HYDROGEOLOGICAL SITE ASSESSMENT
PROPOSED WHITE ROSE RESIDENTIAL SUBDIVISION
NORTH OF BRADLEY STREET
DUNDALK, ONTARIO

for

2570970 ONTARIO INC.

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Report: 2
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ATTACHMENTS:

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CONSULTING ENGINEERS

July 8, 2020

PML Ref.: 19KF007
Report: 2

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Dear Mr. De Palma

Hydrogeological Site Assessment
Proposed White Rose Park Residential Subdivision
North of Bradley Street
Dundalk, Ontario

1. INTRODUCTION AND OBJECTIVES

1.1 Introduction

Peto MacCallum Ltd. (PML) was retained by 2570970 Ontario Inc. to conduct a Hydrogeological Site Assessment (HSA) for the proposed development of a 4.5 ha rural agricultural property into a residential subdivision. The property (hereinafter referred to as the site) is located past the north terminus of Bradley Street, within a fringe rural / urban setting in the northwestern area of Dundalk, Ontario (see Key Plan on Drawing 1 and Figure 1(A) in Appendix A). Legally, the site is in Lot 227, Range 2 West of Toronto and Sydenham Road, Township of Southgate (originally Proton Township), County of Grey.

The proposed road alignments and property boundaries, as supplied by the client, are depicted in Drawing 1. It is understood that the development will include approximately 30 detached houses, 24 townhouse units, 24 senior units, and a planned future block of 8 to 10 senior units. The subdivision includes the construction of three new roads (“A”, “B” and “C”) and a cul-de-sac (“D”), and will be serviced with watermains, and storm and sanitary sewers. The subdivision includes the construction of five new roads, and will be serviced with watermains, and storm and sanitary sewers. Currently the area to be developed is confined to the southern half of the property, see Drawing 1.

A geotechnical investigation (PML Ref.: 19KF007, Report 1, dated July 31, 2019) was conducted by PML simultaneously with the hydrogeological site assessment (HSA) investigation. The HSA is ongoing due to the long-term ground water monitoring.

1.2 Objectives and Scope of Work

The objective of this investigation was to carry out a hydrogeological site assessment and provide recommendations in support of the proposed development. Based on the project requirements, as well as the standard practice guidelines, the HSA involved the following tasks:

Task 1: Conduct a review of the site background and setting, MECP water well records, geological and hydrogeological maps and the development drawings.

Task 2: Visit the site to observe and record the existing site conditions, site settings and features, topography, surface drainage, water bodies, and watercourses.

Task 3: Assess the hydraulic properties of soil samples retrieved from the boreholes based on laboratory gradation tests.

Task 4: Revisit the site to develop and measure the ground water levels in all wells.

Task 5: Complete hydrogeological analysis to provide an estimate of the anticipated dewatering discharge rate.

Task 6: If water taking approval is not required, prepare a HSA report including factual data, assessment findings and recommendations.

Task 7: If water taking approval is required, provide an estimate of the dewatering discharge rate anticipated and type of Water Taking Approval required in a brief memo. Continue to Stage Two (Task 8).

Task 8: Conduct further site background review and provide listing of MECP-recorded water wells. Assess potential impact on nearby water well users, if any. Visit the site to observe and record potentially contaminating areas (PCAs) in the vicinity of the site.

Task 9: Retrieve two representative ground water samples and conduct chemical analyses for parameters/substances related to the Storm Sewer Discharge By-Law and Provincial Water Quality Objectives (PWQO) both filtered and unfiltered to determine disposal options of excess water during construction de-watering.

Task 10: Revisit the site to measure the ground water levels at least two times every three months for one year (minimum 8 site visits).

Task 11: Finalize the Hydrogeological Conceptual Site Model, reassess the maximum construction dewatering rate, and assess the dewatering impacts and the ground water quality based on the chemical test results.

Task 12: Prepare a final HSA report including factual data and recommendations on de-watering requirements, approximate scope of construction dewatering scheme and potential impact of the proposed development on the neighbouring properties and recommendations for mitigation of negative impacts, if any.

2. BACKGROUND REVIEW

2.1 Site Physiographic, Geologic and Hydrogeologic Settings

The site is located within the physiographic region known as Dundalk Till Plain and the physiographic landforms of the area are Drumlinized Till Plains and Drumlins ("The Physiography of Southern Ontario", Ministry of Natural Resources, 1984, Chapman, L.J. and Putnam, D.E.). It is an area of wetlands and poorly drained depressions and a source region for many rivers. The drumlins, which typically consist of medium-textured till, point southwesterly and were built by an ice sheet advancing over the Niagara escarpment from the east.

The OGSEarth map of Surficial Geology of Southern Ontario (Ontario Geological Survey, 2010), indicates that the surficial soil in the portion of the site being developed (the south portion) is Till and may be expected to contain sandy silt to silty sand, while the wetland area contains glaciofluvial (river) deposits which are expected to be sandy. The OGSEarth map of Paleozoic Geology of Southern Ontario (Armstrong and Dodge, 2007), indicates that the bedrock geology at the site comprises dolostone of the Guelph Formation. The ground surface elevation at the site generally varies from about 519.5 to 522.5 mASL, with lowpoints generally in the south east corner and in the wetland that makes up the north part of the site, and the highest elevations along the western property line (see Figure 2(A) in Appendix A).

The site is primarily located within the Upper Grand River Watershed, although a small part of the southwest corner lies within the Saugeen Watershed. A GRCA-regulated tributary of the Grand River flows from the wetland on the site and flows southeasterly through Dundalk (see Figure 2(A) in Appendix A). A large portion of the property lies within the GRCA-regulated limits surrounding the wetland.

According to the Ministry of Environment, Conservation and Parks (MECP) online water-taking mapping utility, annual watershed use is rated to be low and summer watershed use is medium. The site does not lie in either the area under development control as defined by the Niagara Escarpment Planning and Development Act or on the Oak Ridges Moraine Conservation Area.

The hydrogeology of the site and the vicinity is expected to be primarily controlled by topographic elevation, the wetland and the Grand River tributaries. Locally, shallow ground water is expected to flow into valleys and topographic depressions.

No potentially contaminating activities were noted within the vicinity of the site, however, an abandoned rail way line, now called the “Grey County CP Rail Trail” is located about 280 m south of the site.

2.2 MECP Water Well Records Review

The MECP Water Well Records database was searched for water well records in the vicinity of the site (an approximately 1.4 km by 1.4 km square area in UTM coordinates) and a summary of the well record information and a map (Figure 1(B)) indicating the well locations are included in Appendix B.

The wells within about 300 m of the site were identified and numbered on the map to correspond to the record list. The identified wells, which were located generally to the south of the site, included thirteen (13) recorded wells with five (5) of the wells listed as water supply for domestic or municipal uses. The water supply wells were typically drilled before 1970 and were over 35 m deep. Hydrostatic ground water levels ranged from 7 to 12 m deep. Of the remaining wells, four (4) were well abandonment records, two (2) were not used, one (1) was a test hole, and one (1) had no well use recorded.

3. FIELD WORK AND LABORATORY ANALYSES

3.1 Borehole Drilling and Monitoring Well Installation

As part of the geotechnical and HSA investigation, six boreholes were drilled on April 4 and 5, 2019, and all were installed with ground water monitoring wells. Boreholes 1 to 5 were located along the planned roadway corridors and were drilled to a depth of 6.7 m below ground surface (bgs), and borehole 6 was located in the wetland area to the north and was drilled to a depth of 4.9 m bgs. The locations can be seen in the appended Borehole Location Plan, Drawing 1.

The boreholes were advanced using a Diedrich D-50 track-mounted drill rig fitted with continuous flight hollow stem augers and automatic hammer, supplied and operated by a specialist drilling contractor. The work was carried out under the full-time supervision of a PML engineering staff member who directed the drilling and sampling operations, documented the soil stratigraphy, monitored ground water conditions and processed the recovered samples.

Representative samples of the overburden were recovered at regular intervals throughout the depths explored. Standard penetration tests (SPT) (ASTM D1586) were carried out during sampling operations in the boreholes using conventional split spoon equipment. Ground water observations were made in the boreholes during and upon completion of drilling. The boreholes were backfilled in accordance with Ontario Regulation (O. Reg.) 903 upon completion of drilling.

Monitoring wells were installed in all 6 boreholes to more accurately measure ground water levels and to allow in-situ hydraulic conductivity testing. The monitoring wells comprised 50 mm diameter PVC pipe, filter sand, bentonite seals, and protective casings. The monitoring wells will require future decommissioning.

All of the recovered soil samples were returned to PML's laboratory for detailed visual examination, classification, and routine moisture content determinations. The laboratory testing also included particle size distribution analyses on soil samples from Boreholes 1, 2, 3 and 5.

The borehole locations were established in the field by PML. Borehole locations were surveyed by PML using a Global Navigation Satellite System (GNSS). The survey equipment was provided by SOKKIA Canada, model GCX-3.

For further details see the appended log sheets and the geotechnical report.

3.2 Purging and Ground Water Level Monitoring

The six monitoring wells were purged, and after stabilization, the ground water levels were recorded using a Solinst electric water meter tape. Ground water level monitoring began April 4, 2019 and is to continue for one year at a frequency of about two readings per quarter year. The results of the ground water monitoring are listed on Table 1.

3.3 Borehole Permeability Testing

In order to estimate the hydraulic conductivity of the overburden deposits, borehole permeability testing was conducted using a slug test in the monitoring wells of boreholes 1, 2, 3, 5 and 6 on June 25, 2019.

In the test, a volume of water (the ‘slug’) was rapidly removed from the monitoring well using a bailer, and periodic water level measurements were recorded manually using a Solinst flat tape water level meter and with an electronic transducer (a Solinst Levelogger), as the water level recovered inside the well (a rising head test).

Using the Hvorslev method (Hvorslev, 1951), the data was plotted on a semi-logarithmic scale to estimate the basic time lag T_0, which, combined with the geometric configuration of the well screens, resulted to an estimation of hydraulic conductivity (K-value) for the soils in the vicinity of the well screen. The plots of normalized head versus elapsed time and the estimation of the basic time lags (T_0 values) are included in Appendix C. T_0 was estimated by fitting an exponential trend line to the data between the normalized head interval of 0.15 and 0.25, as recommended by Butler (1997) to overcome the ambiguity of double straight-line effects or concave results, and calculating T_0 from the inverse of the slope of the fit line. A plot exhibiting concave-upward curvature reflects compressibility of the formation indicating that a storage effect may exist.

The K-values (in cm/s) were estimated using the following equation:

$$K = \frac{r^2}{2LT_0} \ln\left(\frac{L}{R}\right)$$

where: K = hydraulic conductivity (cm/s)

L = the length of the screen (cm)

R = the radius of the borehole (cm)

r = the radius of the well casing (cm)

T_0 = the basic time lag in seconds (-1/slope of line fitted to data, see Appendix C).

The filter sand packing and wellscreens remained fully submerged throughout all of the tests.

3.4 Soil Particle Size Distribution Analyses and Hydraulic Conductivity Estimate

Four soil samples obtained from boreholes 1, 2, 3 and 5 were submitted to the PML laboratories in Kitchener for particle size distribution analyses. The particle size distribution curves of these soil samples are shown on Figure 1.

In addition to in-situ testing, the hydraulic conductivity (K) value of selected soil samples was estimated using the grain size distribution and an empirical formula as described below.

The hydraulic conductivity of the silt samples were estimated using the grain size distribution and the following equation (Vukovic and Soro, 1992):

$$K = C\ f(n) d_e^2 \frac{g}{\nu}$$

where:

- Hydraulic conductivity K has units of m/s
- Constant C = 8.3×10^{-3}, 2.4×10^{-3}, or 0.7×10^{-3} for coarse, medium, or fine-grained sand, respectively.
- Porosity function $f(n) = \frac{n^3}{(1-n)^2}$

- Porosity $n = 0.255\left(1 + 0.83^{C_u}\right)$
- Uniformity coefficient, $C_u = \frac{d_{60}}{d_{10}}$
- Grain diameter d_x = grain diameter, in mm, for which x% of the sample is finer based on the grain size distribution curve.
- Effective grain size diameter $d_e = f\left(\frac{d_{30}}{d_5}\right)$ (see below)

  The soil uniformity, d_{30}/d_5, and an empirical relationship (Figure 3 of Vukovic and Soro, 1992) are applied to the soil's grain size distribution curve to estimate the effective grain size diameter d_e.
- Gravitational constant g = 9.81 m/s^2
- Ground water kinematic viscosity ν = 1.3 x 10^{-6} m^2/s (assumed 10°C)

The results of field permeability tests as well as the estimated K-values from particle size distribution test results are listed on Table 2.

3.5 Water Sampling

In order to determine the management options for the potential discharge of ground water, ground water samples were collected from monitoring well BH/MW 3 on February 5, 2020. The ground water samples were collected using a Waterra Ecobailer. The samples obtained were immediately placed in bottles supplied by SGS Canada Inc. (SGS) and stored at low temperatures. The ground water samples collected were delivered to SGS Canada Inc for chemical analyses. SGS is accredited by The Standards Council of Canada (SCC) and The Canadian Association for Laboratory Accreditation (CALA).

To assess the baseline ground water quality with respect to future disposal options during potential construction dewatering the ground water samples were analyzed for the following parameters:

- Southgate Township Sanitary and Storm Sewer Bylaw,
- A suite of metals (total and dissolved),
- Nitrate, hardness and alkalinity.

The Chain-of-Custody Record and the laboratory reports are included in Appendix H, and the results are discussed in Section 4.5.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole Sheets, tables, figures, and drawings for details of the field work, including inferred stratigraphy, soil classifications, Standard Penetration Test (SPT) N values, ground water observations and laboratory test results.

Our summarized findings and interpretation of the site subsurface conditions are presented below.

Due to the soil sampling procedures and limited sample size, the depth / elevation demarcations on the borehole logs must be viewed as “transitional” zones between layers, and cannot be construed as exact geologic boundaries between layers.

4.1 Stratigraphy

Based on the findings from the geotechnical investigation, the soil stratigraphy generally comprises topsoil and various interspersed cohesionless layers, over a major deposit of silt till.

The interspersed cohesionless soils typically comprised sandy gravel, gravelly silt, sandy silt or silt and typically extended to 1.5 to 3.0 m bgs (elevation 517.2 to 520.7), except at borehole 6 where the layers extended to 4.1 m bgs (elevation 515.4). The deposits were moist to saturated and N-values indicate a very loose to compact density.

The major deposit of silt till extended to borehole termination in all six boreholes; a depth of 6.7 m bgs (elevation 513.5 to 515.5) at boreholes 1 through 5, and a depth of 4.9 m bgs (elevation 514.6) at borehole 6). The silt till composition varied from gravely to sandy silt, with occasional cobbles and boulders. The silt till was wet to moist and N-values indicate a dense to very dense density. Refer to Figure 1 for the results of particle size distribution analysis conducted on representative samples of the native silt till contacted in the boreholes.

4.2 Ground Water Conditions

4.2.1 Observations During Drilling

Ground water observations carried out during and upon completion of drilling are presented on the appended Log of Borehole Sheets.

During drilling, at boreholes 1 through 5 (i.e. the boreholes not in the wetland), wet or saturated conditions were first encountered in the cohesionless layers at depths ranging from about 0.1 to 0.7 m bgs (elevation 520.0 to 522.0) and continued to depths ranging from 4.1 to 6.7 m bgs (elevation 514.0 to 519.6). Locally at boreholes 1 and 4, the wet soils were separated by a moist layer. Notably, at borehole 6, the stratigraphy was saturated continuously from the surface to the depth of borehole termination.

4.2.2 Long-Term Monitoring

Eleven rounds of hydrostatic ground water level readings have been recorded between April, 2019 and March, 2020. The hydrostatic ground water levels are summarized in Table 1. To date, the highest hydrostatic ground water levels measured at boreholes 1 to 5 (i.e. those not in the wetland) ranged from 0.08 to 0.49 bgs (elevations 520.07 to 521.91) on the April 26, 2019 monitoring date, and the deepest ranged from 2.10 to 3.35 m bgs (elevations 518.35 to 519.05) on the August, September and October, 2019 monitoring dates. The recorded water levels are presented in a chart in Figure 1(D) in Appendix D. The seasonal high ground water level (SHGWL) can be taken to be 0.3 m bgs, based on the average measured ground water levels taken April 26, 2019.

The hydrostatic ground water levels measured at borehole 6 (in the wetland) ranged from 0.04 m bgs (elevation 519.41) on the April 26, 2019 monitoring date, to 1.15 m bgs (elevation 518.30) on the September 28, 2019 monitoring date.

Ground water levels at the site are subject to seasonal fluctuations due to weather patterns and variations in precipitation and climate. As indicated by the monitoring, the seasonal fluctuation at this site appears to be relatively large; the average difference between low and high ground water levels is about 2.5 m.

The readings taken April 4 and 5, 2019 were excluded from the above analysis since they were recorded too soon after drilling.

The hydrostatic ground water readings on April 26, 2019 are depicted on the Ground Water Level Contour Map, Drawing 2. The contours indicate that ground water flow is generally east and southeast.

Ground water temperature was monitored and is presented in a chart in Figure 2(D) in Appendix D. Due to a problem with the temperature probe, on some site visits the temperature could not be recorded.

4.2.3 Aquifer, Discharge, and Recharge Findings

The cohesionless soils and underlying silt till encountered at the site generally contained high amounts of sand, and locally, gravel, and minor amounts of clay and were wet to saturated, and thus act as an aquifer. It is expected that infiltration and recharge at the site would not be significantly impeded.

Preliminary ground water contour mapping indicates that ground water flow is generally towards the wetland and the collected temperature data indicates that the temperature of the ground water in the wetland is typically colder than at the other monitoring wells, suggesting that it may be acting as a discharge wetland (ground water moves out of the aquifer to the surface), although the water level and temperature data is limited and there appears be seasonal variations in both. The annual recharge at the site and vicinity estimated by the GRCA is depicted in Figure 3A in Appendix A.

4.3 Estimated Hydraulic Conductivity and Ground Water Flow Velocities

The hydraulic conductivity K-values of the soils encountered surrounding the monitoring well screens at boreholes 1, 2, 3, 5 and 6 were estimated using in-situ permeability test data (slug tests) and grain size distribution test results as described in Sections 3.3 and 3.4. The results are listed on Table 2.

For the silt till, the estimated hydraulic conductivity ranges from $3x10^{-6}$ to $8x10^{-6}$ cm/s (geometric mean $5x10^{-6}$ cm/s) based on the slug tests, and $2x10^{-6}$ to $1x10^{-5}$ cm/s (geometric mean $4x10^{-6}$ cm/s) based on particle size.

Based on the ground water level readings from April 26, 2018 and estimated site-specific hydraulic conductivities, hydraulic gradients vary from about 0.003 to 0.027, corresponding to ground water flow velocities ranging from $2x10^{-8}$ to $1x10^{-7}$ cm/s.

4.4 Ground Water Sample Chemical Test Results

The chemical analyses carried out by SGS on ground water samples from monitoring well MW 3 in accordance with the chain-of-custody record and the protocols described above (Section 3.5), are included in the laboratory report in Appendix H.

To provide an estimate how the dewatering discharge water may compare to expected regulatory compliance criteria for discharge to a storm sewer, and subsequent conveyance to a watercourse, or direct discharge to a watercourse or ditch, the water quality was compared to the Southgate Township sanitary and storm sewer bylaw criteria, Provincial Water Quality Objectives (PWQO), and where no PWQO limit exists, the guidelines of the Canadian Council of Ministers of the Environment (CCME). Where applicable, the CCME limit is the short-term freshwater water quality guideline for the protection of aquatic life.

The unfiltered ground water sample findings indicate that the discharge water, if untreated, are expected to be:

- Compliant with the Southgate Township Sanitary and Storm sewer use bylaw.

- Compliant with regards to PWQO and CCME for discharge to a natural watercourse or to a storm sewer in close proximity to the receiving natural watercourse.

Please note that we interpret the PWQO concentration limits that have dependencies differently than the laboratory. Based on the measured pH and hardness, the limits for aluminum, copper, lead and phosphorus were taken as 0.075, 5, 30, and 5 µg/L, respectively, and thus were not exceeded by the filtered and unfiltered ground water sample results (see the laboratory reports in Appendix H). In addition, according to Southgate Township, the storm sewer limit of 0.0 mg/L for zinc may be replace with 0.16 mg/L.

4.5 Anticipated Infiltration at the Soak-Away Pits

Soak-away pits are currently proposed within the buffer between the area to be developed and the wetland, at a distance of about 20 m from the defined edge of wetland (see Drawing 1). In this region, at boreholes 2 and 5, the soil stratigraphy consists of gravely silt and silt till, respectively, with very dense conditions below 3.0 m bgs. Hydraulic conductivities measured below 3.0 m bgs ranged from 2×10^{-6} to 8×10^{-6} cm/s, which correspond to infiltration rates of about 15 to 25 mm/hr. Since the minimum guideline value recommended for infiltration gallery design in "Stormwater Management and Planning Design Manual", by MOECC, dated 2003, is 15 mm/hr, the soil at the borehole locations would be deemed acceptable. Infiltration rates between the surface and 3.0 bgs, which are less dense, would be expected to be slightly higher. Note, however, that design rates must be established by the application of a suitable factor of safety based on the soil stratigraphy.

The soak-away-pits will be reassessed as part of detailed engineering design once draft plan of subdivision approval has been issued.

5. WATER BALANCE, RECHARGE AND BASEFLOW

5.1 General

The precipitation of the hydrologic cycle partitions into runoff, evapotranspiration and infiltration. The portion of the infiltration that reaches the ground water table is considered the "ground water recharge" and the portion of the ground water flow to wetlands, ponds, and creeks is considered the "baseflow". The main purpose of the water balance (or budget) analysis is to estimate the current infiltration rates to the subsurface and provide comparison with the estimated rates expected after development of the site (which change primarily due to the increase in hard-surfaced area).

The amount of infiltration in an area to be developed is largely dependent not only on precipitation rates, but upon the infiltration capacity of the area and the nature of the proposed development. For example, areas underlain by fine-grained silt and clayey soils and dense till materials, having naturally low infiltration capacity, will likely experience relatively little reduction in infiltration as a result of hard surfacing by a development compared to more permeable soils which may become partially covered with impermeable surfaces.

The method for calculating the change in infiltration involves the use of a site-specific climate water budget and applying it to the area proposed for development. For this assessment, the monthly precipitation and temperature were obtained from the Government of Canada's Canadian Climate Normals website for a nearby weather station (Proton Station), and monthly and total evapotranspiration and total surplus was estimated using the Thornthwaite and Mather method. The findings are shown in Table 1(E) in Appendix E.

The surplus was further divided into infiltration and runoff rates using a water budget utilizing the conservative infiltration factors of the former Ministry of Environment and Energy (MOEE) "Hydrogeological Technical Information, Requirements for Land Development Application" (dated April 1995) in the manner outlined in "Conservation Authority Guidelines for Hydrogeological Assessments", dated June 2013. In the method, the infiltration is calculated by applying the cumulative infiltration factors to the available surplus water. The infiltration factors provided by the above document are based on a hydrologic analysis of the peak runoff for stormwater management purposes. This provides a worst-case scenario with respect to runoff and is conservative in estimating the amount of ground infiltration. The pre-development (existing) and post-development water budget analyses for the proposed development are outlined on Tables 2(E) and 3(E) in Appendix E; and are further described in the following section.

5.2 Potential Impact of Development

It is recommended that this information be required as a condition of draft plan of subdivision approval and appropriately confirmed through detailed engineering design with the final plan layout. As a preliminary assessment, the following provides a high-level assessment of pre- and post-development infiltration rates.

5.2.1 Pre-development

The yearly surplus water is typically about 566 mm in the project area, obtained by subtracting the yearly typical actual evapotranspiration of 540 mm from the yearly typical precipitation of 1106 mm. The entire site property to be developed was considered as cultivated (no paved areas or buildings). The amount of infiltration at the site is estimated by applying the cumulative infiltration factors to the available surplus water, as shown in Table 2(E). Thus, based on the cumulative infiltration factor, the infiltration at the existing site is estimated to be about 0.57 x 566 mm/year = 323 mm/year. For the site, 4.08 ha in size, the pre-development infiltration rate is estimated at about 13,163 m^3/year; and the runoff is estimated at 9,930 m^3/year.

5.2.2 Post-development

For the post-development condition, the water balance was conducted separately for the cultivated, paved and building catchment regions, based on the given area of each. The total building (rooftop) area and paved areas were estimated at 9,000 and 12,000 m^2, respectively. For the cultivated area, the cumulative infiltration factor was slightly higher, as it was assumed the lots would be graded to be flatter than in the pre-development state. Also, it was assumed that 20% of the precipitation in the paved and building catchment areas is lost to evaporation. At these catchment areas, water that is not evaporated becomes runoff.

The volumes for each catchment area are totalled, resulting in an infiltration rate estimated at about 6,159 m^3/year and runoff rate at about 23,040 m^3/year (see Table 3(E)). A summary of the pre- and post-development water balance water volumes and percent change is given in Table 4(E).

5.2.3 Conclusion

Comparing the pre-and-post water balance calculations, there will be a deficit of about 7,004 m^3/year in infiltration. This reflects a subsequent decrease in contribution to recharge and to baseflow. The infiltration deficit may be compensated by constructing low impact development (LID) features, although this may be made more difficult due to the high ground water level.

6. CONSTRUCTION DEWATERING REQUIREMENTS

6.1 Introduction

The requirements of construction dewatering will depend on the proposed dimensions and depth of the excavations, shoring used, if any, and the site and surrounding ground water conditions (ground water levels, ground water sources, and hydraulic conductivities). It is prudent to note that the site should be re-evaluated with regards to ground water control and construction dewatering requirements once the draft plan of subdivision is approved and design drawings are available and sewer, grading and basement inverts are known. The comments below are generalized.

Typically, construction dewatering is required where the proposed excavation elevation will be deeper than the ground water strike level and/or hydrostatic ground water level. It is assumed that the ground water level is to be lowered at least 0.5 m below the lowest excavation level to maintain dry working conditions.

6.2 In-Construction Water Taking Permitting

Construction dewatering, like other water takings in Ontario, is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation 387/04, a regulation under the OWRA. In accordance with these regulatory requirements, an application for a Permit-To-Take-Water (PTTW) should be filed with the MECP if the construction dewatering discharge rate is expected to be greater than 400,000 L/day or about 4.6 L/s. If the dewatering discharge is expected to be greater than 50,000 L/d and less than 400,000 L/d, the water taking will not require the MECP PTTW approval process and must be registered with the Environmental Activity and Sector Registry (EASR). If the dewatering discharge is expected to be less than 50,000 L/d the water taking will not require water taking approval from the MECP. Also note that if permanent dewatering (ground water lowering) greater than 50,000 L/d is required, an EASR cannot be used and the water taking requires a PTTW.

6.3 Relevant Construction Activities

Topsoil and Organics Removal

A grading plan for the site was not available at the time of writing of this report. However, as noted in the geotechnical report, all surficial topsoil, organic deposits, and deleterious material should be stripped and removed and the subgrade approved. This may expose wet or saturated soils that may require minor dewatering using sump pumps.

Footings / Slab on Grade Building Construction

The proposed invert elevations of the underside of footings and/or basement slabs were not available at the time of the writing of this report but will be reviewed as part of detailed engineering design once draft plan of subdivision approval is issued. However, as recommended in the geotechnical report, the underside of footings, and the basement slab, should be at least 0.6 m and 1.0 m, respectively, above the seasonally high ground water level, which our findings indicate ranges from about 0.1 to 0.5 m below the existing surface grades. Fill placement may be required to satisfy these requirements during building construction. Satisfying these requirements precludes the need for significant ground water control, with the exception of minor near-surface dewatering to maintain a dry working surface and stable bottom.

Stormwater Management Feature

Design plans for the proposed stormwater management feature will be prepared and assessed as part of the overall detailed engineering design which will be completed once draft plan of subdivision is approved. At the proposed location, based on the findings at BH/MW 5, wet, sandy silt and sandy silt till can be expected below depths of about 0.15 m bgs, and near-surface ground water levels can be expected in the wet spring period.

Sewers

It is understood that municipal servicing will be located within the road right of ways, and the maximum invert depths are expected to be: watermain, 2.5 m bgs, sanitary sewer, 6.0 m bgs, and storm sewers, 3.5 m bgs. Since the excavations for these services will extend significantly beneath the ground water level, the construction dewatering discharge rates are estimated based on a geoscientific evaluation of the compiled data and a site conceptual model, below.

6.4 Hydrogeological Conceptual Site Models

The anticipated construction dewatering rates needed to achieve the required drawdown levels for maintaining dry working conditions and stable excavation bottom and slopes for the buried services depend on the proposed excavation depths, dimensions and the site and surrounding hydrogeological conditions such as existing ground water levels, the presence of ground water sources, and soil permeability. A simplified hydrogeological conceptual site model (HCSM) was developed based on the field and laboratory data compiled to date, and anticipated excavation depths and dimensions.

Since there is a relatively substantial fluctuation in ground water level over the year, it was assumed that excavation takes place during the drier summer and fall months, July through October. However, to be conservative, the model ground water level has been taken as 1.8 m bgs, an average of those recorded on July 15, 2019, which had the highest ground water levels from July through October.

It was assumed that excavation is to 6.0 m below existing surface grades, and the ground water level must be drawn down 0.5 m lower, to 6.5 m below existing grades. At the site, an excavation to this depth is likely to encounter the upper cohesionless layers and lower silt layer, thus a weighted hydraulic conductivity of 6×10^{-6} m/s (based on the slug test values and grain size distribution) was assumed for the assessment. The excavation footprint may include storm sewer, sanitary sewer and watermain. A trench with width of 3.0 m and length of 30 m long is assumed. To be conservative, no shoring is assumed. The wetland was considered as an additional ground water source, however it was found to have no significant effect during this time period.

The relevant assumptions for the HCSM are summarized in Table 3, attached. An assessment of the anticipated dewatering discharge rates and further recommendations are described in the following sections.

6.5 Construction Dewatering Discharge Rates

The construction dewatering discharge rates are estimated for the proposed installation of sewers based on the above-noted HCSMs and the anticipated construction activities. The approximate calculations for determining the construction dewatering discharge rates are summarized on Table 3.

Based on the above conditions, the seepage into the sewer trenches, and thus the estimated required dewatering rate if sump pumping is used, is about **48,000 L/d per 30 m length** after application of a factor of safety of 2.0. The “dewatering zone of influence” (or DZOI), the maximum radius of the cone-shaped profile of the temporary lowered ground water level if no barriers are used during construction dewatering, is estimated at about 32 m.

According to the regulations (see Section 6.2), since the construction dewatering discharge rates are expected to be close to 50,000 L/day, but less than 400,000 L/day, we recommend that the water taking be registered on the Environmental Activity and Sector Registry (EASR) prior to construction.

With regards to the above assessment, please note the following:

- The discharge rate and DZOI are conservatively estimated to minimize the risk of not being prepared for unanticipated soil or ground water conditions that may require higher pump rates or cause greater dewatering impacts.

- July was assumed for the assessment; higher pump rates can be expected during wetter periods (November through June) and lower pump rates can be expected during drier periods (July through October), based on the water level data collected.

- The model does not include surface water which is to be prevented from entering the excavation area.

- The discharge rates are estimated under steady state conditions. Pumping rates prior to steady state, controlled by the dewatering contractor, are often increased to achieve the desired drawdown in the shortest period of time but must remain below the 400,000 L/d limit for EASR applicability.

- Estimated rates are per 30 m length; the dewatering contractor may use larger or smaller dewatering zones, thus increasing or reducing the estimated dewatering discharge rates.

Based on the results, where it is expected that sump pumping and/or single stage wellpoints will be sufficient to control ground water flow.

6.6 Requirements of Registration of the Water Taking as an EASR

It should be noted that registering with the EASR entails:

- Meeting certain requirements as outlined in O. Reg. 63/16.

- Having a Water Taking Plan completed by a qualified person (see Appendix F). This must include the dewatering zone of influence, estimated settlement, assessment of potential impact on other water users, and a dewatering monitoring program, if needed.

- Having a Discharge Plan completed by a qualified person (see Appendix G). This must include the expected discharge rate, location(s) of discharge, method of conveyance, and erosion and settlement control measures.

- Notification of the municipality.

- Online registration and fee payment.

No dewatering more than 50,000 L/day at the subject property will commence prior to the permit being obtained.

7. CONSTRUCTION DEWATERING IMPACT ASSESSMENT AND MONITORING PLAN

Within the construction DZOI, impacts such as ground subsidence and reduction in ground water flow to ground water users and watercourses may potentially exist. The preliminary impact assessment and the associated monitoring plan are included in the Water Taking Plan in Appendix F, and preliminary Discharge Plan is included in Appendix G, as required for registration of the water taking as an EASR.

8. CONCLUDING REMARKS AND RECOMMENDATIONS

For the proposed development, the salient assessment findings are outlined as follows:

- The typical stratigraphy underlying the site consists of surficial topsoil underlain by various interspersed cohesionless soils which were generally sandy, underlain by a major silt till deposit which was generally gravelly to sandy.

- Eleven rounds of ground water level readings have been recorded from April 2019 to March 2020. The ground water levels in the part of the site being developed (BH/MW 1 through 5) were highest on the April 26, 2019 site visit, ranging from 0.08 to 0.49 m bgs. The seasonal fluctuation in ground water levels is relatively large at the site; the average difference between low (August through October) and high (December to April) ground water levels is about 2.5 m. The ground water levels and flow direction April 26, 2019 are depicted on the contour map in Drawing 2. The seasonal high ground water level can be taken as 0.3 m bgs.

- The hydraulic conductivities of the silt till encountered were estimated based on grain size analysis and in-situ permeability testing (slug tests). Geometric mean values of $4x10^{-6}$ and $5x10^{-6}$ cm/s were determined based on grain size and slug testing, respectively.

- Ground water flow velocities in the silt till were estimated at $2x10^{-8}$ to $1x10^{-7}$ cm/s based on the April 26, 2019 ground water levels and site-specific hydraulic conductivities.

- A water balance estimation for the site development indicated pre-development infiltration and runoff of about 13,163 m^3/year and 9,930 m^3/year, respectively, and, post-development without infiltration mitigation, about 6,159 m^3/year and 23,040 m^3/year, respectively, a deficit of about 7,004 m^3/year in infiltration. The infiltration deficit may be compensated by low impact development (LID) measures, however this may be made more difficult due to the high ground water levels at the site. The water balance will be reconfirmed as part of detailed engineering design once draft plan of subdivision approval has been issued.

- Excavations over the majority of the site are expected to encounter relatively high permeability gravels, sands, and silts to depths of about 1.5 to 2.0 m bgs underlain by lower permeability silt till, and average ground water levels ranging from near-surface (December to April) to depths averaging about 2.6 m bgs (August to September).

- As described in the attached Water Taking Plan, the impact of the construction dewatering (the drawdown of the local ground water table) is expected to be minimal and will be confirmed through detailed engineering design once draft plan of subdivision has been issued. No contaminant plumes are anticipated to migrate toward the site due to the dewatering, the wetland and creek are not expected to be intercepted by the DZOI, the creek is likely to receive the discharge, thus resulting in a zero net-effect, no private or public water wells will be impacted and negligible settlement is expected.

- The ground water samples complied with the criteria corresponding to discharge to a watercourse or storm sewer.

We recommend the following:

- Some features at the site which may require construction dewatering are too early in development to be assessed for dewatering requirements and should be assessed as part of detailed engineering design.

- The dewatering requirements for the installation of sewers at the site were estimated assuming construction in the summer to fall “dry period” and sanitary sewer depths as deep as 6 m. Based on the hydrogeological findings, and applying a factor of safety of 2.0, the estimated dewatering rate was 48,000 L/d per 30 m length, and zone of influence was 32 m. Since the construction dewatering rates are expected to be close to 50,000 L/d, but less than 400,000 L/d, we recommend that the water taking be registered as an EASR prior to construction.

- It is recommended that all steps be taken to minimize the dewatering and/or sump pump rates. For example, since the ground water levels may vary, it is best to schedule excavation for periods of low ground water level. Also, excavation footprints and depths should be no more than is needed, and surface water intrusion minimized.

- For any pumping method, it is imperative that the filter packs are sufficiently designed and installed and the discharge is monitored for fines content.

- The contractor’s dewatering plan to be implemented for this project should be reviewed by PML for proper implementation of the hydrogeological findings and recommendations presented in this report.

- The water balance presented herein is preliminary and should be re-assessed if post-development catchment areas are altered from that assumed herein. Low Impact Development (LID) measures are recommended to counteract the estimated post-development infiltration deficit.

- The report includes the necessary Water Taking Plan and Discharge Plan required for registering the water taking as an EASR; however, the plans should be reviewed and updated as part of detailed engineering design once draft plan of subdivision approval has been issued.

- In addition to water taking approval, approval from the local municipality and/or conservation authority may be required to permit discharge of dewatering and sump pump water to sewers, ditches, or water courses.

We trust you will find this report complete within our terms of reference. Should you have any questions, please do not hesitate to contact this office.

Sincerely

Peto MacCallum Ltd.

LICENSED PROFESSIONAL ENGINEER
A.J. COOKE
90442021
July 8, 2020
PROVINCE OF ONTARIO

PROFESSIONAL GEOSCIENTIST
S. A. Tarafder
SHAMSUL A. TARAFDER
PRACTISING MEMBER
2594
07/08/2020
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Andrew Cooke, PhD, P.Eng.
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Senior Geoscientist
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TABLE 1

GROUND WATER LEVEL READINGS IN MONITORING WELLS

MONITORING WELL (MW) No.[(1)]	GROUND SURFACE ELEVATION[(2)]	MID-SCREEN ELEVATION[(2)] (DEPH, m)	HYDROSTATIC GROUND WATER LEVEL ELEVATION (DEPTH, m) [(3)]										
			APR. 4 & 5, 2019[(4)]	APR. 26, 2019	MAY 27, 2018	JUN. 25, 2018	JUL. 15, 2019	AUG. 28, 2019	SEP. 28, 2019	OCT. 30, 2019	DEC. 27, 2019	FEB. 5, 2020	MAR. 27, 2020
BH/MW1	521.83	517.2 (4.6)	520.87 (0.96)	521.34 (0.49)	520.70 (1.13)	520.35 (1.48)	519.77 (2.06)	519.12 (2.71)	518.85 (2.98)	519.75 (2.08)	520.79 (1.04)	520.55 (1.28)	521.07 (0.76)
BH/MW2	521.70	517.1 (4.6)	515.91 (5.79)	521.39 (0.31)	520.68 (1.02)	520.13 (1.57)	519.68 (2.02)	519.08 (2.62)	518.53 (3.17)	518.35 (3.35)	521.16 (0.54)	520.74 (0.96)	521.18 (0.52)
BH/MW3	522.17	518.4 (3.8)	521.78 (0.39)	521.91 (0.26)	521.22 (0.95)	520.78 (1.39)	520.19 (1.98)	519.61 (2.56)	519.20 (2.97)	519.27 (2.90)	521.62 (0.55)	521.22 (0.95)	521.54 (0.63)
BH/MW4	520.15	515.6 (4.6)	519.97 (0.18)	520.07 (0.08)	519.92 (0.23)	519.71 (0.44)	518.69 (1.46)	518.05 (2.10)	519.12 (2.03)	519.77 (0.38)	519.93 (0.22)	519.85 (0.30)	520.00 (0.15)
BH/MW5	520.68	516.1 (4.6)	Dry	520.43 (0.25)	520.12 (0.56)	519.77 (0.91)	519.00 (1.68)	518.26 (2.42)	517.88 (2.80)	519.24 (1.44)	520.23 (0.45)	519.98 (0.70)	520.06 (0.62)
BH/MW6	519.45	515.7 (3.8)	518.79 (0.66)	519.41 (0.04)	519.31 (0.14)	519.28 (0.17)	518.92 (0.53)	518.67 (0.78)	518.30 (1.15)	518.78 (0.67)	519.35 (0.10)	Frozen	519.17 (0.28)

Notes:

(1) See Drawing 1 for approximate borehole locations and Log of Borehole sheets for details of monitoring well installation.
(2) Ground surface elevations at the monitoring well locations were surveyed by PML and are geodetic.
(3) Water levels measured using a Solinst flat tape water level reader.
(4) Ground water level on day of drilling.

TABLE 2

ESTIMATED HYDRAULIC CONDUCTIVITY (K) VALUES FROM SOIL SAMPLE GRAIN SIZE DISTRIBUTION AND BOREHOLE PERMEABILITY TEST RESULTS

BOREHOLE (BH) NO.	MONITORING WELL (MW) MID-SCREEN ELEVATION (DEPTH, m)	SOIL TYPE (1) (SAMPLE NO., DEPTH) AND / OR MONITORING WELL (MW) SCREEN SOIL TYPE	% CLAY (2)	ESTIMATED K-VALUES FROM GRAIN SIZE DISTRIBUTION TEST RESULTS (cm/sec) (3)	ESTIMATED K-VALUES FROM BOREHOLE PERMEABILITY TESTS (cm/sec) (4)
BH/MW1	517.2 (4.6)	Silt Till (SS5, 3.1 to 3.7 m)	9%	8×10^{-6} (V)	1×10^{-5}
BH/MW2	517.1 (4.6)	Silt Till (SS6, 4.6 to 5.2 m)	8%	9×10^{-6} (V)	2×10^{-6}
BH/MW3	518.4 (3.8)	Sandy Silt Till (SS5, 3.0 to 3.6 m)	9%	4×10^{-6} (V)	4×10^{-6}
BH/MW5	516.1 (4.6)	Silt Till (SS5, 2.3 to 2.9 m)	12%	3×10^{-6} (V)	8×10^{-6}
BH/MW6	515.6 (3.8)	Silt / Silt Till	-	-	2×10^{-6}

Notes:

(1) Log of Borehole Sheets for soil sample description.
(2) % Clay is percentage of the total soil sample finer than 0.002 mm by weight.
(3) K- value determination using grain size distribution method by Vukovic and Soro (1992) (V) or Puckett (1985) (P).
(4) K-Value estimated using Hvorslev’s Method;

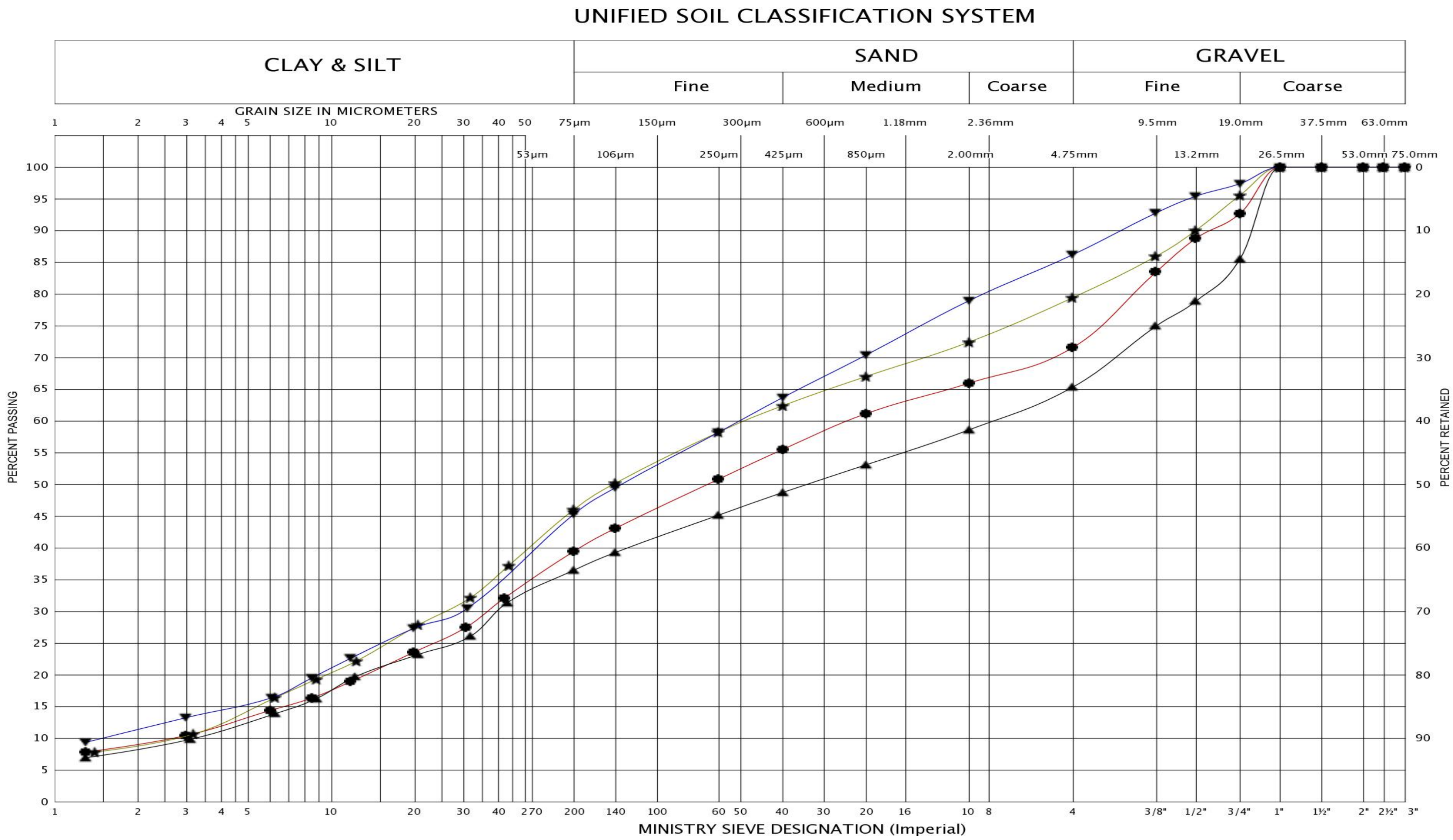
TABLE 3

SUMMARIZED CALCULATIONS OF ESTIMATED DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

ZONE NAME / FEATURE	LOWEST PROPOSED EXCAVATION DEPTH (m) (1)	CLOSEST MONITORING WELLS OR BOREHOLES (2)	GROUND WATER STRIKE DEPTH (m) (3)	HYDROSTATIC GROUND WATER LEVEL DEPTH (m) (4)	LOWERED GROUND WATER LEVEL DEPTH (m) (5)	AVERAGE DRAW-DOWN REQUIRED S_0 (m) (6)	SOIL TYPE (7)	ESTIMATED ZONE OF INFLUENCE R_0 (m) (8)	ESTIMATED DEWATERING DISCHARGE RATE (Q = KiA)[9]				
									LENGTH (m)	K (m/s)	I (%)	A (m^2)	Q (L/day/30 m)
Sewer Installation	6.0	BH/MW 1 through BH/MW 5	1.8	1.8	6.5	4.7	Sandy soils / Silt Till	32	30	5×10^{-6}	0.15	372	24,000 per 30 m * (no Factor of Safety) 48,000 per 30 m * (with Factor of Safety of 2.0)

Notes:

(1) Based on typical excavation for one basement level.
(2) See Drawing 1 for approximate borehole locations.
(3) Model value based on reported or interpreted depth to ground water strike.
(4) Model value based on the average measured hydrostatic ground water level for zone, in July 2019.
(5) Ground water level lowered during construction dewatering is assumed to be 0.5 m below the general excavation level.
(6) Difference between the hydrostatic ground water level measured in the monitoring wells and the lowered ground water level elevation.
(7) See Log of Borehole Sheets for soil description.
(8) $R_0 = 3000 S_o K^{1/2}$, R_o in m, S_o in m and K in m/s. Rounded to nearest 1 m.
(9) K is model K of soil. Q = KiA, where K=hydraulic conductivity, i=hydraulic gradient = S_o / R_o and A = seepage area in excavation floor and sides below the ground water strike level.
* Note that the estimates are dependent on the ground water levels, which varied considerably over the year. These estimates are based on July, 2019 ground water levels.



LEGEND	**BH**	1	2	3	5
	SAMPLE	5	6	5	4
	SYMBOL	●	▲	★	▼

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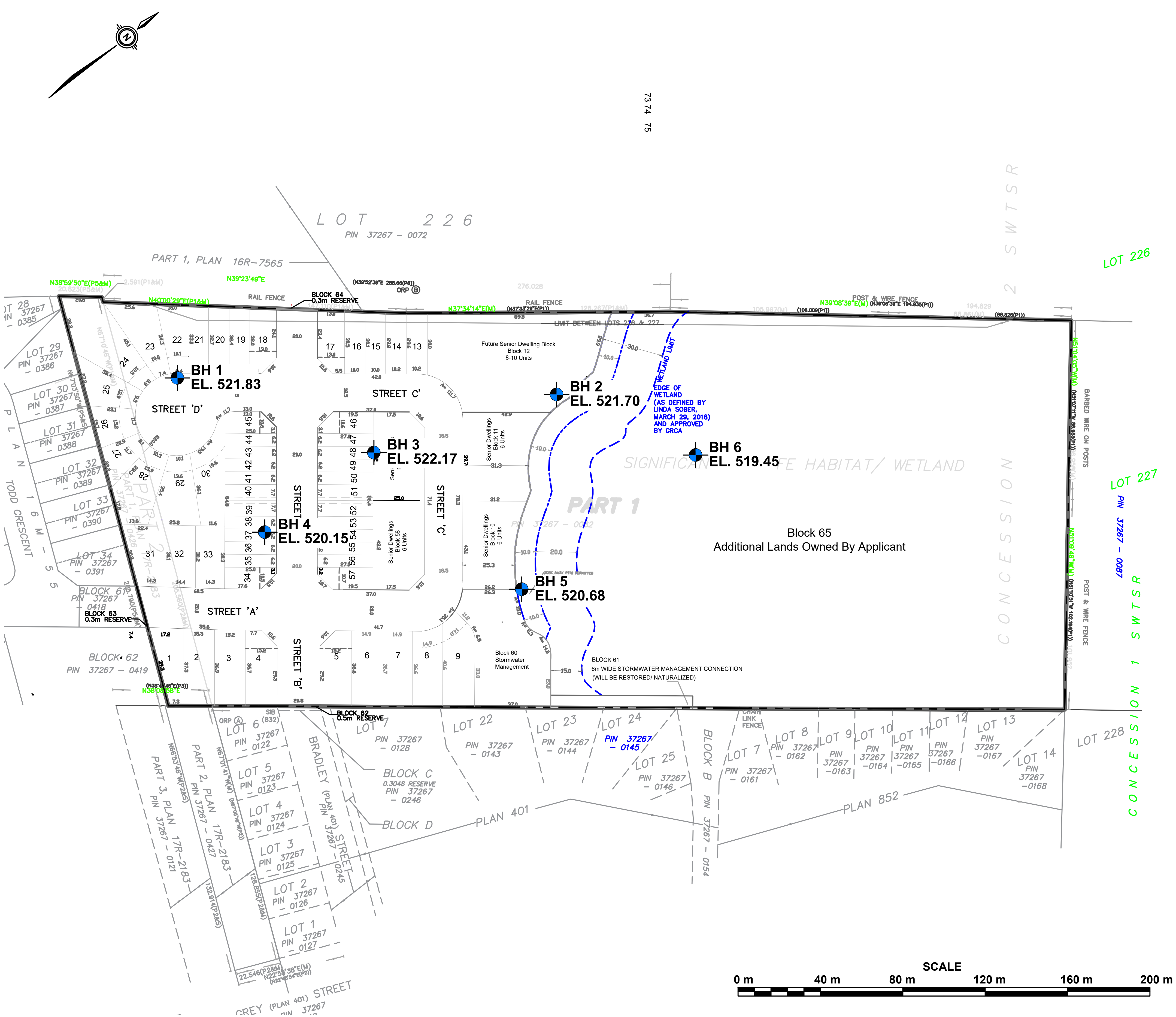
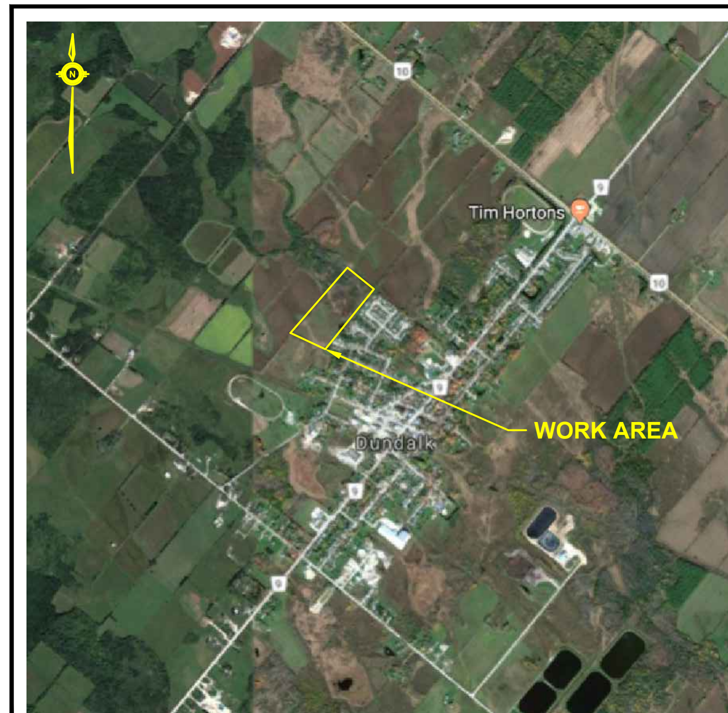
GRAIN SIZE DISTRIBUTION

FIG No.: 1

GWP





KEY PLAN

LEGEND:

BOREHOLE / MONITORING WELL LOCATION

REFERENCE:

BOREHOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTES:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

THE BOREHOLE LOCATIONS AND GEODETIC ELEVATIONS WERE SURVEYED WITH A SOKKIA GCX3 REAL TIME KINEMATIC RECEIVER CONNECTED TO THE GLOBAL NAVIGATION SATELLITE SYSTEM.

2570970 ONTARIO INC.

WHITE ROSE PARK RESIDENTIAL SUBDIVISION

DUNDALK, ONTARIO

BOREHOLE LOCATION PLAN

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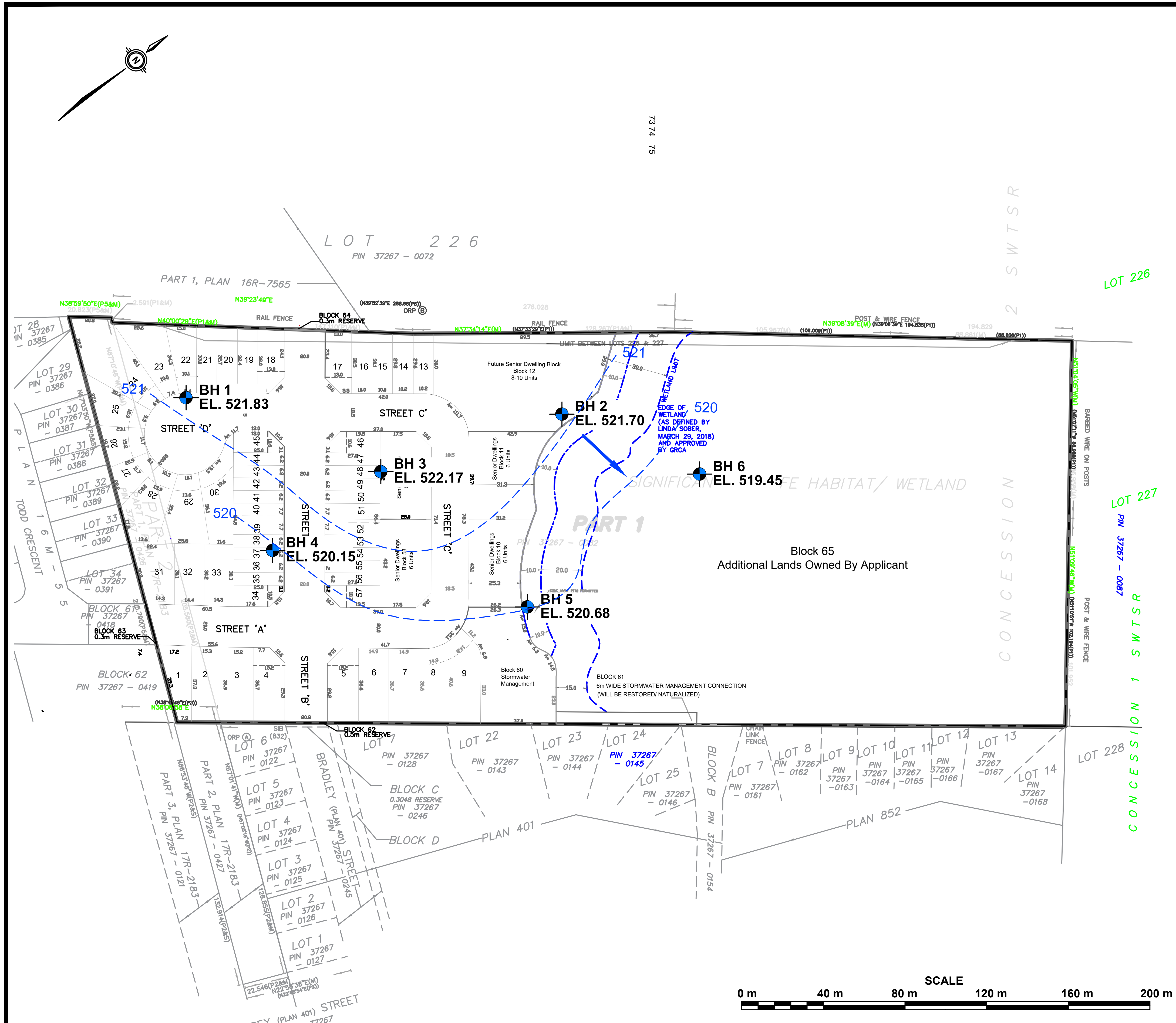
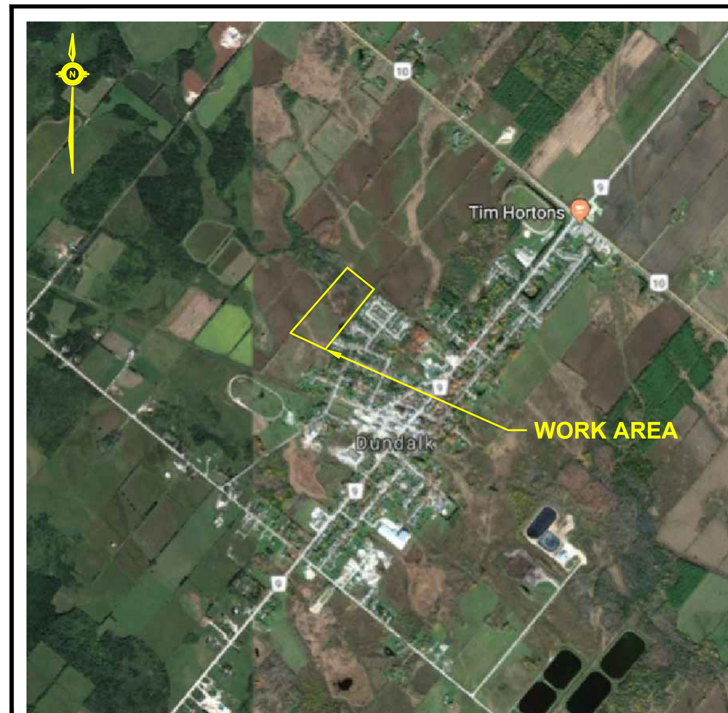
DRAWN	D. BRICE	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	K. HANES	JUNE 2020	AS SHOWN	19KF007	1 REVISED
APPROVED	A. COOKE				





KEY PLAN

LEGEND:

BOREHOLE / MONITORING WELL LOCATION

333 INTERPRETED HYDROSTATIC GROUND WATER LEVEL CONTOUR, APRIL 26 2019

INTERPRETED GROUND WATER FLOW DIRECTION

REFERENCE:

BOREHOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTES:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

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GROUND WATER CONTOUR MAP

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DRAWN	D. BRICE	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	K. HANES	JUNE 2020	AS SHOWN	19KF007	2 REVISED
APPROVED	A. COOKE				

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. - Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample	USS	Undisturbed Shear Strength
PH	Sample Advanced Hydraulically	RSS	Remoulded Shear Strength
PM	Sample Advanced Manually		

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE/MONITORING WELL NO. 1

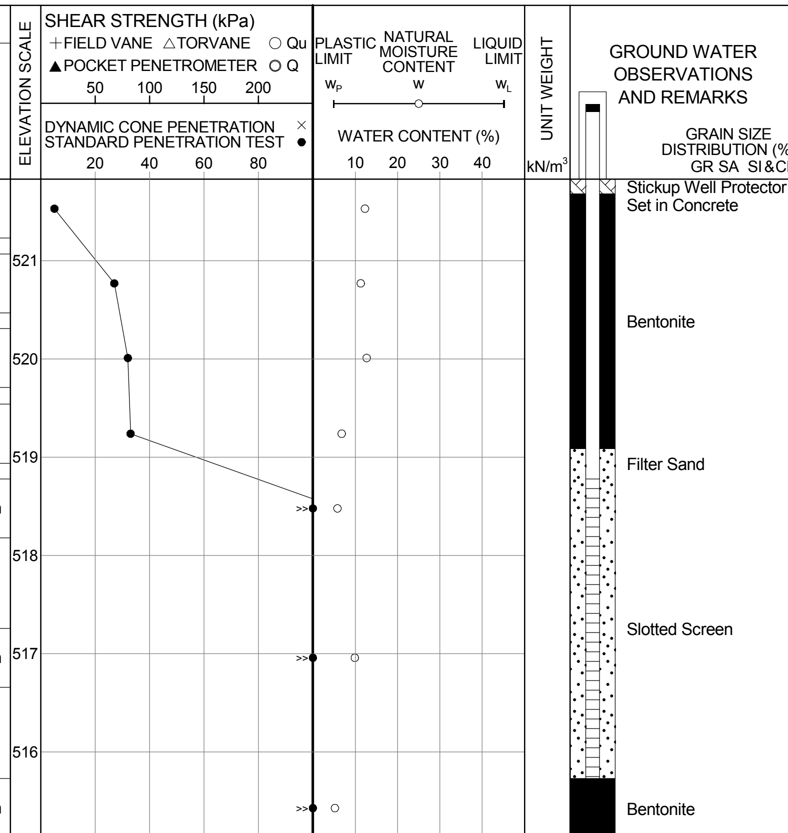
PROJECT White Rose Park Residential Subdivision | **PML REF.** 19KF007

LOCATION North of Bradley Street, Dundalk, Ontario | **BORING DATE** April 4, 2019 | **ENGINEER** K. Hanes

BORING METHOD Continuous Flight Hollow Stem Augers | **TECHNICIAN** D. Patterson

SURFACE ELEVATION 521.83

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.20 / 521.63	TOPSOIL: Dark brown silt, some sand, moist-wet	1	SS	5	Stickup Well Protector Set in Concrete
0.69 / 521.14	SANDY SILT: Loose brown sandy silt, moist				
	SANDY GRAVEL: Compact to dense brown sandy gravel, some silt, occasional cobbles and boulders, wet to saturated	2	SS	27	Bentonite
		3	SS	32	
2.2 / 519.6	SILT: Dense to very dense brown silt, some gravel, some sand, trace clay, occasional cobbles and boulders, moist	4	SS	33	Filter Sand
		5	SS	50/130mm	
4.1 / 517.7	becoming wet	6	SS	50/130mm	Slotted Screen
5.6 / 516.2	becoming moist	7	SS	50/100mm	Bentonite
6.7 / 515.1	BOREHOLE TERMINATE at 6.7 m				



Water Level Readings:

Date	Depth	Elev.
2019-04-04	1.0	520.8
2019-04-26	0.5	521.3
2019-05-27	1.1	520.7

NOTES

Peto MacCallum Ltd. CONSULTING ENGINEERS

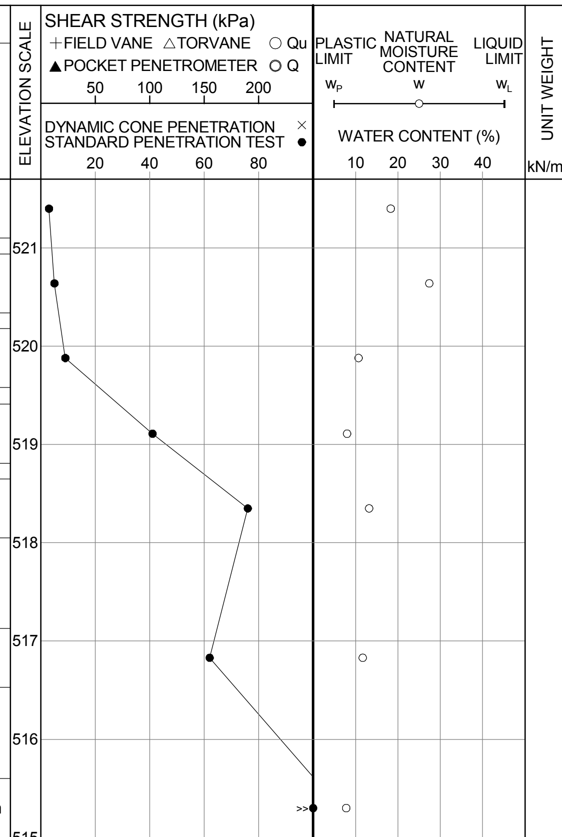
LOG OF BOREHOLE/MONITORING WELL NO. 2

PROJECT White Rose Park Residential Subdivision
PML REF. 19KF007
LOCATION North of Bradley Street, Dundalk, Ontario
BORING DATE April 5, 2019
ENGINEER K. Hanes
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Patterson

SURFACE ELEVATION 521.70

DEPTH (m)	ELEV (m)	DESCRIPTION
0.18	521.52	TOPSOIL: Dark brown silt, some sand, moist to wet
0.69	521.01	SILT: Very loose brown silt, some sand
		GRAVELLY SILT: Loose brown gravelly silt, some sand, occasional cobbles and boulders, moist
2.2	519.5	becoming dense
3.0	518.7	becoming wet, very dense
5.6	516.1	becoming moist
6.7	515.0	BOREHOLE TERMINATED AT 6.7 m

NUMBER	TYPE	"N" VALUES
1	SS	3
2	SS	5
3	SS	9
4	SS	41
5	SS	76
6	SS	62
7	SS	50/130mm



GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stickup Well Protector Set in Concrete
Bentonite
Filter Sand
Slotted Screen
Bentonite

Water Level Readings:

Date	Depth	Elev.
2019-04-05	5.8	515.9
2019-04-26	0.3	521.4
2019-05-27	1.0	520.7

NOTES

Peto MacCallum Ltd.
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LOG OF BOREHOLE/MONITORING WELL NO. 3

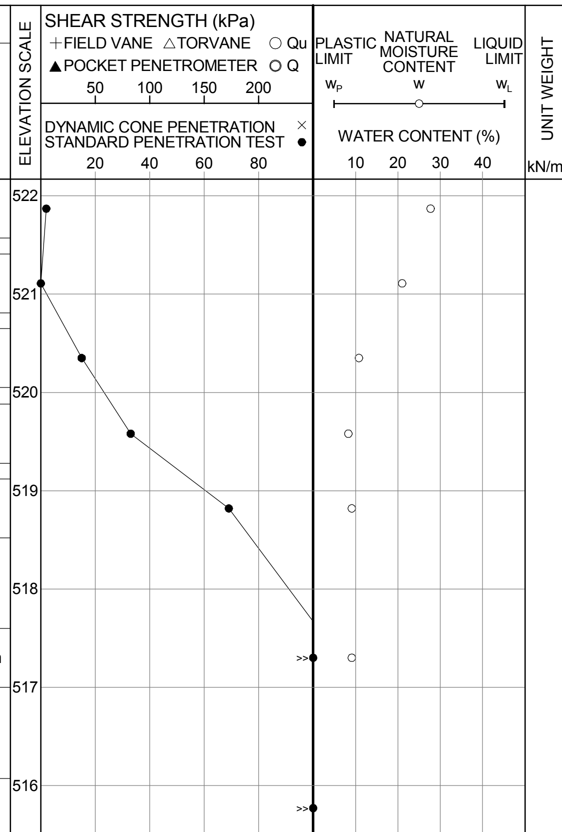
PROJECT White Rose Park Residential Subdivision
PML REF. 19KF007
LOCATION North of Bradley Street, Dundalk, Ontario
BORING DATE April 4, 2019
ENGINEER K. Hanes
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Patterson

SOIL PROFILE

DEPTH / ELEV (metres)	DESCRIPTION
	SURFACE ELEVATION 522.17
0.15 / 522.02	TOPSOIL: Dark brown silt, trace sand, wet
0.69 / 521.48	SILT: Very loose brown silt, trace sand, trace gravel, wet, occasional organics; some gravel
1.5 / 520.7	SANDY SILT TILL: Compact to very dense brown sandy silt, some gravel, trace clay, occasional cobbles and boulders, wet
4.1 / 518.1	becoming moist
6.7 / 515.5	BOREHOLE TERMINATED AT 6.7 m

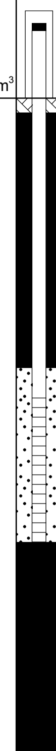
SAMPLES

NUMBER	TYPE	"N" VALUES
1	SS	2
2	SS	0
3	SS	15
4	SS	33
5	SS	69
6	SS	50/130mm
7	SS	50/30mm



GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL



Water Level Readings:

Date	Depth	Elev.
2019-04-04	0.4	521.8
2019-04-26	0.3	521.9
2019-05-27	1.0	521.2

NOTES

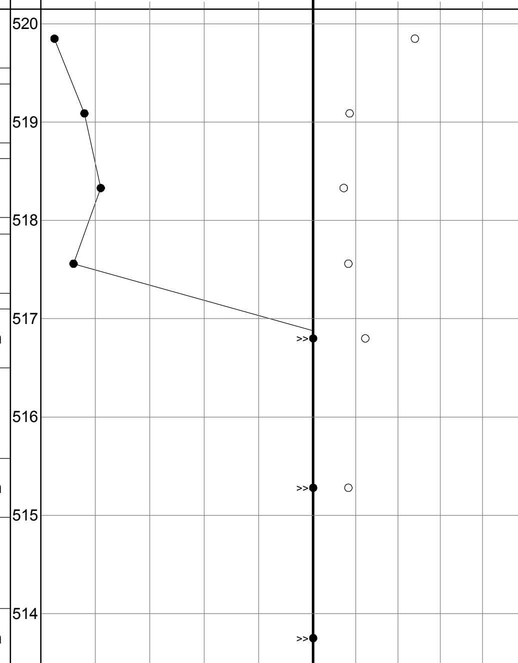
Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 4

PROJECT White Rose Park Residential Subdivision **PML REF.** 19KF007
LOCATION North of Bradley Street, Dundalk, Ontario **BORING DATE** April 4, 2019 **ENGINEER** K. Hanes
BORING METHOD Continuous Flight Hollow Stem Augers **TECHNICIAN** D. Patterson

SURFACE ELEVATION 520.15

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES
0.13 / 520.02	TOPSOIL: Dark brown silt, some sand, moist			
	SANDY SILT: Compact brown sandy silt, moist	1	SS	5
		2	SS	16
1.5 / 518.7	GRAVELLY SILT: Compact brown gravelly silt, some sand, trace clay, moist	3	SS	22
2.2 / 518.0	becoming wet	4	SS	12
3.0 / 517.2	SILT TILL: Very dense brown silt, some gravel, some sand, trace clay, occasional cobbles and boulders, wet	5	SS	74/250mm
		6	SS	50/130mm
5.6 / 514.6	becoming damp	7	SS	50/100mm
6.7 / 513.5	BOREHOLE TERMINATED AT 6.7 m			



UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS — GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

- Stickup Well Protector Set in Concrete
- Bentonite
- Filter Sand
- Slotted Screen
- Bentonite

Water Level Readings:

Date	Depth	Elev.
2019-04-04	0.2	520.0
2019-04-26	0.1	520.1
2019-05-27	0.2	520.0

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 5

PROJECT White Rose Park Residential Subdivision
PML REF. 19KF007
LOCATION North of Bradley Street, Dundalk, Ontario
BORING DATE April 4, 2019
ENGINEER K. Hanes
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN D. Patterson

SURFACE ELEVATION 520.68

DEPTH / ELEV (metres)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.15 / 520.53	TOPSOIL: Dark brown silt, some sand, wet to moist	1	SS	12	Stickup Well Protector Set in Concrete
	SILT: Loose brown silt, some sand, some gravel, wet	2	SS	8	Bentonite
1.5 / 519.2	SILT TILL: Compact to very dense silt, some sand, some gravel, trace clay, occasional cobbles and boulders, wet	3	SS	10	
		4	SS	85/280mm	Filter Sand
		5	SS	50/130mm	
		6	SS	90/130mm	Slotted Screen
		7	SS	50/100mm	Bentonite
6.7 / 514.0	BOREHOLE TERMINATED AT 6.7 m				

Water Level Readings:

Date	Depth	Elev.
2019-04-05	Dry	----
2019-04-26	0.3	520.4
2019-05-27	0.6	520.1

NOTES

PML - BH/TP LOG GEO/ENV WITH MWS 19KF007 BOREHOLE LOGS.GPJ ON_MOT.GDT 6/13/2019 10:22:48 AM

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 6

PROJECT White Rose Park Residential Subdivision — **PML REF.** 19KF007

LOCATION North of Bradley Street, Dundalk, Ontario — **BORING DATE** April 4, 2019 — **ENGINEER** K. Hanes

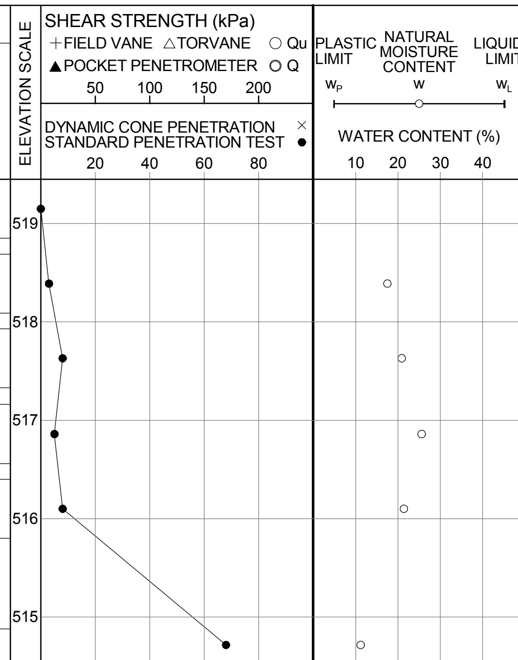
BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** D. Patterson

SURFACE ELEVATION 519.45

DEPTH / ELEV (metres)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	WATER CONTENT (%)	GROUND WATER OBSERVATIONS AND REMARKS
0.0 / 519.45	PEAT: Very loose dark brown fine fiberous peat, numerous organics, saturated	1	SS	0		Stickup Well Protector Set in Concrete
0.91 / 518.54	SILT: Very loose to loose dark grey silt, some sand, trace clay, saturated	2	SS	3	~18	Bentonite
		3	SS	8	~21	
		4	SS	5	~26	Filter Sand
		5	SS	8	~21	Slotted Screen
4.1 / 515.4	SILT TILL: Very dense grey silt, some gravel, some sand, trace clay, occasional cobbles and boulders, saturated	6	SS	68	~11	Bentonite
4.9 / 514.6	BOREHOLE TERMINATED AT 4.9 m DUE TO AUGER REFUSAL ON PROBABLE BOULDER					

Water Level Readings:

Date	Depth	Elev.
2019-04-04	0.7	518.8
2019-04-26	0.1	519.4
2019-05-27	0.1	519.4



NOTES

APPENDIX A

Ministry of Natural Resources and Forestry
and Grand River Conservation Authority (GRCA) Maps

Ontario

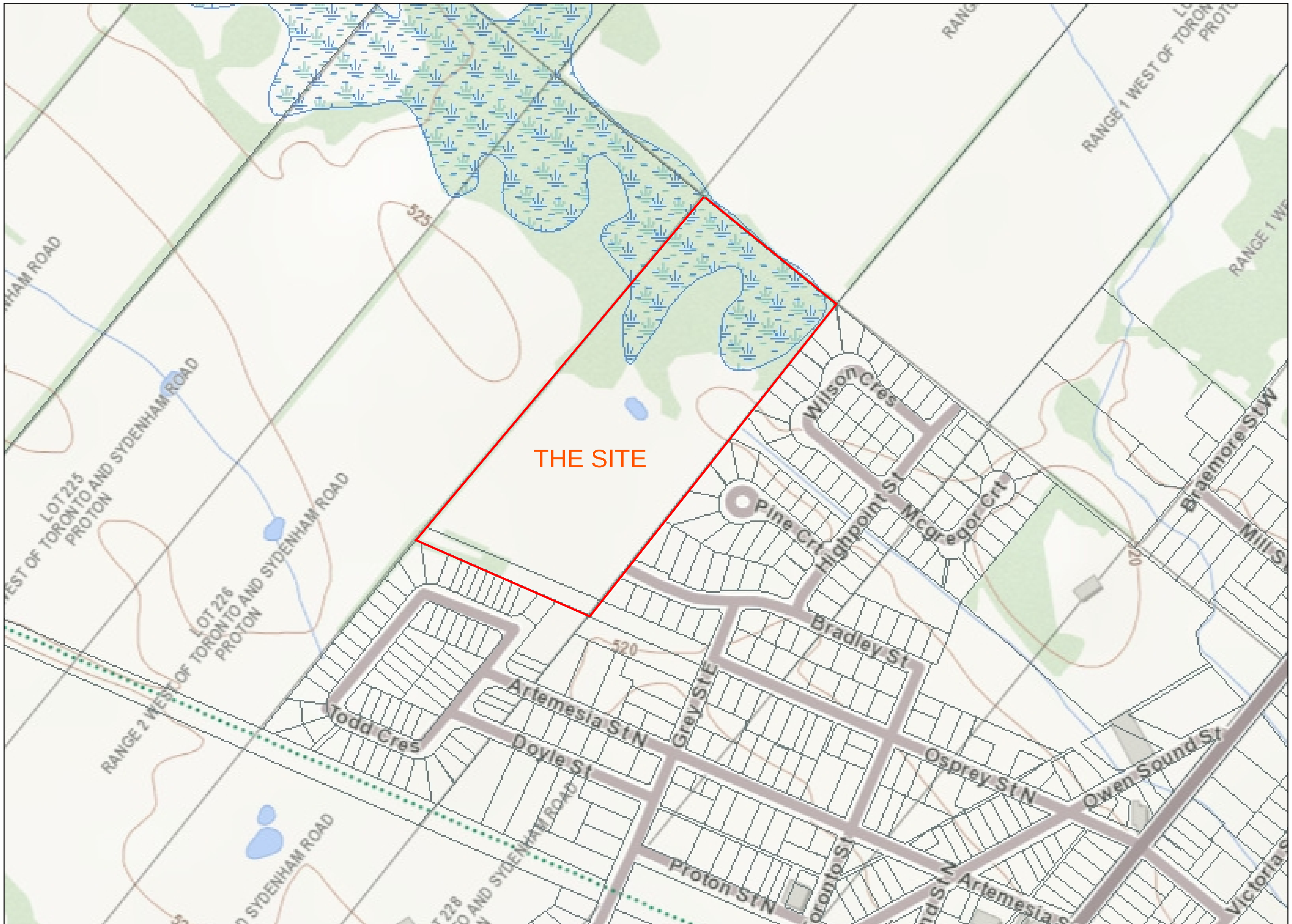
Ministry of Natural Resources and Forestry

Make-a-Map: Natural Heritage Areas

White Rose Park

Notes:

Figure 1(A)



Legend

- Assessment Parcel
- Woodland
- Conservation Reserve
- Provincial Park
- Natural Heritage System
- Ecoregion

Wetland

- Provincially Significant Wetland Evaluated
- Non - Provincially Significant Wetland Evaluated
- Unevaluated Wetland

Area of Natural Heritage & Scientific Interest (ANSI)

- Provincially Significant Life Science ANSI
- Provincially Significant Earth Science ANSI

Greenbelt Plan

- Boundary
- River Valley Connections

Land Use Designations

- Protected Countryside
- Towns and Villages
- Hamlets
- Urban River Valley
- Specialty Crop Area

Niagara Escarpment Plan (NEP)

- Boundary
- Parks and Open Space System

Land Use Designations

- Escarpment Natural Area
- Escarpment Protection Area
- Escarpment Rural Area
- Mineral Resource Extraction Area
- Escarpment Recreation Area
- Urban Area
- Minor Urban Centre

Oak Ridges Moraine Conservation Plan (ORM)

- Boundary

Land Use Designations

- Natural Core Area
- Natural Linkage Area
- Countryside Area
- Rural Settlement
- Palgrave Estates Residential Community
- Settlement Area

0.3 0 0.16 0.3 Kilometers

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

Map Centre (UTM NAD83 z17): 548,215.52 4,891,398.10

This map is not to be used for navigation | 2015 Ortho (ON)

Grand River Conservation Authority

Date: Oct 15, 2019

White Rose Park Subdivision

FIGURE 2A

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

0 15 30 60 90 Metres

NAD 1983 UTM Zone 17N

Scale: 3,249

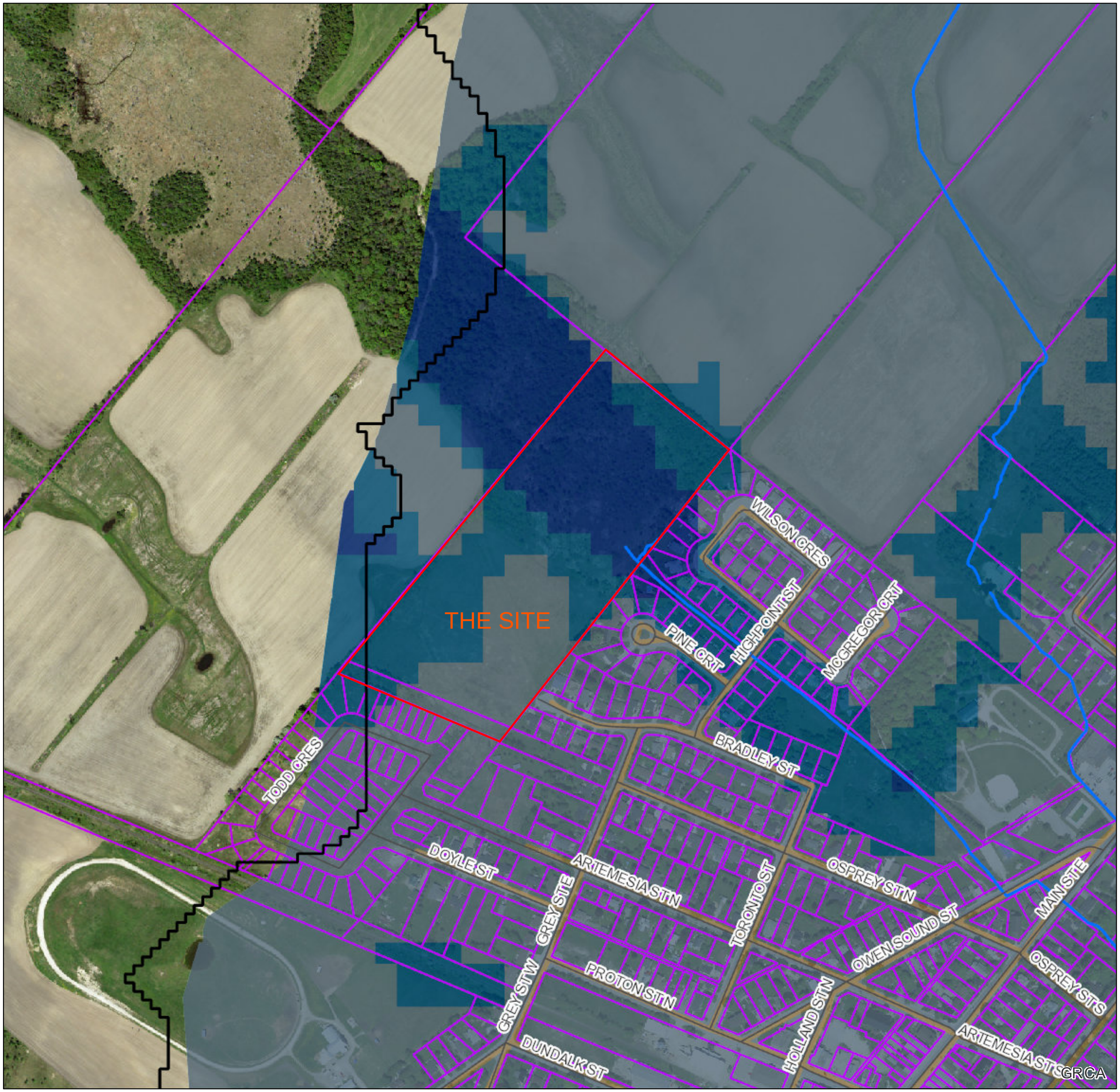
N

Grand River
Conservation Authority
Date: Oct 15, 2019

White Rose Park Subdivision

Average Annual Recharge

FIGURE 3A



Map Centre (UTM NAD83 z17): 548,164.87 4,891,417.45

This map is not to be used for navigation | 2015 Ortho (ON)

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

Legend

- less than 50 mm/yr
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400

0 37.5 75 150 225 Metres

NAD 1983 UTM Zone 17N

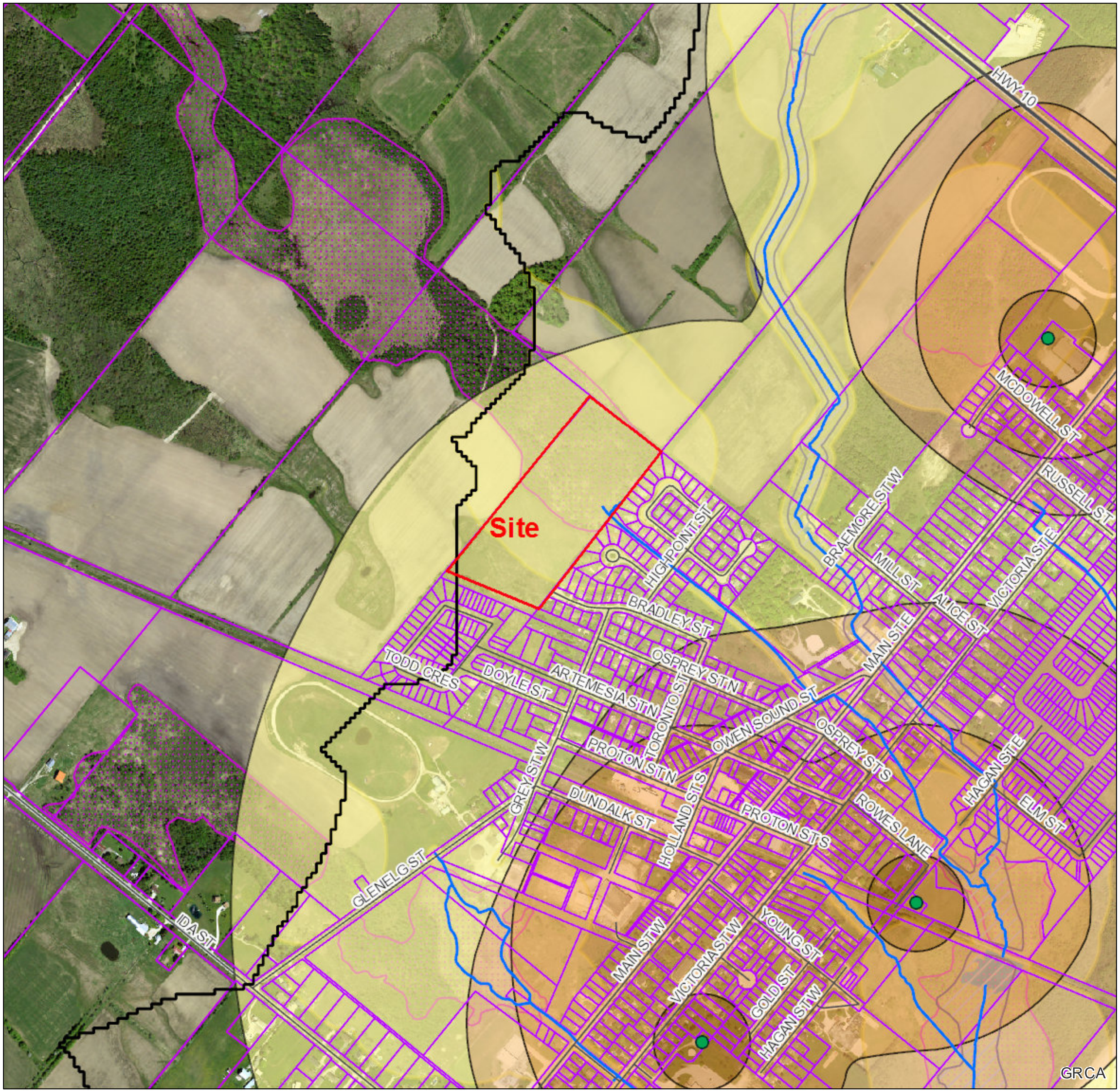
Scale: 6,498

N

Grand River Conservation Authority
Date: Jan 22, 2020

White Rose Park Subdivision

FIGURE 4A



Map Centre (UTM NAD83 z17): 548,153.07 4,891,335.26

This map is not to be used for navigation | 2015 Ortho (ON)

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

0 70 140 280 420 Metres

N

NAD 1983 UTM Zone 17N

Scale: 11,555

APPENDIX B

Ministry of the Environment, Conservation and Parks (MECP)
Water Well Record Summary and Map

Note:
- This figure was reproduced from the MECP Water Well Mapping website.
- Numbers correspond to well record summary entries in list, attached.

2570970 ONTARIO INC.

HYDROGEOLOGICAL SITE ASSESSMENT FOR PROPOSED WHITE ROSE RESIDENTIAL SUBDIVISION, DUNDALK, ONTARIO

MECP RECORDED WATER WELL LOCATION MAP

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN: A.C.	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED: A.C.	JAN. 2020	AS SHOWN	19KF007	1(B)
APPROVED: S.T.				

MECP WELL RECORD SUMMARY

Proposed White Rose Residential Subdivision

Summarized well records of wells within UTM Easting +/- 500 m and UTM Northing +/- 500 m of property limits

PML Number	UTM ZONE	UTM EASTING	UTM NORTHING	LOT	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL ID	FORMATION
	17	548325	4890729	W	2016/10 7282						7279968 (C36108) P	
1	17	547975	4891096	W	2014/12 7190	2	FR 0005		MO	0010 10	7237016 (Z186058) A166231	BRWN SAND GRVL CLAY 0020
	17	548320	4890750	W	2012/06 7241						7188757 (C15552) A116585 P	
5	17	548174	4890936	W	2011/06 7215	2			TH	0015 5	7166939 (Z133646) A117947	BRWN FILL SNDY 0008 BRWN TILL DRY 0015
7	17	548256	4890914	W	2010/09 6032						7155347 (Z121173) A	
6	17	548215	4890919	W	2010/09 6032						7155361 (Z108898) A	
	17	548676	4890734	W	2010/02 4011			7///:	OT		7140447 (Z103958) A	
	17	548409	4890775	W	2009/11 4011	66.9	UK	21///:	OT		7141631 (Z117406) A	
6	17	548200	4890909	W	2008/11 7147	1.97	FR 0004			0003 17	7116620 (Z85200) A	
7	17	548236	4890905	W	2007/04 6988	2				0004 10	7049155 (Z53653) A047429	BRWN SILT SAND 0004 BRWN SILT SAND GRVL 0015
7	17	548228	4890907	W	2006/11 6032	0.2			NU	0005 10	7041281 (Z46561) A005365	BLCK LOAM SAND 0001 BRWN SILT SAND 0015
	17	548784	4890808	W	2005/10 6634						2516756 (Z39517) A030201 A	
4	17	548212	4890953	W	2005/06 6607	1.97	5		NU	0004 16	2516415 (Z28263) A027686	GREY GRVL 0000 BRWN SAND GRVL 0003 BRWN SAND SILT 0007 BRWN SILT SAND 0020
	17	548453	4890875	W	2005/04 7154						2516363 (Z20344) A	
	17	548394	4890751	W	2004/11 7190	1.97				0005 10	2516288 (Z14241) A014181	BRWN FILL 0003 BRWN SILT SAND TILL 0015
2	17	547848	4891041	L	2003/06 7015	6 6	FR 0121 UK 0133	27/31/12/2:0	DO		2515624 (262208)	LOAM 0001 BRWN CLAY HPAN STNS 0116 LMSN 0142
	17	548664	4891348	W	1987/09 3813	6	FR 0183	54/128/6/:	DO		2509109 (14815)	LOAM 0001 CLAY STNS GRVL 0053 HPAN STNS 0106 LMSN 0183
	17	548814	4890923	W	1982/12 3813	5	FR 0105	39/48/12/15:0	DO		2507815 ()	LOAM 0001 CLAY STNS 0028 HPAN STNS 0096 LMSN 0105
	17	548714	4891373	W	1977/04 4856	4 4	FR 0107	38/60/18/1:30	DO		2506029 ()	BLCK LOAM 0001 BRWN CLAY GRVL SNDY 0027 BRWN HPAN GRVL BLDR 0100 GREY LMSN SHLE 0109
	17	548814	4891583	W	1976/08 4856	4 4	FR 0128	60/90/8/1:45	DO		2505795 ()	BLCK LOAM 0001 BRWN HPAN BLDR SAND 0067 GREY HPAN 0074 BRWN HPAN BLDR 0104 GREY LMSN 0112 BLUE LMSN 0119 GREY LMSN SHLE HARD 0132
1	17	548014	4891073	W	1969/03 1804	4 4	FR 0135	35/60/15/2:0	ST DO		2502801 ()	LOAM 0003 CLAY MSND 0020 GRVL BLDR 0030 CLAY GRVL 0040 GRVL BLDR 0050 CLAY GRVL 0127 ROCK 0144
1	17	547989	4891073	W	1965/06 1804	4	FR 0115	40/50/5/5:0	DO		2500900 ()	HPAN BLDR 0014 GRVL 0117
5	17	548154	4890923	W	1960/05 1705	10 10	FR 0104 FR 0195 FR 0228 FR 0248	23/153/45/20:0	MN		2500897 ()	FILL 0002 MSND GRVL 0012 HPAN STNS 0054 MSND CLAY 0062 MSND GRVL 0098 BRWN LMSN 0102 LMSN 0152 BRWN LMSN 0195 WHIT LMSN 0208 BRWN LMSN 0218 LMSN 0228 BRWN LMSN 0273
	17	548454	4890873	W	1960/04 1705	10 10	FR 0126 FR 0168 FR 0200	21/95/118/18:30	PS		2500898 ()	MSND 0008 GRVL HPAN 0014 HPAN 0066 GRVL MSND 0103 GREY LMSN 0142 BRWN LMSN 0201
	17	548614	4890883	W	1957/08 1723	4 4	FR 0159	30/37/10/:	DO		2500895 ()	CLAY STNS GRVL 0108 GREY ROCK 0159
	17	548454	4890923	W	1957/01 1317	4 4	FR 0158	13/13/15/:	DO		2500892 ()	CLAY BLDR 0108 LMSN 0158
	17	548464	4890853	W	1956/07 1317	4 4	FR 0140	20/20/15/:	DO		2500889 ()	CLAY STNS 0114 LMSN 0140
	17	548004	4890748	W	1956/05 1317	4 4	FR 0150	13/13/15/:	DO		2500888 ()	CLAY BLDR 0102 LMSN 0158
	17	548674	4890823	W	1955/12 1317	4 4	FR 0157	20/20/8/1:0	DO		2500886 ()	CLAY STNS 0102 LMSN 0157
	17	548859	4891048	W	1955/02 1317	4 4	FR 0159	19/19/8/2:0	DO		2500884 ()	PRDG 0020 CLAY STNS 0101 GREY LMSN 0159
	17	548649	4890823	W	1954/12 1317	6 6	FR 0145	20/20/5/3:0	PS		2500883 ()	CLAY STNS 0101 LMSN 0145
3	17	548239	4891003	W	1954/10 1317	4 4	FR 0150	25/25/4/1:0	DO		2500882 ()	CLAY STNS 0100 LMSN 0150
	17	548514	4890833	W	1954/01 1317	4 4	FR 0165	27/35/5/1:0	IN		2500879 ()	CLAY STNS 0110 WHIT LMSN 0165
	17	548139	4890873	W	1953/06 1317	4 4	FR	20/20/10/1:0	DO		2500876 ()	CLAY BLDR 0119 ROCK 0141

MECP WELL RECORD TABLE ABBREVIATIONS AND DESCRIPTIONS

Header Descriptions

ABBREVIATION	DESCRIPTION
UTM	UTM in Zone, Easting, Northing and Datum is NAD83
LOT	UTM estimated from Centroid of Lot
W	UTM not from Lot Centroid
DATE CNTR	Date Work Completed and Well Contractor Licence Number
CASING DIA	Casing diameter in inches
WATER	Unit of Depth in Feet. See below for Meaning of Code
PUMP TEST	Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour:Minutes
WELL USE	See below for Meaning of Code
SCREEN	Screen Depth and Length in feet
WELL	Well ID, AUDIT #, Well Tag, A for abandonment; P for Partial Data Entry Only
FORMATION	See below for Meaning of Code

Meaning of Core Material and Descriptive Terms

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

Core Color

ABBV	DESCRIPTION
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLC K	BLACK
BLGY	BLUE-GREY

Well Use

ABBV	DESCRIPTION
DO	Domestic
ST	Livestock
IR	Irrigation
IN	Industrial
CO	Commercial
MN	Municipal
PS	Public
AC	Cooling And AC
NU	Not Used
OT	Other
TH	Test Hole
DE	Dewatering
MO	Monitoring
MT	Monitoring and Test Hole

Water Kind

ABBV	DESCRIPTION
FR	Fresh
SA	Salty
SU	Sulphur
MN	Minerial
UK	Not Stated
GS	Gas
IR	Iron
UT	Untested
OT	Other

APPENDIX C

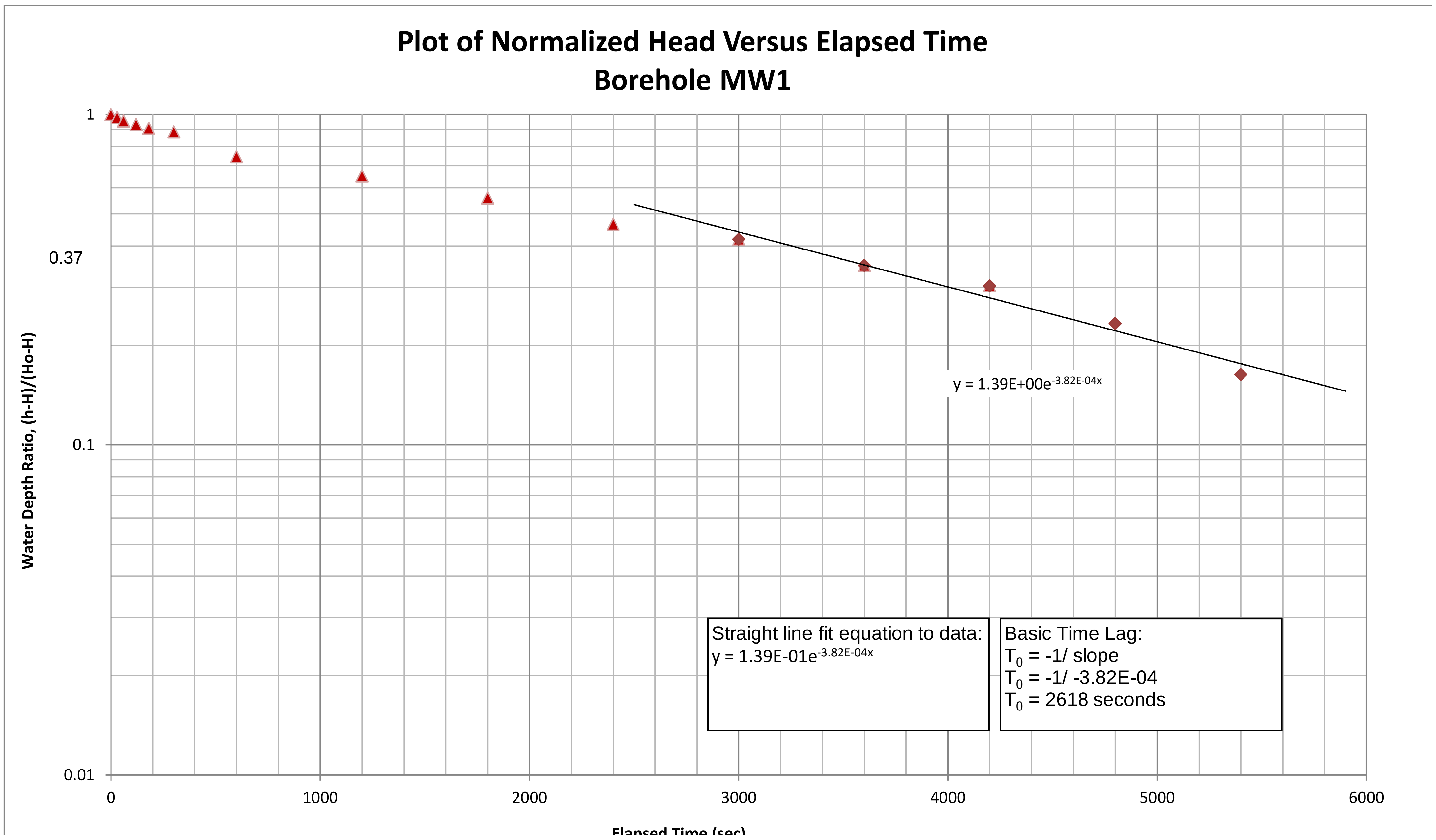
Borehole Permeability Testing Plots

Estimation of K by Slug Test, based on Hvorslev equation

Date:	June 25, 2019		Static water depth, H:	1.48	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.91	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW1		Basic time lag, To:	2,618	sec
Well Screen Bottom:	5.5	mbgs	Length of well screen, L:	300	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:	521.83	masl			
Static Water Level:	1.48	mbgs			
Ground Elevation:	306.48	masl	$K = r^2 \ln(L/R)/(2LTo) =$	**1.4E-05**	cm/s
WATER LEVEL BEFORE TEST = H =	1.48	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.910	304.57
30.0	1.900	304.58
60.0	1.890	304.59
120.0	1.880	304.60
180.0	1.870	304.61
300.0	1.860	304.62
600.0	1.800	304.68
1200.0	1.760	304.72
1800.0	1.720	304.76
2400.0	1.680	304.80
3000.0	1.660	304.82
3600.0	1.630	304.85
4200.0	1.610	304.87
4800.0	1.580	304.90
5400.0	1.550	304.93

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.430	0.430	1.000
30	0.420	0.430	0.977
60	0.410	0.430	0.953
120	0.400	0.430	0.930
180	0.390	0.430	0.907
300	0.380	0.430	0.884
600	0.320	0.430	0.744
1200	0.280	0.430	0.651
1800	0.240	0.430	0.558
2400	0.200	0.430	0.465
3000	0.180	0.430	0.419
3600	0.150	0.430	0.349
4200	0.130	0.430	0.302
4800	0.100	0.430	0.233
5400	0.070	0.430	0.163



Plot of Normalized Head Versus Elapsed Time
Borehole MW1
Water Depth Ratio, (h-H)/(Ho-H)
1
0.37
0.1
0.01
0
1000
2000
3000
4000
5000
6000
Elapsed Time (sec)
y = 1.39E+00e^-3.82E-04x
Straight line fit equation to data:
y = 1.39E-01e^-3.82E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -3.82E-04
T0 = 2618 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	June 25, 2019		Static water depth, H:	1.57	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.96	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW2		Basic time lag, To:	15,898	sec
Well Screen Bottom:		mbgs	Length of well screen, L:	300	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:		masl			
Static Water Level:	1.03	mbgs			
Ground Elevation:	521.7	masl	$K = r^2 \ln(L/R)/(2LTo)$ =	**2.3E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.57	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.958	519.74
1.0	1.956	519.74
2.0	1.955	519.74
3.0	1.953	519.75
4.0	1.953	519.75
5.0	1.950	519.75
6.0	1.951	519.75
7.0	1.950	519.75
8.0	1.950	519.75
9.0	1.949	519.75
10.0	1.948	519.75
11.0	1.947	519.75
12.0	1.947	519.75
13.0	1.945	519.75
14.0	1.946	519.75
15.0	1.946	519.75
16.0	1.945	519.76
17.0	1.945	519.76
18.0	1.944	519.76
19.0	1.943	519.76
20.0	1.942	519.76
21.0	1.942	519.76
22.0	1.942	519.76
23.0	1.942	519.76
24.0	1.941	519.76
25.0	1.939	519.76
26.0	1.940	519.76
27.0	1.941	519.76
28.0	1.941	519.76
29.0	1.941	519.76
30.0	1.940	519.76
31.0	1.940	519.76
32.0	1.940	519.76
33.0	1.940	519.76
34.0	1.941	519.76
35.0	1.941	519.76
36.0	1.940	519.76
37.0	1.942	519.76
38.0	1.941	519.76
39.0	1.941	519.76

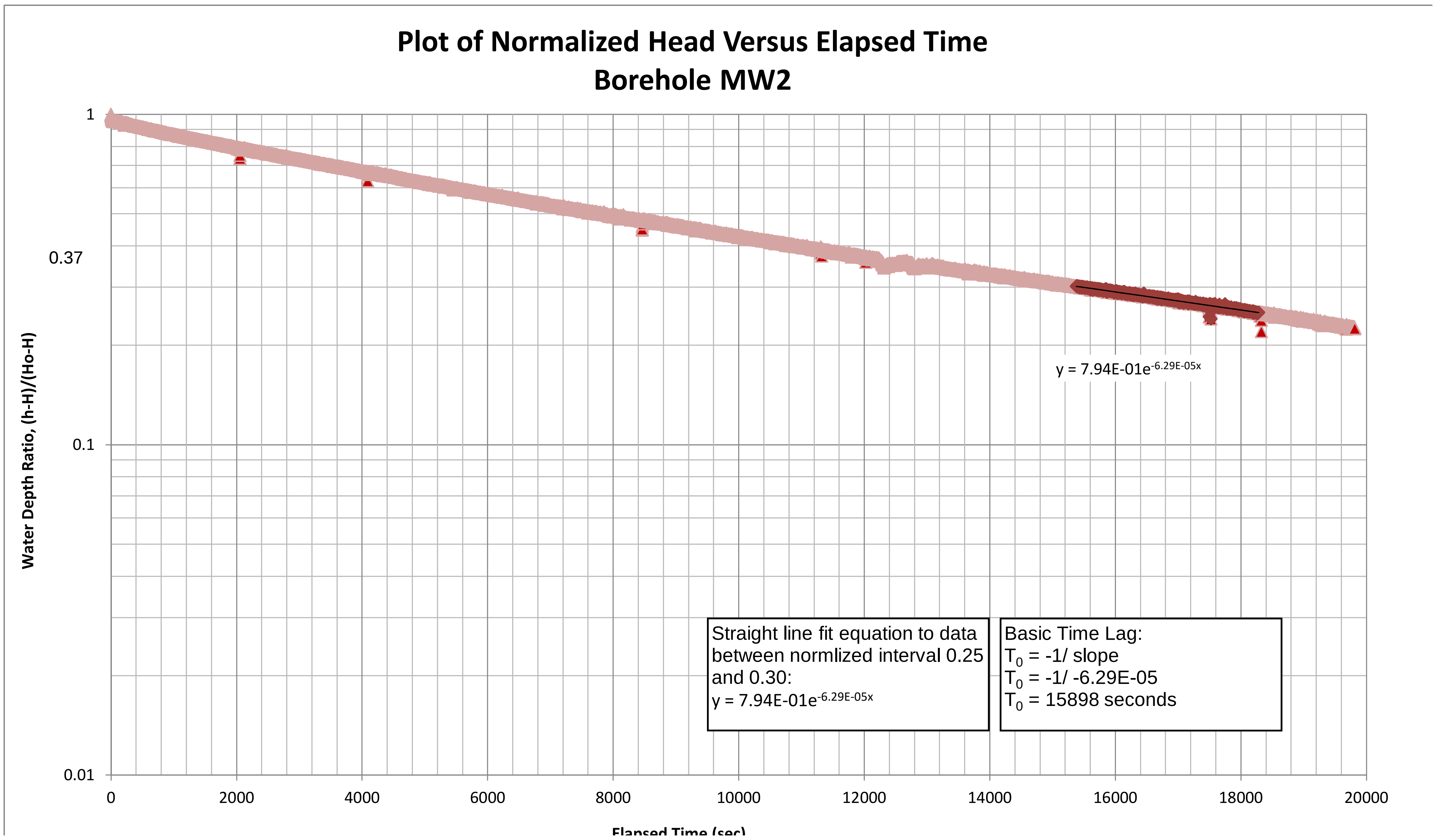
Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.388	0.388	1.000
1	0.386	0.388	0.995
2	0.385	0.388	0.991
3	0.383	0.388	0.987
4	0.383	0.388	0.986
5	0.380	0.388	0.979
6	0.381	0.388	0.981
7	0.380	0.388	0.979
8	0.380	0.388	0.977
9	0.379	0.388	0.976
10	0.378	0.388	0.974
11	0.377	0.388	0.970
12	0.377	0.388	0.970
13	0.375	0.388	0.966
14	0.376	0.388	0.967
15	0.376	0.388	0.968
16	0.375	0.388	0.965
17	0.375	0.388	0.965
18	0.374	0.388	0.963
19	0.373	0.388	0.960
20	0.372	0.388	0.959
21	0.372	0.388	0.958
22	0.372	0.388	0.958
23	0.372	0.388	0.957
24	0.371	0.388	0.955
25	0.369	0.388	0.951
26	0.370	0.388	0.952
27	0.371	0.388	0.954
28	0.371	0.388	0.955
29	0.371	0.388	0.954
30	0.370	0.388	0.953
31	0.370	0.388	0.953
32	0.370	0.388	0.953
33	0.370	0.388	0.952
34	0.371	0.388	0.955
35	0.371	0.388	0.955
36	0.370	0.388	0.953
37	0.372	0.388	0.956
38	0.371	0.388	0.956
39	0.371	0.388	0.955

40.0	1.940	519.76
41.0	1.940	519.76
42.0	1.940	519.76
43.0	1.939	519.76
44.0	1.940	519.76
45.0	1.940	519.76
46.0	1.940	519.76
47.0	1.941	519.76
48.0	1.940	519.76
49.0	1.940	519.76
50.0	1.940	519.76
51.0	1.940	519.76
52.0	1.940	519.76
53.0	1.939	519.76
54.0	1.939	519.76
55.0	1.939	519.76
56.0	1.939	519.76
57.0	1.939	519.76
58.0	1.940	519.76
59.0	1.939	519.76
60.0	1.940	519.76
61.0	1.940	519.76
62.0	1.941	519.76
63.0	1.941	519.76
64.0	1.941	519.76
65.0	1.940	519.76
66.0	1.940	519.76
67.0	1.941	519.76
68.0	1.940	519.76
69.0	1.940	519.76
70.0	1.940	519.76
71.0	1.940	519.76
72.0	1.941	519.76
73.0	1.941	519.76
74.0	1.940	519.76
75.0	1.940	519.76
76.0	1.940	519.76
77.0	1.940	519.76
78.0	1.941	519.76
79.0	1.941	519.76
80.0	1.940	519.76
81.0	1.940	519.76
82.0	1.939	519.76
83.0	1.940	519.76
84.0	1.940	519.76
85.0	1.940	519.76
86.0	1.940	519.76
87.0	1.940	519.76
88.0	1.939	519.76
89.0	1.940	519.76
90.0	1.940	519.76
91.0	1.940	519.76
92.0	1.940	519.76
93.0	1.940	519.76
94.0	1.940	519.76
95.0	1.940	519.76
96.0	1.940	519.76
97.0	1.939	519.76
98.0	1.939	519.76

40	0.370	0.388	0.953
41	0.370	0.388	0.953
42	0.370	0.388	0.953
43	0.369	0.388	0.951
44	0.370	0.388	0.952
45	0.370	0.388	0.953
46	0.370	0.388	0.952
47	0.371	0.388	0.955
48	0.370	0.388	0.952
49	0.370	0.388	0.952
50	0.370	0.388	0.953
51	0.370	0.388	0.951
52	0.370	0.388	0.952
53	0.369	0.388	0.951
54	0.369	0.388	0.950
55	0.369	0.388	0.951
56	0.369	0.388	0.951
57	0.369	0.388	0.951
58	0.370	0.388	0.952
59	0.369	0.388	0.951
60	0.370	0.388	0.952
61	0.370	0.388	0.952
62	0.371	0.388	0.954
63	0.371	0.388	0.954
64	0.371	0.388	0.954
65	0.370	0.388	0.953
66	0.370	0.388	0.952
67	0.371	0.388	0.954
68	0.370	0.388	0.953
69	0.370	0.388	0.954
70	0.370	0.388	0.952
71	0.370	0.388	0.952
72	0.371	0.388	0.954
73	0.371	0.388	0.955
74	0.370	0.388	0.952
75	0.370	0.388	0.952
76	0.370	0.388	0.952
77	0.370	0.388	0.951
78	0.371	0.388	0.954
79	0.371	0.388	0.956
80	0.370	0.388	0.952
81	0.370	0.388	0.953
82	0.369	0.388	0.950
83	0.370	0.388	0.953
84	0.370	0.388	0.954
85	0.370	0.388	0.953
86	0.370	0.388	0.952
87	0.370	0.388	0.952
88	0.369	0.388	0.951
89	0.370	0.388	0.952
90	0.370	0.388	0.953
91	0.370	0.388	0.951
92	0.370	0.388	0.952
93	0.370	0.388	0.952
94	0.370	0.388	0.953
95	0.370	0.388	0.952
96	0.370	0.388	0.952
97	0.369	0.388	0.951
98	0.369	0.388	0.951

99.0	1.940	519.76
100.0	1.939	519.76
101.0	1.939	519.76
102.0	1.940	519.76
103.0	1.939	519.76
104.0	1.939	519.76
105.0	1.939	519.76
106.0	1.939	519.76
107.0	1.939	519.76
108.0	1.940	519.76
109.0	1.940	519.76
110.0	1.940	519.76
111.0	1.940	519.76
112.0	1.940	519.76
113.0	1.939	519.76
114.0	1.940	519.76
115.0	1.940	519.76
116.0	1.940	519.76
117.0	1.939	519.76
118.0	1.941	519.76
119.0	1.941	519.76
120.0	1.940	519.76
121.0	1.940	519.76
122.0	1.939	519.76
123.0	1.940	519.76
124.0	1.939	519.76
125.0	1.939	519.76
126.0	1.940	519.76
127.0	1.939	519.76
128.0	1.939	519.76
129.0	1.938	519.76
130.0	1.938	519.76
131.0	1.938	519.76
132.0	1.938	519.76
133.0	1.939	519.76
134.0	1.938	519.76
135.0	1.940	519.76
136.0	1.939	519.76
137.0	1.939	519.76
138.0	1.939	519.76
139.0	1.939	519.76
140.0	1.939	519.76
141.0	1.939	519.76
142.0	1.939	519.76
143.0	1.938	519.76
144.0	1.939	519.76
145.0	1.938	519.76
146.0	1.939	519.76
147.0	1.938	519.76
148.0	1.938	519.76
149.0	1.938	519.76
150.0	1.939	519.76
151.0	1.939	519.76
152.0	1.938	519.76
153.0	1.938	519.76
154.0	1.939	519.76
155.0	1.938	519.76
156.0	1.938	519.76
157.0	1.937	519.76

99	0.370	0.388	0.952
100	0.369	0.388	0.951
101	0.369	0.388	0.950
102	0.370	0.388	0.952
103	0.369	0.388	0.950
104	0.369	0.388	0.950
105	0.369	0.388	0.951
106	0.369	0.388	0.950
107	0.369	0.388	0.951
108	0.370	0.388	0.951
109	0.370	0.388	0.953
110	0.370	0.388	0.952
111	0.370	0.388	0.951
112	0.370	0.388	0.953
113	0.369	0.388	0.950
114	0.370	0.388	0.953
115	0.370	0.388	0.952
116	0.370	0.388	0.952
117	0.369	0.388	0.951
118	0.371	0.388	0.955
119	0.371	0.388	0.955
120	0.370	0.388	0.953
121	0.370	0.388	0.953
122	0.369	0.388	0.950
123	0.370	0.388	0.952
124	0.369	0.388	0.950
125	0.369	0.388	0.951
126	0.370	0.388	0.951
127	0.369	0.388	0.951
128	0.369	0.388	0.951
129	0.368	0.388	0.949
130	0.368	0.388	0.947
131	0.368	0.388	0.949
132	0.368	0.388	0.947
133	0.369	0.388	0.950
134	0.368	0.388	0.948
135	0.370	0.388	0.952
136	0.369	0.388	0.949
137	0.369	0.388	0.950
138	0.369	0.388	0.951
139	0.369	0.388	0.950
140	0.369	0.388	0.950
141	0.369	0.388	0.949
142	0.369	0.388	0.950
143	0.368	0.388	0.947
144	0.369	0.388	0.949
145	0.368	0.388	0.948
146	0.369	0.388	0.949
147	0.368	0.388	0.946
148	0.368	0.388	0.947
149	0.368	0.388	0.947
150	0.369	0.388	0.950
151	0.369	0.388	0.950
152	0.368	0.388	0.946
153	0.368	0.388	0.948
154	0.369	0.388	0.949
155	0.368	0.388	0.947
156	0.368	0.388	0.947
157	0.367	0.388	0.946


Plot of Normalized Head Versus Elapsed Time
Borehole MW2
Water Depth Ratio, (h-H)/(Ho-H)
1
0.37
0.1
0.01
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Elapsed Time (sec)
y = 7.94E-01e^-6.29E-05x
Straight line fit equation to data between normlized interval 0.25 and 0.30:
y = 7.94E-01e^-6.29E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -6.29E-05
T0 = 15898 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	June 25, 2019		Static water depth, H:	1.39	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.85	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW3		Basic time lag, To:	14,749	sec
Well Screen Bottom:	4.8	mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:		masl			
Static Water Level:	1.39	mbgs			
Ground Elevation:	522.17	masl	$K = r^2 \ln(L/R)/(2LTo)$ =	**4.0E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	1.39	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.851	520.32
1.0	1.851	520.32
2.0	1.849	520.32
3.0	1.849	520.32
4.0	1.848	520.32
5.0	1.848	520.32
6.0	1.847	520.32
7.0	1.846	520.32
8.0	1.846	520.32
9.0	1.845	520.32
10.0	1.846	520.32
11.0	1.843	520.33
12.0	1.844	520.33
13.0	1.845	520.33
14.0	1.845	520.33
15.0	1.844	520.33
16.0	1.844	520.33
17.0	1.844	520.33
18.0	1.868	520.30
19.0	1.842	520.33
20.0	1.842	520.33
21.0	1.843	520.33
22.0	1.842	520.33
23.0	1.842	520.33
24.0	1.842	520.33
25.0	1.842	520.33
26.0	1.842	520.33
27.0	1.841	520.33
28.0	1.841	520.33
29.0	1.841	520.33
30.0	1.841	520.33
31.0	1.841	520.33
32.0	1.841	520.33
33.0	1.841	520.33
34.0	1.841	520.33
35.0	1.841	520.33
36.0	1.841	520.33
37.0	1.840	520.33
38.0	1.840	520.33
39.0	1.840	520.33

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.461	0.461	1.000
1	0.461	0.461	0.998
2	0.459	0.461	0.994
3	0.459	0.461	0.994
4	0.458	0.461	0.992
5	0.458	0.461	0.992
6	0.457	0.461	0.991
7	0.456	0.461	0.989
8	0.456	0.461	0.989
9	0.455	0.461	0.987
10	0.456	0.461	0.987
11	0.453	0.461	0.981
12	0.454	0.461	0.984
13	0.455	0.461	0.986
14	0.455	0.461	0.985
15	0.454	0.461	0.985
16	0.454	0.461	0.985
17	0.454	0.461	0.983
18	0.478	0.461	1.036
19	0.452	0.461	0.981
20	0.452	0.461	0.980
21	0.453	0.461	0.981
22	0.452	0.461	0.980
23	0.452	0.461	0.980
24	0.452	0.461	0.979
25	0.452	0.461	0.979
26	0.452	0.461	0.979
27	0.451	0.461	0.979
28	0.451	0.461	0.978
29	0.451	0.461	0.977
30	0.451	0.461	0.977
31	0.451	0.461	0.977
32	0.451	0.461	0.978
33	0.451	0.461	0.977
34	0.451	0.461	0.977
35	0.451	0.461	0.977
36	0.451	0.461	0.977
37	0.450	0.461	0.975
38	0.450	0.461	0.976
39	0.450	0.461	0.976

40.0	1.840	520.33
41.0	1.839	520.33
42.0	1.840	520.33
43.0	1.840	520.33
44.0	1.839	520.33
45.0	1.840	520.33
46.0	1.840	520.33
47.0	1.839	520.33
48.0	1.840	520.33
49.0	1.839	520.33
50.0	1.839	520.33
51.0	1.839	520.33
52.0	1.839	520.33
53.0	1.839	520.33
54.0	1.839	520.33
55.0	1.839	520.33
56.0	1.839	520.33
57.0	1.839	520.33
58.0	1.824	520.35
59.0	1.828	520.34
60.0	1.839	520.33
61.0	1.836	520.33
62.0	1.838	520.33
63.0	1.838	520.33
64.0	1.838	520.33
65.0	1.838	520.33
66.0	1.838	520.33
67.0	1.838	520.33
68.0	1.838	520.33
69.0	1.838	520.33
70.0	1.838	520.33
71.0	1.838	520.33
72.0	1.838	520.33
73.0	1.839	520.33
74.0	1.838	520.33
75.0	1.838	520.33
76.0	1.838	520.33
77.0	1.837	520.33
78.0	1.837	520.33
79.0	1.837	520.33
80.0	1.837	520.33
81.0	1.837	520.33
82.0	1.837	520.33
83.0	1.837	520.33
84.0	1.836	520.33
85.0	1.836	520.33
86.0	1.837	520.33
87.0	1.836	520.33
88.0	1.837	520.33
89.0	1.837	520.33
90.0	1.837	520.33
91.0	1.837	520.33
92.0	1.836	520.33
93.0	1.836	520.33
94.0	1.836	520.33
95.0	1.836	520.33
96.0	1.836	520.33
97.0	1.836	520.33
98.0	1.836	520.33

40	0.450	0.461	0.975
41	0.449	0.461	0.973
42	0.450	0.461	0.975
43	0.450	0.461	0.975
44	0.449	0.461	0.974
45	0.450	0.461	0.975
46	0.450	0.461	0.975
47	0.449	0.461	0.974
48	0.450	0.461	0.975
49	0.449	0.461	0.974
50	0.449	0.461	0.974
51	0.449	0.461	0.974
52	0.449	0.461	0.973
53	0.449	0.461	0.973
54	0.449	0.461	0.973
55	0.449	0.461	0.973
56	0.449	0.461	0.973
57	0.449	0.461	0.973
58	0.434	0.461	0.942
59	0.438	0.461	0.950
60	0.449	0.461	0.974
61	0.446	0.461	0.967
62	0.448	0.461	0.971
63	0.448	0.461	0.971
64	0.448	0.461	0.971
65	0.448	0.461	0.971
66	0.448	0.461	0.971
67	0.448	0.461	0.971
68	0.448	0.461	0.970
69	0.448	0.461	0.971
70	0.448	0.461	0.970
71	0.448	0.461	0.971
72	0.448	0.461	0.971
73	0.449	0.461	0.972
74	0.448	0.461	0.971
75	0.448	0.461	0.971
76	0.448	0.461	0.970
77	0.447	0.461	0.969
78	0.447	0.461	0.969
79	0.447	0.461	0.969
80	0.447	0.461	0.970
81	0.447	0.461	0.969
82	0.447	0.461	0.968
83	0.447	0.461	0.968
84	0.446	0.461	0.967
85	0.446	0.461	0.968
86	0.447	0.461	0.968
87	0.446	0.461	0.968
88	0.447	0.461	0.968
89	0.447	0.461	0.968
90	0.447	0.461	0.968
91	0.447	0.461	0.968
92	0.446	0.461	0.967
93	0.446	0.461	0.967
94	0.446	0.461	0.966
95	0.446	0.461	0.968
96	0.446	0.461	0.967
97	0.446	0.461	0.967
98	0.446	0.461	0.967

99.0	1.836	520.33
100.0	1.835	520.33
101.0	1.836	520.33
102.0	1.835	520.33
103.0	1.835	520.34
104.0	1.835	520.34
105.0	1.836	520.33
106.0	1.836	520.33
107.0	1.835	520.33
108.0	1.835	520.33
109.0	1.835	520.33
110.0	1.835	520.34
111.0	1.835	520.33
112.0	1.836	520.33
113.0	1.835	520.33
114.0	1.835	520.34
115.0	1.834	520.34
116.0	1.835	520.33
117.0	1.834	520.34
118.0	1.835	520.33
119.0	1.835	520.34
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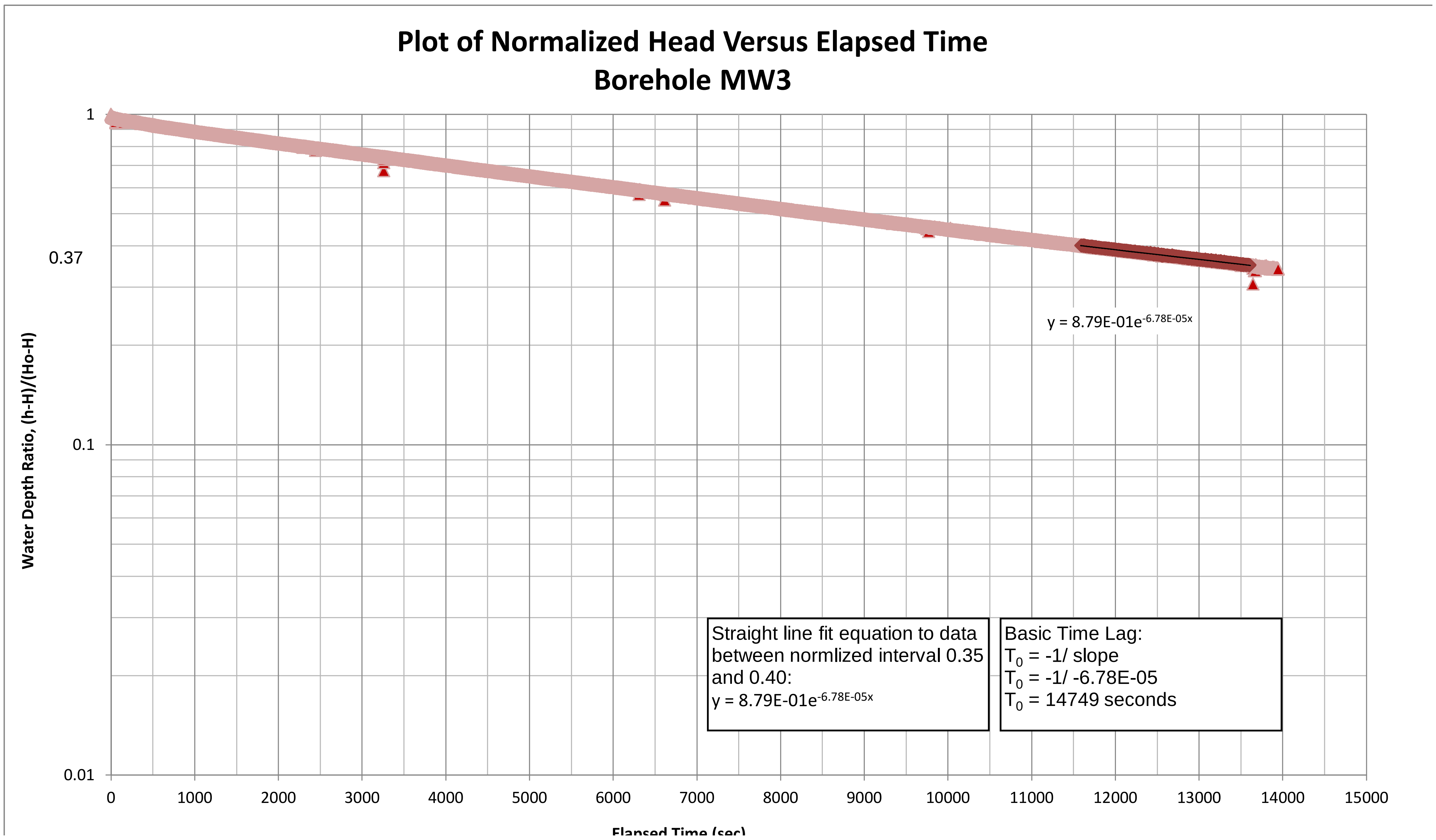
122.0	1.834	520.34
123.0	1.834	520.34
124.0	1.834	520.34
125.0	1.835	520.34
126.0	1.834	520.34
127.0	1.834	520.34
128.0	1.834	520.34
129.0	1.834	520.34
130.0	1.834	520.34
131.0	1.834	520.34
132.0	1.834	520.34
133.0	1.833	520.34
134.0	1.834	520.34
135.0	1.834	520.34
136.0	1.834	520.34
137.0	1.833	520.34
138.0	1.833	520.34
139.0	1.834	520.34
140.0	1.834	520.34
141.0	1.833	520.34
142.0	1.833	520.34
143.0	1.833	520.34
144.0	1.833	520.34
145.0	1.833	520.34
146.0	1.833	520.34
147.0	1.833	520.34
148.0	1.833	520.34
149.0	1.833	520.34
150.0	1.832	520.34
151.0	1.826	520.34
152.0	1.832	520.34
153.0	1.832	520.34
154.0	1.832	520.34
155.0	1.832	520.34
156.0	1.833	520.34
157.0	1.832	520.34

99	0.446	0.461	0.966
100	0.445	0.461	0.965
101	0.446	0.461	0.966
102	0.445	0.461	0.965
103	0.445	0.461	0.965
104	0.445	0.461	0.965
105	0.446	0.461	0.966
106	0.446	0.461	0.966
107	0.445	0.461	0.965
108	0.445	0.461	0.965
109	0.445	0.461	0.965
110	0.445	0.461	0.964
111	0.445	0.461	0.965
112	0.446	0.461	0.966
113	0.445	0.461	0.965
114	0.445	0.461	0.964
115	0.444	0.461	0.964
116	0.445	0.461	0.965
117	0.444	0.461	0.964
118	0.445	0.461	0.965
119	0.445	0.461	0.964
120	0.445	0.461	0.964
121	0.445	0.461	0.964
122	0.444	0.461	0.964
123	0.444	0.461	0.962
124	0.444	0.461	0.963
125	0.445	0.461	0.964
126	0.444	0.461	0.962
127	0.444	0.461	0.963
128	0.444	0.461	0.962
129	0.444	0.461	0.963
130	0.444	0.461	0.962
131	0.444	0.461	0.963
132	0.444	0.461	0.963
133	0.443	0.461	0.961
134	0.444	0.461	0.962
135	0.444	0.461	0.962
136	0.444	0.461	0.962
137	0.443	0.461	0.961
138	0.443	0.461	0.960
139	0.444	0.461	0.962
140	0.444	0.461	0.962
141	0.443	0.461	0.961
142	0.443	0.461	0.961
143	0.443	0.461	0.960
144	0.443	0.461	0.961
145	0.443	0.461	0.961
146	0.443	0.461	0.960
147	0.443	0.461	0.960
148	0.443	0.461	0.960
149	0.443	0.461	0.959
150	0.442	0.461	0.959
151	0.436	0.461	0.945
152	0.442	0.461	0.958
153	0.442	0.461	0.958
154	0.442	0.461	0.959
155	0.442	0.461	0.958
156	0.443	0.461	0.960
157	0.442	0.461	0.959

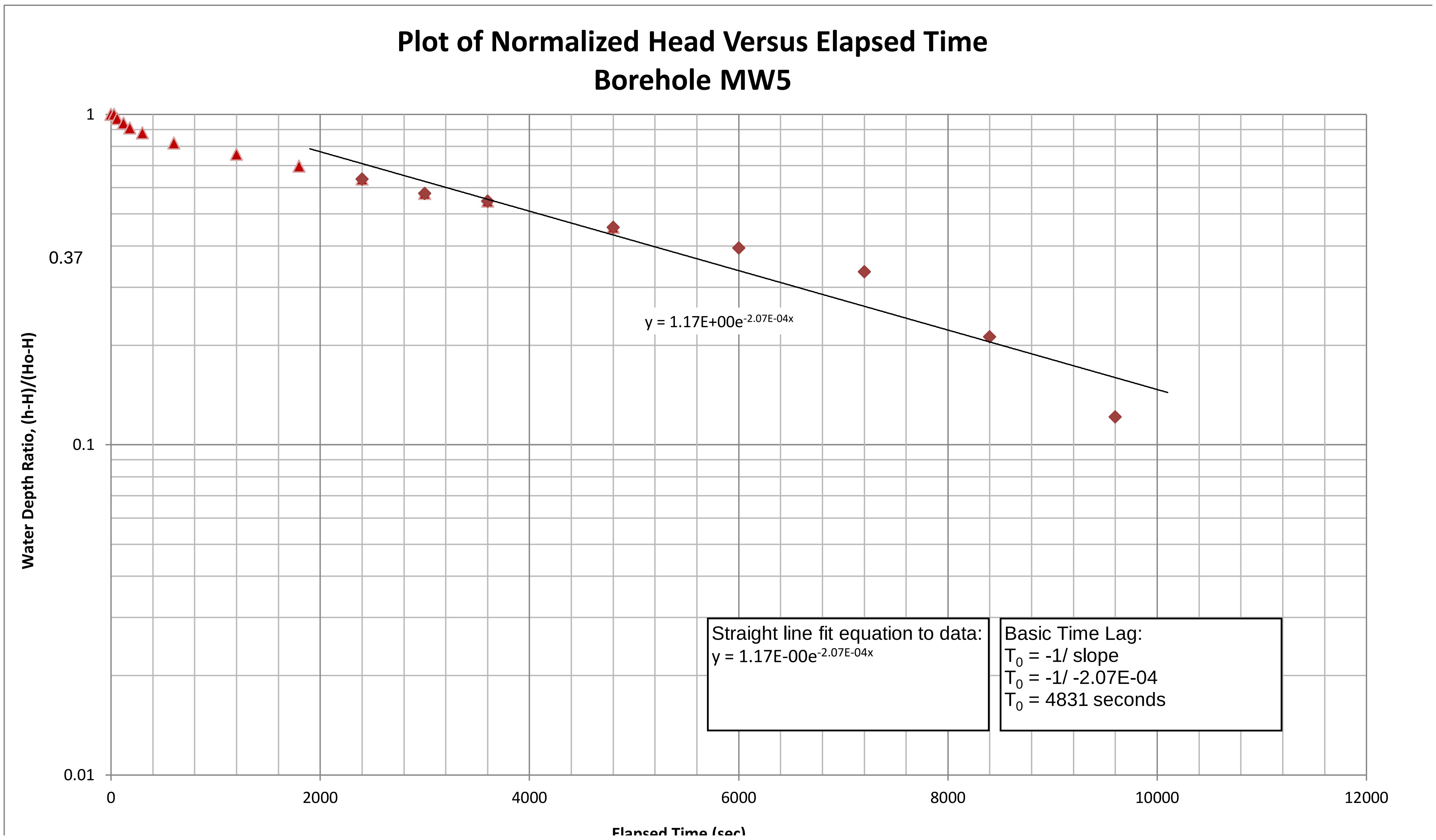

Plot of Normalized Head Versus Elapsed Time
Borehole MW3
Water Depth Ratio, (h-H)/(Ho-H)
1
0.37
0.1
0.01
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
Elapsed Time (sec)
y = 8.79E-01e^-6.78E-05x
Straight line fit equation to data between normlized interval 0.35 and 0.40:
y = 8.79E-01e^-6.78E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -6.78E-05
T0 = 14749 seconds

Estimation of K by Slug Test, based on Hvorslev equation

Date:	June 25, 2019		Static water depth, H:	0.91	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	1.24	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW5		Basic time lag, To:	4,831	sec
Well Screen Bottom:	6.1	mbgs	Length of well screen, L:	300	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:		masl			
Static Water Level:	0.91	mbgs			
Ground Elevation:	520.68	masl	$K = r^2 \ln(L/R)/(2LTo)$ =	**7.6E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	0.91	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	1.240	519.44
30.0	1.240	519.44
60.0	1.230	519.45
120.0	1.220	519.46
180.0	1.210	519.47
300.0	1.200	519.48
600.0	1.180	519.50
1200.0	1.160	519.52
1800.0	1.140	519.54
2400.0	1.120	519.56
3000.0	1.100	519.58
3600.0	1.090	519.59
4800.0	1.060	519.62
6000.0	1.040	519.64
7200.0	1.020	519.66
8400.0	0.980	519.70
9600.0	0.950	519.73

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.330	0.330	1.000
30	0.330	0.330	1.000
60	0.320	0.330	0.970
120	0.310	0.330	0.939
180	0.300	0.330	0.909
300	0.290	0.330	0.879
600	0.270	0.330	0.818
1200	0.250	0.330	0.758
1800	0.230	0.330	0.697
2400	0.210	0.330	0.636
3000	0.190	0.330	0.576
3600	0.180	0.330	0.545
4800	0.150	0.330	0.455
6000	0.130	0.330	0.394
7200	0.110	0.330	0.333
8400	0.070	0.330	0.212
9600	0.040	0.330	0.121



Plot of Normalized Head Versus Elapsed Time
Borehole MW5
1
0.37
0.1
0.01
Water Depth Ratio, (h-H)/(Ho-H)
y = 1.17E+00e-2.07E-04x
Straight line fit equation to data:
y = 1.17E-00e-2.07E-04x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -2.07E-04
T0 = 4831 seconds
0
2000
4000
6000
8000
10000
12000
Elapsed Time (sec)

Estimation of K by Slug Test, based on Hvorslev equation

Date:	June 25, 2019		Static water depth, H:	0.17	mbgs
Conducted by:	D.P.		Water depth at time t = 0, Ho:	0.64	mbgs
			Water depth at time t, h:	see below	mbgs
Well Number:	MW6		Basic time lag, To:	32,051	sec
Well Screen Bottom:		mbgs	Length of well screen, L:	150	cm
Top of Pipe:		mags	Diameter of the borehole, 2R:	20.3	cm
Well Casing Diameter:	5.1	cm	Diameter of the well casing, 2r:	5.1	cm
Well Elevation:		masl			
Static Water Level:	0.17	mbgs			
Ground Elevation:	519.45	masl	$K = r^2 \ln(L/R)/(2LTo)$ =	**1.8E-06**	cm/s
WATER LEVEL BEFORE TEST = H =	0.17	mbgs			

Time t (sec)	h Water Level (mbgs)	Water Level Elevation (masl)
0.0	0.642	518.81
1.0	0.641	518.81
2.0	0.639	518.81
3.0	0.638	518.81
4.0	0.638	518.81
5.0	0.638	518.81
6.0	0.637	518.81
7.0	0.637	518.81
8.0	0.637	518.81
9.0	0.636	518.81
10.0	0.636	518.81
11.0	0.637	518.81
12.0	0.637	518.81
13.0	0.637	518.81
14.0	0.636	518.81
15.0	0.636	518.81
16.0	0.636	518.81
17.0	0.636	518.81
18.0	0.635	518.81
19.0	0.635	518.82
20.0	0.635	518.81
21.0	0.635	518.81
22.0	0.635	518.82
23.0	0.635	518.82
24.0	0.635	518.82
25.0	0.635	518.81
26.0	0.635	518.81
27.0	0.630	518.82
28.0	0.633	518.82
29.0	0.634	518.82
30.0	0.634	518.82
31.0	0.634	518.82
32.0	0.635	518.82
33.0	0.634	518.82
34.0	0.634	518.82
35.0	0.635	518.82
36.0	0.634	518.82
37.0	0.634	518.82
38.0	0.634	518.82
39.0	0.634	518.82

Time t (sec)	h - H	Ho - H	(h-H)/(Ho-H)
0	0.472	0.472	1.000
1	0.471	0.472	0.998
2	0.469	0.472	0.994
3	0.468	0.472	0.993
4	0.468	0.472	0.992
5	0.468	0.472	0.991
6	0.467	0.472	0.991
7	0.467	0.472	0.989
8	0.467	0.472	0.989
9	0.466	0.472	0.989
10	0.466	0.472	0.989
11	0.467	0.472	0.989
12	0.467	0.472	0.991
13	0.467	0.472	0.989
14	0.466	0.472	0.987
15	0.466	0.472	0.988
16	0.466	0.472	0.987
17	0.466	0.472	0.987
18	0.465	0.472	0.987
19	0.465	0.472	0.986
20	0.465	0.472	0.986
21	0.465	0.472	0.986
22	0.465	0.472	0.986
23	0.465	0.472	0.986
24	0.465	0.472	0.986
25	0.465	0.472	0.986
26	0.465	0.472	0.987
27	0.460	0.472	0.976
28	0.463	0.472	0.981
29	0.464	0.472	0.984
30	0.464	0.472	0.984
31	0.464	0.472	0.984
32	0.465	0.472	0.986
33	0.464	0.472	0.985
34	0.464	0.472	0.985
35	0.465	0.472	0.985
36	0.464	0.472	0.983
37	0.464	0.472	0.984
38	0.464	0.472	0.984
39	0.464	0.472	0.984

40.0	0.634	518.82
41.0	0.634	518.82
42.0	0.633	518.82
43.0	0.634	518.82
44.0	0.634	518.82
45.0	0.634	518.82
46.0	0.634	518.82
47.0	0.634	518.82
48.0	0.634	518.82
49.0	0.634	518.82
50.0	0.634	518.82
51.0	0.633	518.82
52.0	0.633	518.82
53.0	0.634	518.82
54.0	0.634	518.82
55.0	0.634	518.82
56.0	0.634	518.82
57.0	0.633	518.82
58.0	0.634	518.82
59.0	0.633	518.82
60.0	0.634	518.82
61.0	0.633	518.82
62.0	0.634	518.82
63.0	0.634	518.82
64.0	0.633	518.82
65.0	0.634	518.82
66.0	0.634	518.82
67.0	0.634	518.82
68.0	0.634	518.82
69.0	0.633	518.82
70.0	0.634	518.82
71.0	0.634	518.82
72.0	0.634	518.82
73.0	0.634	518.82
74.0	0.633	518.82
75.0	0.634	518.82
76.0	0.633	518.82
77.0	0.633	518.82
78.0	0.633	518.82
79.0	0.634	518.82
80.0	0.633	518.82
81.0	0.634	518.82
82.0	0.633	518.82
83.0	0.634	518.82
84.0	0.634	518.82
85.0	0.634	518.82
86.0	0.633	518.82
87.0	0.633	518.82
88.0	0.633	518.82
89.0	0.633	518.82
90.0	0.633	518.82
91.0	0.633	518.82
92.0	0.634	518.82
93.0	0.633	518.82
94.0	0.634	518.82
95.0	0.633	518.82
96.0	0.633	518.82
97.0	0.633	518.82
98.0	0.633	518.82

40	0.464	0.472	0.984
41	0.464	0.472	0.984
42	0.463	0.472	0.982
43	0.464	0.472	0.984
44	0.464	0.472	0.985
45	0.464	0.472	0.984
46	0.464	0.472	0.984
47	0.464	0.472	0.984
48	0.464	0.472	0.983
49	0.464	0.472	0.983
50	0.464	0.472	0.983
51	0.463	0.472	0.982
52	0.463	0.472	0.982
53	0.464	0.472	0.985
54	0.464	0.472	0.984
55	0.464	0.472	0.983
56	0.464	0.472	0.984
57	0.463	0.472	0.983
58	0.464	0.472	0.984
59	0.463	0.472	0.981
60	0.464	0.472	0.983
61	0.463	0.472	0.982
62	0.464	0.472	0.983
63	0.464	0.472	0.984
64	0.463	0.472	0.983
65	0.464	0.472	0.983
66	0.464	0.472	0.984
67	0.464	0.472	0.983
68	0.464	0.472	0.983
69	0.463	0.472	0.982
70	0.464	0.472	0.983
71	0.464	0.472	0.984
72	0.464	0.472	0.984
73	0.464	0.472	0.984
74	0.463	0.472	0.983
75	0.464	0.472	0.983
76	0.463	0.472	0.982
77	0.463	0.472	0.983
78	0.463	0.472	0.982
79	0.464	0.472	0.984
80	0.463	0.472	0.983
81	0.464	0.472	0.984
82	0.463	0.472	0.982
83	0.464	0.472	0.983
84	0.464	0.472	0.983
85	0.464	0.472	0.983
86	0.463	0.472	0.982
87	0.463	0.472	0.982
88	0.463	0.472	0.982
89	0.463	0.472	0.982
90	0.463	0.472	0.982
91	0.463	0.472	0.982
92	0.464	0.472	0.984
93	0.463	0.472	0.982
94	0.464	0.472	0.983
95	0.463	0.472	0.982
96	0.463	0.472	0.982
97	0.463	0.472	0.982
98	0.463	0.472	0.982

99.0	0.633	518.82
100.0	0.633	518.82
101.0	0.633	518.82
102.0	0.634	518.82
103.0	0.633	518.82
104.0	0.633	518.82
105.0	0.633	518.82
106.0	0.633	518.82
107.0	0.633	518.82
108.0	0.633	518.82
109.0	0.633	518.82
110.0	0.634	518.82
111.0	0.633	518.82
112.0	0.633	518.82
113.0	0.633	518.82
114.0	0.633	518.82
115.0	0.633	518.82
116.0	0.633	518.82
117.0	0.633	518.82
118.0	0.633	518.82
119.0	0.633	518.82
120.0	0.633	518.82
121.0	0.633	518.82
122.0	0.634	518.82
123.0	0.633	518.82
124.0	0.633	518.82
125.0	0.633	518.82
126.0	0.633	518.82
127.0	0.633	518.82
128.0	0.633	518.82
129.0	0.633	518.82
130.0	0.633	518.82
131.0	0.633	518.82
132.0	0.633	518.82
133.0	0.633	518.82
134.0	0.633	518.82
135.0	0.633	518.82
136.0	0.633	518.82
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142.0	0.633	518.82
143.0	0.633	518.82
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145.0	0.633	518.82
146.0	0.633	518.82
147.0	0.633	518.82
148.0	0.633	518.82
149.0	0.633	518.82
150.0	0.633	518.82
151.0	0.633	518.82
152.0	0.633	518.82
153.0	0.633	518.82
154.0	0.633	518.82
155.0	0.633	518.82
156.0	0.633	518.82
157.0	0.633	518.82

99	0.463	0.472	0.982
100	0.463	0.472	0.981
101	0.463	0.472	0.982
102	0.464	0.472	0.983
103	0.463	0.472	0.981
104	0.463	0.472	0.981
105	0.463	0.472	0.982
106	0.463	0.472	0.981
107	0.463	0.472	0.982
108	0.463	0.472	0.981
109	0.463	0.472	0.981
110	0.464	0.472	0.983
111	0.463	0.472	0.982
112	0.463	0.472	0.982
113	0.463	0.472	0.982
114	0.463	0.472	0.982
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116	0.463	0.472	0.982
117	0.463	0.472	0.982
118	0.463	0.472	0.982
119	0.463	0.472	0.982
120	0.463	0.472	0.982
121	0.463	0.472	0.982
122	0.464	0.472	0.983
123	0.463	0.472	0.982
124	0.463	0.472	0.982
125	0.463	0.472	0.982
126	0.463	0.472	0.981
127	0.463	0.472	0.982
128	0.463	0.472	0.981
129	0.463	0.472	0.982
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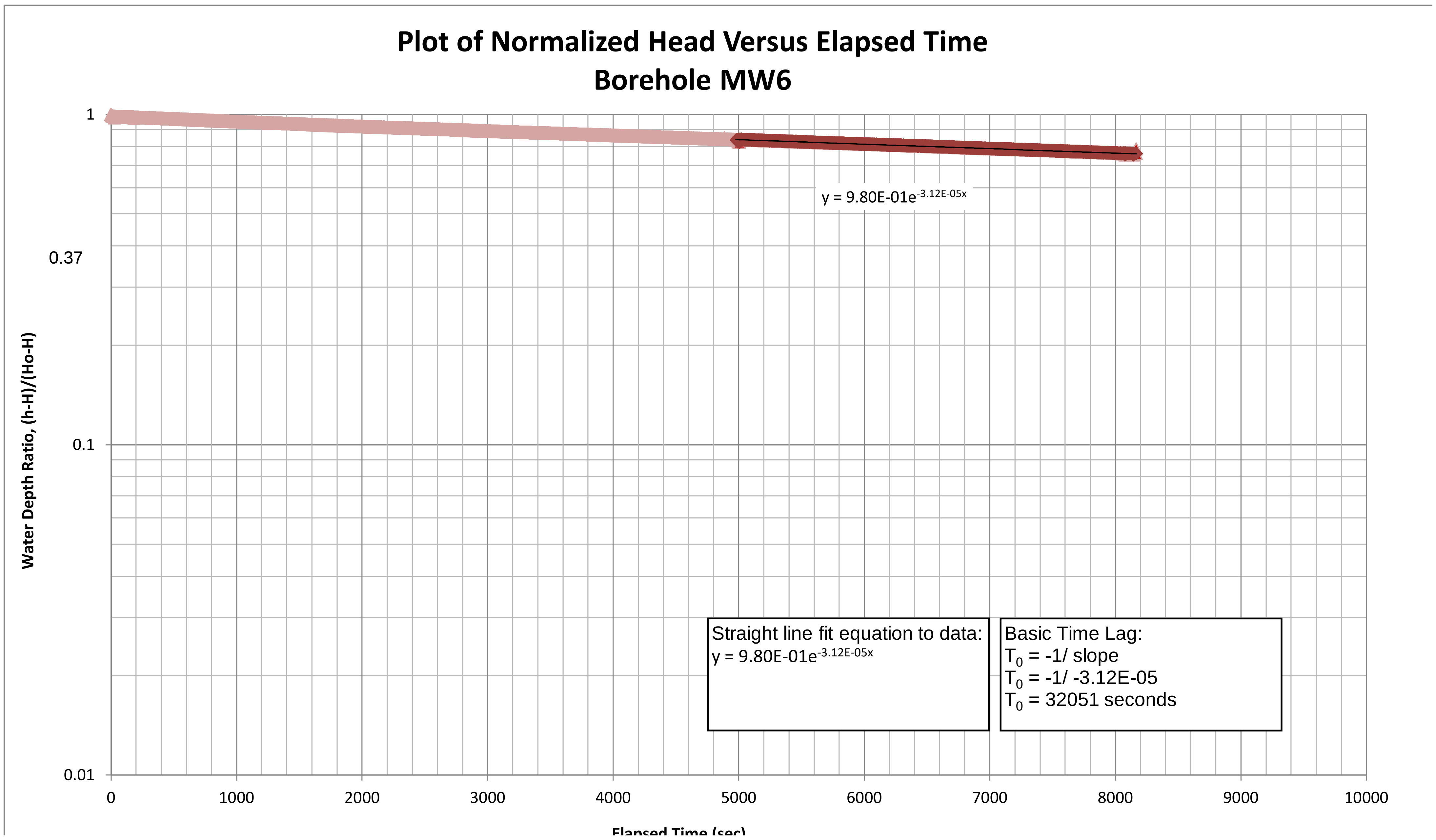
139	0.463	0.472	0.982
140	0.463	0.472	0.982
141	0.463	0.472	0.981
142	0.463	0.472	0.981
143	0.463	0.472	0.981
144	0.463	0.472	0.981
145	0.463	0.472	0.981
146	0.463	0.472	0.981
147	0.463	0.472	0.981
148	0.463	0.472	0.982
149	0.463	0.472	0.982
150	0.463	0.472	0.981
151	0.463	0.472	0.982
152	0.463	0.472	0.982
153	0.463	0.472	0.981
154	0.463	0.472	0.981
155	0.463	0.472	0.982
156	0.463	0.472	0.981
157	0.463	0.472	0.982


Plot of Normalized Head Versus Elapsed Time
Borehole MW6
y = 9.80E-01e^-3.12E-05x
Water Depth Ratio, (h-H)/(Ho-H)
1
0.37
0.1
0.01
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Elapsed Time (sec)
Straight line fit equation to data:
y = 9.80E-01e^-3.12E-05x
Basic Time Lag:
T0 = -1/ slope
T0 = -1/ -3.12E-05
T0 = 32051 seconds

APPENDIX D

Charts of Measured Ground Water Level and Temperatures

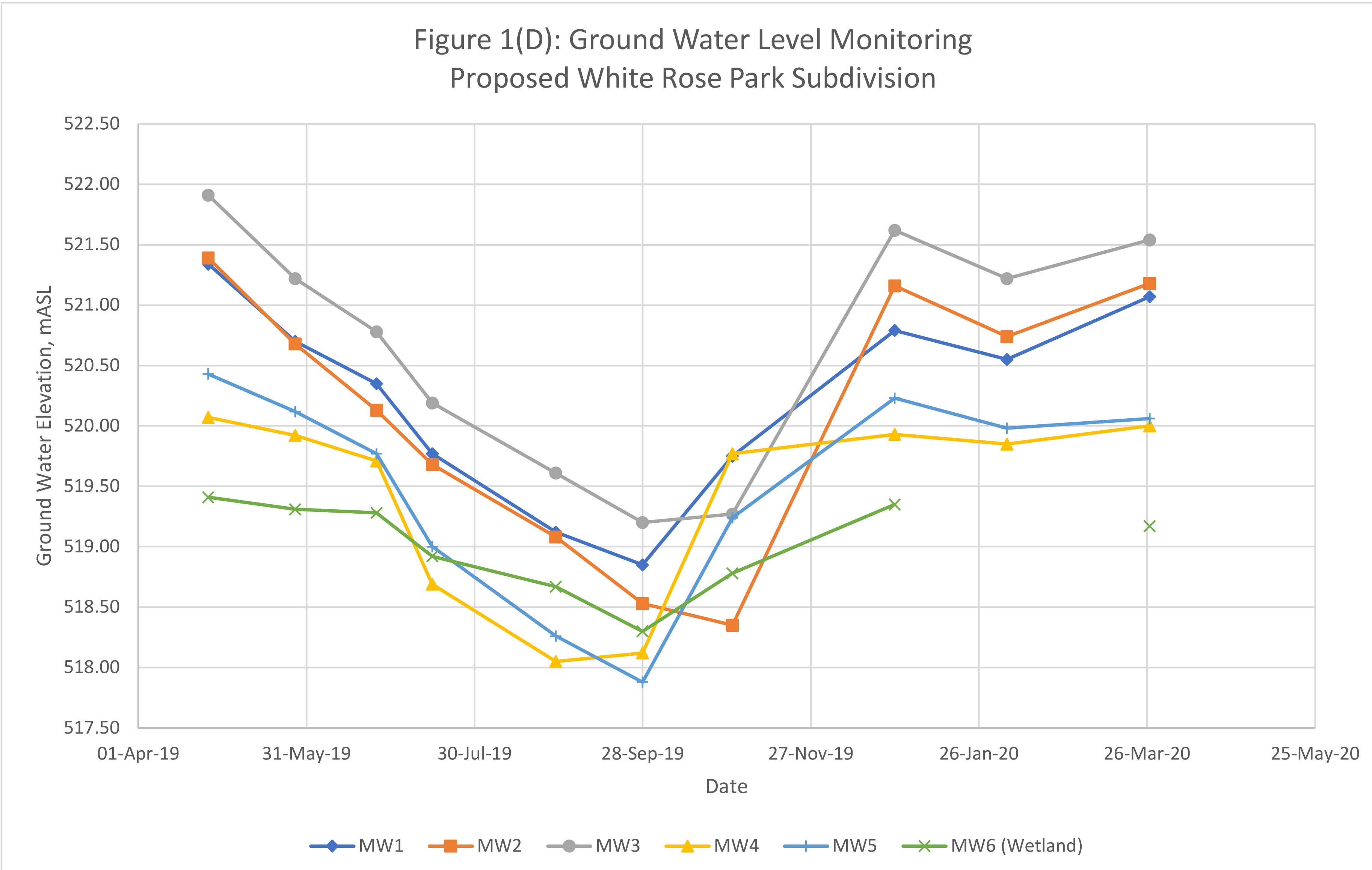


Figure 1(D): Ground Water Level Monitoring
Proposed White Rose Park Subdivision
522.50
522.00
521.50
521.00
520.50
520.00
519.50
519.00
518.50
518.00
517.50
Ground Water Elevation, mASL
01-Apr-19
31-May-19
30-Jul-19
28-Sep-19
27-Nov-19
26-Jan-20
26-Mar-20
25-May-20
Date
MW1
MW2
MW3
MW4
MW5
MW6 (Wetland)

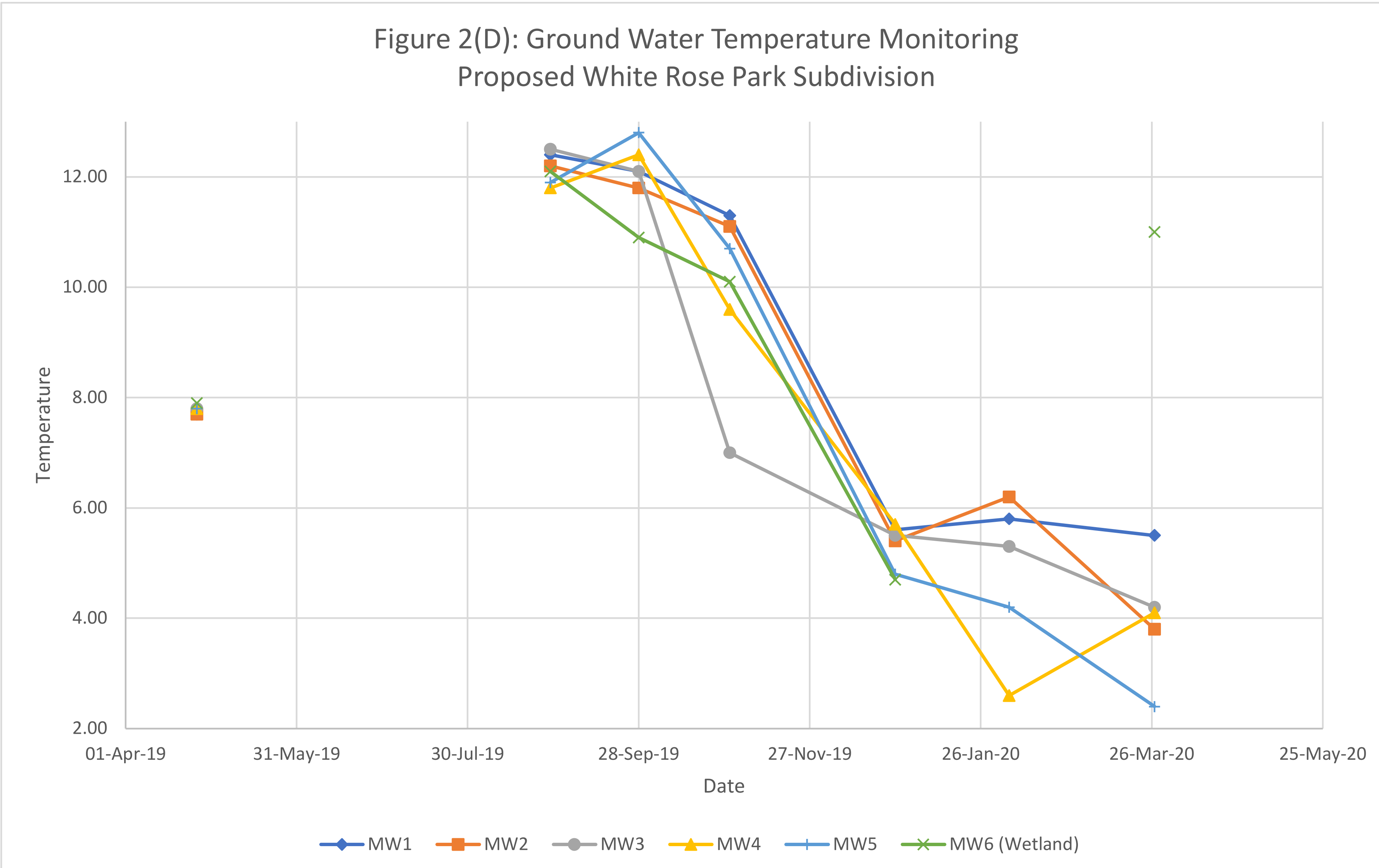


Figure 2(D): Ground Water Temperature Monitoring
Proposed White Rose Park Subdivision
Temperature
12.00
10.00
8.00
6.00
4.00
2.00
01-Apr-19
31-May-19
30-Jul-19
28-Sep-19
27-Nov-19
26-Jan-20
26-Mar-20
25-May-20
Date
MW1
MW2
MW3
MW4
MW5
MW6 (Wetland)

APPENDIX E

Water Balance / Budget Assessment Tables

Table 1(E): Monthly Evapotranspiration by the Thornthwaite Formula

Project: White Rose Park Subdivision

Month	Daily Average Temp.	Monthly Heat Index, It	Potential Evapo-transpiration (PET) (mm)	Daylight Correction Factor (Lat. = 44 °) (Ref: Chow)	Adjusted PET (mm)	Mean Monthly Precip. (mm)	Mean Monthly Surplus (mm)	Mean Monthly Deficit (mm)
1	-8.3	0	0	0.81	0	107.8	107.8	0.0
2	-7.4	0	0	0.81	0	84.3	84.3	0.0
3	-3.4	0	0	1.02	0	79.2	79.2	0.0
4	4.5	0.85	24.5	1.13	27.6	72.1	44.5	0.0
5	10.8	3.21	56.9	1.27	72.4	89.8	17.4	0.0
6	15.5	5.55	80.6	1.28	103.3	93.5	0.0	9.8
7	17.8	6.84	92.0	1.30	119.8	77.9	0.0	41.9
8	17.1	6.43	88.5	1.20	106.6	91.9	0.0	14.7
9	12.9	4.20	67.5	1.04	70.2	104.4	34.2	0.0
10	7.1	1.70	38.0	0.94	35.9	92.3	56.4	0.0
11	0.9	0.07	5.2	0.80	4.2	110.9	106.7	0.0
12	-5	0	0	0.76	0.0	102.1	102.1	0.0
Heat Index TE=		28.9						
a=		0.96						
Total (mm)			453		**540**	**1106**	**633**	**66**

Surplus, Cultivated Area			Surplus, Roof Area (if discharge to ground surface)		
Yearly Precipitation =	1106	mm	Precipitation after evaporation =	885	mm
Calculated Yearly Adjusted PET =	540	mm	Calculated Yearly Adjusted PET =	540	mm
P-AdjPET = I + R =Total Surplus	566	mm	P-AdjPET = I + R =Total Surplus	345	mm

Weather station is at Latitude 44 deg 10 min
Site is at Latitude 44 deg 10 min
Source: Canadian Climate Normals, 1981 to 2010, "Proton" weather station

Table 2(E): Water Balance / Water Budget Assessment - Predevelopment

Project: White Rose Park Subdivision

Catchment Designation	Cultivated	Paved	Building	Open Water	Total
Area (m^2)	40,800	-	-	-	40,800
Pervious Area (m^2)	40,800	-	-	-	40,800
Impervious Area (m^2)	-	-	-	-	-
Infiltration Factors					
Topography Infiltration Factor	0.17	0	0	0	
Soil Infiltration Factor	0.3	0	0	0	
Land Cover Infiltration Factor	0.1	0	0	0	
MECP Infiltration Factor (Total)	**0.57**	**0**	**0**	**0**	
Actual Infiltration Factor (Total)	0.57	0	0	0	
Run-off Coefficient	0.43	1	1	1	
Run-off from Impervious Surfaces	0.0	0.8	0.8	0.8	
Inputs (per Unit Area)					
Precipitation (mm/yr)	1,106	-	-	-	
Run-On (mm/yr)	-	-	-	-	
Other Inputs (mm/yr)	-	-	-	-	
Total Inputs (mm/yr)	**1,106**	**-**	**-**	**-**	
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	566	-	-	-	
Net Surplus (mm/yr)	566	-	-	-	
Evapotranspiration (mm/yr)	540	-	-	-	
Infiltration (mm/yr)	323	-	-	-	
Rooftop Infiltration (mm/yr)	-	-	-	-	
Total Infiltration (mm/yr)	**323**	**-**	**-**	**-**	
Run-off Pervious Areas	243	-	-	-	
Run-off Impervious Areas	-	-	-	-	
Total Runoff (mm/yr)	**243**	**-**	**-**	**-**	
Total Outputs (mm/yr)	**1,106**	**-**	**-**	**-**	
Difference (Inputs - Outputs)	**-**	**-**	**-**	**-**	
Inputs (by Volume)					
Precipitation (m^3/yr)	45,125	-	-	-	45,125
Run-On (m^3/yr)	-	-	-	-	-
Other Inputs (m^3/yr)	-	-	-	-	-
Total Inputs (m^3/yr)	**45,125**	**-**	**-**	**-**	**45,125**
Outputs (by Volume)					
Precipitation Surplus (m^3/yr)	23,093	-	-	-	23,093
Net Surplus (m^3/yr)	**23,093**	**-**	**-**	**-**	**23,093**
Evapotranspiration (m^3/yr)	22,032	-	-	-	22,032
Infiltration (m^3/yr)	13,163	-	-	-	13,163
Rooftop Infiltration (m^3/yr)	-	-	-	-	-
Total Infiltration (m^3/yr)	**13,163**	**-**	**-**	**-**	**13,163**
Run-off Pervious Areas	9,930	-	-	-	9,930
Run-off Impervious Areas	-	-	-	-	-
Total Runoff (m^3/yr)	**9,930**	**-**	**-**	**-**	**9,930**
Total Outputs (m^3/yr)	**45,125**	**-**	**-**	**-**	**45,125**
Difference (Inputs - Outputs)	-	-	-	-	-

Table 3(E): Water Balance / Water Budget Assessment - Post Development

Project: White Rose Park Subdivision

Catchment Designation	Cultivated	Paved	Building	Open Water	Total
Area (m^2)	18,760	12,000	9,000	-	39,760
Pervious Area (m^2)	18,760	-	-	-	18,760
Impervious Area (m^2)	-	12,000	9,000	-	21,000
Infiltration Factors					
Topography Infiltration Factor	0.18	0	0	0	
Soil Infiltration Factor	0.3	0	0	0	
Land Cover Infiltration Factor	0.1	0	0	0	
MECP Infiltration Factor (Total)	**0.58**	**0**	**0**	**0**	
Actual Infiltration Factor (Total)	0.58	0	0	0	
Run-off Coefficient	0.42	1	1	1	
Run-off from Impervious Surfaces	0.0	0.8	0.8	0.8	
Inputs (per Unit Area)					
Precipitation (mm/yr)	1,106	1,106	1,106	-	
Run-On (mm/yr)	-	-	-	-	
Other Inputs (mm/yr)	-	-	-	-	
Total Inputs (mm/yr)	**1,106**	**1,106**	**1,106**	**-**	
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	566	885	885	-	
Net Surplus (mm/yr)	566	885	885	-	
Evapotranspiration (mm/yr)	540	221	221	-	
Infiltration (mm/yr)	328	-	-	-	
Rooftop Infiltration (mm/yr)	-	-	-	-	
Total Infiltration (mm/yr)	**328**	**-**	**-**	**-**	
Run-off Pervious Areas	238	-	-	-	
Run-off Impervious Areas	-	885	885	-	
Total Runoff (mm/yr)	**238**	**885**	**885**	**-**	
Total Outputs (mm/yr)	**1,106**	**1,106**	**1,106**	**-**	
Difference (Inputs - Outputs)	**-**	**-**	**-**	**-**	
Inputs (by Volume)					
Precipitation (m^3/yr)	20,749	13,272	9,954	-	43,975
Run-On (m^3/yr)	-	-	-	-	-
Other Inputs (m^3/yr)	-	-	-	-	-
Total Inputs (m^3/yr)	**20,749**	**13,272**	**9,954**	**-**	**43,975**
Outputs (by Volume)					
Precipitation Surplus (m^3/yr)	10,618	10,618	7,963	-	29,199
Net Surplus (m^3/yr)	**10,618**	**10,618**	**7,963**	**-**	**29,199**
Evapotranspiration (m^3/yr)	10,130	2,654	1,991	-	14,776
Infiltration (m^3/yr)	6,159	-	-	-	6,159
Rooftop Infiltration (m^3/yr)	-	-	-	-	-
Total Infiltration (m^3/yr)	**6,159**	**-**	**-**	**-**	**6,159**
Run-off Pervious Areas	4,460	-	-	-	4,460
Run-off Impervious Areas	-	10,618	7,963	-	18,581
Total Runoff (m^3/yr)	**4,460**	**10,618**	**7,963**	**-**	**23,040**
Total Outputs (m^3/yr)	**20,749**	**13,272**	**9,954**	**-**	**43,975**
Difference (Inputs - Outputs)	-	-	-	-	-

Table 4(E): Water Balance / Water Budget Assessment - Summary

Project: White Rose Park Subdivision

Characteristic	Pre-Development	Post-Development	Change (Pre- to Post)
INPUTS (by VOLUME)			
Precipitation (m^3/yr)	45,125	43,975	-3%
Run-On (m^3/yr)	-	-	0%
Other Inputs (m^3/yr)	-	-	0%
Total Inputs (m^3/yr)	45,125	43,975	-3%
OUTPUTS (by VOLUME)			
Precipitation Surplus (m^3/yr)	23,093	29,199	26%
Net Surplus (m^3/yr)	23,093	29,199	26%
Evapotranspiration (m^3/yr)	22,032	14,776	-33%
Infiltration (m^3/yr)	13,163	6,159	-53%
Rooftop Infiltration (m^3/yr)	-	-	0%
Total Infiltration (m^3/yr)	**13,163**	**6,159**	**-53%**
Run-off Pervious Areas	9,930	4,460	-55%
Run-off Impervious Areas	-	18,581	0%
Total Runoff (m^3/yr)	**9,930**	**23,040**	**132%**
Total Outputs (m^3/yr)	45,125	43,975	-3%
Total Infiltration Deficit (m^3/yr)		7,004	

APPENDIX F

Water Taking Plan

WATER TAKING PLAN

F.1 Construction Dewatering Discharge Rate and Zone of Influence

The dewatering zone of influence (DZOI) and discharge rate for the sewer installation were estimated in Section 6 and Table 3 of the report based on the findings of the hydrogeological investigation and the conceptual hydrogeological site models. Please see Section 6 for assumptions and limitations. Consequently, the seepage into the sewer trenches, and thus the estimated required dewatering rate if sump pumping is used, is about **48,000 L/d per 30 m length** after application of a factor of safety of 2.0. The DZOI is estimated at about 32 m.

With regards to the above assessment, please note the following:

- The discharge rate and DZOI are conservatively estimated to minimize the risk of not being prepared for unanticipated soil or ground water conditions that may require higher pump rates or cause greater dewatering impacts.

- The ground water levels taken in July were assumed for the assessment; higher pump rates can be expected during wetter periods (November through June) and lower pump rates can be expected during drier periods (July through October), based on the water level data collected.

- The model does not include surface water which is to be prevented from entering the excavation area.

- The discharge rates are estimated under steady state conditions. Pumping rates prior to steady state, controlled by the dewatering contractor, are often increased to achieve the desired drawdown in the shortest period of time but must remain below the 400,000 L/d limit for EASR applicability.

- Estimated rates are per 30 m length; the dewatering contractor may use larger or smaller dewatering zones, thus increasing or reducing the estimated dewatering discharge rates.

F.2 Potential Settlement and Monitoring

Settlement Estimate

The potential for settlement was assessed by a qualified professional engineer as described below.

Ground subsidence may be caused by the increase in effective stresses due to the lowering of the ground water level and subsequent reduction (or elimination) of pore water pressure. Typically, subsidence due to dewatering is most likely to occur where the estimated drawdown is significant, structures are located close to the excavation and within the DZOI, and soils within the drawdown depths are compressible.

Since no structures are expected to be adjacent to the dewatering and the majority of the soil encountered within the drawdown depth was found to have high N values or partial penetration during SPT testing, settlement is not expected to have a significant impact. If required, PML can provide an outline for a settlement monitoring and mitigation program to add to the water taking plan.

F.3 Potential Impact on Other Ground Water Users and the Wetland/Creek

As described in Section 2.2, the water wells recorded by the MECP within an approximately 1.4 km by 1.4 km square area (the site and vicinity) are summarized in a table and are mapped on Figure 1, in Appendix C. The closest recorded water supply well is over 100 m to the south of the site. The estimated DZOI is only about 32 m, and thus it is expected that the dewatering will have no impact on the well, if it is still operational. Thus, since the majority of the vicinity of the site is serviced by municipal water supply, and no wells are indicated in the MECP records to be within the DZOI of the site, no water well users are expected to be impacted by the dewatering.

With regards to well head protection areas (WHPA), three municipal wells are located in Dundalk (see Figure 4(A) in Appendix A). The Site lies within the WHPA-D radius of one or both of the wells to the south / southeast, which range from about 970 to 1000 m from the site. It is anticipated that the dewatering activities will not impact any municipal water wells.

The estimated zone of influence of the construction dewatering due to the installation of the sewers is about 32 m, and is not expected to reach the edge of the wetland, thus it is not expected that the ground water level in the wetland area will be drawn down. The wetland and creek may experience a temporary reduction in ground water baseflow; however, since the discharge water is to be returned to the creek (after appropriate treatment), the net effect downstream is expected to be negligible.

F.4 Water Quantity, Quality and Ground Water Level Monitoring Program

Ground Water Quality

As discussed in Section 4.4 of the report, the unfiltered ground water sample was compliant with discharge to a sanitary sewer, storm sewer or watercourse. Nevertheless, it is recommended that the discharge water be treated to remove sediment (total suspended solids) by filtration and/or by using a sedimentation tank.

Preferred Discharge Methods

It is preferred that dewatering discharge be to a storm sewer; however, discharge to a ditch or watercourse (the Grand River tributary) will be an alternative. No water will be discharged if the associated regulated limits are exceeded in regularly taken water samples (see monitoring plan, below). Discharge water quality results must comply with the Southgate Township storm sewer bylaw criteria and PWQO and CCME where no PWQO guideline exists for discharge to a storm sewer. If discharge water quality results do not comply with the above criteria, the dewatering operations will be shut-down and treatment options re-evaluated and discharge to storm sewer continued. Discharge directly to a watercourse is also an option, however, discharge to a storm sewer is preferred since superior erosion-reduction features are typically in place at the outflow location.

Water Quality Monitoring and Potential Treatment Plan

The monitoring plan for discharge to a storm sewer is outlined on Table 1(F). The monitoring will be implemented both during a trial dewatering, if conducted, and during construction. The trial dewatering may be conducted for a short period of time once the dewatering wells, header pipes, and sediment control facilities (filtration bags, decantation tanks, sedimentation ponds, or the like) are installed to obtain a representative water sample from the outflow of the sediment control facility (the "discharge") for chemical analysis. The results of this water quality analysis will provide guidance in the selection of discharge treatment requirements during construction dewatering. If discharge is directly to a ditch or watercourse, the monitoring plan is outlined on Table 2(F).

Ground Water Level Monitoring Program

The ground water level monitoring program is outlined on Table 3(F).

Discharge Rate Monitoring

The total daily ground water volume pumped should be measured by the dewatering contractor using a flow measuring device.

A record of the water taking must be maintained by the registered water-taker. This record will include the dates and duration of water takings, and the total measured volume of water pumped per day for each day that water is taken and will be updated and reported to the Client once each week. The Client will keep all the required records up to date and available at or near the site of the water taking and will produce the records immediately for inspection by a Provincial Officer upon his or her request. The records are to be reported to the MECP through the online Regulatory Self-Reporting System (RSRS) by the registered water-taker, even if dewatering rates are low.

F.5 Summary of Qualifications

Shamsul A. Tarafder, MSc, PhD, P.Geo.

Dr. Tarafder is a licensed professional Geoscientist with a B.Sc. (Honours) and M.Sc. in Geology from University of Dhaka, Bangladesh, M.Sc. in Hydrogeology and PhD in Applied Geosciences from University of Tuebingen, Germany, and M.Sc. in Environmental Science from University of Toronto, Canada.

Dr. Tarafder is a Senior Geoscientist and responsible for geoenvironmental and hydrogeological investigations including data acquisition, sampling and monitoring programs, environmental site assessments, hydrogeological site assessments for Permit-To-Take-Water (PTTW) and Environmental Activity and Sector Registry (EASR), geoenvironmental, hydrogeological and hydrological design and modelling and construction inspection. He has completed hundreds of Phase One and Phase Two ESAs and hydrogeological site assessments for commercial, industrial, and residential clients for a wide variety of project types (industrial complexes, commercial developments, entertainment and institutional buildings, and residential development).

Andrew Cooke, PhD, PEng.

Dr. Andrew Cooke is a licensed professional engineer with a Bachelor's degree in civil engineering and PhD in geoenvironmental engineering from the University of Western Ontario, and has twelve years of professional experience in hydrogeology, and geoenvironmental and geotechnical engineering.

He is the project lead for hydrogeological site assessments and geoenvironmental and hydrogeological monitoring and has been responsible for environmental and hydrogeological field work, water taking approvals, environmental site assessments, and hydrogeological and hydrological modelling. Dr. Cooke has obtained more than twenty PTTW approvals for clients conducting construction dewatering.

F.6 Date of Plan Preparation

This plan prepared on the date: July 8, 2020.

TABLE 1(F)

SUMMARIZED WATER QUALITY MONITORING PLAN FOR DEWATERING DISCHARGE TO A STORM WATER SEWER[1]

PERIOD	MONITORING LOCATION	PARAMETERS[3]	MONITORING FREQUENCY	TRIGGER FOR MITIGATION	MITIGATION MEASURES / COMMENTS
Trial Dewatering	Dewatering discharge	Southgate Township storm sewer bylaw parameters, metals, nitrate, and hardness.	Once during trial dewatering	Water quality exceeds sewer-use bylaw criteria (storm), PWQO, or CCME where no PWQO criteria is available.	Re-sample. Change treatment method (much preferred) and/or dispose discharge water to sanitary sewer (last resort)
During Construction	Dewatering discharge	Southgate Township storm sewer bylaw parameters, metals, nitrate, and hardness.	Every week, then every two weeks after three consecutive compliant samples[2]	Water quality exceeds sewer-use bylaw criteria (storm), PWQO, or CCME where no PWQO criteria is available.	Re-sample. Change treatment method (much preferred) and/or dispose discharge water to sanitary sewer (last resort)
	Discharge point to a natural watercourse	Impact assessment	At each sampling event	Sedimentation, erosion	Reduced pumping and/or improve sediment / erosion control measures

Notes:
1. It is recommended that discharge be treated by a sediment control facility such as a decantation tank or filtration bags.
2. If dewatering moves to a different location or a non-compliant result is detected, the sampling will return to the initial frequency.

TABLE 2(F)

SUMMARIZED WATER QUALITY MONITORING PLAN FOR DEWATERING DISCHARGE TO A WATERCOURSE[1]

PERIOD	MONITORING LOCATION	PARAMETERS[3]	MONITORING FREQUENCY	TRIGGER FOR MITIGATION	MITIGATION MEASURES / COMMENTS
Trial Dewatering	Dewatering discharge	TSS, turbidity, metals, nitrate, and hardness.	Once during trial dewatering	TSS exceeds 25 mg/L, water quality exceeds PWQO, or CCME where no PWQO criteria is available.	Re-sample. Change treatment method (much preferred) and/or dispose discharge water to sanitary sewer (last resort)
During Construction	Dewatering discharge	TSS, turbidity, metals, nitrate, and hardness.	Every week, then every two weeks after three consecutive compliant samples [2]	TSS exceeds 25 mg/L, water quality exceeds PWQO, or CCME where no PWQO criteria is available.	Re-sample. Change treatment method (much preferred) and/or dispose discharge water to sanitary sewer (last resort)
	Discharge point to a natural watercourse	Impact assessment	At each sampling event	Sedimentation, erosion	Reduced pumping and/or improve sediment / erosion control measures

Notes:
1. It is recommended that discharge be treated by a sediment control facility such as a decantation tank or filtration bags.
2. If dewatering moves to a different location or a non-compliant result is detected, the sampling will return to the initial frequency.

TABLE 3(F)

SUMMARIZED GROUND WATER LEVEL MONITORING PLAN

PERIOD	MONITORING LOCATION	METHOD	MONITORING FREQUENCY	TRIGGERS FOR MITIGATION	MITIGATION MEASURES / COMMENTS
Pre-Construction	On-site monitoring wells (BH/MW 1 to 5)	Water level meter	At minimum once prior to dewatering	None	With previous measurement (s), develop baseline water level
	Wetland and BH/MW 6	Monitor elevation of wetland surface and ground water in BH/MW 6	At minimum once prior to dewatering	None	Develop baseline water level
During Construction	On-site monitoring wells (BH/MW 1 to 5)	Water level meter	Every week	Water level more than 1 m lower than proposed	Reduced pumping
	Wetland and BH/MW 6	Monitor elevation of wetland surface and ground water in BH/MW 6	Every week	Decrease in water level with apparent correlation to dewatering.	Contact GRCA. Reduce pumping if GRCA deem the water level to be a risk to aquatic life.
Post- Construction	On-site monitoring wells (BH/MW 1 to 6)	Water level meter	Every two weeks for four weeks, then every four weeks until 90% recovery	Water level recovery less than 90% of baseline level	Continue monitoring

APPENDIX G

Discharge Plan

DISCHARGE PLAN

G.1 Anticipated Construction Dewatering Discharge Rate

The dewatering zone of influence (DZOI) and discharge rate were estimated in Section 6 and Table 3 of the report based on the findings of the hydrogeological investigation and the conceptual hydrogeological site models. Please see Section 6 for assumptions and limitations. Consequently, the seepage into the sewer trenches, and thus the estimated required dewatering rate if sump pumping is used, is about **48,000 L/d per 30 m length** after application of a factor of safety of 2.0. The DZOI is estimated at about 32 m.

With regards to the above assessment, please note the following:

- The discharge rate and DZOI are conservatively estimated to minimize the risk of not being prepared for unanticipated soil or ground water conditions that may require higher pump rates or cause greater dewatering impacts.

- The ground water levels taken in July were assumed for the assessment; higher pump rates can be expected during wetter periods (November through June) and lower pump rates can be expected during drier periods (July through October), based on the water level data collected.

- The model does not include surface water which is to be prevented from entering the excavation area.

- The discharge rates are estimated under steady state conditions. Pumping rates prior to steady state, controlled by the dewatering contractor, are often increased to achieve the desired drawdown in the shortest period of time but must remain below the 400,000 L/d limit for EASR applicability.

- Estimated rates are per 30 m length; the dewatering contractor may use larger or smaller dewatering zones, thus increasing or reducing the estimated dewatering discharge rates.

G.2 Proposed Discharge Method and Location

It is anticipated that the discharge location will be an existing storm sewer and the method of the discharge outflow will be by a hose from the effluent port of a sediment weir tank.

Discharge water temperature is not expected to exceed the limits of the typical Sewer Use Bylaw criterion (40°C for storm sewer) under normal operation.

In the event of a 100-year storm the dewatering operations will be temporarily ceased until storm water flow subsides.

G.3 Erosion and Sediment Control Measures

Erosion and sedimentation should not be of significant concern since it is expected that the discharge will be directed via a hose to a storm sewer, and since the flow rate is not expected to be significant.

Nevertheless, the construction dewatering discharges will follow Best Management Practices, including sediment and erosion control measures as well as the removal of suspended solids by a sediment weir tank together with a water quality and quantity control monitoring program.

G.4 Statements

If discharge is directed to a storm sewer with adherence to the water quantity and quality monitoring program outlined in the Water Taking Plan in Appendix F, no adverse effect on the environment is expected.

In addition, as discussed in Section G.2, above, the discharge water temperature was considered in determining the method of transfer and discharge, and is not expected to have an adverse impact.

G.5 Summary of Qualifications

Shamsul A. Tarafder, MSc, PhD, P.Geo.

Dr. Tarafder is a licensed professional Geoscientist with a B.Sc. (Honours) and M.Sc. in Geology from University of Dhaka, Bangladesh, M.Sc. in Hydrogeology and PhD in Applied Geosciences from University of Tuebingen, Germany, and M.Sc. in Environmental Science from University of Toronto, Canada.

Dr. Tarafder is a Senior Geoscientist and responsible for geoenvironmental and hydrogeological investigations including data acquisition, sampling and monitoring programs, environmental site assessments, hydrogeological site assessments for Permit-To-Take-Water (PTTW) and Environmental Activity and Sector Registry (EASR), geoenvironmental, hydrogeological and hydrological design and modelling and construction inspection. He has completed hundreds of Phase One and Phase Two ESAs and hydrogeological site assessments for commercial, industrial, and residential clients for a wide variety of project types (industrial complexes, commercial developments, entertainment and institutional buildings, and residential development).

Andrew Cooke, PhD, PEng.

Dr. Andrew Cooke is a licensed professional engineer with a Bachelor’s degree in civil engineering and PhD in geoenvironmental engineering from the University of Western Ontario, and has twelve years of professional experience in hydrogeology, and geoenvironmental and geotechnical engineering.

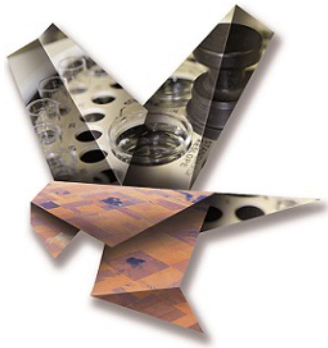
He is the project lead for hydrogeological site assessments and geoenvironmental and hydrogeological monitoring and has been responsible for environmental and hydrogeological field work, water taking approvals, environmental site assessments, and hydrogeological and hydrological modelling. Dr. Cooke has obtained more than twenty PTTW approvals for clients conducting construction dewatering.

G.6 Date of Plan Preparation

This plan prepared on the date: July 8, 2020.

APPENDIX H

Ground Water Sample Laboratory Results



FINAL REPORT

CA14181-FEB20 R1

19KF007 Dundalk - White Rose

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	16 Franklin St S Kitchener, ON N2C 1R4, Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Dylan Patterson	Telephone	705-652-2143
Telephone	519-893-7500	Facsimile	705-652-6365
Facsimile	519-893-0654	Email	brad.moore@sgs.com
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.cor	SGS Reference	CA14181-FEB20
Project	19KF007 Dundalk - White Rose	Received	02/05/2020
Order Number		Approved	02/14/2020
Samples	Ground Water (1)	Report Number	CA14181-FEB20 R1
		Date Reported	02/14/2020

COMMENTS

RL - SGS Reporting Limit

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present: yes

Custody Seal Present: yes

Chain of Custody Number: 008696

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

SGS

FINAL REPORT

CA14181-FEB20 R1

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **SANSEW - General Chemistry** (WATER)

Sample Number 8

Sample Name MW3 GW 1001

Sample Matrix Ground Water

Sample Date 05/02/2020

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Parameter	Units	RL	L1	L2	Result
General Chemistry					
Biochemical Oxygen Demand (BOD5)	mg/L	2	300		< 4↑
Chemical Oxygen Demand	mg/L	8	600		< 8
Total Kjeldahl Nitrogen	as N mg/L	0.5	50		< 0.5
Total Suspended Solids	mg/L	2	300	15	11

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

Sample Number 8

Sample Name MW3 GW 1001

Sample Matrix Ground Water

Sample Date 05/02/2020

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Parameter	Units	RL	L1	L2	Result
Metals and Inorganics					
Cyanide (total)	mg/L	0.01	1.2		< 0.01
Sulphide	mg/L	0.02			< 0.02
Arsenic (total)	mg/L	0.0002	1		0.0012
Cadmium (total)	mg/L	0.000003	0.7	0.001	0.000006
Chromium (total)	mg/L	0.00008	3	0.2	0.00062
Cobalt (total)	mg/L	0.000004	5		0.000176
Copper (total)	mg/L	0.0002	2	0.01	0.0010
Lead (total)	mg/L	0.00001	3	0.05	0.00080

PACKAGE: **SANSEW - Metals and Inorganics** (WATER)

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

				Sample Number	8
				Sample Name	MW3 GW 1001
				Sample Matrix	Ground Water
				Sample Date	05/02/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**
Metals and Inorganics (continued)					
Molybdenum (total)	mg/L	0.00004	5		0.00261
Nickel (total)	mg/L	0.0001	2	0.05	0.0004
Phosphorus (total)	mg/L	0.003	10		0.021
Selenium (total)	mg/L	0.00004	2		0.00013
Silver (total)	mg/L	0.00005	1		< 0.00005
Zinc (total)	mg/L	0.002		0.05	0.004

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

				Sample Number	8
				Sample Name	MW3 GW 1001
				Sample Matrix	Ground Water
				Sample Date	05/02/2020
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**
Oil and Grease					
Oil & Grease (total)	mg/L	2			< 2
Oil & Grease (animal/vegetable)	mg/L	4	150		< 4
Oil & Grease (mineral/synthetic)	mg/L	4	15		< 4

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **SANSEW - Other (ORP)** (WATER)

Sample Number 8
Sample Name MW3 GW 1001
Sample Matrix Ground Water
Sample Date 05/02/2020

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Parameter	Units	RL	L1	L2	Result
Other (ORP)					
pH	no unit	0.05	10.5	9	8.04
Mercury (total)	mg/L	0.00001	0.1	0.001	< 0.00001

PACKAGE: **SANSEW - PCBs** (WATER)

Sample Number 8
Sample Name MW3 GW 1001
Sample Matrix Ground Water
Sample Date 05/02/2020

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Parameter	Units	RL	L1	L2	Result
PCBs					
Polychlorinated Biphenyls (PCBs) - Total	mg/L	0.0001	0.004		< 0.0001

PACKAGE: **SANSEW - Phenols** (WATER)

Sample Number 8
Sample Name MW3 GW 1001
Sample Matrix Ground Water
Sample Date 05/02/2020

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Parameter	Units	RL	L1	L2	Result
Phenols					
4AAP-Phenolics	mg/L	0.002			< 0.002

PACKAGE: **SANSEW - SVOCs** (WATER)

Sample Number 8
Sample Name MW3 GW 1001

PACKAGE: **SANSEW - SVOCs** (WATER)

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Sample Number: 8
Sample Name: MW3 GW 1001
Sample Matrix: Ground Water
Sample Date: 05/02/2020

Parameter	Units	RL	L1	L2	Result
SVOCs					
Hexachlorobenzene	mg/L	0.00001	0.0001		< 0.0001↑

PACKAGE: **SANSEW - VOCs** (WATER)

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Sample Number: 8
Sample Name: MW3 GW 1001
Sample Matrix: Ground Water
Sample Date: 05/02/2020

Parameter	Units	RL	L1	L2	Result
VOCs					
Chloroform	mg/L	0.0005	0.04		< 0.0005
1,2-Dichlorobenzene	mg/L	0.0005	0.05		< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005	0.08		< 0.0005
Methylene Chloride	mg/L	0.0005	0.09		< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.0005	0.06		< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	0.06		< 0.0005
Trichloroethylene	mg/L	0.0005	0.05		< 0.0005

FINAL REPORT

CA14181-FEB20 R1

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **SANSEW - VOCs - BTEX** (WATER)

L1 = SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011

L2 = SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011

Sample Number 8

Sample Name MW3 GW 1001

Sample Matrix Ground Water

Sample Date 05/02/2020

Parameter	Units	RL	L1	L2	Result
VOCs - BTEX					
Benzene	mg/L	0.0005	0.01		< 0.0005
Ethylbenzene	mg/L	0.0005	0.06		< 0.0005
Toluene	mg/L	0.0005	0.02		< 0.0005
Xylene (total)	mg/L	0.0005			< 0.0005
m-p-xylene	mg/L	0.0005			< 0.0005
o-xylene	mg/L	0.0005			< 0.0005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	SANSEW / WATER / - - Southgate Sewer Use - Sanitary and Combined Sewer Discharge - BL_13_2011 L1	SANSEW / WATER / - - Southgate Sewer Use - Storm Sewer Discharge - BL_13_2011 L2
MW3 GW 1001					
Zinc	SM 3030/EPA 200.8	mg/L	0.004	0	

QC SUMMARY

Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0008-FEB20	mg/L	2	< 2	6	30	83	70	130	86	70	130

Chemical Oxygen Demand

Method: HACH 8000 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chemical Oxygen Demand	EWL0089-FEB20	mg/L	8	<8	2	20	94	80	120	81	75	125

Cyanide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0055-FEB20	mg/L	0.01	<0.01	ND	10	93	90	110	NV	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0008-FEB20	mg/L	0.00001	< 0.00001	ND	20	95	80	120	97	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0032-FEB20	mg/L	0.00005	<0.00005	2	20	101	90	110	80	70	130
Arsenic (total)	EMS0032-FEB20	mg/L	0.0002	<0.0002	1	20	98	90	110	NV	70	130
Cadmium (total)	EMS0032-FEB20	mg/L	0.000003	<0.000003	3	20	99	90	110	93	70	130
Cobalt (total)	EMS0032-FEB20	mg/L	0.000004	<0.000004	3	20	100	90	110	94	70	130
Chromium (total)	EMS0032-FEB20	mg/L	0.00008	<0.00008	5	20	98	90	110	120	70	130
Copper (total)	EMS0032-FEB20	mg/L	0.0002	<0.0002	5	20	100	90	110	77	70	130
Molybdenum (total)	EMS0032-FEB20	mg/L	0.00004	<0.00004	4	20	94	90	110	103	70	130
Nickel (total)	EMS0032-FEB20	mg/L	0.0001	<0.0001	3	20	96	90	110	98	70	130
Lead (total)	EMS0032-FEB20	mg/L	0.00001	<0.00001	11	20	97	90	110	NV	70	130
Phosphorus (total)	EMS0032-FEB20	mg/L	0.003	<0.003	4	20	92	90	110	NV	70	130
Selenium (total)	EMS0032-FEB20	mg/L	0.00004	<0.00004	1	20	103	90	110	101	70	130
Zinc (total)	EMS0032-FEB20	mg/L	0.002	<0.002	2	20	105	90	110	NV	70	130

QC SUMMARY

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
Oil & Grease (total)	GCM0099-FEB20	mg/L	2	<2	NSS	20	102	75	125			

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
Oil & Grease (animal/vegetable)	GCM0099-FEB20	mg/L	4	< 4	NSS	20	NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0099-FEB20	mg/L	4	< 4	NSS	20	NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
pH	EWL0090-FEB20	no unit	0.05	NA	0		101			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0050-FEB20	mg/L	0.002	<0.002	ND	10	104	90	110	104	75	125

Polychlorinated Biphenyls

Method: MOE E3400/EPA 8082A | Internal ref.: ME-CA-[ENV]GC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Polychlorinated Biphenyls (PCBs) - Total	GCM0096-FEB20	mg/L	0.0001	<0.0001	ND	30	111	60	140	114	60	140

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hexachlorobenzene	GCM0091-FEB20	mg/L	0.00001	< 0.0001	NSS	30	86	50	140	NSS	50	140

QC SUMMARY

Sulphide by SFA

Method: SM 4500 | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0053-FEB20	mg/L	0.02	<0.02	ND	20	99	80	120	NA	75	125

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0103-FEB20	mg/L	2	< 2	3	10	NV	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0052-FEB20	as N mg/L	0.5	<0.5	7	10	100	90	110	102	75	125

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,2,2-Tetrachloroethane	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	85	60	130	98	50	140
1,2-Dichlorobenzene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	93	60	130	100	50	140
1,4-Dichlorobenzene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	98	60	130	101	50	140
Benzene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	102	60	130	101	50	140
Chloroform	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	100	60	130	100	50	140
Ethylbenzene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	104	60	130	101	50	140
m-p-xylene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	105	60	130	101	50	140
Methylene Chloride	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	96	60	130	96	50	140
o-xylene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	103	60	130	101	50	140
Tetrachloroethylene (perchloroethylene)	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	103	60	130	102	50	140
Toluene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	102	60	130	102	50	140
Trichloroethylene	GCM0109-FEB20	mg/L	0.0005	<0.0005	ND	30	101	60	130	101	50	140

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates 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.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

-- End of Analytical Report --

SGS Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 008696

Page ___ of ___

Laboratory Information Section - Lab use only

Received By: Olay Mozhi
Received Date (mm/dd/yy): 2/5/20 (mm\dd\yy)
Received Time: 15:30
Received By (signature): [signature]
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑ ice pack
Temperature Upon Receipt (°C): 6, 6, 6
LAB LIMS #: CA14181/14867-Feb

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin St S
Phone: 519-893-7500
Email: dpatterson@petomaccallum.com
Email: acooke@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 19KF007
Site Location/ID: Dundalk - White Rose

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ☐ R/P/I ☐ I/C/C ☐ A/O

Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH☐ ABN☐ SVOC(all)☐	PCB Total ☐ Aroclor ☐	PHC F1-F4☐ VOC☐ BTEX☐ BTEX/F1☐ F2-F4☐	VOC☐ BTEX☐ THM☐	Pesticides OC☐ OP☐	TCLP M&I☐ VOC☐ PCB☐ B(a)P☐ ABN☐ Ignit.☐	Water Pkg Gen.☐ Ext.☐	Sewer Use:						COMMENTS:
1	MW3 GW100	02/05/20	12 pm	21	GW																
2																					-1 set of Southgate Township
3																					storm & sanitary sewer bylaw
4																					-2 sets of PWQO metals
5																					suite (one with instruction to
6																					lab filter)
7																					-2 sets of Hardness, Alkalinity,
8																					Nitrate (one with instructions to
9																					lab filter)
10																					
11																					
12																					

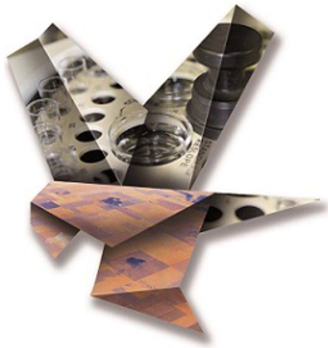
Observations/Comments/Special Instructions

Sampled By (NAME): Dylan Patterson
Signature: [signature]
Date: 02/05/20 (mm/dd/yy)

Relinquished by (NAME):
Signature:
Date: 02/05/20 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018



FINAL REPORT

CA14186-FEB20 R

19KF007 Dundalk - White Rose

Prepared for

Peto MacCallum Ltd

SGS

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	16 Franklin St S Kitchener, ON N2C 1R4, Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Dylan Patterson	Telephone	705-652-2143
Telephone	519-893-7500	Facsimile	705-652-6365
Facsimile	519-893-0654	Email	brad.moore@sgs.com
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.cor	SGS Reference	CA14186-FEB20
Project	19KF007 Dundalk - White Rose	Received	02/05/2020
Order Number		Approved	02/10/2020
Samples	Ground Water (2)	Report Number	CA14186-FEB20 R
		Date Reported	02/10/2020

COMMENTS

PWQO - Provincial Water Quality Objectives

Limits based on MOE PIBS 3303E publication July 1994 reprinted February 1999

a PWQO limit based on pH >6.5-9.0 (at pH 4.5-5.5 PWQO = 15ug/L, pH >5.5-6.5 PWQO 10% above background levels in geological area.

b PWQO limit based on Hardness <75 mg/L (For Hardness >75 mg/L PWQO = 1100 ug/L)

c PWQO limit based on Hardness 0-100 mg/L(For Hardness >100 mg/L PWQO = 0.5 ug/L)

d PWQO limit based on Cr VI (PWQO limit for Cr III = 8.9 ug/L)

e PWQO limit based on Hardness 0-20 (For Hardness >20 mg/L PWQO = 5 ug/L)

f PWQO limit based on Hardness <30 (For Hardness 30-80 PWQO = 3 ug/L, & >80 PWQO=5)

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA14186-FEB20 R

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **PWQO - Metals and Inorganics** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

			Sample Number	6	7
			Sample Name	MW3 GW 1001	MW3 GW 1001_Dissolved
			Sample Matrix	Ground Water	Ground Water
			Sample Date	05/02/2020	05/02/2020
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**
Metals and Inorganics					
Silver	µg/L	0.05	0.1	< 0.05	< 0.05
Aluminum (0.2µm)	mg/L	0.001	0.015	0.035	
Arsenic	µg/L	0.2	5	1.3	1.3
Boron	µg/L	2	200	30	31
Beryllium	µg/L	0.007	11	< 0.007	< 0.007
Cadmium	µg/L	0.003	0.1	0.013	0.025
Cobalt	µg/L	0.004	0.9	0.234	0.054
Chromium	µg/L	0.08		0.90	0.27
Copper	µg/L	0.2	1	1.4	1.1
Iron	ug/L	7	300	230	52
Molybdenum	µg/L	0.04	40	2.58	2.54
Nickel	µg/L	0.1	25	0.6	0.2
Phosphorus	mg/L	0.003	0.01	0.023	0.014
Lead	µg/L	0.01	1	1.30	0.07
Antimony	µg/L	0.09	20	0.46	0.98
Selenium	µg/L	0.04	100	0.14	0.11
Thallium	µg/L	0.005	0.3	< 0.005	< 0.005
Uranium	µg/L	0.002	5	1.90	1.74
Vanadium	µg/L	0.01	6	1.15	0.72
Tungsten	µg/L	0.02	30	0.08	0.07
Zinc	µg/L	2	20	4	15
Zirconium	µg/L	2	4	< 2	< 2

FINAL REPORT

CA14186-FEB20 R

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **PWQO - Other (ORP)** (WATER)

L1 = PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E

			Sample Number	6	7
			Sample Name	MW3 GW 1001	MW3 GW 1001_Dissolved
			Sample Matrix	Ground Water	Ground Water
			Sample Date	05/02/2020	05/02/2020
Parameter	**Units**	**RL**	**L1**	**Result**	**Result**
Other (ORP)					
Chromium VI	µg/L	0.2	1	< 0.2	< 0.2
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001	< 0.00001

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQO / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1

MW3 GW 1001

Parameter	Method	Units	Result	L1
Aluminum (dissolved)	SM 3030/EPA 200.8	µg/L	0.035	0.015
Copper	SM 3030/EPA 200.8	µg/L	1.4	1
Lead	SM 3030/EPA 200.8	µg/L	1.30	1
Phosphorus	SM 3030/EPA 200.8	µg/L	0.023	0.01

MW3 GW 1001_Dissolved

Parameter	Method	Units	Result	L1
Copper	SM 3030/EPA 200.8	µg/L	1.1	1
Phosphorus	SM 3030/EPA 200.8	µg/L	0.014	0.01

FINAL REPORT

QC SUMMARY

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-[ENV]SKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA0057-FEB20	ug/L	0.2	<0.2	4	20	105	80	120	90	75	125

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0008-FEB20	mg/L	0.00001	< 0.00001	ND	20	95	80	120	97	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0032-FEB20	ug/L	0.05	<0.00005	2	20	101	90	110	80	70	130
Aluminum (0.2µm)	EMS0032-FEB20	mg/L	0.001	<0.001	11	20	98	90	110	NV	70	130
Arsenic	EMS0032-FEB20	ug/L	0.2	<0.0002	1	20	98	90	110	NV	70	130
Beryllium	EMS0032-FEB20	ug/L	0.007	<0.000007	11	20	98	90	110	96	70	130
Boron	EMS0032-FEB20	ug/L	2	<0.002	1	20	90	90	110	NV	70	130
Cadmium	EMS0032-FEB20	ug/L	0.003	<0.000003	3	20	99	90	110	93	70	130
Cobalt	EMS0032-FEB20	ug/L	0.004	<0.000004	3	20	100	90	110	94	70	130
Chromium	EMS0032-FEB20	ug/L	0.08	<0.00008	5	20	98	90	110	120	70	130
Copper	EMS0032-FEB20	ug/L	0.2	<0.0002	5	20	100	90	110	77	70	130
Iron	EMS0032-FEB20	ug/L	7	<0.007	5	20	92	90	110	NV	70	130
Molybdenum	EMS0032-FEB20	ug/L	0.04	<0.00004	4	20	94	90	110	103	70	130
Nickel	EMS0032-FEB20	ug/L	0.1	<0.0001	3	20	96	90	110	98	70	130
Lead	EMS0032-FEB20	ug/L	0.01	<0.00001	11	20	97	90	110	NV	70	130
Phosphorus	EMS0032-FEB20	mg/L	0.003	<0.003	4	20	92	90	110	NV	70	130
Antimony	EMS0032-FEB20	ug/L	0.09	<0.0009	7	20	99	90	110	114	70	130
Selenium	EMS0032-FEB20	ug/L	0.04	<0.00004	1	20	103	90	110	101	70	130
Thallium	EMS0032-FEB20	ug/L	0.005	<0.000005	2	20	98	90	110	101	70	130
Uranium	EMS0032-FEB20	ug/L	0.002	<0.000002	5	20	100	90	110	107	70	130
Vanadium	EMS0032-FEB20	ug/L	0.01	<0.00001	6	20	99	90	110	121	70	130
Tungsten	EMS0032-FEB20	ug/L	0.02	<0.00002	7	20	92	90	110	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 I Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Zinc	EMS0032-FEB20	ug/L	2	<0.002	2	20	105	90	110	NV	70	130
Zirconium	EMS0032-FEB20	ug/L	2	<0.002	ND	20	93	90	110	NV	70	130

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates 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.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 008696

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Olay Mozhiv
Received Date (mm/dd/yyyy) 2/5/20 (mm\dd\yy)
Received Time: 15:30
Received By (signature): [signature]
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑ ice pack
Temperature Upon Receipt (°C) 6, 6, 6
LAB LIMS #: CA14181/14186-87-Feb20

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin St S
Phone: 519-893-7500
Email: dpatterson@petomaccallum.com
Email: acooke@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 19KF007
Site Location/ID: Dundalk - White Rose

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ R/P/I ☐ Table 2 ☐ I/C/C ☐ Table 3 ☐ A/O ☐ Table ____

Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH☐ ABN☐ SVOC(all)☐	PCB Total ☐ Aroclor ☐	PHC F1-F4☐ VOC☐ BTEX☐ BTEX/F1☐ F2-F4☐	VOC☐ BTEX☐ THM☐	Pesticides OC☐ OP☐	TCLP M&I☐ VOC☐ PCB☐ B(a)P☐ ABN☐ Ignit.☐	Water Pkg Gen.☐ Ext.☐	Sewer Use:					COMMENTS:
1	MW3 GW 1001	02/05/20	12 pm	21	GW															-1 set of Southgate Township storm & sanitary sewer bylaw -2 sets of PWQO metals suite (one with instruction to lab filter) -2 sets of Hardness, Alkalinity, Nitrate (one with instructions to lab filter)
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions

Sampled By (NAME): Signature: Date: 02/05/20 (mm/dd/yy) Pink Copy - Client

Relinquished by (NAME): Dylan Patterson Signature: Dylan Patterson Date: 02/05/20 (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA14187-FEB20 R---

19KF007 Dundalk - White Rose

Prepared for

Peto MacCallum Ltd

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Peto MacCallum Ltd	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	16 Franklin St S Kitchener, ON N2C 1R4, Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Dylan Patterson	Telephone	705-652-2143
Telephone	519-893-7500	Facsimile	705-652-6365
Facsimile	519-893-0654	Email	brad.moore@sgs.com
Email	dpatterson@petomaccallum.com; khanes@petomaccallum.cor	SGS Reference	CA14187-FEB20
Project	19KF007 Dundalk - White Rose	Received	02/05/2020
Order Number		Approved	02/10/2020
Samples	Ground Water (2)	Report Number	CA14187-FEB20 R---
		Date Reported	02/10/2020

COMMENTS

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA14187-FEB20 R---

Client: Peto MacCallum Ltd

Project: 19KF007 Dundalk - White Rose

Project Manager: Dylan Patterson

Samplers: Dylan Patterson

PACKAGE: **- General Chemistry** (WATER)

				Sample Number	5	6
				Sample Name	MW3 GW 1001	MW3 GW 1001_Dissolved
				Sample Matrix	Ground Water	Ground Water
				Sample Date	05/02/2020	05/02/2020
Parameter	**Units**	**RL**			**Result**	**Result**
General Chemistry						
Alkalinity	mg/L as CaCO3	2			293	292

PACKAGE: **- Metals and Inorganics** (WATER)

				Sample Number	5	6
				Sample Name	MW3 GW 1001	MW3 GW 1001_Dissolved
				Sample Matrix	Ground Water	Ground Water
				Sample Date	05/02/2020	05/02/2020
Parameter	**Units**	**RL**			**Result**	**Result**
Metals and Inorganics						
Hardness	mg/L as CaCO3	0.05			307	294
Nitrite (as N)	as N mg/L	0.03			< 0.03	< 0.03
Nitrate (as N)	as N mg/L	0.06			< 0.06	0.12
Nitrate + Nitrite (as N)	as N mg/L	0.06			< 0.06	0.12

QC SUMMARY

Alkalinity

Method: SM 2320 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0096-FEB20	mg/L as CaCO3	2	< 2	0	10	104	80	120	NA		

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nitrate + Nitrite (as N)	DIO0083-FEB20	mg/L	0.06	<0.06	NA		NA			NA		
Nitrite (as N)	DIO0083-FEB20	mg/L	0.03	<0.03	ND	20	105	80	120	113	75	125
Nitrate (as N)	DIO0083-FEB20	mg/L	0.06	<0.06	ND	20	104	80	120	109	75	125

QC SUMMARY

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0032-FEB20	mg/L as CaCO3	0.05	<0.01	4	20	93	90	110	72	70	130
Hardness	EMS0041-FEB20	mg/L as CaCO3	0.05	<0.01	1	20	101	90	110	NV	70	130

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates 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.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. “Temperature Upon Receipt” is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act” published by the Ministry and dated March 9, 2004 as amended.

-- End of Analytical Report --

SGS

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 008696

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Olay Mozhiv
Received Date (mm/dd/yyyy): 2.5.20 (mm\dd\yy)
Received Time: 15:30
Received By (signature): [signature]
Custody Seal Present: ☐ –
Custody Seal Intact: ☑
Cooling Agent Present: ☑ ice pack
Temperature Upon Receipt (°C): 6,6,6
LAB LIMS #: CA14181/14186-87-Feb

REPORT INFORMATION

Company: Peto MacCallum
Contact: Dylan Patterson
Address: 16 Franklin ST S
Phone: 519-893-7500
Email: dpatterson@petomaccallum.com
Email: acooke@petomaccallum.com

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #: ____ P.O. #: ____
Project #: 19KF007
Site Location/ID: Dundalk - White Rose

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH☐ ABN☐ SVOC(all)☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☐ VOC☐ BTEX☐ BTEX/F1☐ F2-F4☐	VOC☐ BTEX☐ THM☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB☐ B(a)P ☐ ABN ☐ Ignit.☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	COMMENTS:
1	MW3 GW 100	02/05/20	12 pm	21	GW											
2																-1 set of Southgate Township storm & sanitary sewer bylaw
3																-2 sets of PWQO metals suite (one with instruction to lab filter)
4																-2 sets of Hardness, Alkalinity, Nitrate (one with instructions to lab filter)
5																
6																
7																
8																
9																
10																
11																
12																

Observations/Comments/Special Instructions

Sampled By (NAME): Signature:
Relinquished by (NAME): Dylan Patterson Signature: Dylan Patterson
Date: 02/05/20 (mm/dd/yy)
Date: 02/05/20 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

APPENDIX I

Statement of Limitations

STATEMENT OF LIMITATIONS

This report is prepared for and made available for the sole use of the client named. Peto MacCallum Ltd. (PML) hereby disclaims any liability or responsibility to any person or entity, other than those for whom this report is specifically issued, for any loss, damage, expenses, or penalties that may arise or result from the use of any information or recommendations contained in this report. The contents of this report may not be used or relied upon by any other person without the express written consent and authorization of PML.

This report shall not be relied upon for any purpose other than as agreed with the client named without the written consent of PML. It shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. A portion of this report may not be used as a separate entity: that is to say the report is to be read in its entirety at all times.

The report is based solely on the scope of services which are specifically referred to in this report. No physical or intrusive testing has been performed, except as specifically referenced in this report. This report is not a certification of compliance with past or present regulations, codes, guidelines and policies.

The scope of services carried out by PML is based on details of the proposed development and land use to address certain issues, purposes and objectives with respect to the specific site as identified by the client. Services not expressly set forth in writing are expressly excluded from the services provided by PML. In other words, PML has not performed any observations, investigations, study analysis, engineering evaluation or testing that is not specifically listed in the scope of services in this report. PML assumes no responsibility or duty to the client for any such services and shall not be liable for failing to discover any condition, whose discovery would require the performance of services not specifically referred to in this report.

STATEMENT OF LIMITATIONS
(continued)

The findings and comments made by PML in this report are based on the conditions observed at the time of PML's site reconnaissance. No assurances can be made and no assurances are given with respect to any potential changes in site conditions following the time of completion of PML's field work. Furthermore, regulations, codes and guidelines may change at any time subsequent to the date of this report and these changes may affect the validity of the findings and recommendations given in this report.

The results and conclusions with respect to site conditions are therefore in no way intended to be taken as a guarantee or representation, expressed or implied, that the site is free from any contaminants from past or current land use activities or that the conditions in all areas of the site and beneath or within structures are the same as those areas specifically sampled.

Any investigation, examination, measurements or sampling explorations at a particular location may not be representative of conditions between sampled locations. Soil, ground water, surface water, or building material conditions between and beyond the sampled locations may differ from those encountered at the sampling locations and conditions may become apparent during construction which could not be detected or anticipated at the time of the intrusive sampling investigation.

Budget estimates contained in this report are to be viewed as an engineering estimate of probable costs and provided solely for the purposes of assisting the client in its budgeting process. It is understood and agreed that PML will not in any way be held liable as a result of any budget figures provided by it.

The Client expressly waives its right to withhold PML's fees, either in whole or in part, or to make any claim or commence an action or bring any other proceedings, whether in contract, tort, or otherwise against PML in anyway connected with advice or information given by PML relating to the cost estimate or Environmental Remediation/Cleanup and Restoration or Soil and Ground Water Management Plan Cost Estimate.