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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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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 m^3/day which increases to a maximum of 247.43 m^3/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^{o} 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 km^2. The outstanding heritage of this watershed (7000 square kilometers) has been recognized by the designation of the Grand Riveras 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 cay 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 and102)

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 finding 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 Measurment**

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 consists of residences with basements. Therefore, and an excavation depth of 3.0± 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± 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± 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 m^3/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 m^3/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

Parameter / Well ID	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 m^3/day; by applying 3x safety factor, the dewatering rate could reach an approximate daily maximum of 247.43 m^3/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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3. Gwyn, Q.H.J. and Frazer, J.Z., 1975 Bedrock Topography of the Dundalk Area, Southern Ontario, Ministry of Northern Development and Mines, Ontario Division of Mines, Ontario Geological Survey, Map P.308, Scale 50,000.
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5. Grand River Watershed Characterization Report, January 2008, Grand River Conservation Authority.
6. G. Tchobanoglous and E. Schroeder, 1987, Water Quality.

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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

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 '—●—'

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 '○'

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

SOIL DESCRIPTION

Cohesionless Soils:

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

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

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

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

JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 101

FIGURE NO: 1

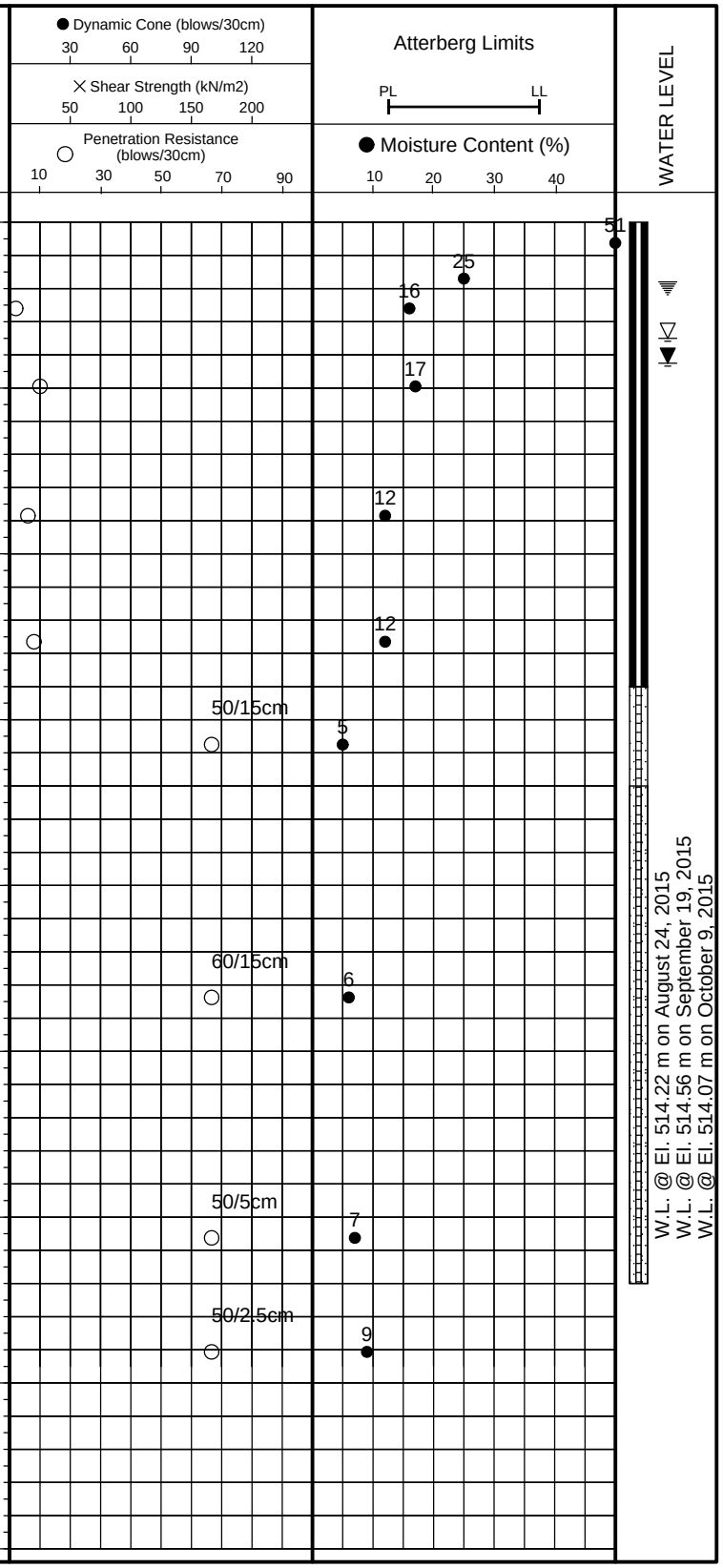
JOB DESCRIPTION: Proposed Residential Development

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

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 9, 2015

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
514.92	**25 cm TOPSOIL**	1A	DO	-
	Brown, very loose to compact	1B	DO	-
	SANDY SILT	1C	DO	3
	clay			
	wet			
	fine sand and trace of gravel	2	DO	15
1.5				
513.4	Brown, loose	3	DO	9
	SILTY SAND, Till			
	wet			
2.3				
512.6	Brown, stiff	4	DO	12
	SILTY CLAY, Till			
	trace of sand			
	wet			
3.0				
511.9	Brown, very dense	5	DO	50/15
	GRAVELLY SAND			
	silty and a trace of clay			
	damp			
4.6				
510.3	Brown, hard	6	DO	60/15
	SILTY CLAY, Till			
		7	DO	50/5
6.9		8	DO	50/2.5
508.0	**END OF BOREHOLE**			
	Installed 50 mm diameter standpipe to 6.4 m.			
	Sand backfill from 3.0 to 6.4 m.			
	Bentonite seal from 0.0 to 2.8 m.			
	3.0 m screen from 3.4 to 6.4 m.			
	Provided with monument protective casing.			



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JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 102

FIGURE NO: 2

JOB DESCRIPTION: Proposed Residential Development

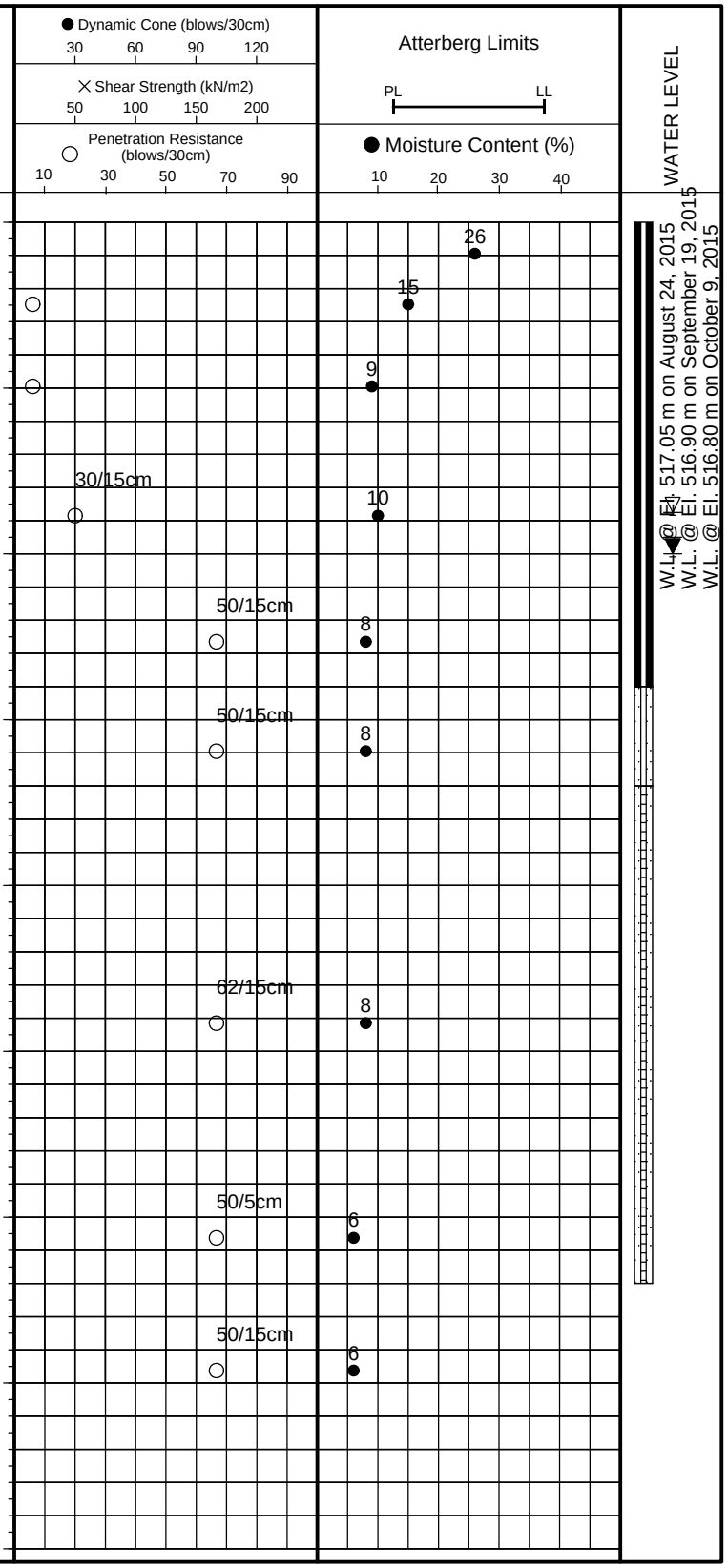
JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 8, 2015

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
518.80	**38 cm TOPSOIL**	1A	DO	-
	Brown, loose **SILTY FINE SAND** wet	1B	DO	9
0.8 / 518.0	Brown, loose **SILTY SAND, Till**	2	DO	9
1.5 / 517.3	Brown, hard **SILTY CLAY, Till**	3	DO	30/15
2.3 / 516.5	Brown, very dense **GRAVELLY SAND** silty, a trace of clay	4	DO	50/15
2.8 / 516.0	Brown, hard **SILTY CLAY, Till**	5	DO	50/15
		6	DO	62/15
		7	DO	50/5
7.0 / 511.8	**END OF BOREHOLE**	8	DO	50/15

Installed 50 mm diameter standpipe to 6.4 m.
Sand backfill from 2.8 to 6.4 m.
Bentonite seal from 0.0 to 2.8 m.
3.0 m screen from 3.4 to 6.4 m.
Provided with monument protective casing.



Soil Engineers Ltd.

JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 103 D

FIGURE NO: 3

JOB DESCRIPTION: Proposed Residential Development

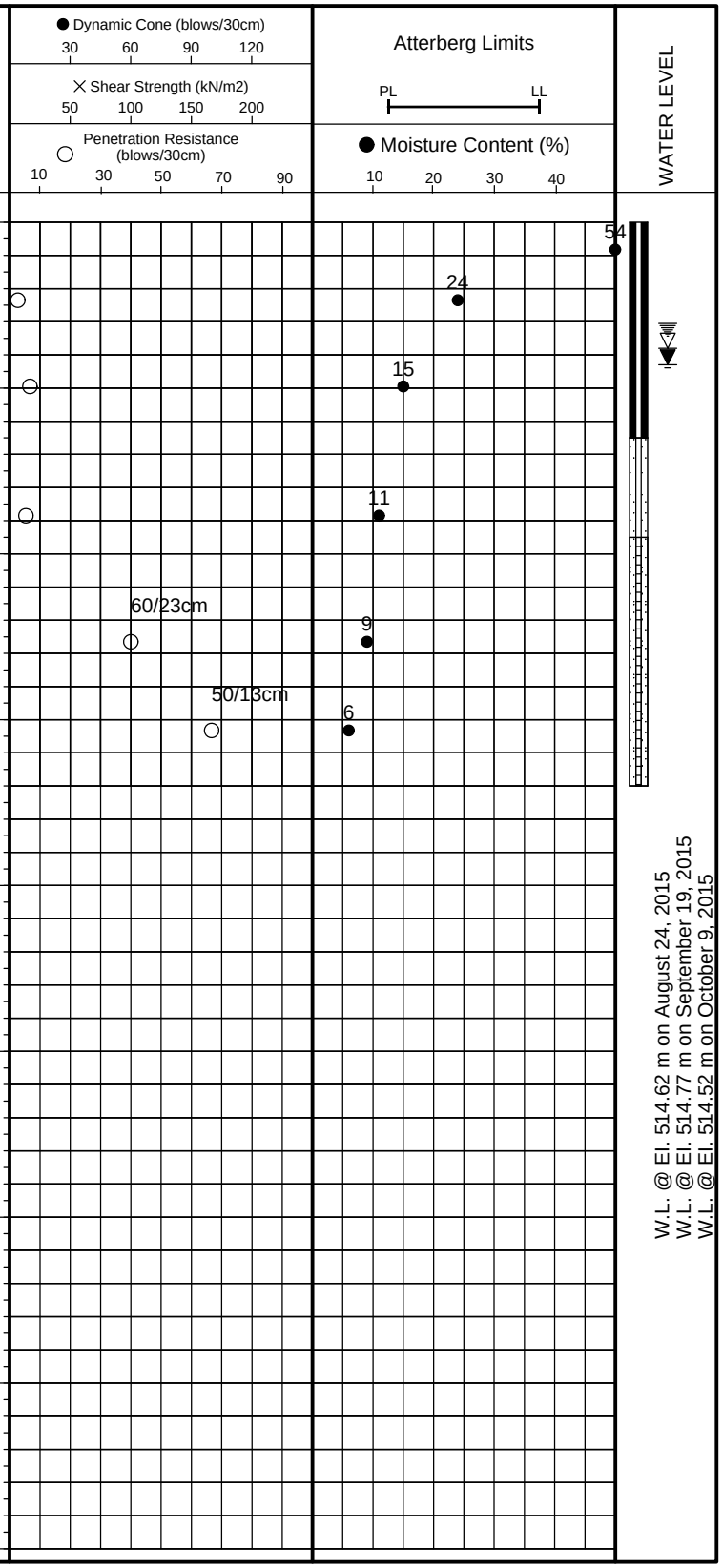
JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 7, 2015

Depth (m) / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 /	Ground Surface			
515.38	**33 cm TOPSOIL**	1A	DO	-
	Brown, very loose **SANDY SILT**	1B	DO	4
0.6 / 514.8	Brown, stiff to hard **SILTY CLAY, Till**	2	DO	10
		3	DO	8
		4	DO	60/23
		5	DO	50/13
3.4 / 512.0	**END OF BOREHOLE**			

Installed 50 mm diameter standpipe to 3.4 m.
Sand backfill from 1.3 to 3.4 m.
Bentonite seal from 0.0 to 1.3 m.
1.5 m screen from 1.9 to 3.4 m.
Provided with monument protective casing.



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JOB NO: 1506-W067 **LOG OF BOREHOLE NO: BH/MW 103 S** ***FIGURE NO: 4***

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

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0 / 515.23	Ground Surface			
	33 cm TOPSOIL			
0.6 / 514.6	Brown, very loose **SANDY SILT**			
	Brown, stiff to hard **SILTY CLAY, Till**			
2.1 / 513.1	**END OF BOREHOLE**			
	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.			

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

● Dynamic Cone (blows/30cm): 30, 60, 90, 120

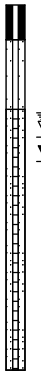
× Shear Strength (kN/m2): 50, 100, 150, 200

○ Penetration Resistance (blows/30cm): 10, 30, 50, 70, 90

Atterberg Limits: PL — LL

● Moisture Content (%): 10, 20, 30, 40

WATER LEVEL



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

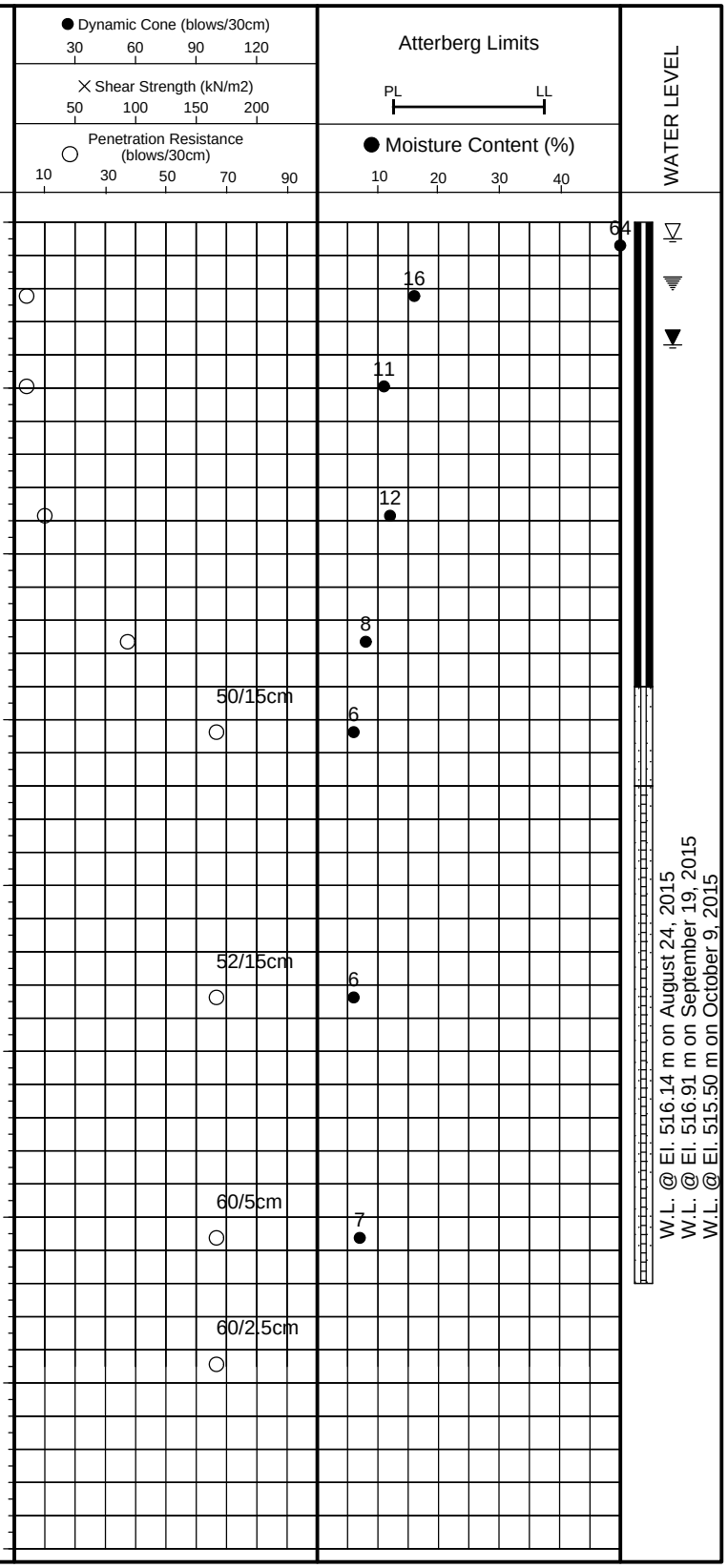
JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 7, 2015

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
516.24	**28 cm TOPSOIL**	1A	DO	-
	Brown, very loose **SANDY SILT**	1B	DO	6
0.8				
515.5	Brown, firm to hard **SILTY CLAY, Till**	2	DO	6
		3	DO	15
		4	DO	56
		5	DO	50/15
		6	DO	52/15
		7	DO	60/5
6.9		8	DO	60/2.5
509.3	**END OF BOREHOLE**			

Installed 50 mm diameter standpipe to 6.4 m.
Sand backfill from 2.8 to 6.4 m.
Bentonite seal from 0.0 to 2.8 m.
3.0 m screen from 3.4 to 6.4 m.
Provided with monument protective casing.



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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

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30cm) 30 60 90 120 / Shear Strength (kN/m2) 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
0.0	Ground Surface				0			
516.43		1A	DO	-			31	
	36 cm TOPSOIL							
	Brown, firm to hard	1B	DO	5			17	
	SILTY CLAY, Till							
		2	DO	8	1		14	
						50/7.6cm		
		3	DO	50/7.6			16	
					2			
		4	DO	28			11	
					3			
		5	DO	28			9	
	rock fragments and gravel				4			
		6	DO	30			8	
					5			
					6	50/15cm		
		7	DO	50/15			8	
						50/15cm		
7.0		8	DO	50/15	7		6	
509.4	**END OF BOREHOLE**							
	Installed 50 mm diameter standpipe to 6.4 m. Sand backfill from 2.8 to 6.4 m. Bentonite seal from 0.0 to 2.8 m. 3.0 m screen from 3.4 to 6.4 m. Provided with monument protective casing.				8			

W.L. @ El. 515.23 m on August 24, 2015
W.L. @ El. 515.41 m on September 19, 2015
W.L. @ El. 515.01 m on October 9, 2015

Soil Engineers Ltd.

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

JOB DESCRIPTION: Proposed Residential Development

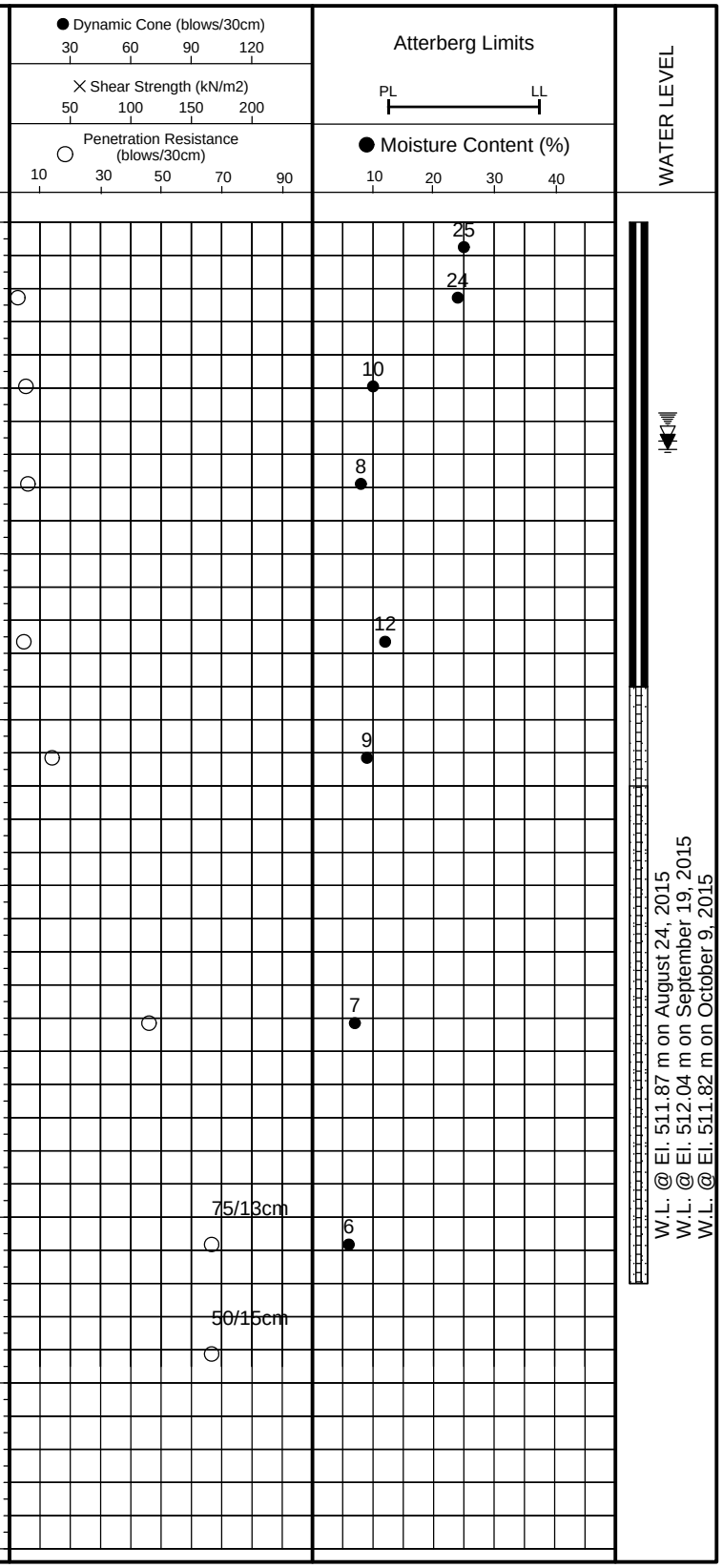
JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 6, 2015

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
513.19	**30 cm TOPSOIL**	1A	DO	-
	Brown, firm to hard	1B	DO	4
	SILTY CLAY, Till			
		2	DO	8
		3	DO	9
		4	DO	7
	rock fragments and gravel	5	DO	21
		6	DO	69
		7	DO	75/13
6.9		8	DO	50/15
506.3	**END OF BOREHOLE**			

Installed 50 mm diameter standpipe to 6.4 m.
Sand backfill from 3.0 to 6.4 m.
Bentonite seal from 0.0 to 2.8 m.
3.0 m screen from 3.4 to 6.4 m.
Provided with monument protective casing.



Soil Engineers Ltd.

JOB NO: 1506-W067 **LOG OF BOREHOLE NO: BH/MW 106 S** ***FIGURE NO: 8***

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

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	Dynamic Cone (blows/30cm) 30 60 90 120 / Shear Strength (kN/m2) 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
0.0	Ground Surface				0			
513.23	**30 cm TOPSOIL**							
	Brown, firm to hard							
	SILTY CLAY, Till				1			
					2			
3.0					3			
510.2	**END OF BOREHOLE**							
	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			

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

Soil Engineers Ltd.

JOB NO: 1506-W067

LOG OF BOREHOLE NO: BH/MW 107 D

FIGURE NO: 9

JOB DESCRIPTION: Proposed Residential Development

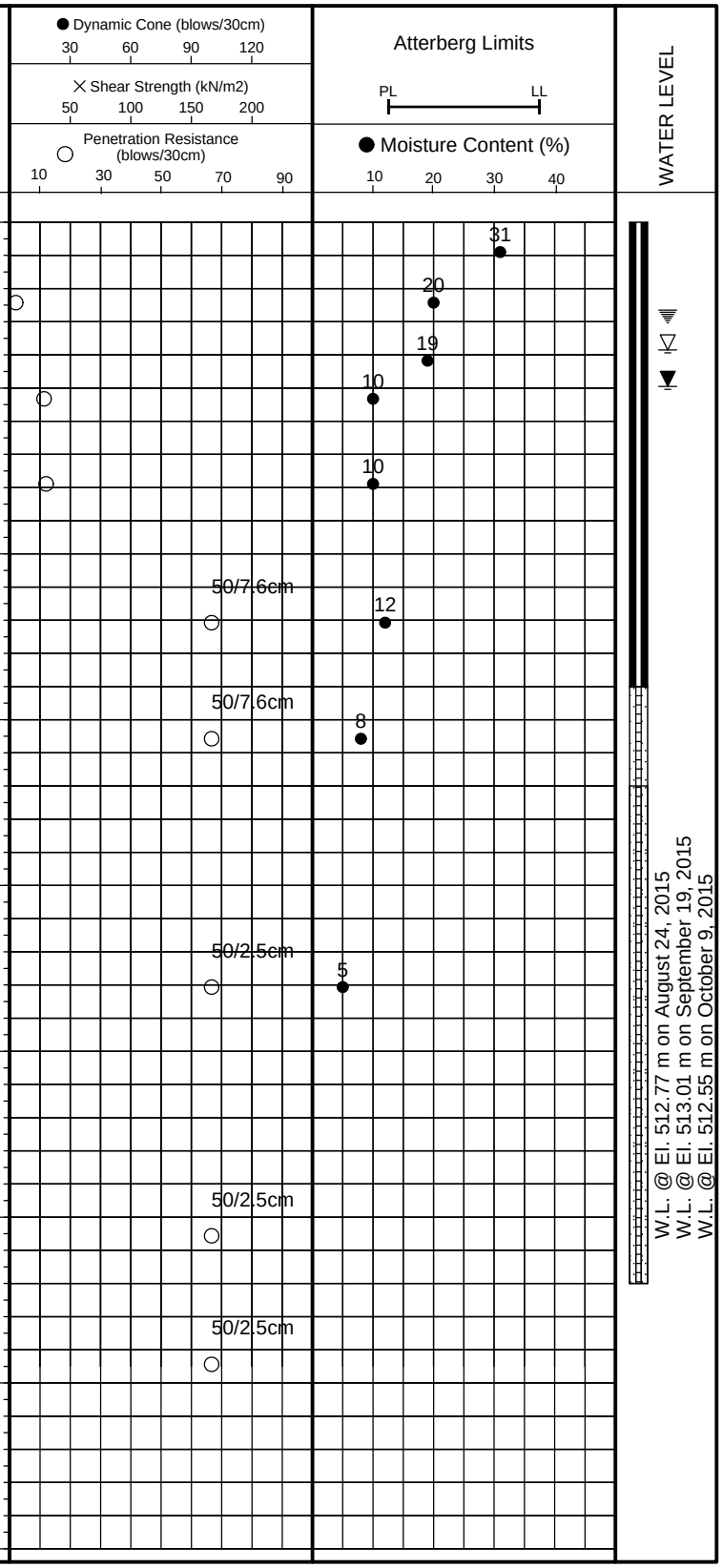
JOB LOCATION: 772146 Highway 10
Township of Southgate (Community of Dundalk)

METHOD OF BORING: Hollow Stem Flight-Auger

DATE: July 8, 2015

Depth / Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
513.54	**36 cm TOPSOIL**	1A	DO	-
	Brown, very loose	1B	DO	3
	SANDY SILT			
0.9	a trace of clay	2A	DO	-
512.6	Brown, compact	2B	DO	17
	SILTY SAND, Till some gravel, a trace of clay			
		3	DO	18
2.3				
511.2	Brown, hard rock fragments and gravel	4	DO	50/7.6
	SILTY CLAY, Till			
		5	DO	50/7.6
		6	DO	50/2.5
		7	DO	50/2.5
6.9				
506.6	**END OF BOREHOLE**	8	DO	50/2.5

Installed 50 mm diameter standpipe to 6.4 m.
Sand backfill from 3.0 to 6.4 m.
Bentonite seal from 0.0 to 2.8 m.
3.0 m screen from 3.4 to 6.4 m.
Provided with monument protective casing.



Soil Engineers Ltd.

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

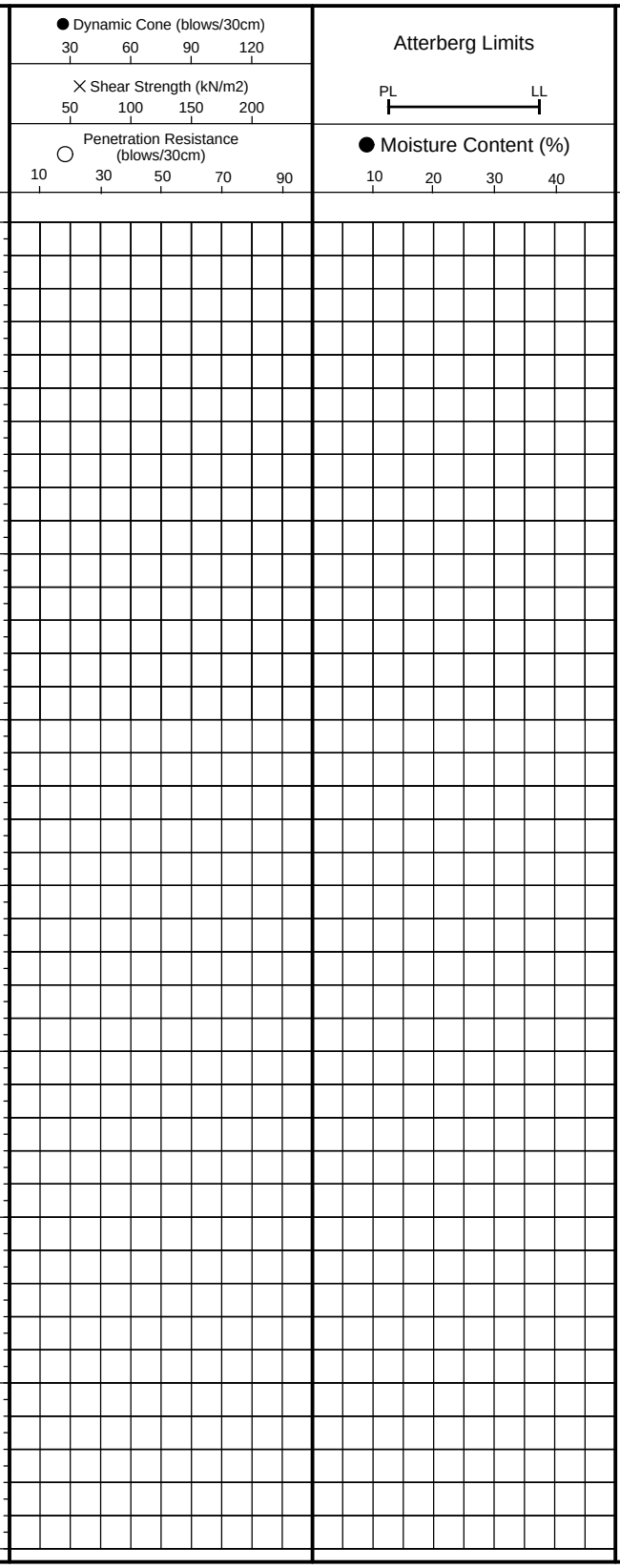
JOB DESCRIPTION: Proposed Residential Development

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 Number	Type	N-Value
0.0	Ground Surface			
513.55	**36 cm TOPSOIL**			
	Brown, very loose **SANDY SILT** a trace of clay			
0.9				
512.6	Brown, compact **SILTY SAND, Till** some gravel, a trace of clay			
2.3				
511.3	Brown, hard rock fragments and gravel **SILTY CLAY, Till**			
3.0				
510.6	**END OF BOREHOLE** 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.			



WATER LEVEL

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

Soil Engineers Ltd.

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

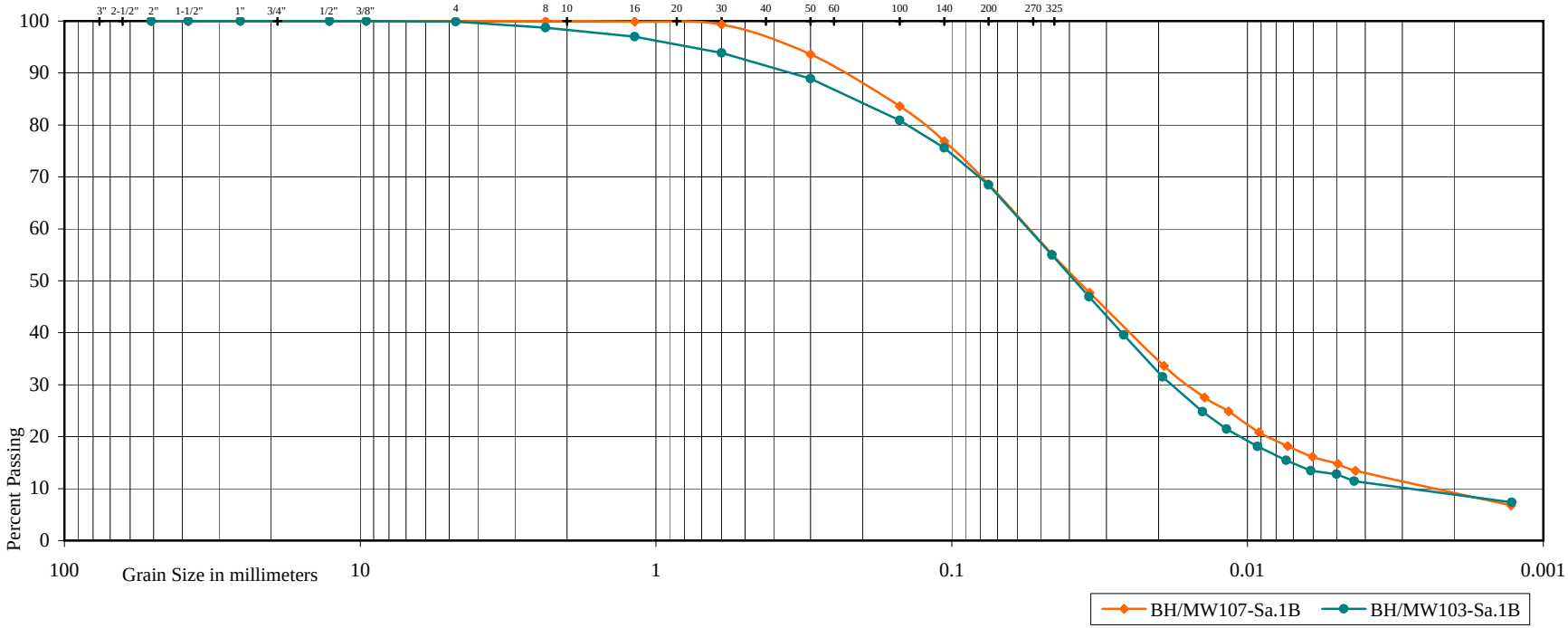
Reference No: 1506-W067

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

Figure No. 11

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

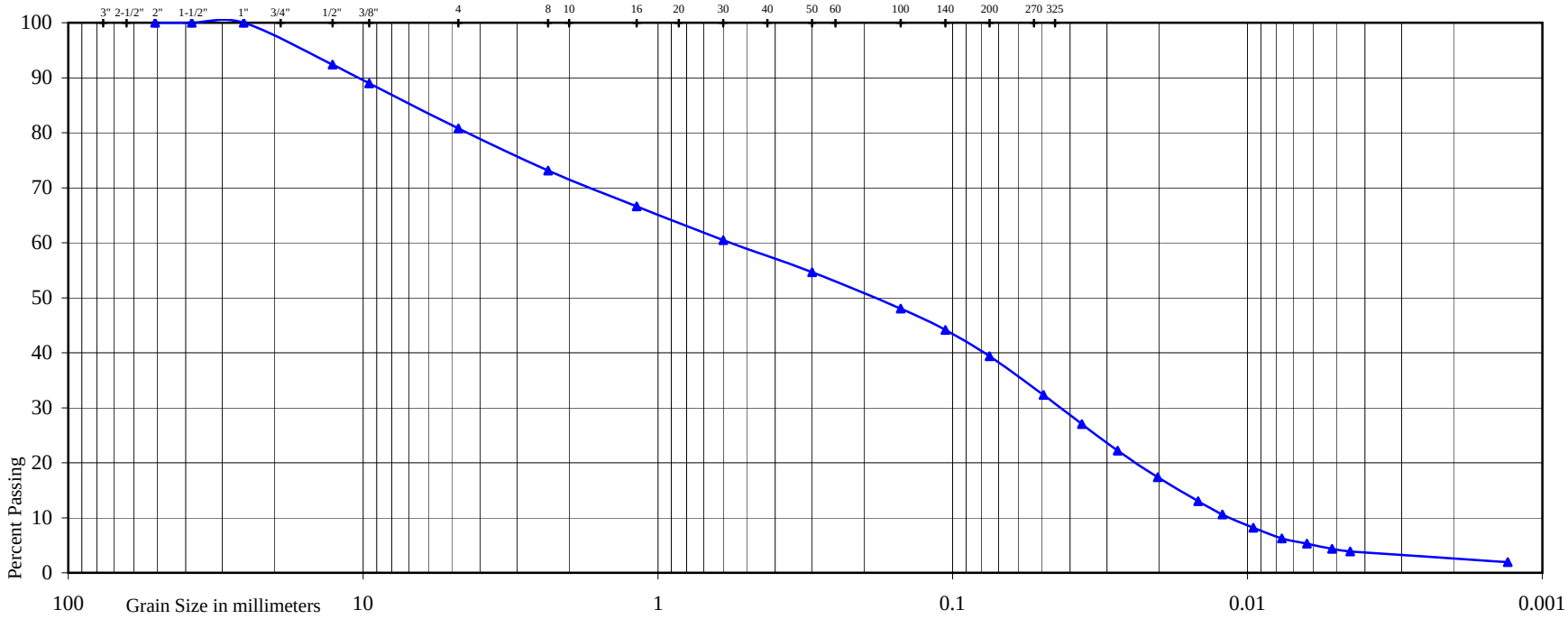
Reference No: 1506-W067

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

Figure No. 12

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

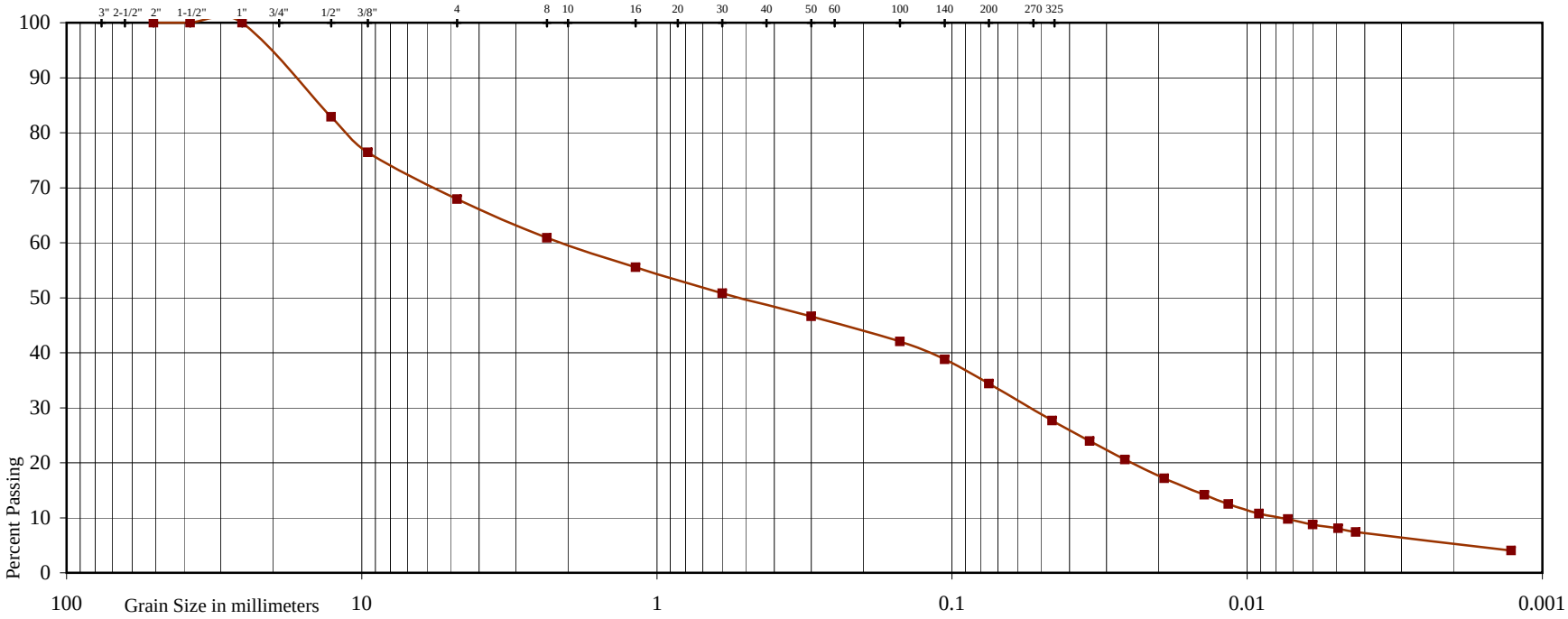
Reference No: 1506-W067

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

Figure No. 13

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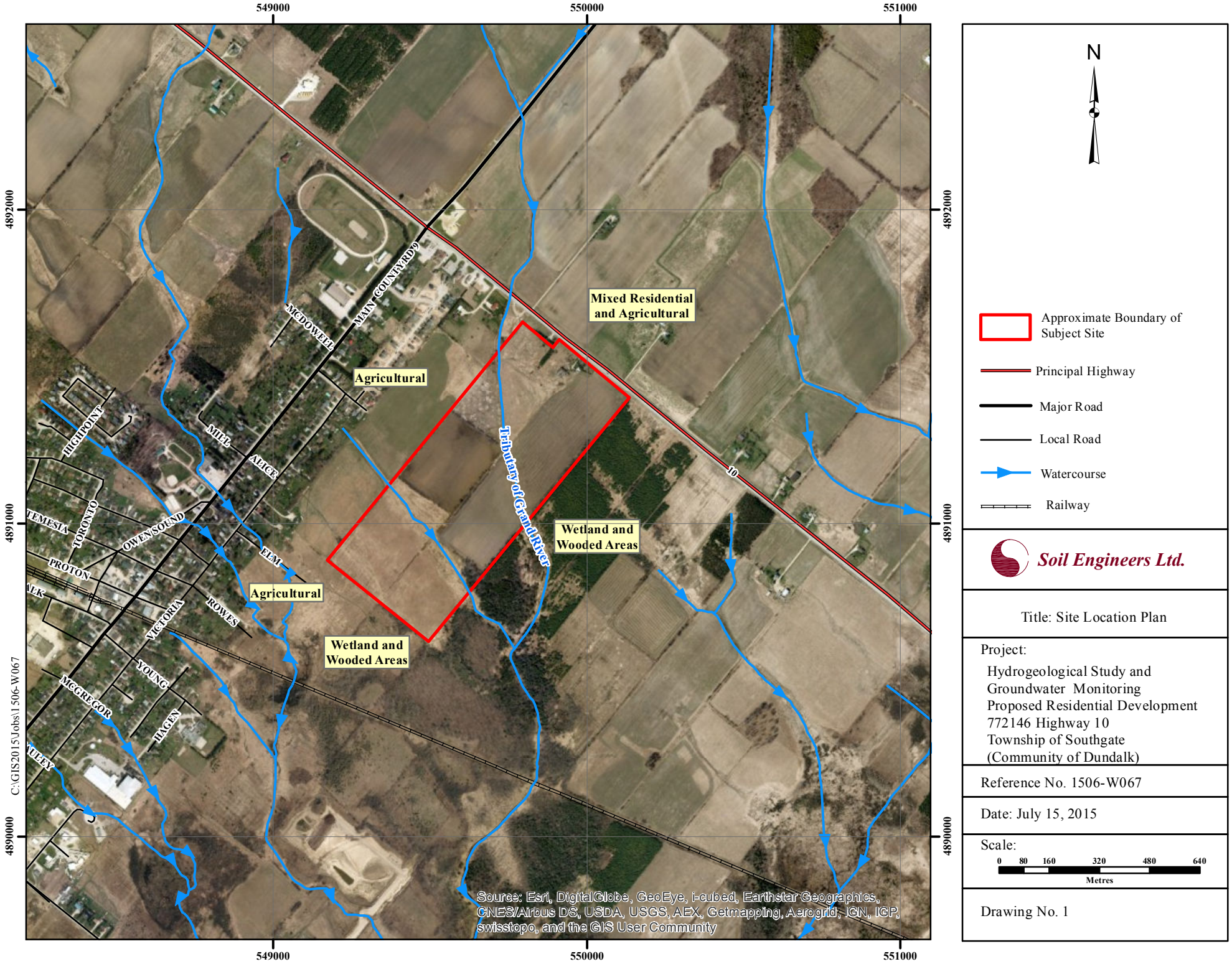
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

DRAWINGS

REFERENCE NO. 1506-W067



C:\GIS2015\Jobs\1506-W067

N

Approximate Boundary of Subject Site

Principal Highway

Major Road

Local Road

Watercourse

Railway

Soil Engineers Ltd.

Title: Site Location Plan

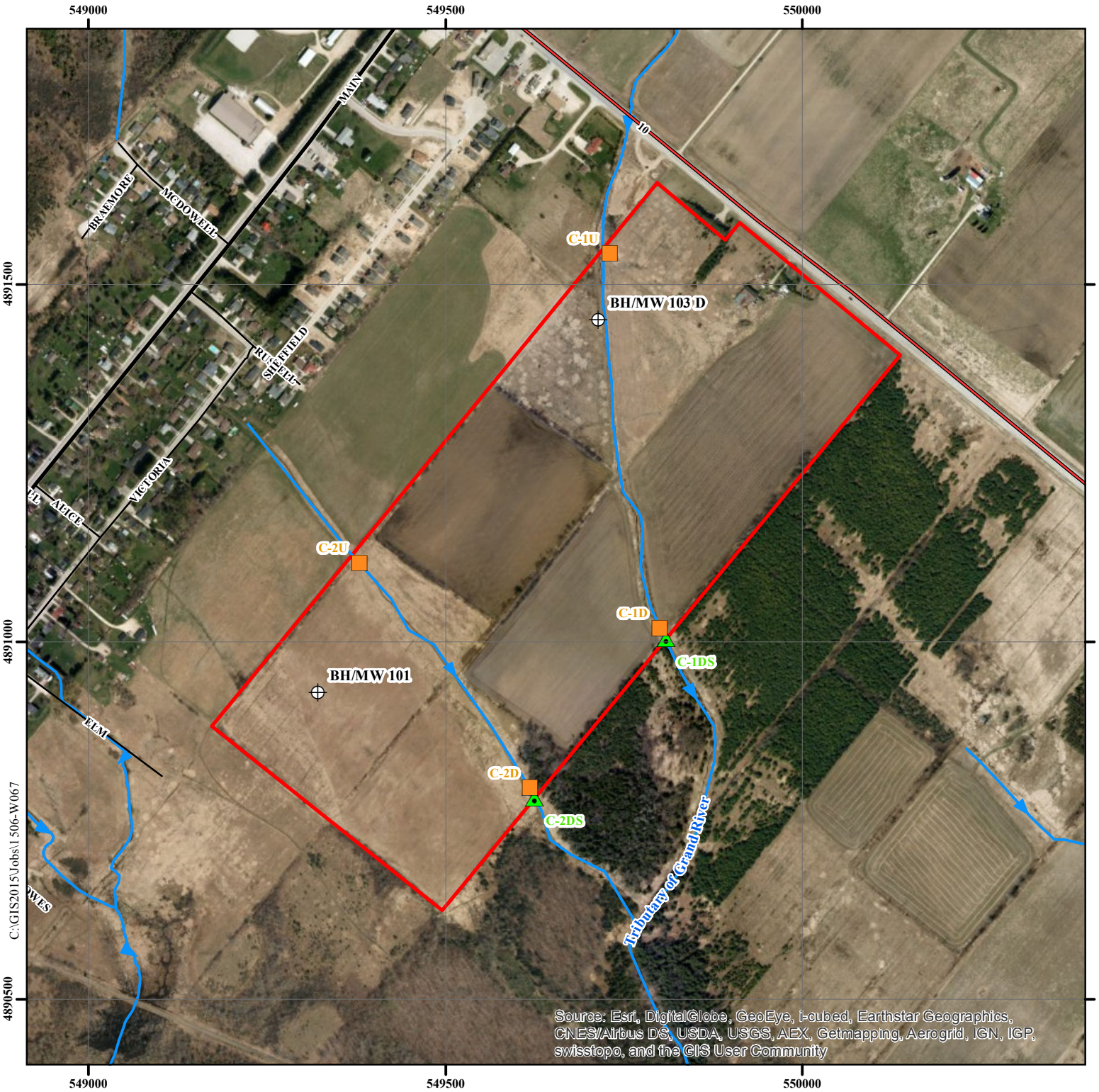
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

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

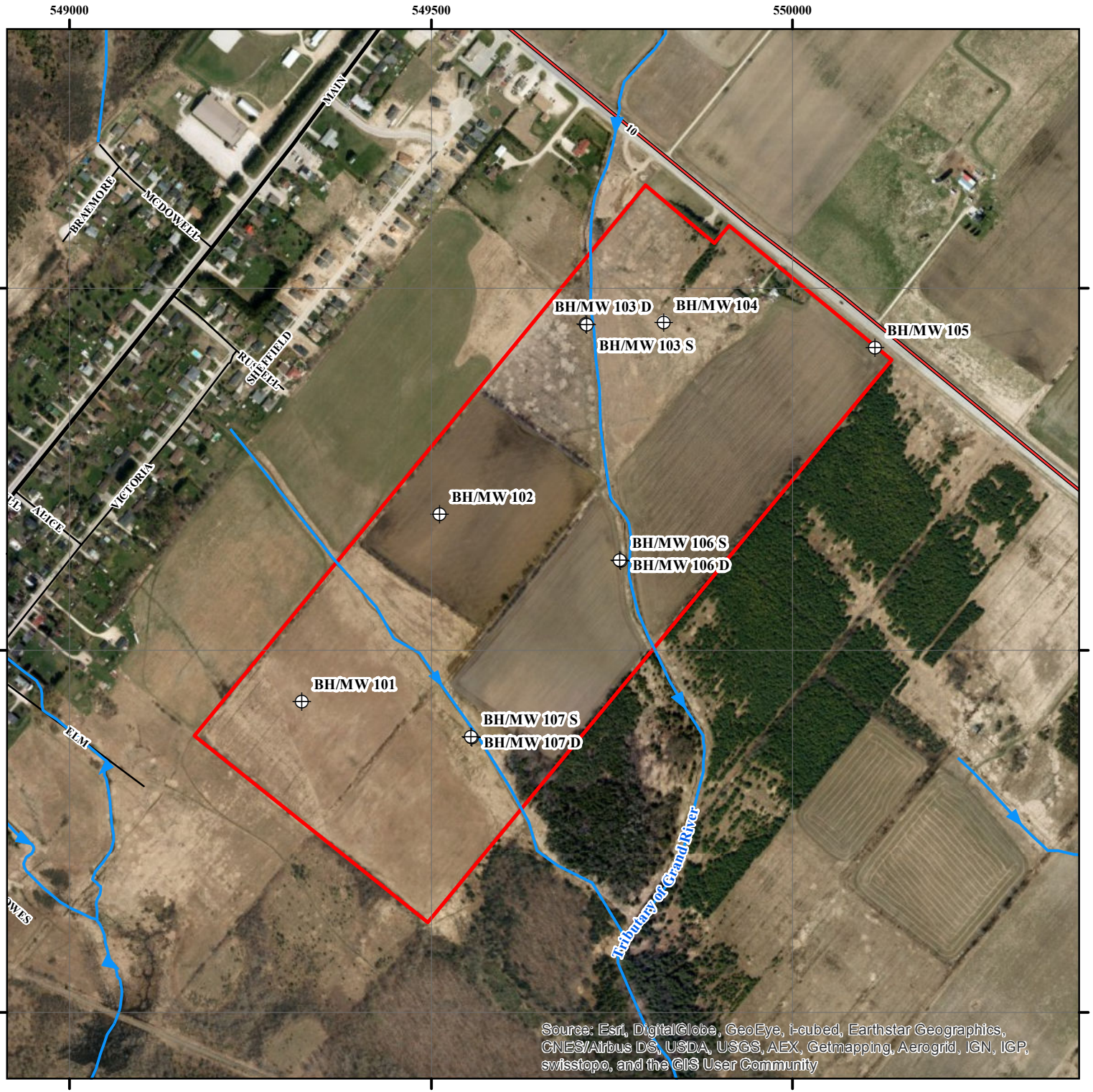
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 22, 2015

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 10



C:\GIS2015\Jobs\1506-W067

N

Approximate Boundary of Subject site

Borehole and Monitoring Well Location

Principal Highway

Major Road

Local Road

Watercourse

Soil Engineers Ltd.

Title: Borehole and Monitoring Well Location Plan

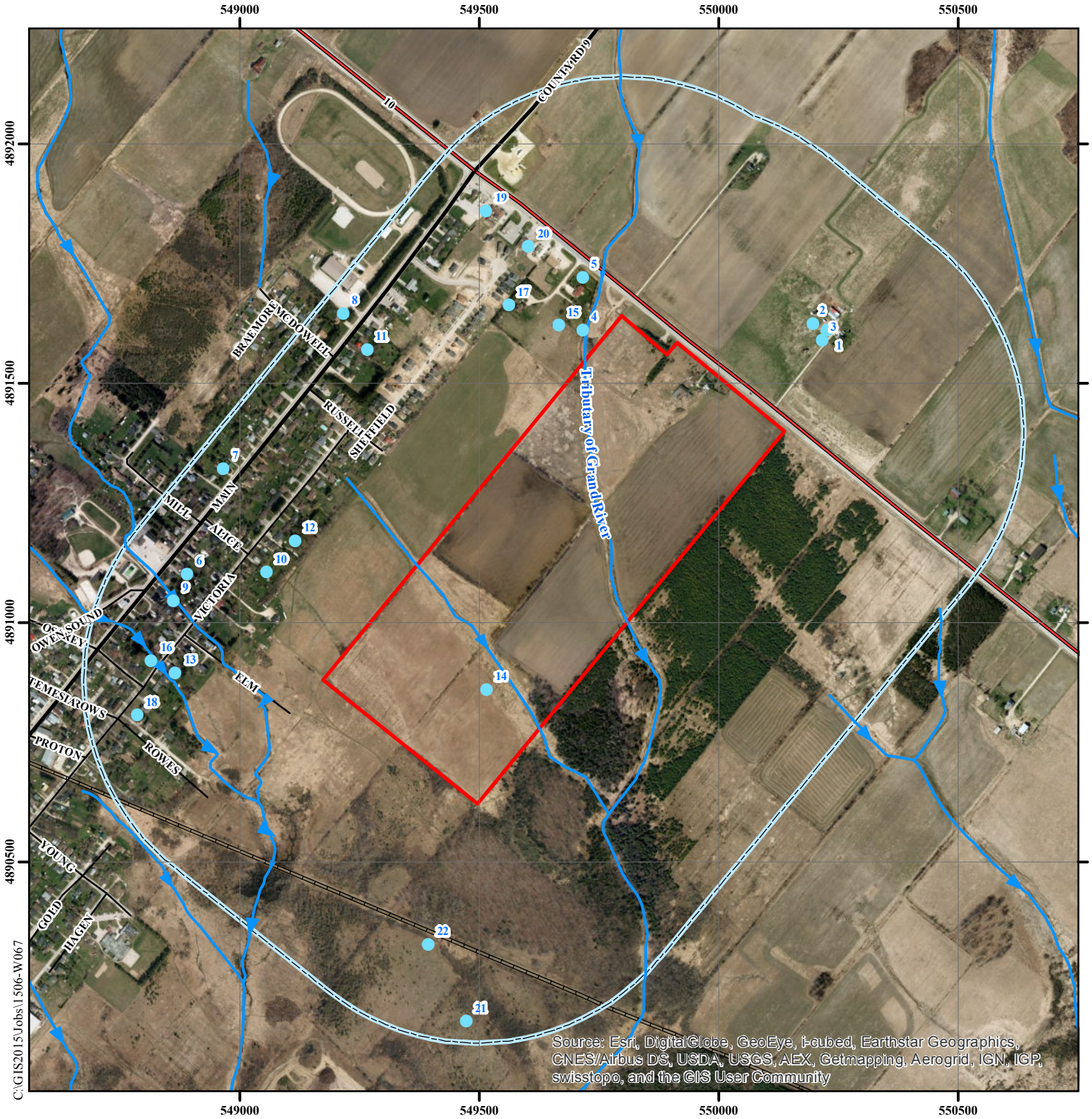
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 22, 2015

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 2



N

Approximate 500 metres from Subject Site Boundary

Approximate Boundary of Subject Site

1 Well Locations from MOECC Well Records

Principal Highway

Major Road

Local Road

Watercourse

Railway

Soil Engineers Ltd.

Title: MOECC Well Location Plan

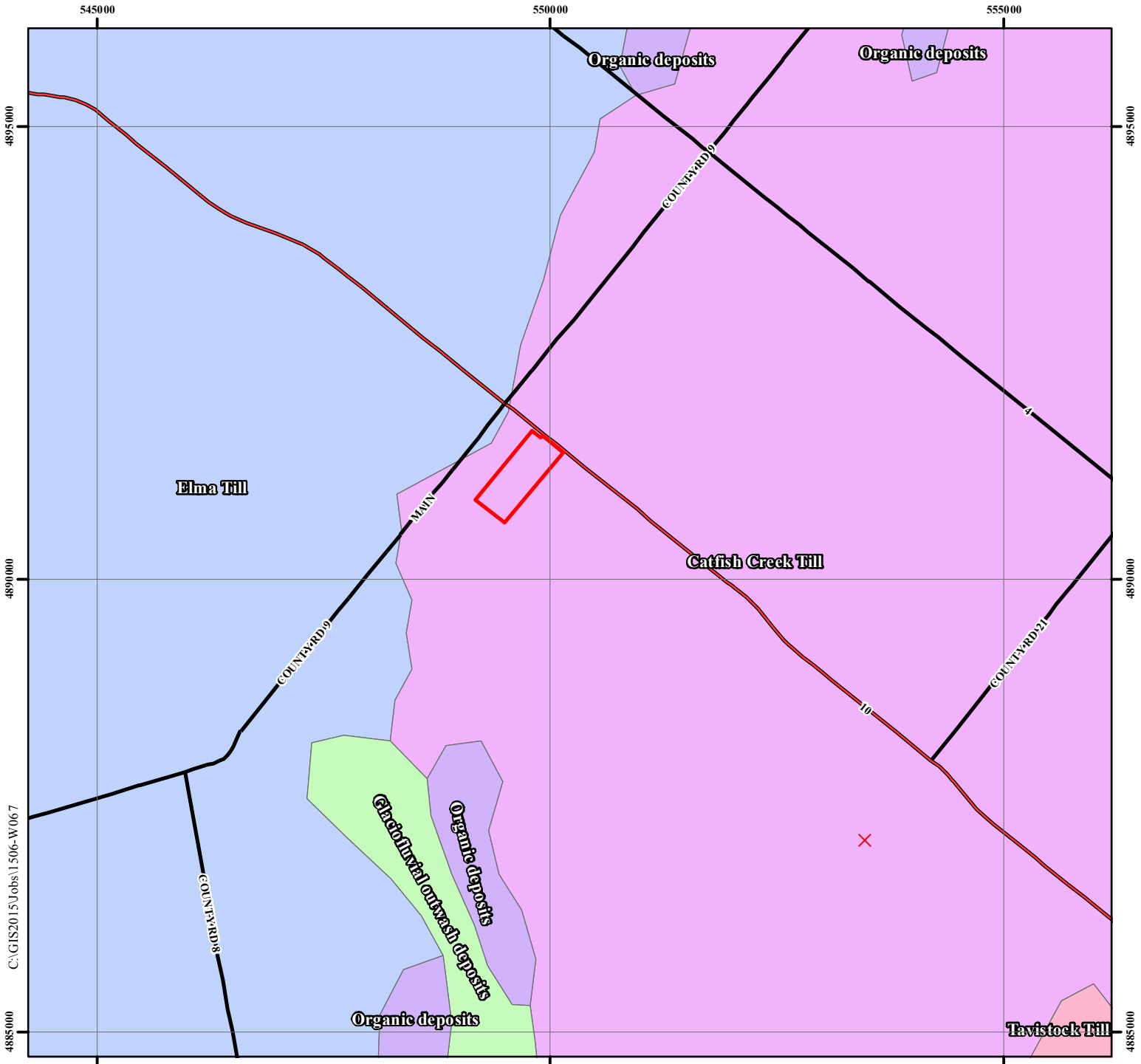
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

Date: July 15, 2015

Scale:
0 50 100 200 300 400 500
Metres

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

N

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

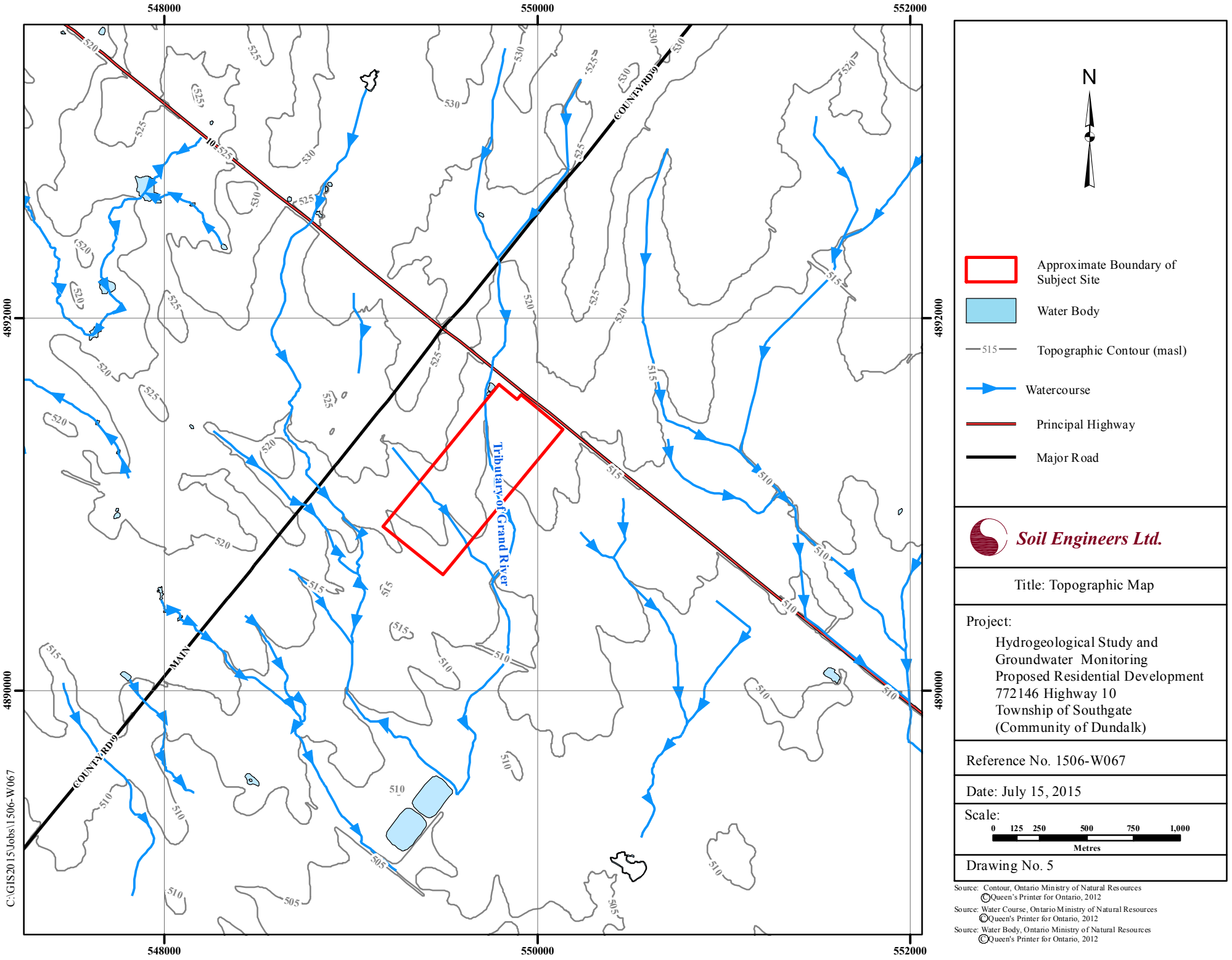
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

Reference No. 1506-W067

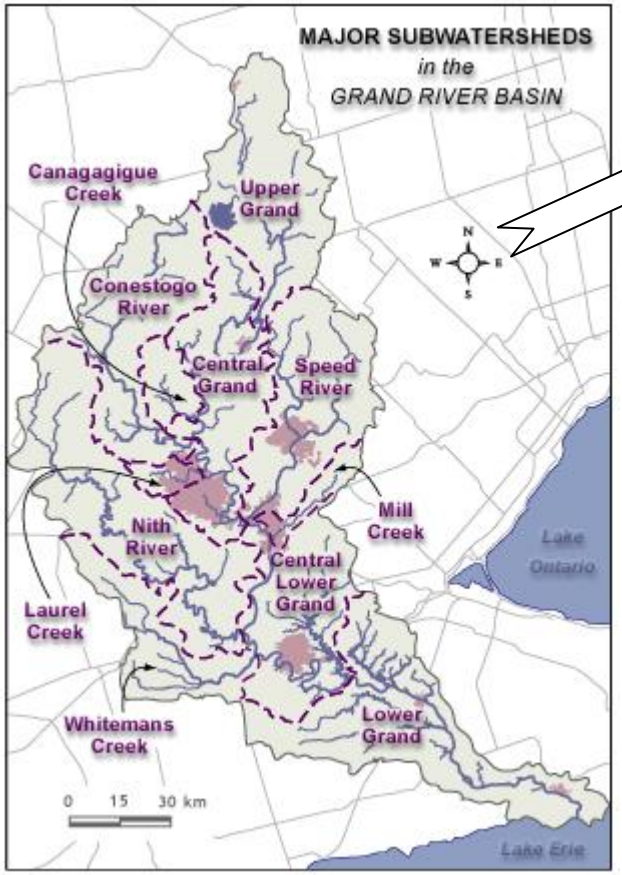
Date: July 15, 2015

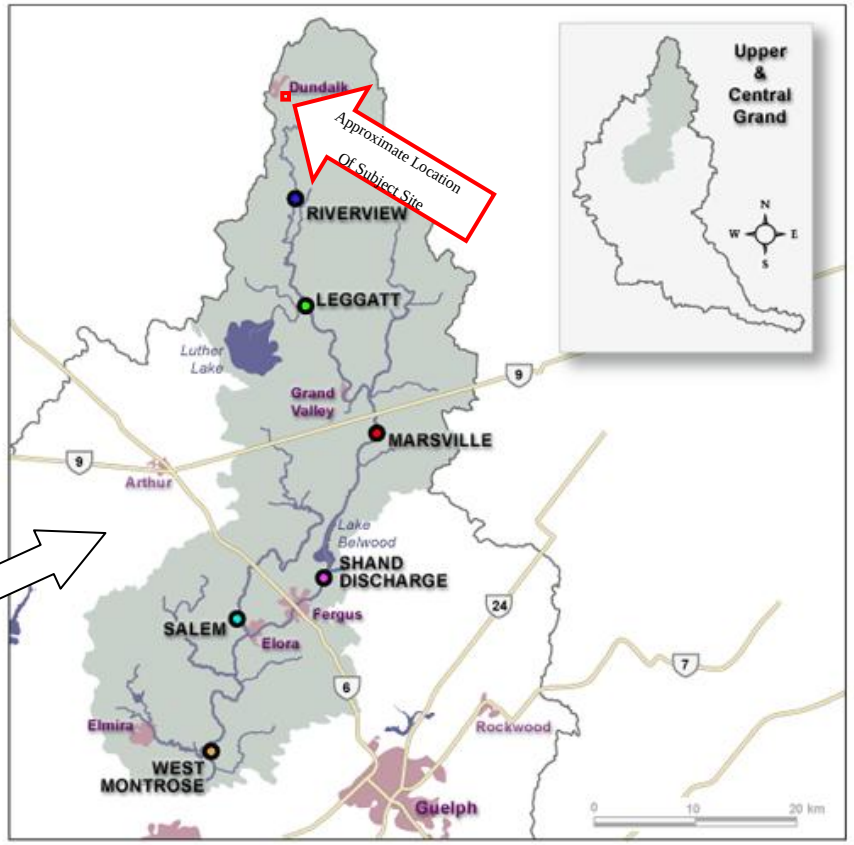
Scale:
0 250 500 1,000 1,500 2,000 2,500
Metres

Drawing No. 4



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

N

Approximate Location of Subject Site

Soil Engineers Ltd.

Title
Watershed and Sub-watershed Map

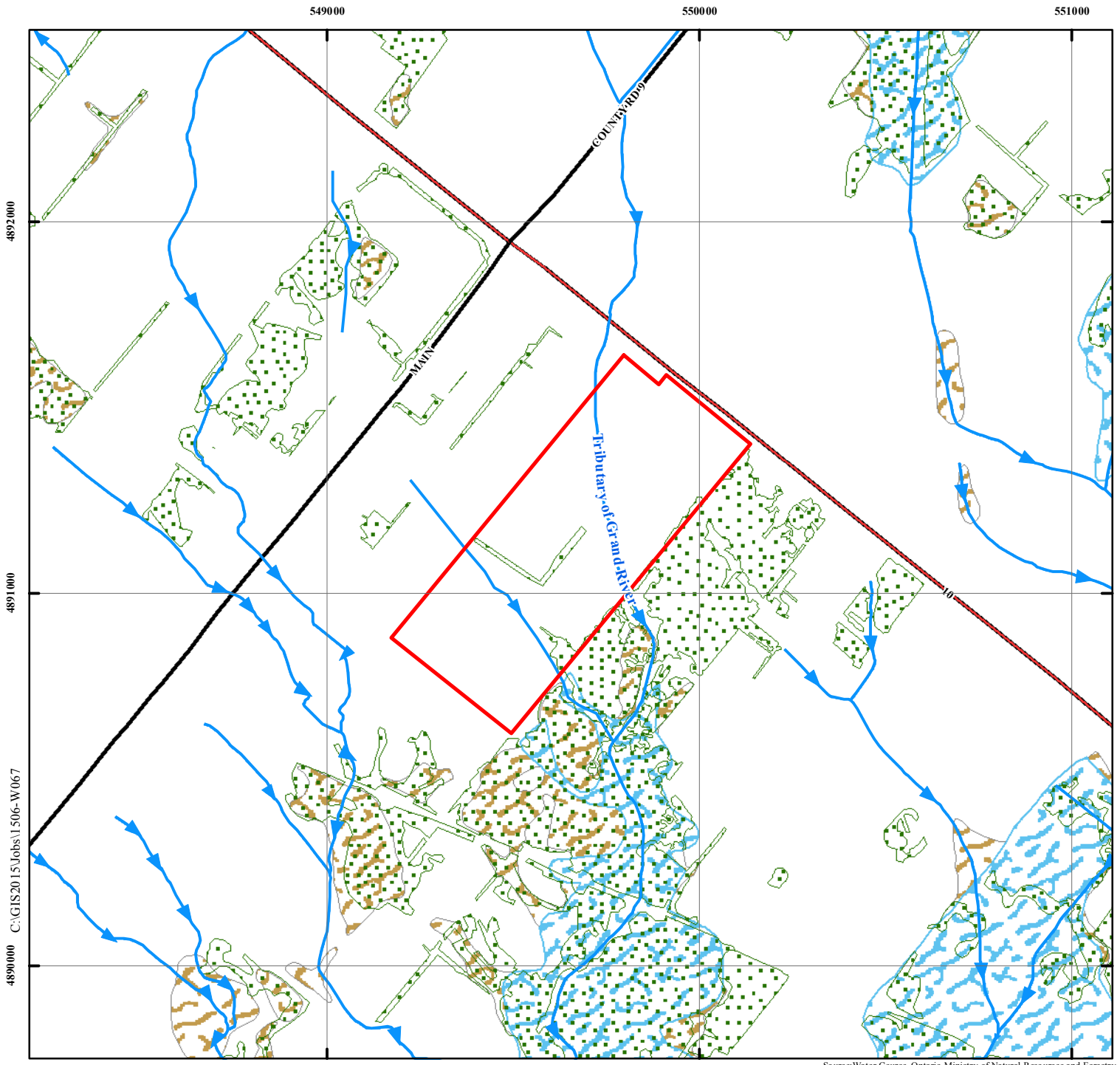
Project
Limited Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township pf Southgate
(Community of Dundalk)

Reference No.
1506-W067

Date
July 16, 2015

Scale
See maps

Drawing No. 6



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N

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

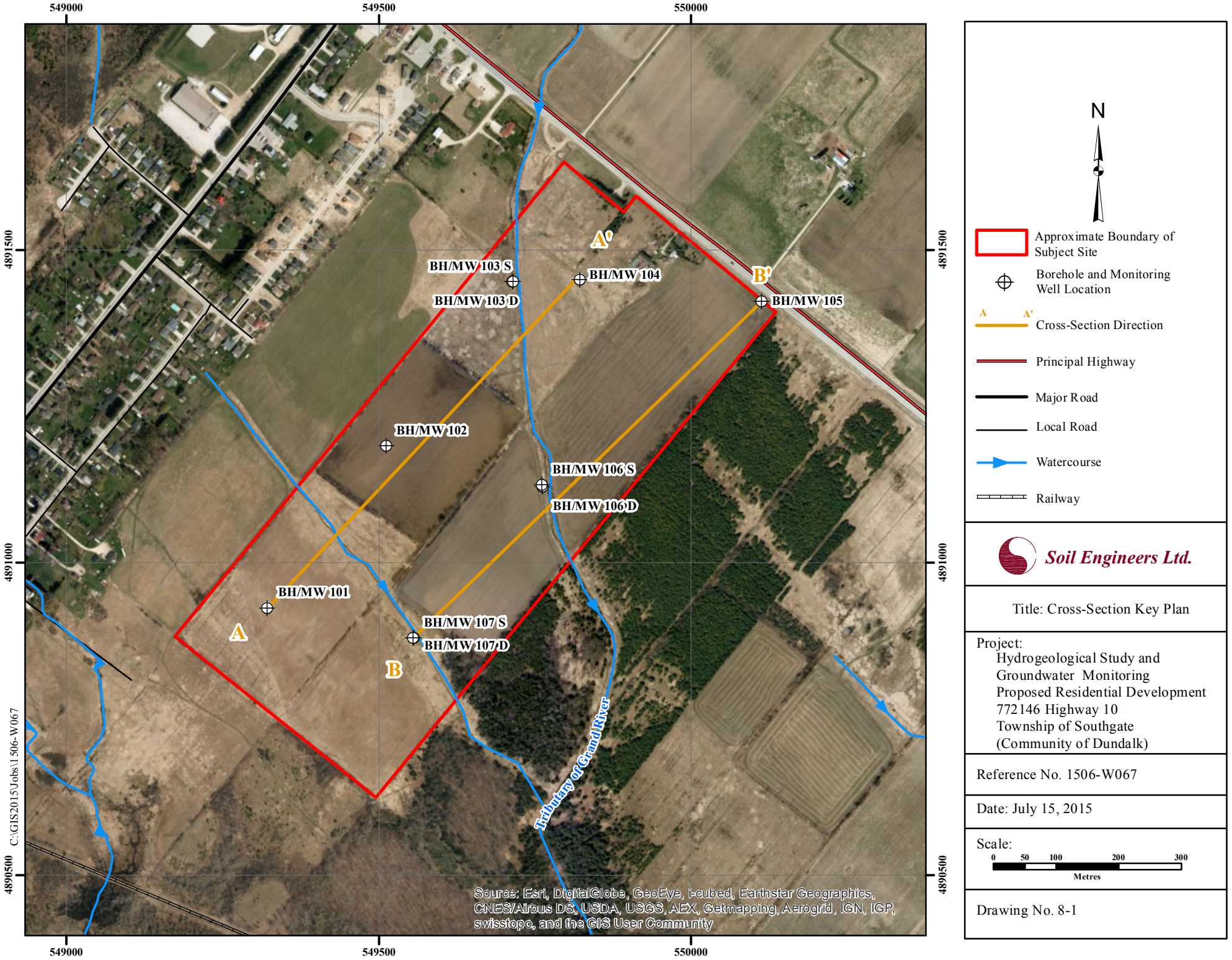
Project:
Hydrogeological Study and Groundwater Monitoring
Proposed Residential Development
772146 Highway 10
Township of Southgate
(Community of Dundalk)

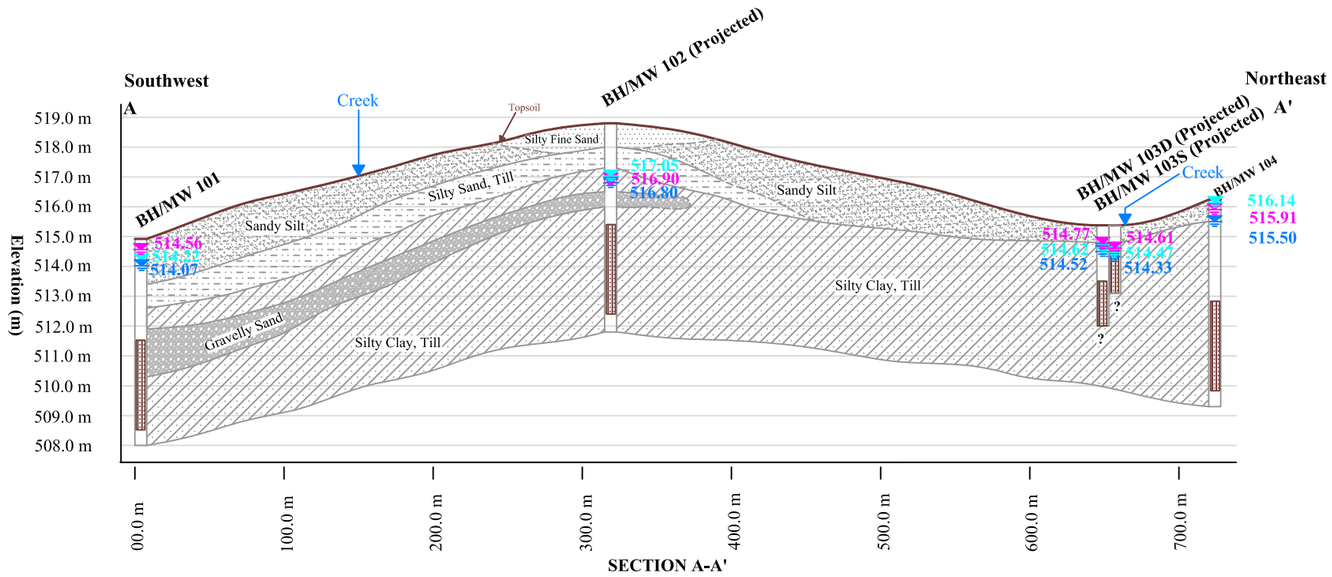
Reference No. 1506-W067

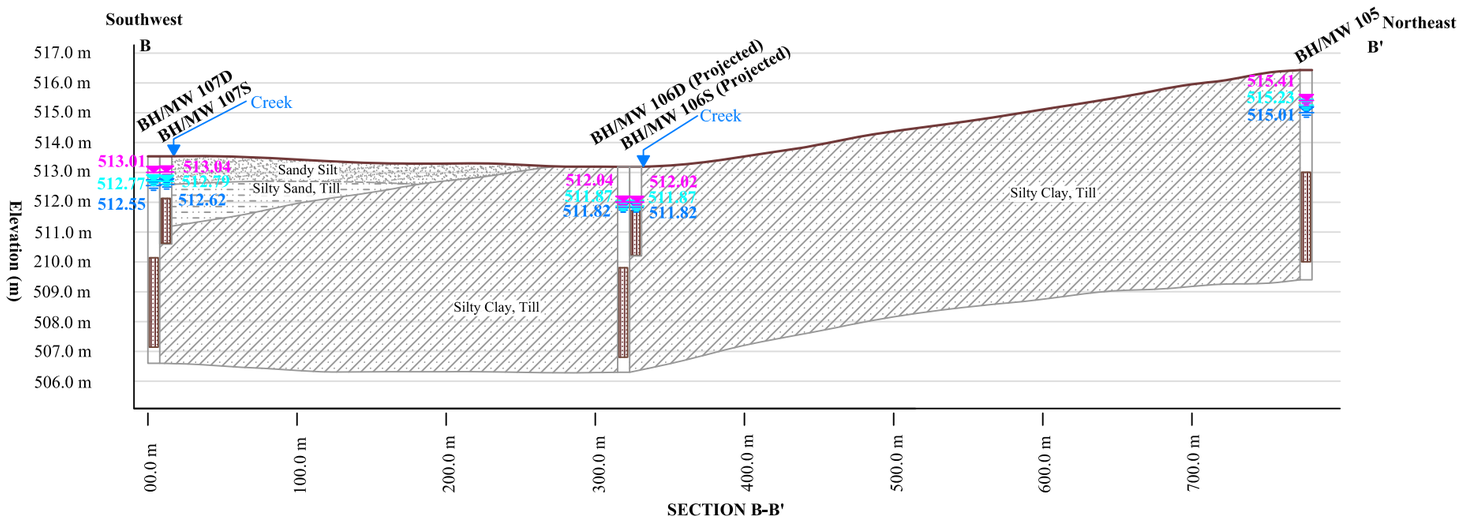
Date: July 15, 2015

Scale:
0 75 150 300 450 600 750
Metres

Drawing No. 7


549000
549500
550000
4891500
4891000
4890500
A'
B'
BH/MW 103 S
BH/MW 103 D
BH/MW 104
BH/MW 105
BH/MW 102
BH/MW 106 S
BH/MW 106 D
BH/MW 101
BH/MW 107 S
BH/MW 107 D
A
B
Tributary of Grand River
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
C:\GIS2015\Jobs\1506-W067
N
Approximate Boundary of Subject Site
Borehole and Monitoring Well Location
A A'
Cross-Section Direction
Principal Highway
Major Road
Local Road
Watercourse
Railway
Soil Engineers Ltd.
Title: Cross-Section Key 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 50 100 200 300
Metres
Drawing No. 8-1





Silty Clay, Till

Gravelly Sand

Silty Fine Sand

Sandy Silt

Silty Sand, Till

Screen

Water Table on October 9, 2015

Water Table on September 19, 2015

Water Table on August 24, 2015

C:\Hydrog./Projects/1507-W067/Cross-section

Soil Engineers Ltd.
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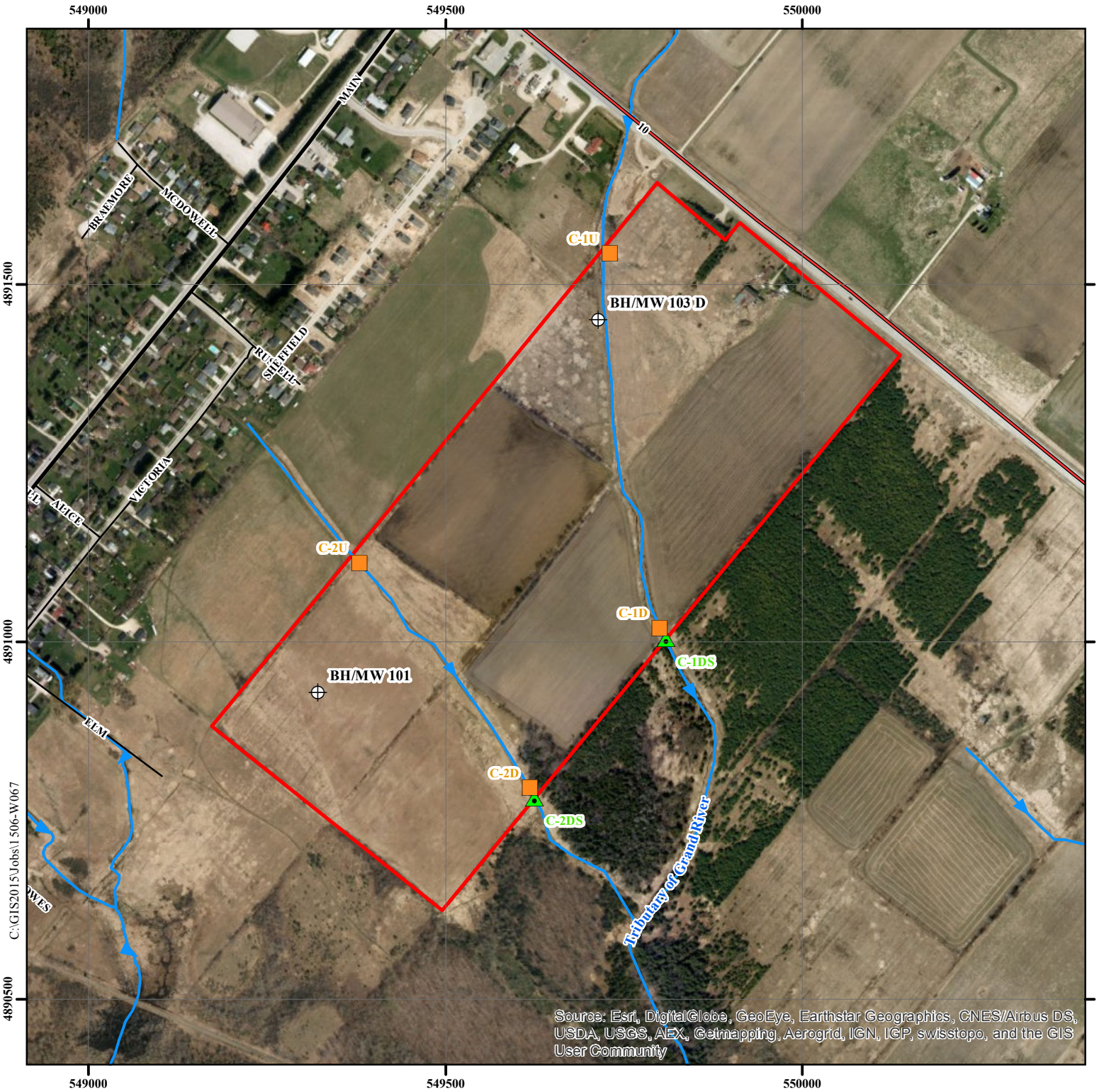
Title:	Geological Cross-Sections (A-A' and B-B')
Project:	Proposed Single Lot Residential Development 772146 Highway 10, Township of Southgate (Community of Dundalk)

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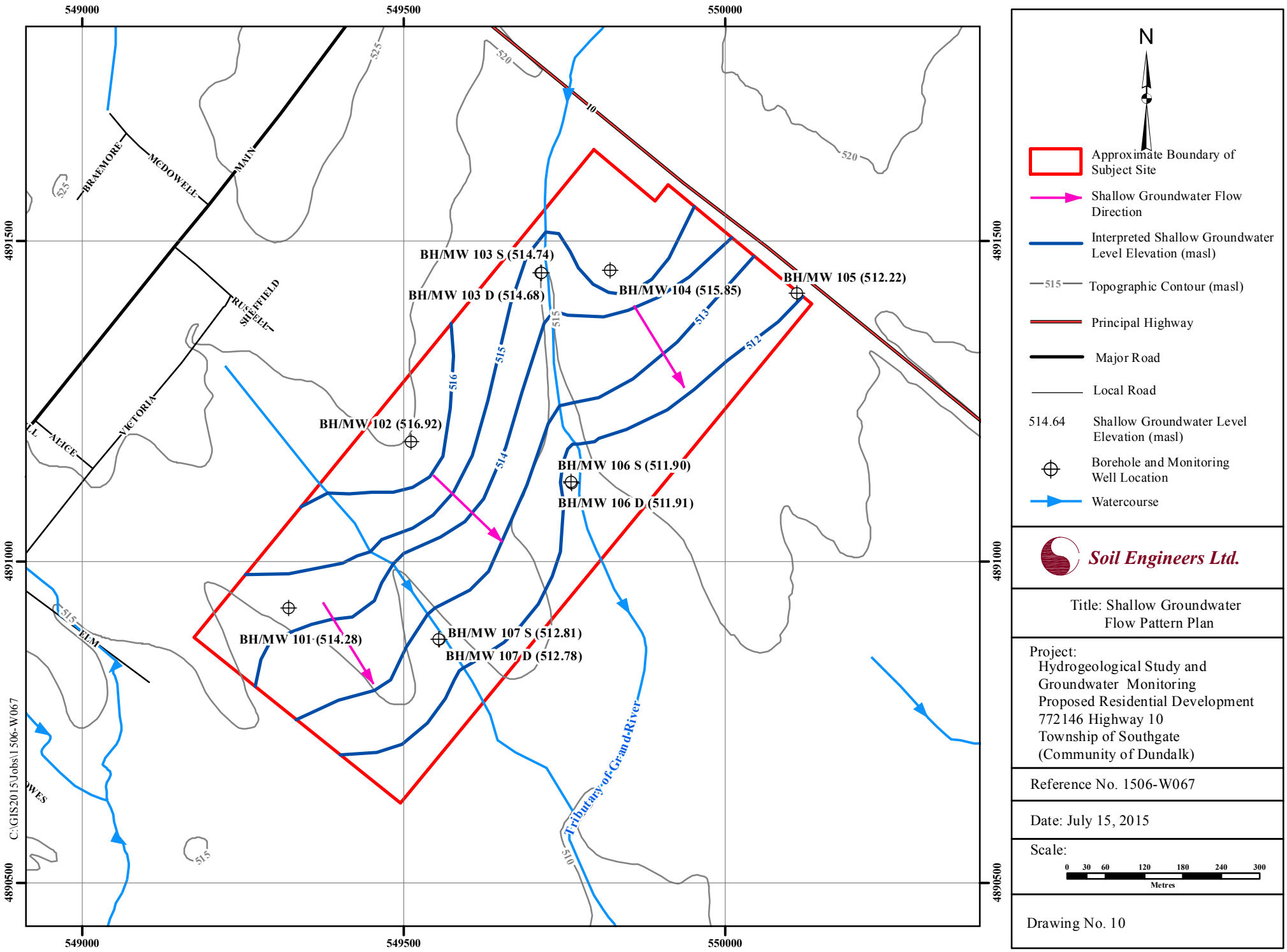
Metres

Drawing No. 9



N

Approximate Boundary of Subject Site

Shallow Groundwater Flow Direction

Interpreted Shallow Groundwater Level Elevation (masl)

515 Topographic Contour (masl)

Principal Highway

Major Road

Local Road

514.64 Shallow Groundwater Level Elevation (masl)

Borehole and Monitoring Well Location

Watercourse

Soil Engineers Ltd.

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:

0 30 60 120 180 240 300
Metres

Drawing No. 10

Source: Contour Map, York Region
©York Maps, Open Data

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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	Ho=	-0.421	m
Initial water depth		0.43	m
Aquifer material:		**Silty Clay Till and Gravelly Sand**	

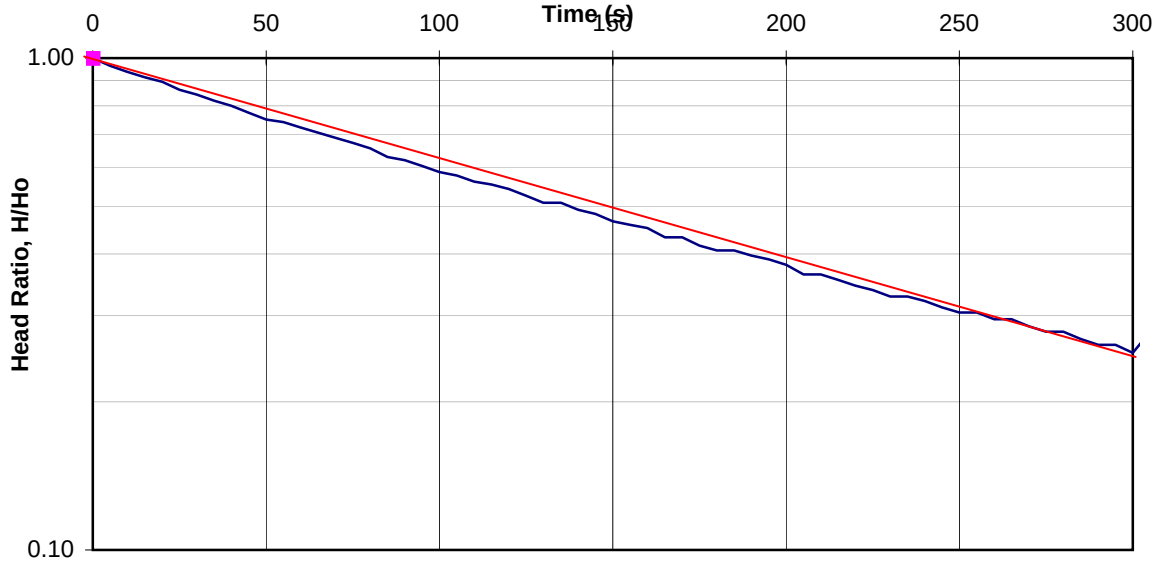
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00434316$

K= **1.5E-04** cm/s

1.5E-06 m/s



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**	

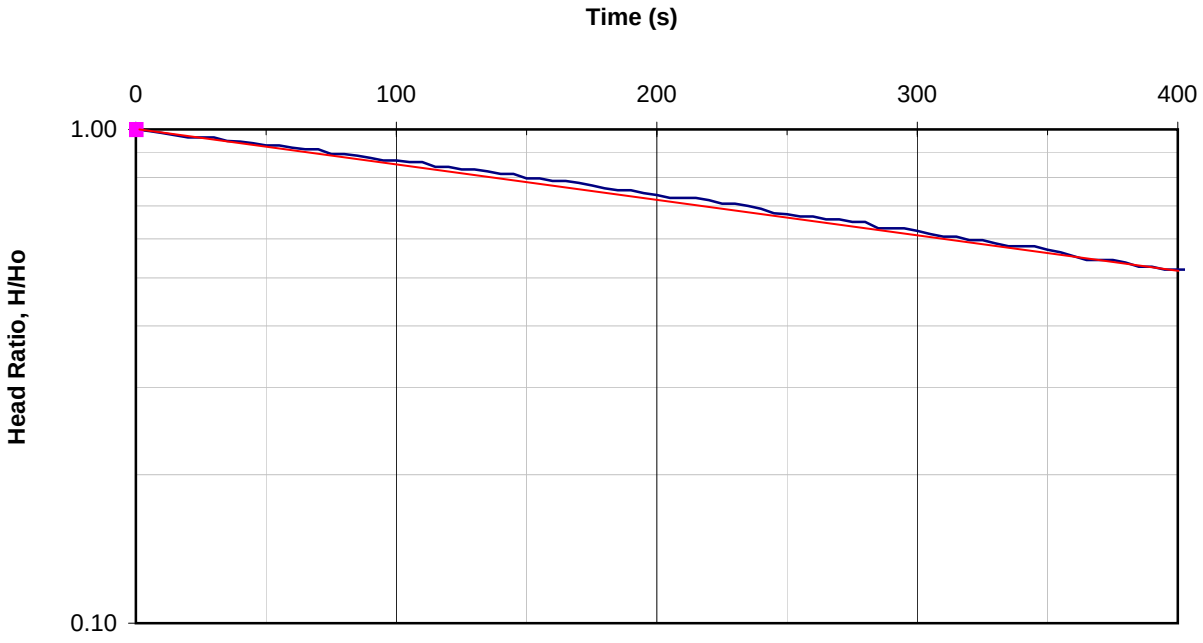
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.001679069$

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**	

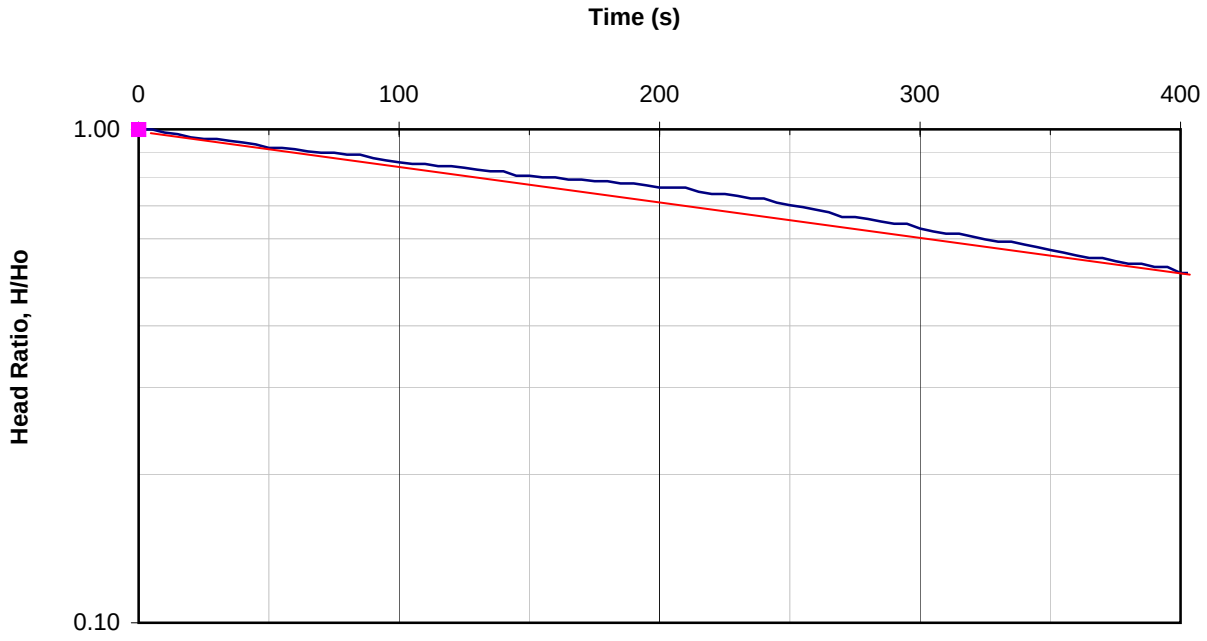
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 3.607239$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.001801004$

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**	

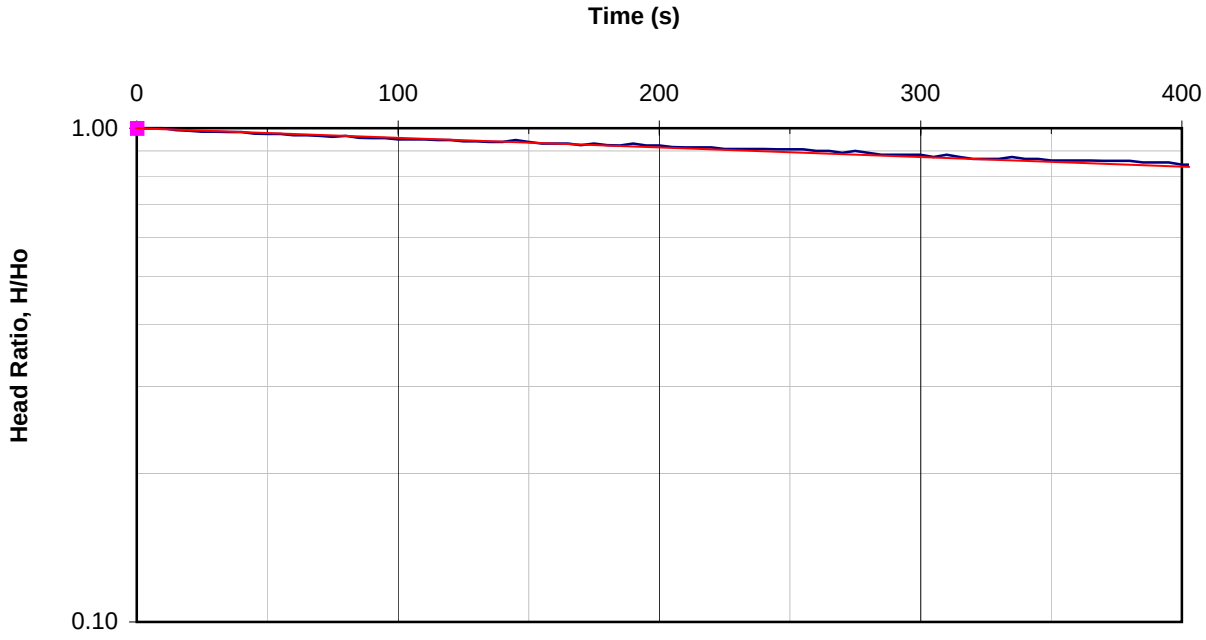
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000345109$

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**	

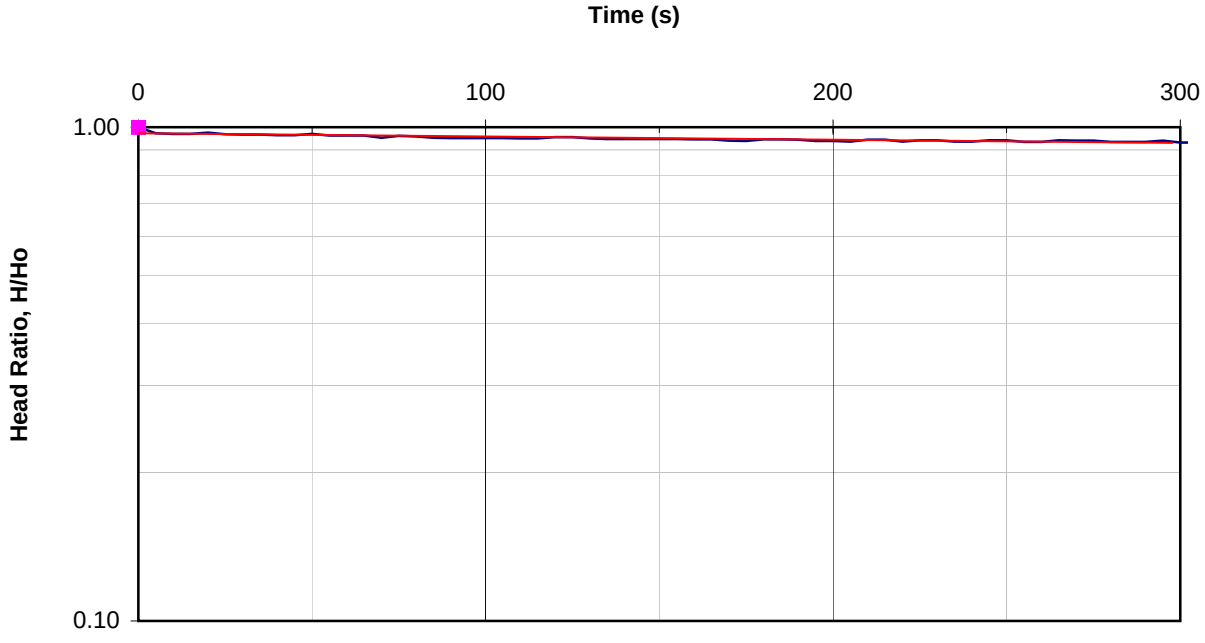
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000154104$

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**	

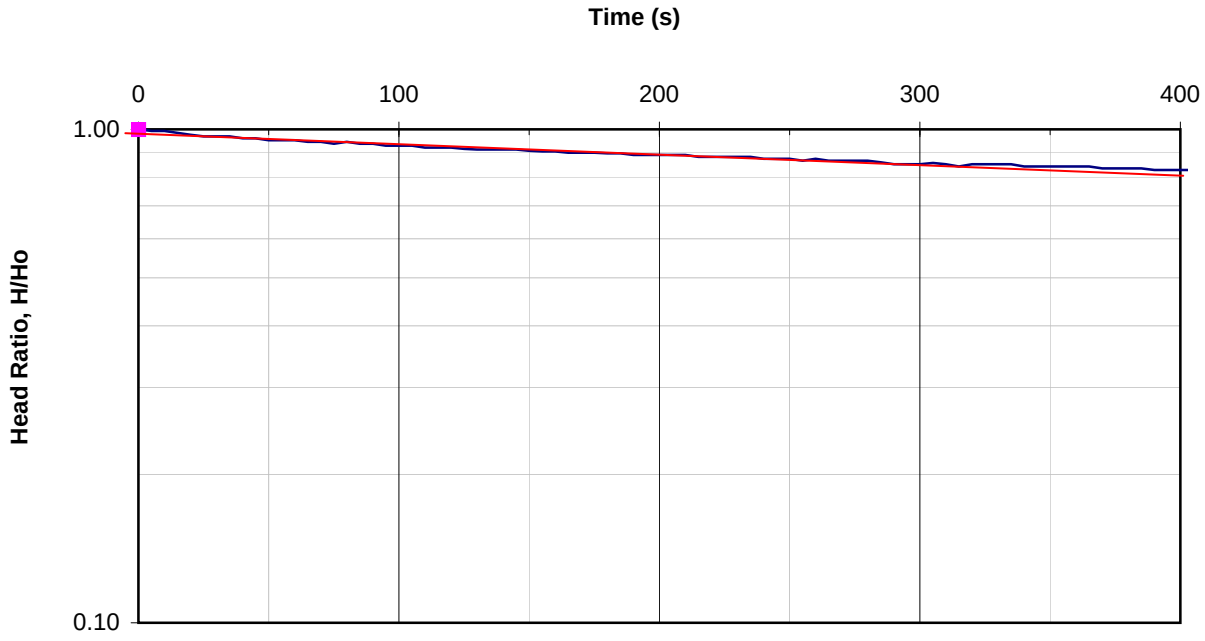
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000373548$

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**	

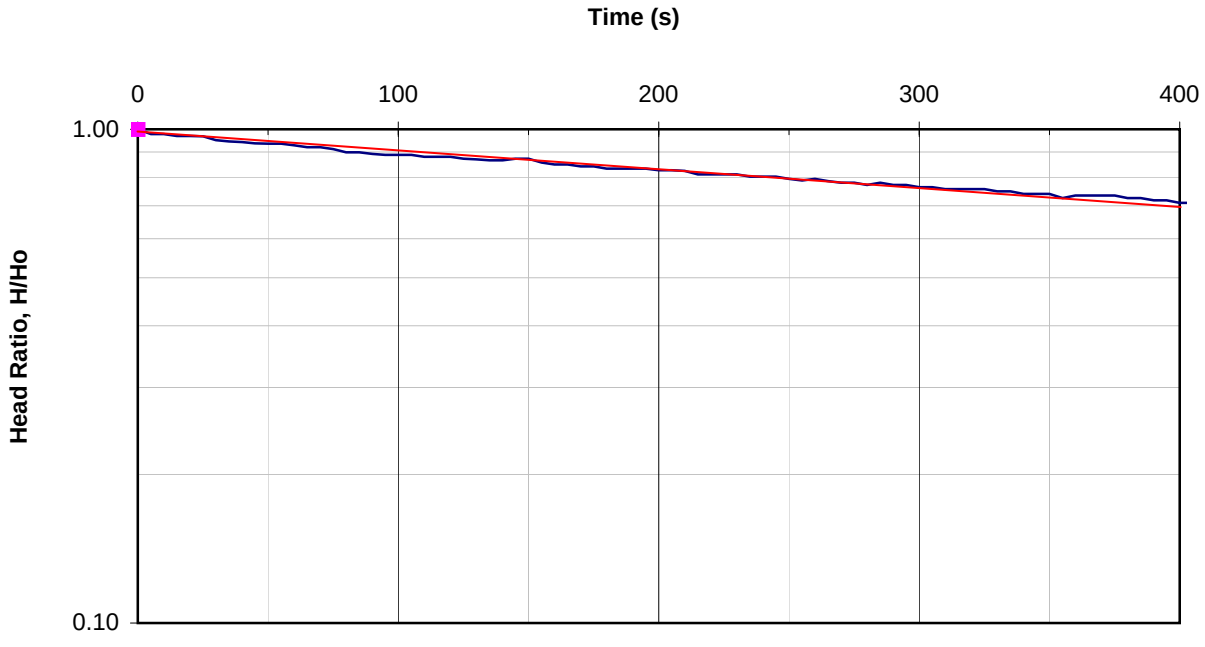
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.701815$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.000748919$

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

2.6E-07 m/s



Soil Engineers Ltd.
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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 'C'

WATER QUALITY CERTIFICATES OF ANALYSIS

REFERENCE NO. 1506-W067

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

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, Calcum, 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.

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

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

		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
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: Elizabeth Rolakowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

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 CaCO3)	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 Rotakowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

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 Rolakowska

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

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
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Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

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 CaCO3)	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 Rolakowska

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Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

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
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 Rolakowska

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Certificate of Analysis

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

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

		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
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 Rolokowska

AGAT Laboratories

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jan 11, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	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%

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 15T055705

PROJECT: 1506-W067

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

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

Comments: NA signifies Not Applicable.

Certified By: Elizabeth Rolakowska

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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 CaCO3)	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

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Chain of Custody Record

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

Report Information:

Company: Soil Engineers Ltd.
Contact: Gavin
Address: 100 Nugget Ave
Toronto M1S3A7
Phone: 416-754-8515 Fax: 416-754-8516
Reports to be sent to:
1. Email: gavin@soilengineersltd.com
2. Email: Nturjes@soilengineersltd.com

Project Information:

Project: 1506-w067
Site Location: Dundalk
Sampled By: Kevin
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes [X] No [ ]
Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

[ ] No Regulatory Requirement

[ ] Regulation 153/04
Table ____ (Indicate One)
[ ] Ind/Com
[ ] Res/Park
[ ] Agriculture
Soil Texture (Check One)
[ ] Coarse
[ ] Fine

[ ] Sewer Use
[ ] Sanitary
[ ] Storm
Region ____ (Indicate One)

[ ] Regulation 558
[ ] CCME
[X] Prov. Water Quality Objectives (PWQO)
[ ] Other
____ (Indicate One)

Is this submission for a Record of Site Condition? [ ] Yes [X] No

Report Guideline on Certificate of Analysis [ ] Yes [X] No

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 15T055705
Cooler Quantity:
Arrival Temperatures: 8.9 | 8.7 | 8.5
Custody Seal Intact: [ ] Yes [ ] No [ ] N/A
Notes:

Turnaround Time (TAT) Required:

Regular TAT [X] 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
[ ] 3 Business Days [ ] 2 Business Days [ ] 1 Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	(Check Applicable) ORPs: [ ] CN [ ] B-HWS [ ] Cl [ ] EC [ ] FOC [ ] NO_2/NO_3 [ ] Cr^{6+} [ ] Total N [ ] Hg [ ] pH [ ] SAR	(Check Applicable) Nutrients: [X] TP [ ] NH_3 [X] TKN [ ] NO_3 [ ] NO_2 [ ] NO_3/NO_2	(Check Applicable) Volatiles: [ ] VOC [ ] BTEX [ ] THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	MERCURY	Metals	Total Phosphorous
C-1 DS	12-22-15	11:30 AM	7	SW		X					X										X	X	X
C-2 DS	12-22-15	2:30 PM	7	SW		X					X										X	X	X

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
BRIAN DEEP BRAR	12-22-15	6:45PM	Gator Bello	Dec 22/15	18:40
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page ____ of ____
No: T 019835

AGAT Laboratories

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Guideline Violation

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

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 CaCO3)	(80-100)	252
7310713	MW 103	O.Reg.169/03(mg/L)	Inorganic Chemistry (Water)	Total Hardness (as CaCO3)	(80-100)	283

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jan 11, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	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%

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 15T055697

PROJECT: 1506-W067

ATTENTION TO: Gavin O'Brein

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

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

Comments: NA signifies Not Applicable.

Certified By: Elizabeth Rolakowska

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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 CaCO3)	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 NH3-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

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

Chain of Custody Record

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

Laboratory Use Only

Work Order #: 1STOSS697

Cooler Quantity:

Arrival Temperatures: 9.0 9.1 8.7

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Soil 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@soilengineers.ltd.com
2. Email: Navjes@soilengineers.ltd.com

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region ____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☒ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 1506-4067
Site Location: Dundalk
Sampled By: Gavin
AGAT Quote #: ____ PO: ____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl⁻ ☐CN ☐Cr⁶⁺ ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☒TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	metals	MERCURY	AMMONIA
MW 101	12-22-15	11:00pm	8	GW		X															X	X	X
MW 103	12-22-15	3:30pm	8	GW		X															X	X	X

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
BHAWANDEEP	12-22-15	6:45pm		Dec 22/15	18:40
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

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N°: T 019834