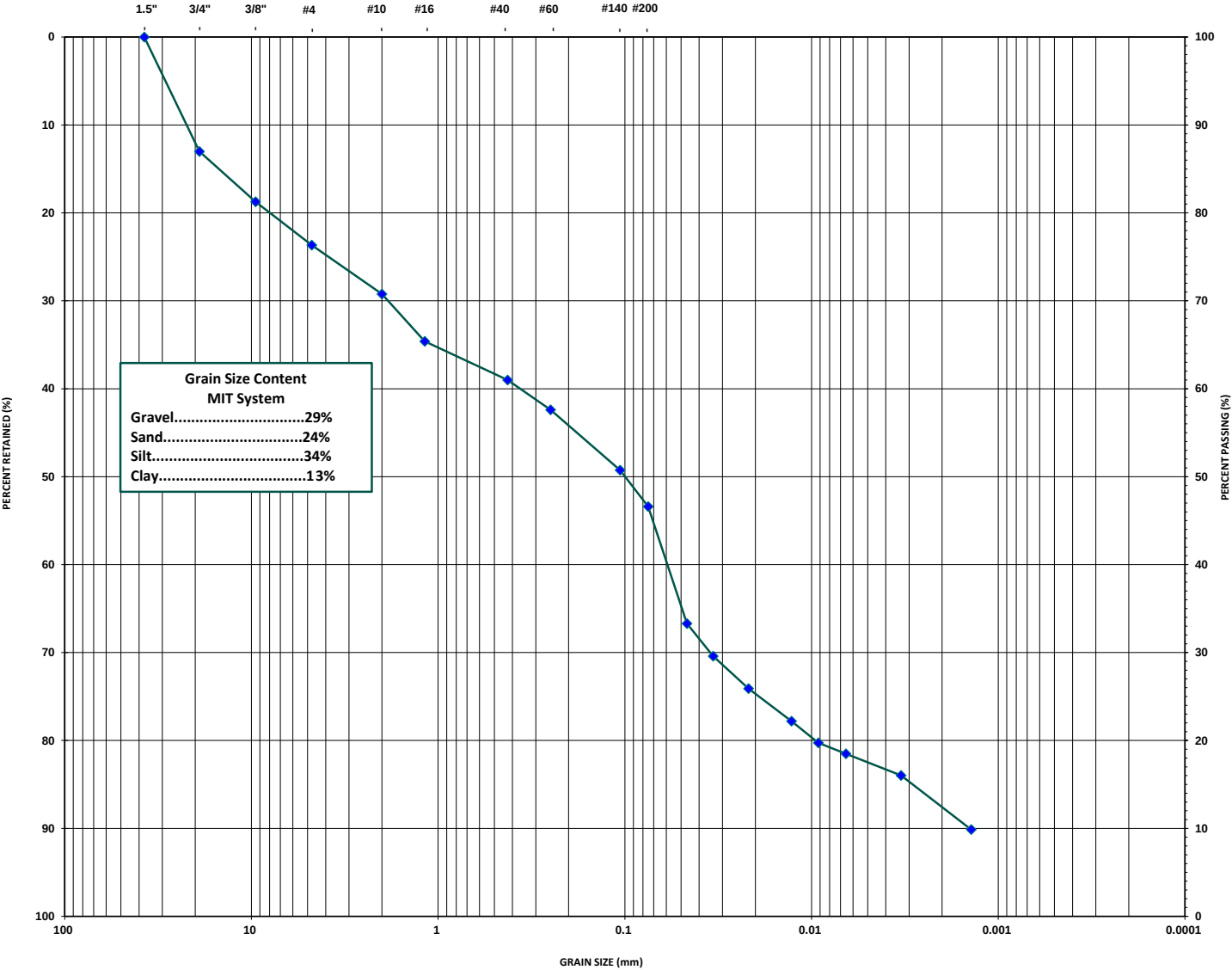


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L4N 9P6

Hydrometer Analysis Form

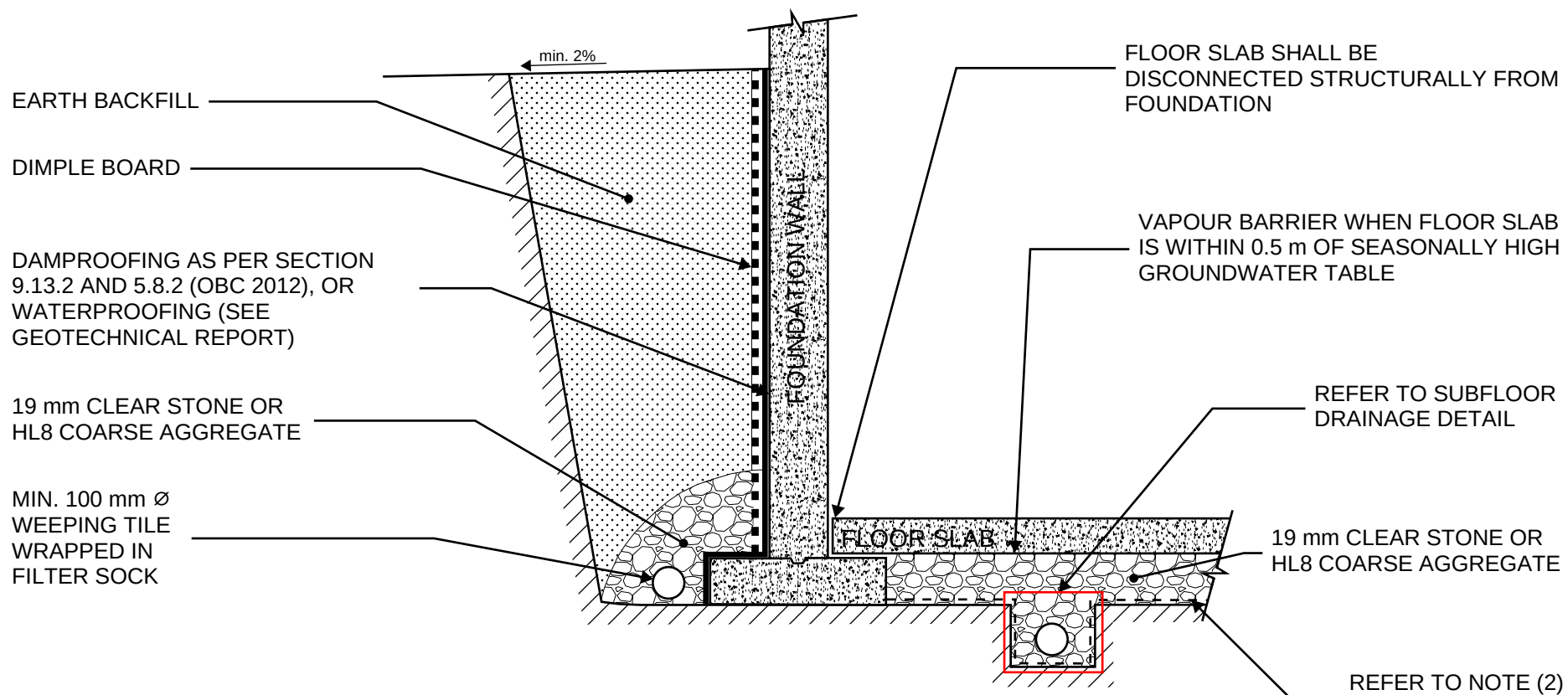
Project Number:	23-115-01	Location:	Dundalk, ON	Project Name:	271 Main Street East
Sample Date:	November 27, 2023	Test Date:	January 9, 2023	Client Name:	271 Main Street East Inc.
Sample Description:	Gravelly, sandy silt, some clay	Lab Number:	117	Tested By:	NC
Sample Location:	N/A	Sample Depth:	7.5 to 9'	Sampled By:	NC
Borehole:	1	Sample Number:	4		
Estimated Septic T-Time:		N/A		Unified Soil Classification	SM

Grain Size Distribution
U.S. Standard Sieve Sizes



MIT System	Gravel				Coarse	Medium	Fine	Silt		Clay
					Sand					
Unified System	Coarse	Fine	Coarse	Medium	Fine	Silt and Clay				
	Gravel		Sand							

APPENDIX C



NOTES:

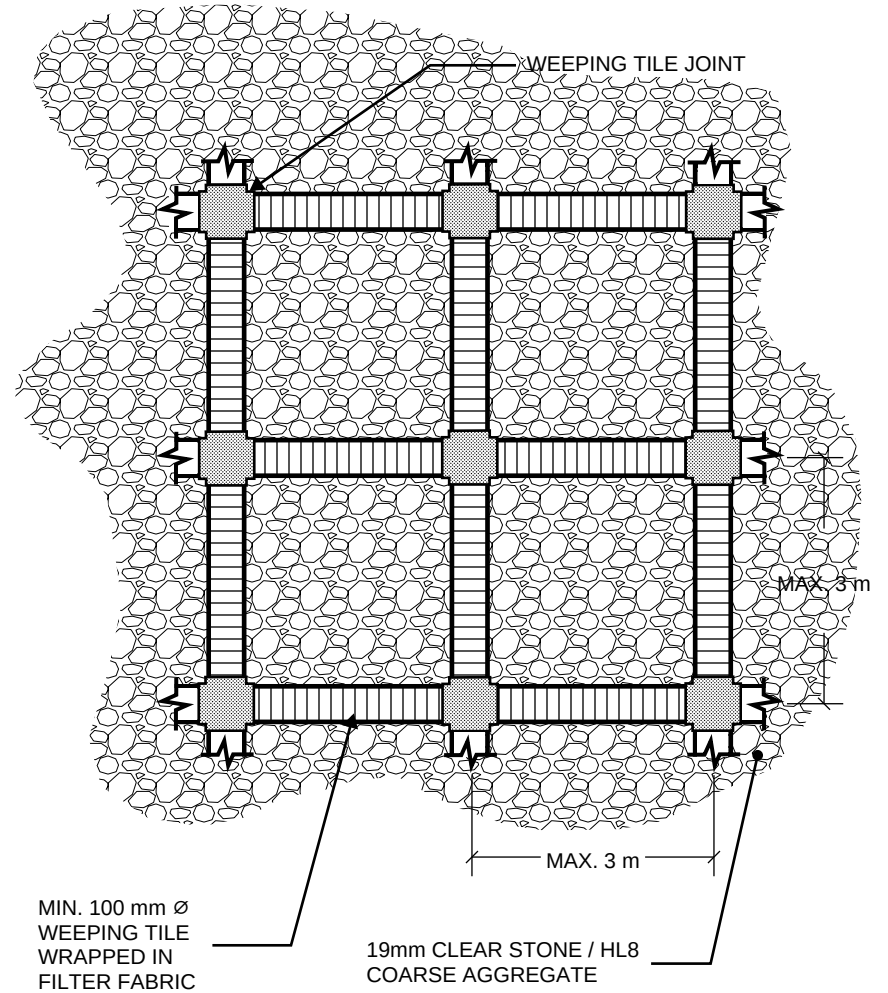
1. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.
2. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (TERRAFIX 360R OR EQUIVALENT)
3. NOT TO SCALE

Title:

TYPICAL BASEMENT DRAINAGE SCHEMATIC (OPEN EXCAVATION)



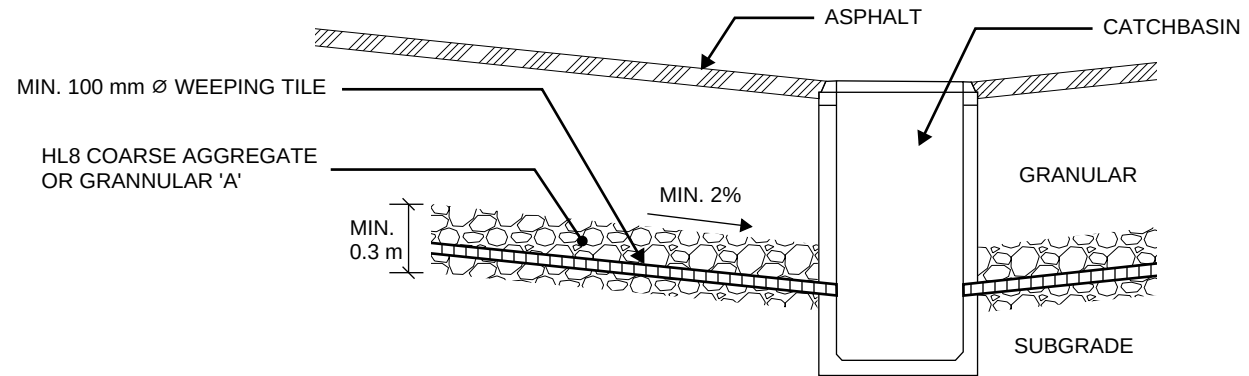
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info@greengeo.ca



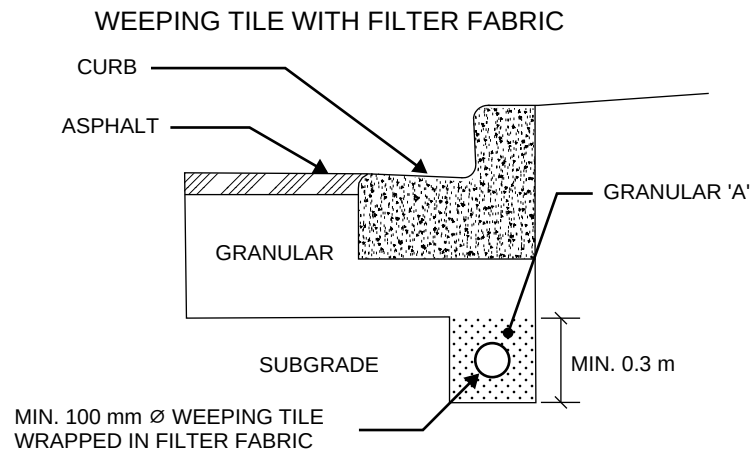
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info@greengeo.ca**

APPENDIX D

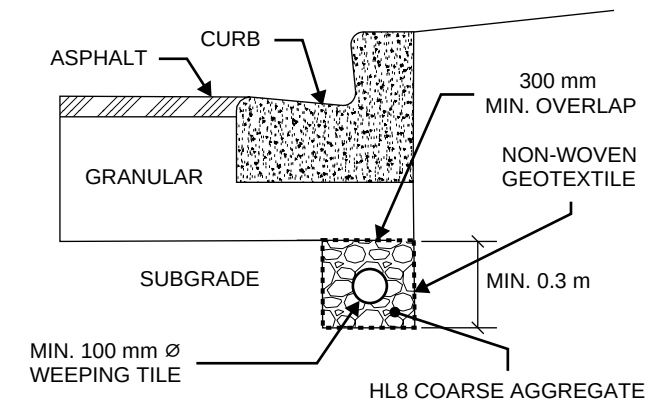
LONGITUDINAL SUBDRAIN CONNECTION TO CATCHBASIN



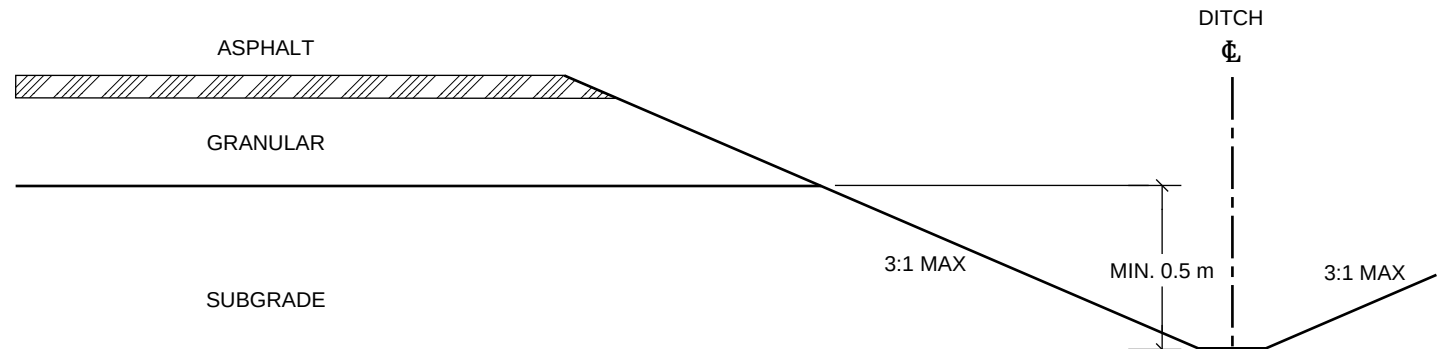
URBAN CROSS SECTIONS



WEeping TILE WITHOUT FILTER FABRIC



RURAL CROSS SECTIONS



Title:

PAVEMENT DRAINAGE ALTERNATIVES



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705-503-9626
info@greengeo.ca

APPENDIX E

ENGINEERED FILL SPECIFICATIONS

Overview

- Engineered Fill is a pre-approved material which has been placed under the full-time supervision of Green Geotechnical, including testing and inspection during construction to ensure subgrade stability, material quality, proper lift thickness, and adequate compaction have all been maintained.
- Engineered Fill is used to accommodate structural loads (such as for foundations, slabs, etc.) where site grades are being altered, or in order to accommodate structural design loads.
- Prior to concrete placement for footings and poured walls on Engineered Fill, Green Geotechnical must inspect the foundation subgrade soils, and reinforcing steel respectively.

Design

- Engineered fill material must be free of organic inclusions, construction debris, and any other deleterious material.
- Ideally, granular type soils, with less than 8% fines, such as OPSS 1010 Granular 'B,' are used.
- In sites where a high groundwater table or where wet conditions exist, (even with dewatering operations), in order to achieve stable layers and the specified compaction on the first one to two lifts, OPSS 1010 Granular 'B' Type II or 50 mm crusher run limestone may be advisable.
- The determination of whether the site soils are suitable for reuse as Engineered Fill, or if an imported material is to be used, is at the discretion of the opinion of the Geotechnical Engineer.
- Post construction settlement of the Engineered Fill is to be expected. The timeframe that this occurs varies based on the type of material used. Typically, time intervals of the following can be used:

	Self-Consolidation Settlement		Foundation Loading Settlement	
Material	Settlement Rate	Time Rate	Settlement Rate	Time Rate
Granular 'B' or Coarser	Minimal (0.2% D)	Immediate	Minor (0.5", 12mm)	Immediate
Fine Sand	Minimal (0.5% D)	1-50 hours	Minor (0.75", 19mm)	1-50 hours
Sandy Silt	Minor (0.75% D)	2-30 days	Minor (1", 25mm)	2-30 days
Clayey Silt	Moderate (1% D)	3-6 months	Moderate (1.25", 31mm)	3-6 months
Silty Clay	Major (1.5% D)	6-7 years	Major (1.5", 37mm)	6-7 years

D is the depth of the Engineered Fill

- It is imperative for avoiding excessive settlements that the construction of foundations take into account the post-construction settlement period.
- Engineered Fill is to extend a minimum of 1m beyond the base of any structure's foundations, and project down to the subgrade at a slope with a maximum steepness of 1H:1V.
- An allowable design bearing capacity of 150 kPa (SLS) can usually be used for Engineered Fill constructed on a stable, approved subgrade.
 - This is unless a different bearing capacity for the Engineered Fill has been recommended by the Geotechnical Engineer, based on the properties of the site soils.
- The Engineered Fill is to extend at least 1m above the highest foundation base elevation to provide the Engineered Fill at founding level(s) protection from frost, precipitation, runoff, wind, and weathering.
- Poured concrete footings are to be a minimum width of 0.6m for strip footings and 1.0m for individual footings.



- Reinforcing steel comprised of two (2) continuous 15M bars at the top and bottom of foundation walls, and 15M bars spaced at 0.3m in column pad footings, are required in all poured concrete foundations.

Construction

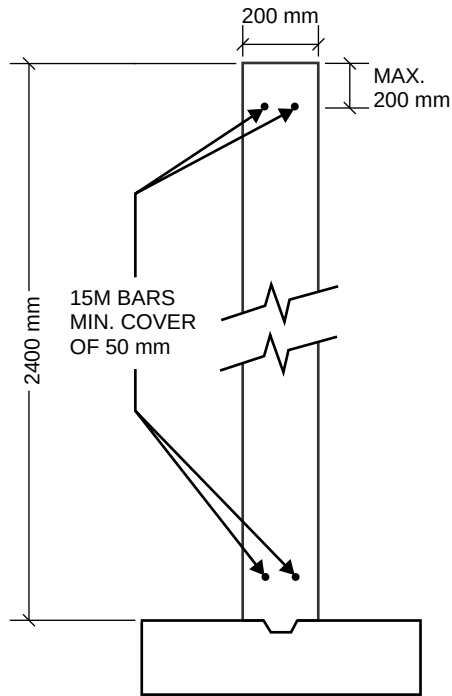
- Surveying should be done by the earthworks contractor or the surveying contractor to ensure that Engineered fill elevations and footprint are accurate and meet the specifications outlined in this document.
- The elevations should be provided to Green Geotechnical by the earthworks contractor or the surveying contractor at each placed lift of material, for recording compaction levels by elevation, and to ensure proper lift thickness.
- Topsoil and uncontrolled fill/deleterious material are to be excavated, leaving a stable, dry, native subgrade.
- Dewatering may be required, depending on the groundwater conditions at the site.
- Prior to the placement of any Engineered Fill, Green Geotechnical must approve the stability of the exposed native subgrade for Engineered Fill placement.
- Depending on the groundwater conditions and soil type at the site, a proof-roll with a heavy compaction roller or rubber-tire front-end loader with a full bucket may be required on the subgrade. Any noted unstable areas will have to be sub-excavated and brought back up with the placement of Engineered Fill.
- As previously mentioned, if wet conditions exist at the site, for the first one to two lifts of the Engineered Fill, the use of OPSS 101 Granular 'B' Type II or 50 mm crusher run limestone may be advisable.
- All material must be compacted to at least 98% SPMDD (Standard Proctor Maximum Dry Density) within 2% of OMC (Optimum Moisture Content).
- Green Geotechnical will take a sample of the Engineered Fill material to determine its SPMDD, OMC, and gradation.
- Green Geotechnical must test the compaction of the placed Engineered Fill at each lift.
- In wet site conditions, it is typically advisable that the first lift be static rolled, and that all subsequent lifts be compacted with vibration. In dry site conditions, compaction by vibration can occur at all lifts.
- Engineered Fill material shall be placed in maximum 150mm loose lifts.
 - The only exception to this is in the first one to two lifts placed in wet site conditions. Here, loose lifts shall be a maximum of 300mm-450mm.
- Engineered Fill should not be placed during months where freezing temperatures occur.

Certification

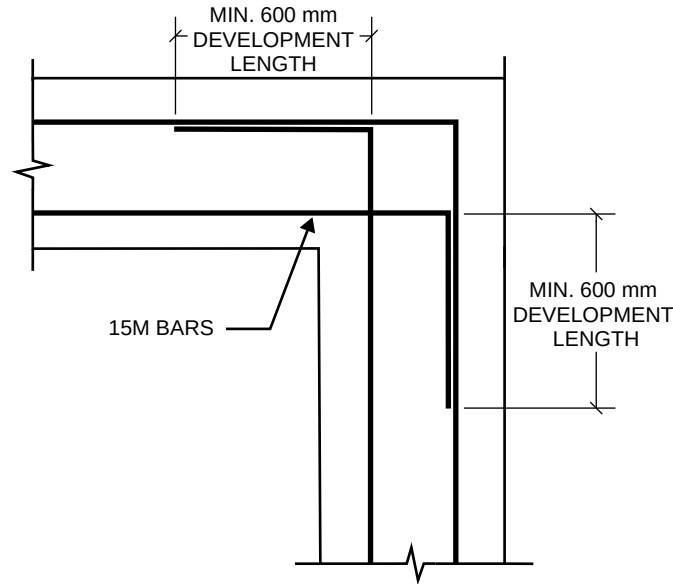
- Green Geotechnical must be present during Engineered Fill construction to approve the native subgrade, approve of and take a sample of the material, as well as record compaction and lift thickness at every lift.
 - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the Engineered Fill as being properly constructed, and displaying the field records.
- Green Geotechnical must inspect the foundation subgrade immediately prior to the placement of concrete for footings.
 - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the Engineered Fill foundation subgrade as being adequate to support the design bearing capacity.
- Green Geotechnical must inspect the reinforcing steel in the foundation walls prior to the placement of concrete. See the attached Typical Reinforced Wall Detail for more information.
 - Following this, a letter signed and sealed by a P.Eng. will be submitted certifying the reinforcing steel as being placed in accordance with the design.



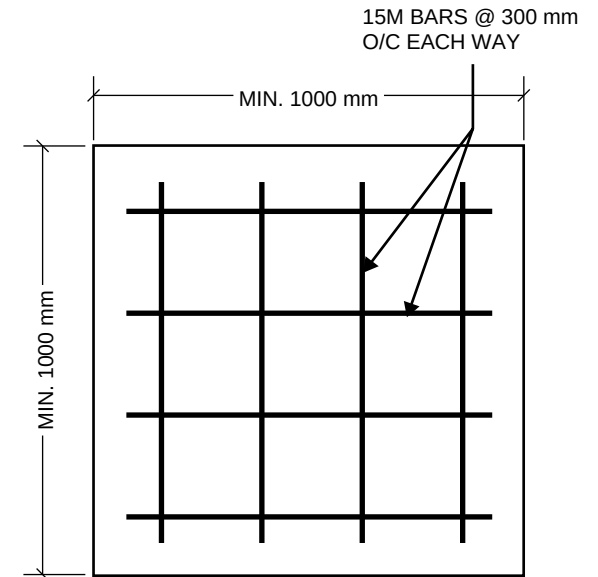
TYPICAL REINFORCED WALL



TYPICAL SPLICING AT CORNERS

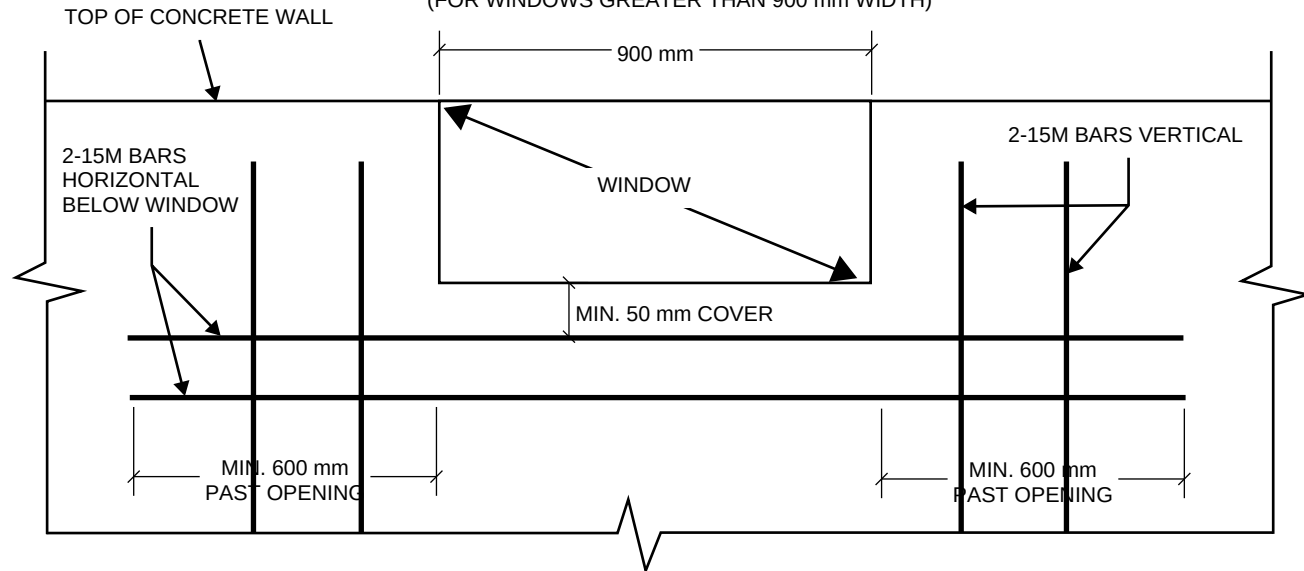


TYPICAL REINFORCEMENT OF COLUMN FOOTINGS



TYPICAL WINDOW REINFORCING

(FOR WINDOWS GREATER THAN 900 mm WIDTH)



NOTES:

1. REINFORCING STEEL C.S.A G30.18-09 GRADE 400
2. CONCRETE MINIMUM 28 DAY STRENGTH 20 MPa
3. BASE OF ALL FOOTING EXCAVATION TO BE INSPECTED AND APPROVED PRIOR TO PLACING FORMWORK
4. TO BE USED IN CONJUNCTION WITH STRUCTURAL REPORT
5. DRAWINGS ARE NOT TO SCALE

Title:

TYPICAL REINFORCED WALL DETAILS FOR HOUSES ON ENGINEERED FILL

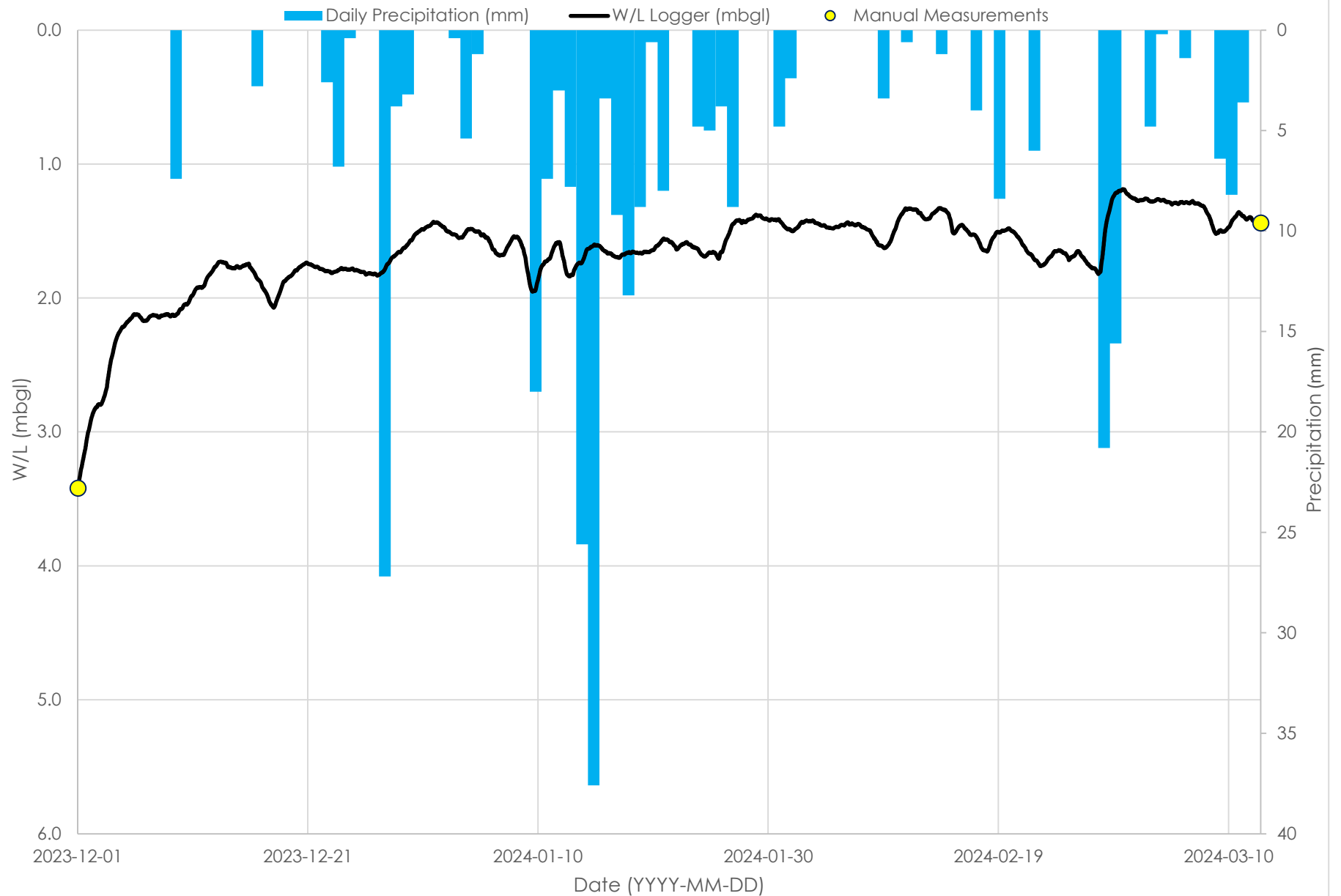


576 Bryne Drive, Unit 'O', Barrie, ON
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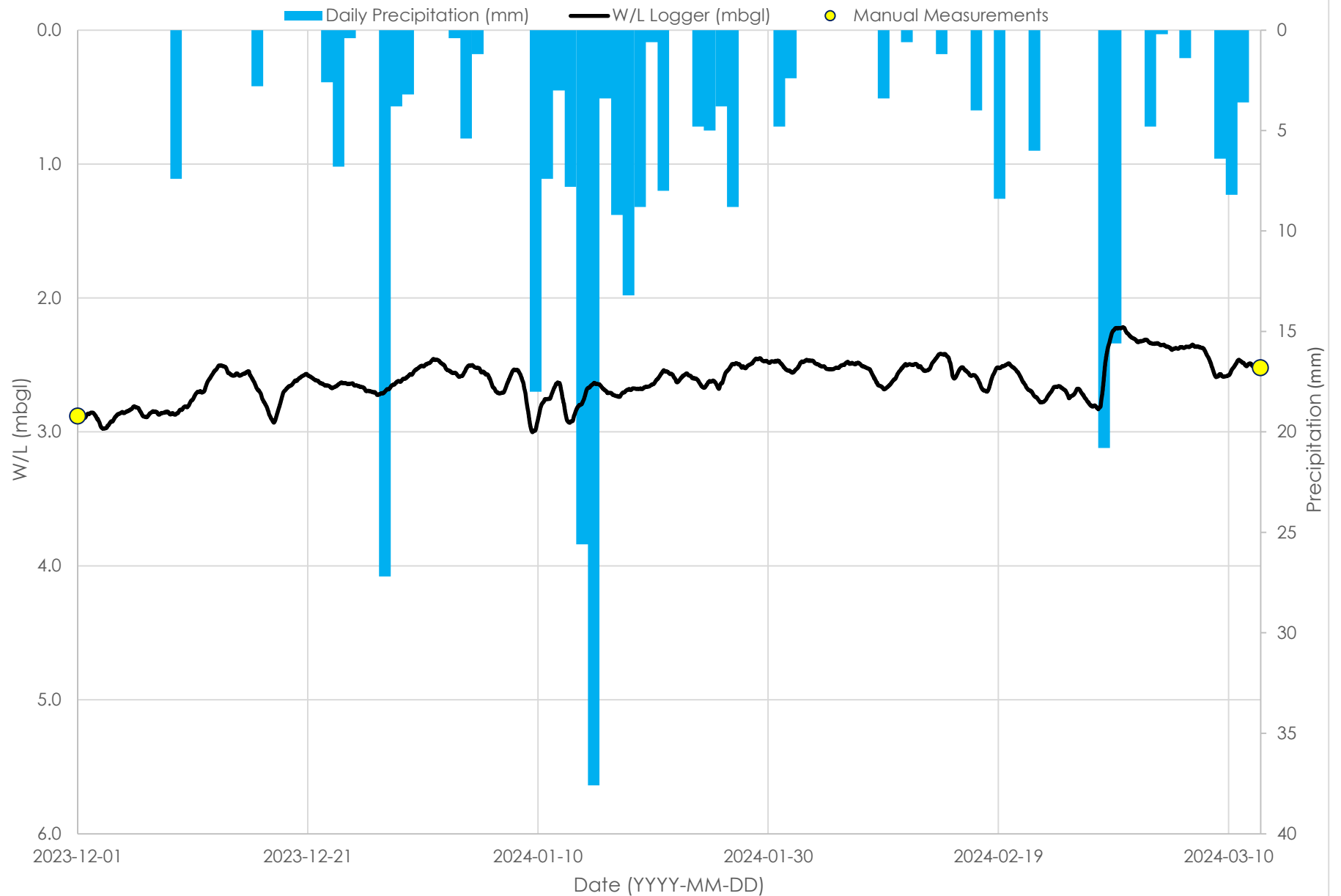
APPENDIX E

Monitoring Well Hydrographs

MW23-1 - 271 Main Street East, Dundalk



MW23-2 - 271 Main Street East, Dundalk



FIGURES



Legend

- Watercourse
- Site Boundary

Figure Notes:

Project:
Countryside Communities Inc.
271 Main Street E, Dundalk

Figure:
Site Location Plan



Drawn: D.M	Design: D.M	Project No. 2514 - 6796	
Date: 2024-04-22	GCS: NAD 1983	Scale: 1:2,500	Fig. 1



1:25,000

Key Plan: Site Location

©OpenStreetMap (and contributors, CC-BY-SA)

Legend

Watercourse

Site Boundary

Surficial Geology

5b: Stone-poor, carbonate-derived silty to sandy till

7a: Sandy deposits

Figure Notes:

Project:
Countryside Communities Inc.
271 Main Street E, Dundalk

Figure:
Surficial Geology

CROZIER

Drawn: D.M	Design: D.M	Project No. 2514 - 6796	
Date: 2024-04-22	GCS: NAD 1983	Scale: 1:2,500	Fig. 2



Legend

- Watercourse
- Site Boundary
- Bedrock Geology
 - 20: Guelph

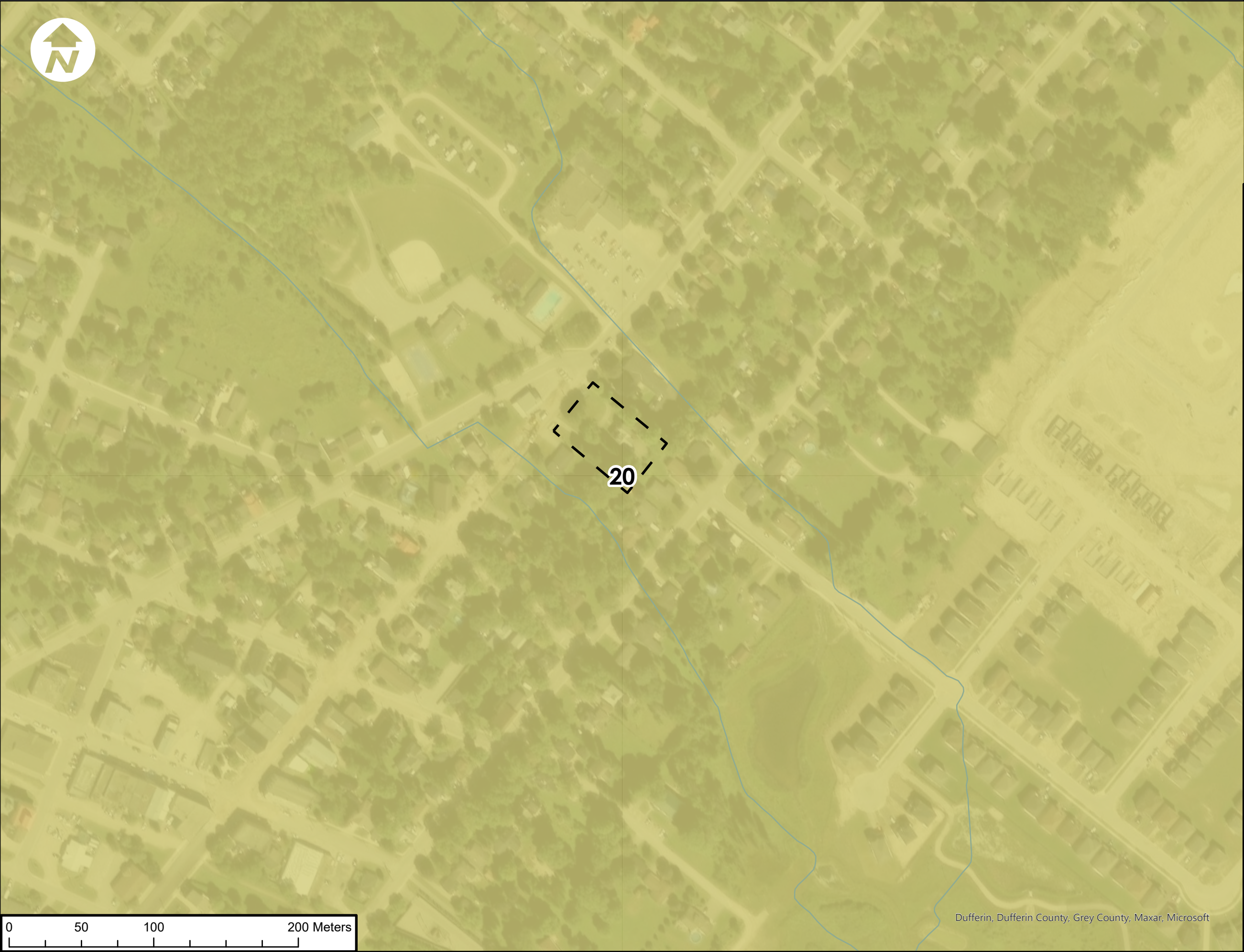
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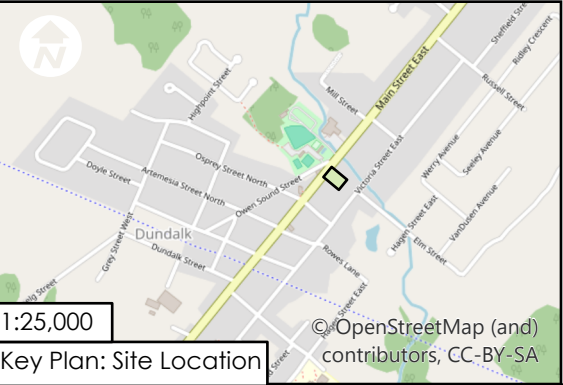
Project:
Countryside Communities Inc.
271 Main Street E, Dundalk

Figure:
Bedrock Geology



Drawn: D.M	Design: D.M	Project No. 2514 - 6796	
Date: 2024-04-22	GCS: NAD 1983	Scale: 1:2,500	Fig. 3





Legend

— Watercourse

┌ ┐ Site Boundary

Physiography

7, Dundalk Till Plain

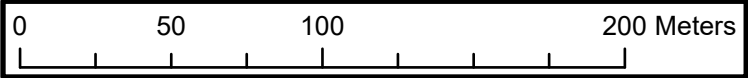
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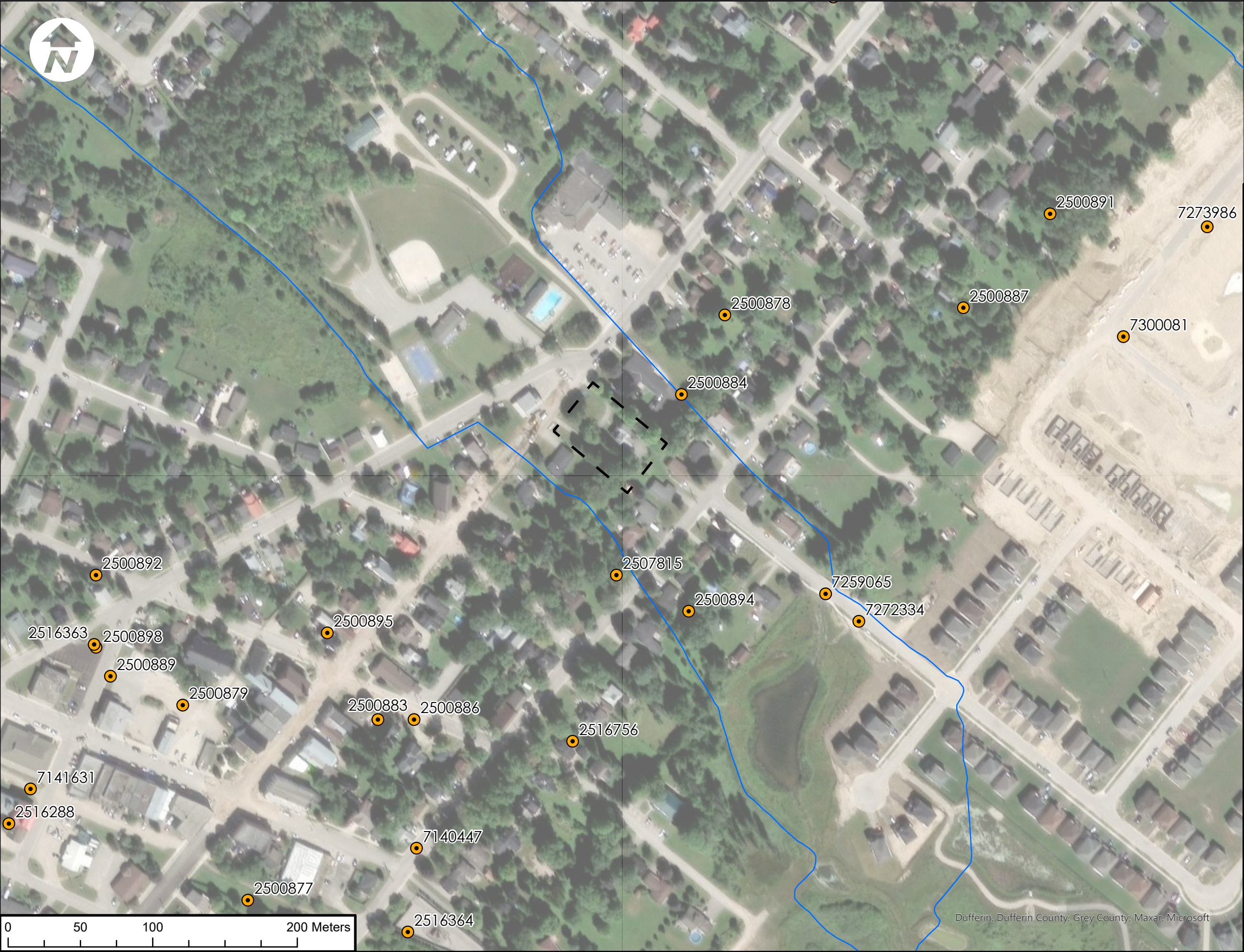
Project:
Countryside Communities Inc.
271 Main Street E, Dundalk

Figure:
Physiography



Drawn: D.M	Design: D.M	Project No. 2514 - 6796	
Date: 2024-04-22	GCS: NAD 1983	Scale: 1:2,500	Fig. 4





Legend

- Watercourse
- Site Boundary
- MECP Well

Figure Notes:

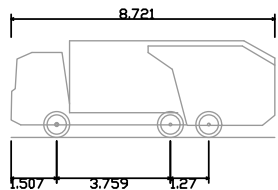
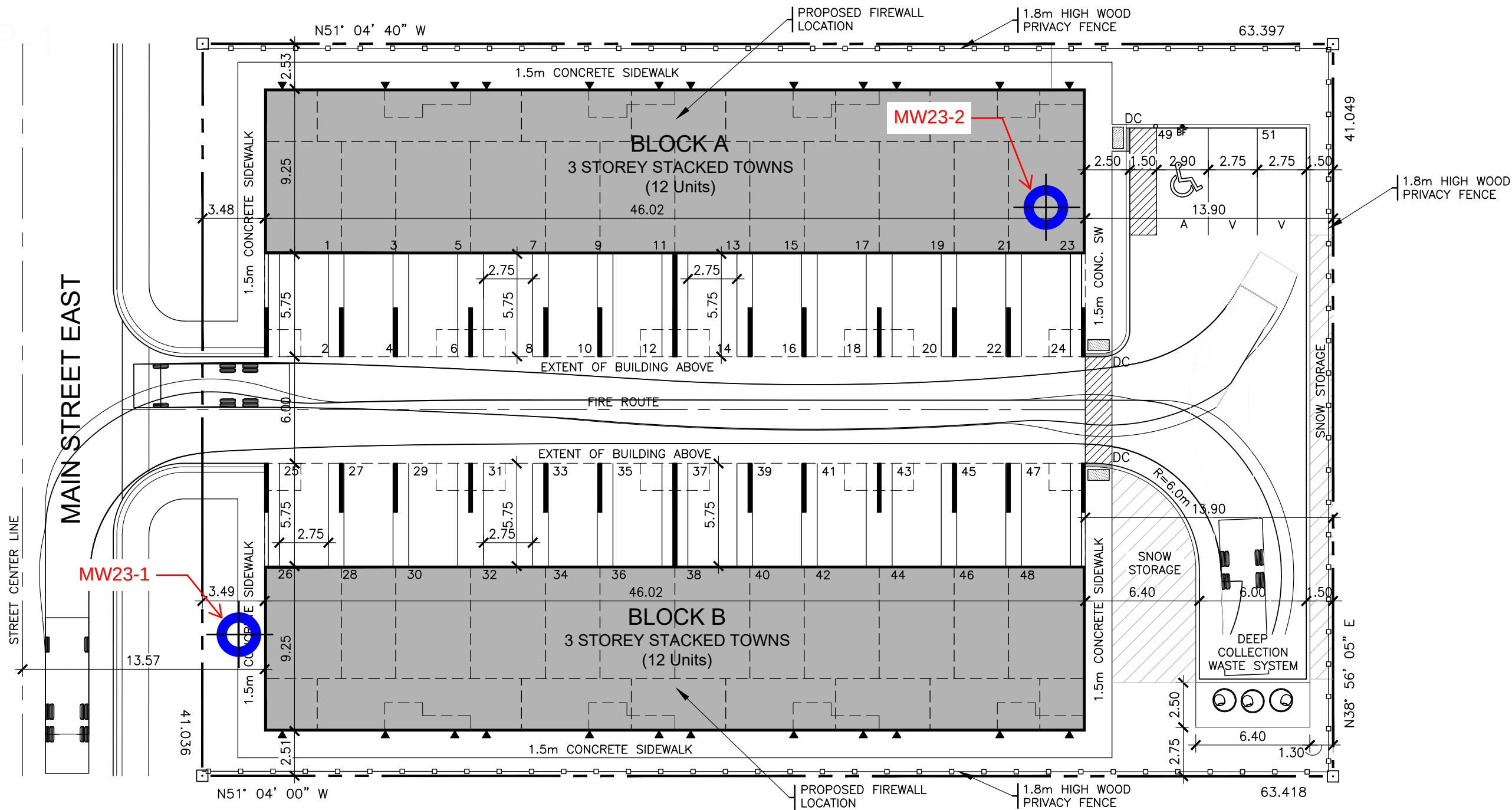
Project:
Countryside Communities Inc.
271 Main Street E, Dundalk

Figure:
Well Location Plan



Drawn: D.M	Design: D.M	Project No. 2514 - 6796	
Date: 2024-04-22	GCS: NAD 1983	Scale: 1:2,500	Fig. 5

SP-1



Mack TerraPro Cabover 6x4 MRU613 + Wayne Curbtender 31cu yd
Overall Length 8.721m
Overall Width 2.438m
Overall Body Height 3.195m
Min Body Ground Clearance 0.400m
Track Width 2.438m
Lock-to-lock time 6.00s
Curb to Curb Turning Radius 10.211m

UNITS BREAKDOWN		
NUMBER OF BEDROOMS	AREA	NUMBER OF UNITS
2 BEDROOM UNIT	105.8 sq. m (1,139 sq. ft.)	16
3 BEDROOM UNIT	155.3 sq. m (1,672 sq. ft.)	8

PARKING		
NUMBER OF PARKING SPACES	REQUIRED	PROPOSED
	2.0 PER UNIT = 48 SPACES	24 WITHIN GARAGE 24 DRIVEWAYS + 2 VISITOR + 1 B.F. SPACE= 51 SPACES

EXISTING ZONING R3 - 10.1 (e) PROPOSED SITE SPECIFIC ZONING		
REGULATION	REQUIRED	PROPOSED
LOT FRONTAGE	40 m	41.036 m
LOT AREA	1,200 sq.m	2,602.3 sq.m
UNITS ALLOWED (MAXIMUM)	LOT AREA (2,602.3 sq.m) / 300 = 8 UNITS	* 24 UNITS
LOT COVERAGE (MAXIMUM)	910.8 sq.m (35%)	* 1,391.0 sq.m (53.1%)
FRONT YARD (MINIMUM)	7.5 m	* 3.48 m
INTERIOR SIDE YARD (MINIMUM)	4.0 m	* 2.51 m
REAR YARD (MINIMUM)	10.0 m	13.9 m
FLOOR AREA (MINIMUM)	2 BEDROOM: 70 sq.m 3 BEDROOM: 83 sq.m	2 BEDROOM: 105.8 sq.m 3 BEDROOM: 155.3 sq.m
BUILDING HEIGHT (MAXIMUM)	3 STOREYS	3 STOREYS
PLAY SPACE (MINIMUM)	104.0 sq.m	* 75.4 sq.m
AMENITY SPACE (MINIMUM)	1120.0 sq.m	* 0.0 sq.m

*DENOTES ZONING VARIANCE REQUIRED

North Arrow
True North:

ORCHARD
DESIGN STUDIO INC.
marketingmeetsarchitecture

CALE BARNES
MAIN ST. EAST STACKED TOWNS
271 MAIN STREET EAST, DUNDALK, ON

Set Issuance		
No.	Date	Description
1	2024-01-25	REVISED AS PER CLIENT
2	2024-03-25	REVISED PER MHBC
2	2024-04-29	ISS. TO CONSULTANTS

Sheet Information

SITE PLAN

Project No. 15572
Project Start Date: 2024-01-25
File: 271 Main Street - Site Plan.dwg
Drawn by: J.P.
Scale: 1:250

SPA

A1.01