Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL/HYRDOGEOLOGICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
ARDAGH ROAD AND SUMMERSET DRIVE
BARRIE, ONTARIO

for

WYNSTAR BEAR CREEK LP

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

March 23, 2021

PML Ref.: 21BX003
Report: 1

Mr. David Seaman
Wynstar Bear Creek LP
100 New Park Place, Suite 820
Vaughan, Ontario
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Dear Mr. Seaman

Geotechnical/Hydrogeological Investigation
Proposed Residential Development
Ardagh Road and Summerset Drive
Barrie, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical/hydrogeological investigation recently completed at the above noted project site. Authorization for this work was provided by Mr. D. Seaman in an email dated January 12, 2021, with the provision of Purchase Order No. WBC-10013.

A residential development is proposed for the parcel of land between Ardagh Road and the meandering Summerset Drive in Barrie. A six-storey condominium building is currently proposed and two levels of underground parking are being considered. Approximately 220 back-to-back town homes are proposed without basements (slab-on-grade). Full municipal servicing is proposed along with a network of internal paved roads. A Storm Water Management (SWM) pond is proposed for the northeast corner of the site. It is understood grades will likely be raised 1.0 to 2.0 m. The preliminary concept plans for the property layout are shown on Drawing 1, appended.

A geotechnical/hydrogeological investigation has been requested to determine the general subsurface conditions at the site, and based on this information, provide geotechnical engineering recommendations for earthworks, building foundations and basements, site servicing, SWM pond and pavement design. Hydrogeological input will be provided for preliminary LID parameters, preliminary water quality assessment, ground water levels, gradient, and flow direction.

Geoenvironmental services (observations, recording, chemical testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. If excess excavated soils requiring transportation off-site are generated, a program of sampling and chemical testing will be needed to determine the chemical properties of the soil to evaluate appropriate receiving site options, in accordance with O.Reg. 406/19.

We trust the report is complete within our terms of reference and the information presented is sufficient for your present purposes. If you have any questions or when we may be of further service, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

Geoffrey R. White, P.Eng.
Director
Manager, Geotechnical Services

AK/DP/GRW:tc

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1. INTRODUCTION

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this work was provided by Mr. D. Seaman in the signed Engineering Services Agreement, dated January 12, 2021 with the provision of Purchase Order No. WBC-10013.

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The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to re-assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

This report is subject to the Statement of Limitations in Appendix A and should be read in conjunction with the report.

2. INVESTIGATION PROCEDURES

2.1 Borehole Drilling and Monitoring Well Installation

The field work for the investigation was carried out February 8 and 9, 2021 and consisted of Boreholes 1 to 13. Two boreholes were advanced to 6.5 m and two boreholes were advanced to 8.0 m depth for the condominium building. Nine boreholes were advanced to 5.0 m depth across the remainder of the site. The borehole locations are shown on Drawing 1, appended.

PML laid out the boreholes in the field. The ground surface elevation at the borehole locations, with the exception of Boreholes 8 and 9, were obtained with a Sokkia SHC5000 GPS System equipped with a GCX3 (network RTK rover) Global Navigation Satellite System (GNSS) Receiver. Vertical and horizontal accuracy of the GPS unit are 0.1 m and 0.5 m, respectively.

Surface elevations for Boreholes 8 and 9, were established relative to a Temporary Bench Mark (TBM), described as follows:

TBM: Temporary Bench Mark
Borehole 10
Elevation 238.50 (metric, geodetic)

All borehole elevations in this report are geodetic and expressed in metres.

Co-ordination for clearances of underground utilities was provided by PML. The boreholes were advanced cognizant of the underground utilities.

The boreholes were advanced using continuous flight solid stem augers, powered by a track mounted CME-55 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of PML's engineering staff.

The thickness of the topsoil unit, where encountered at borehole locations, was measured in hand dug divots.

Representative samples of the overburden were recovered at frequent depth intervals for identification purposes using a conventional 51 mm OD split spoon sampler. The sampler excludes particles larger than 38 mm. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the subsoil. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler, and drill rods as the samples were retrieved, and measurement of the water level in the open boreholes, if any.

Monitoring wells, comprised of 50 mm diameter pipe, filter sand, bentonite seal, and stick-up protection casing, were installed in six boreholes. The details of the monitoring well installation are shown on the applicable Log of Borehole Sheets. It should be noted that the wells become the property of the Owner and will have to be decommissioned by the Owner when no longer required. PML would be pleased to assist, if requested.

Boreholes without wells were backfilled in accordance with O.Reg. 903.

All recovered samples were returned to our laboratory for detailed examination and moisture content determinations. Grain size analyses were carried out on seven representative samples of the major soil unit. The results are provided on Figure 1, appended.

Geotechnical engineering considerations are provided in Section 5.

2.2 Borehole Permeability Testing

In order to estimate the hydraulic conductivity of the soils surrounding the well screens, borehole permeability testing was conducted in the monitoring wells in Boreholes 1, 4, 10, 12, and 13, on March 10, 2021.

The field permeability testing was conducted by using the rising head method, in which periodic water level measurements were recorded manually, as well as using an electronic data recorder

or transducer, as the water level recovered inside the monitoring wells after rapid removal of a volume of water. The field permeability testing was completed after well development, which consisted of removing an equivalent of about ten times the well volume.

After purging the monitoring well, the rising head data was recorded at intervals of one second using a datalogger until the water level returned to the equilibrium condition or until a steady state was attained.

Aqtesolv, which is a specialized software designed to interpret aquifer tests, was utilized in the interpretation of the field permeability results. The results are included in Appendix B and further discussed in Section 6.0.

2.3 Ground Water Sampling

On March 10, 2021, a ground water sample was obtained from the monitoring well in Borehole 12 for chemical analyses. Following well development and the borehole permeability testing the ground water sample was collected and submitted for chemical testing as described below. The ground water sample was kept cool with ice in a cooler until delivery to the laboratory for analysis.

The ground water sample was delivered to Caduceon Environmental Laboratories (Caduceon) for chemical analyses. Caduceon Laboratories is accredited by The Standards Council of Canada (SCC) and CALA.

To address the potential in-construction ground water dewatering discharge quality issues, the ground water sample was analyzed for the City of Barrie Storm and Sanitary Sewer Use Criteria and Provincial Water Quality Objectives (PWQO) metals.

The Chain-of-Custody Record and the laboratory certificates of analyses are included in Appendix C.

2.4 Ground Water Level Monitoring Program

An six month ground water level monitoring program is currently on-going and results will be provided under a separate cover when completed. Ground water levels recorded to date are provided in this report.

Hydrogeological considerations are presented in Section 6.

3. SITE SETTING

The site is located in the northeast quadrant of Ardagh Road and Summerset Drive intersection and is about 4.5 ha in size.

The site is undeveloped and treed, within a predominately residential area.

3.1 Physiography and Topography

The site is located within the physiographic region known as the Simcoe Lowlands comprising sand plains (Chapman and Putnam, 1984). To the south of the site the land is characterized as till plains of the Peterborough Drumlin Field.

The Ontario Department of Agriculture Soil Report notes the near surface soils are part of the Tioga Series consisting of sand loam (good drainage) with smooth gently to steeply sloping topography.

The borehole elevations indicate about 3.5 m of relief across the site, ranging from elevation 238.5 to elevation 242.0.

3.2 Drainage and Surface Water Flow

A creek is located immediately to the east and the Bear Creek Wetland lies to the north of the site. Surface drainage on the site is expected to follow the topography towards the north to the Bear Creek wetland.

4. GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Geology

Bedrock below the overburden is mapped as limestone, dolostone, shale, arkose, and sand stone of the Simcoe Group from the Middle Ordovian period of the Paleozoic era of the Phanerzoic eon. Bedrock is typically over 120 m in the area based on the Ontario Division of Mines Map P-980 Drift Thickness Series for the Barrie Area.

4.2 Subsurface Conditions

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, existing topsoil thicknesses, inferred stratigraphy and thicknesses, Standard Penetration test N Values (N Values, blows per 300 mm penetration of the split spoon sampler), ground water observations and well installation details, and the results of laboratory moisture content determinations.

Due to the soil sampling procedures and the limited size of samples, the depth/elevation demarcations on the borehole logs must be viewed as “transitional” zones and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in defining the geological boundaries in the field during construction, if required.

The site is characterized by topsoil over gravelly sand/sand. A description of the distribution and characteristics of the soil units and ground water observations encountered in the boreholes is presented below.

4.3 Soil

Topsoil was encountered at the surface of all boreholes, ranging in thickness from 50 to 250 mm.

A major sand deposit was encountered in all boreholes beneath the topsoil, extending to the 5.0 to 8.0 m depth of exploration. The deposit comprised sand with trace to some silt and gravel, locally gravelly sand with trace silt. Seven samples of the material were submitted for grain size

analysis and the results are presented on Figure 1, appended. Cobbles were noted during drilling in some boreholes. The unit was very loose to very dense, with N Values of 2 to greater than 50, typically compact to dense. Moisture contents ranged from 3 to 19%, being moist in the upper portion becoming wet below about 2.0 to 4.0 m depth.

4.4 Ground Water

The first ground water strike during drilling, the water level in the boreholes upon completion, and measured in the wells about two weeks after installation are provided below.

BOREHOLE	FIRST STRIKE DURING DRILLING DEPTH (m) / ELEVATION	UPON COMPLETION OF AUGERING DEPTH (m) / ELEVATION	WATER LEVEL IN WELL DEPTH (m) / ELEVATION	
			2021-03-05	2021-03-10
1	2.9 / 236.0	3.0 / 235.9	2.5 / 236.4	2.6 / 236.3
2	4.0 / 235.2	3.2 / 236.0	--	--
3	4.0 / 235.9	4.0 / 235.9	--	--
4	4.0 / 235.6	4.0 / 235.6	3.1 / 236.5	3.1 / 236.5
5	No Water	4.3 / 236.6	--	--
6	4.0 / 237.5	4.4 / 237.1	Dry	Dry
7	No Water	4.4 / 237.6	--	--
8	4.0 / 237.1	3.7 / 237.4	--	--
9	4.3 / 236.6	4.4 / 236.5	--	--
10	2.9 / 235.6	2.4 / 236.1	2.3 / 236.2	2.4 / 236.1
11	3.4 / 236.1	3.2 / 236.3	--	--
12	2.9 / 236.0	3.0 / 235.9	2.2 / 236.7	2.3 / 236.6
13	4.0 / 236.0	3.8 / 236.2	3.0 / 237.0	3.0 / 237.0

The regional ground water table is believed to be below the depth of exploration. The shallow ground water encountered in the sand unit stabilized at 2.3 to 3.1 m below existing grade, corresponding to elevation 236.1 to 237.0.

The shallow ground water flow direction is towards the northwest, with a gradient of 0.2 to 0.3% towards the Bear Creek wetland.

Ground water levels are subject to seasonal variation and will fluctuate in response to precipitation.

5. GEOTECHNICAL ENGINEERING CONSIDERATIONS

5.1 Site Grading and Engineered Fill

In general, it is understood the site grade will be raised about 1.0 to 2.0 m. Upfill in building and road/servicing areas need to be constructed as engineered fill. Topsoil, very loose to loose soils, or otherwise deleterious material will need to be removed prior to placement of engineered fill due to potential for gross and differential settlement.

General guidelines for engineered fill construction are provided in Appendix D. Highlights are as follows:

- Sub-excavate the existing topsoil, very loose to loose native soil (upper 0.5 to 1.0 m depth), and deleterious material to competent native soil. The soil should be separated during excavation for reuse or disposal, based on geotechnical review during construction;
- Proofroll exposed subgrade using a heavy vibrating roller to targeted 100% Standard Proctor maximum dry density (SPmdd) for the building, and 95% SPmdd under paved/servicing areas, subject to geotechnical review;
- Following geotechnical subgrade approval, the site can be raised up to the design levels using engineered fill. The engineered fill material must be spread in maximum 200 mm thick loose lifts and uniformly compacted to 100% SPmdd in building areas and 95% SPmdd in paved areas;
- The excavated inorganic native soils are generally suitable for reuse as engineered fill, subject to geotechnical approval. Imported material will be required, and shall comprise OPSS Select Subgrade Material (SSM) or OPSS Granular B. It is recommended that imported fill be utilized under building and site soil be used under pavement/servicing areas;

- The engineered fill pad must extend at least 1 m beyond the structures to be supported, then outwards and downwards at no steeper than 45° to the horizontal to meet the underlying approved subgrade. In this regard, strict survey control and detailed documentation of the lateral and vertical extent of the engineered fill limits should be carried out to ensure that the engineered fill pad fully incorporates the structure to be supported;

- Engineered fill construction must be carried out under full-time field review by PML, to approve sub-excavation and subgrade preparation, backfill materials, placement and compaction procedures, and to verify that the specified compaction standards are achieved throughout.

5.2 Foundations

Floor elevations were not provided at the time of this report. Based on the intended grade raise, it is assumed that floor slab-on-grade elevations will be 1.0 to 2.0 m above existing grade. Based on the boreholes and grading discussion earlier, footings for slab-on-grade structures can be founded on native soil or engineered fill where a net geotechnical bearing resistance of 150 kPa at Serviceability Limit State (SLS) and a factored bearing resistance of 225 kPa at Ultimate Limit State (ULS) may be adopted for design.

The condominium building (Boreholes 1 to 4) is to have an underground paring level (possibly two levels). Based on the ground water levels noted to date, the lowest footings are recommended at elevation 237.0, 0.5 m above the ground water level. At this elevation, footings will be founded on native soil and can be designed for a geotechnical bearing resistance of 200 kPa at SLS and a factored bearing resistance of 300 kPa at ULS.

The geotechnical bearing resistance at SLS is based on 25 mm or settlement in the bearing stratum with differential settlement not exceeding 75% of the value.

Footings subject to frost action must be provided with a minimum 1.2 m of earth cover or equivalent insulation.

Prior to placement of structural concrete, all founding surfaces shall be reviewed by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions revealed in the excavation.

5.2.1 Seismic Design

Based on the soil profile revealed in the boreholes, Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the type and relative density of the soil cover at the site there is a low potential for liquefaction of soils to occur.

5.3 Floor Slab-on-Grade

Floor slab-on-grade construction is feasible on native soil or engineered fill, constructed as discussed earlier.

A minimum 200 mm thick base layer of crushed stone (nominal 20 mm size) is recommended directly beneath the floor slab. A polyethylene sheeting or similar means shall be incorporated as a vapour barrier. An underfloor drainage system is not considered necessary.

Exterior grades must be established to promote surface drainage away from the building.

5.4 Basements

Underground parking level(s) are proposed for the condominium. The lowest recommended floor slab is at elevation 237.5 (minimum 1.0 m above highest ground water level). Perimeter walls must be designed to resist the unbalanced horizontal earth pressure imposed by the backfill adjacent to the walls. The lateral earth pressure, P, may be computed using the following equation and assuming a triangular pressure distribution:

$$P = K(\gamma h + q) + C_p$$

Where
- P = lateral pressure at depth h (m) below ground surface (kPa)
- K = lateral earth pressure coefficient of granular backfill = 0.5
- h = depth below grade (m) at which lateral pressure is calculated
- γ = unit weight of compacted granular backfill = 21.0 kN/m^3
- q = surcharge loads (kPa)
- C_p = compaction pressure

The above equation assumes that drainage measures will be incorporated to prevent the buildup of hydrostatic pressure. In this regard, foundation wall backfill should comprise free draining granular material conforming to OPSS Granular B in conjunction with a weeping tile system. The weeping tiles should be protected by a properly designed granular filter or geotextile to prevent migration of fines into the system. The drainage pipe should be placed on a positive grade and lead to a frost-free outlet. The basement walls should be damp proofed. Alternatively, the native sand can be utilized with a proprietary drainage board product.

Basement wall backfill should be placed in thin lifts compacted to a minimum 95% SPmdd. Over compaction close to the walls should be avoided as this could generate excessive pressure on the walls.

Basement floor slab construction is feasible on native soils as discussed above. A minimum 200 mm thick base layer of crushed stone (nominal 19 mm size) is recommended directly under the slab. Underfloor drains are not considered necessary, provided floor slabs are a minimum 1.0 m above the ground water level (elevation 237.5 or higher, as noted above). A polyethylene sheet vapour barrier is recommended as a vapour barrier. Exterior grades should be established to promote surface drainage away from the buildings.

Reference is made to appended Figure 2, for general recommendations regarding drainage and backfill requirements for basement walls and floor slabs.

5.5 Site Servicing

At the time of this report, design inverts were not established. Services are anticipated to be as much as 3.0 m below proposed grades, corresponding to as much as 2.0 m below proposed grades based on the grade raise.

5.5.1 Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

5.5.2 Pipe Support, Pipe Bedding and Cover

Native soil or engineered fill are generally expected at invert levels, which is considered satisfactory for pipe support. Where existing fill or other deleterious material is encountered at the design invert level, such material should be sub-excavated and replaced with an increased thickness of bedding material, subject to geotechnical field review and approval.

OPSS bedding and cover thickness and compaction standards are recommended. Bedding and cover material should comprise OPSS Granular A.

5.5.3 Trench Backfill

Backfill in trenches shall comprise select inorganic soil, placed in maximum 200 mm thick loose lifts and compacted to at least 95% SPmdd to minimize post construction settlement in the backfill. Topsoil, organic, excessively wet, frozen oversized (greater than 150 mm in diameter), or otherwise deleterious material must not be incorporated as trench backfill. The moisture content of the trench backfill shall be within 2% of the optimum moisture content in order to achieve the specified compaction and be close to optimum moisture content in the upper 1 m to prevent subgrade instability issues. Ideally the backfill shall comprise excavated site soil, in order to minimize differential frost heave.

The excavated soil will comprise topsoil and native sand. The excavated inorganic native soils will generally be acceptable for reuse as trench backfill subject to geotechnical review during construction for moisture content and general composition acceptance.

Earthworks operations must be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

5.6 Storm Water Management Pond

A SWM pond is proposed in northeast corner of the site. The design concepts were not established at the time of this report. The following preliminary recommendations are provided, and should be reviewed by PML when further details are finalized.

Borehole 12 and 13 were advanced within the footprint of SWM Pond. Below the topsoil, a sand unit was present to the 5.0 m depth of exploration. Ground water was encountered about 2 to 3 m below existing grade, corresponding to elevation 236.6 to 237.0.

Cognizant of the subsurface conditions, the following geotechnical comments and recommendations are provided for your consideration:

1. Berms, where required, should be constructed as engineered fill, using select material, compacted to minimum 95% SPmdd, and be a minimum of 3 m in width;

2. Interior pond side slopes should be no steeper than five horizontal to one vertical (5H:1V) and protected with erosion control blankets or other vegetation. Rip rap will be required in areas of moving water;

3. Exterior pond side slopes and ditch/berm side slopes should be no steeper than 3H:1V;

4. If a wet pond is desired, a clay or synthetic liner is required;

5. If the pond is to be used for infiltration purposes, the bottom of the pond should be a minimum 1.0 m above high ground water table (currently the lowest proposed bottom would be elevation 238.0). The sand unit has a permeability on the order of 10^{-4} to 10^{-5} m/s.

5.7 Excavation and Ground Water Control

Excavation for services is anticipated to extend about as much as 2.0 m below existing grades. Excavation for engineered fill is anticipated to extend to about 1.0 m below existing grades. Excavation for the condominium basement is expected to extend as much as 2.0 to 3.0 m below existing grade.

All construction work must be carried out in accordance with the Occupational Health and Safety Act (OHSA). The site soils are classified as Type 3 soils requiring excavation/trench slopes to be cut back at 1H:1V from the base of the excavation, subject to appropriate groundwater control.

Excavation side slopes will need to be continuously examined and reviewed for evidence of instability, particularly following periods of heavy rain or thawing. When required, remedial action must be taken to ensure the continued stability of the excavation slope and the safety of the workers.

Stabilized water depth varies between 2.0 to 3.0 m below grade corresponding to elevation 236 to 237, roughly following the site topography. Based on the anticipated excavation depths, excavation will generally be above, or slightly below the ground water table where conventional sump pumping should suffice. Excavation much below the ground water table will require dewatering.

Excavation is recommended during the dry time of the year when the ground water is at its lowest, thus aiding in reducing ground water control requirements.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation O.Reg. 387/040, Section 34 of the OWRA requires any one taking more than 50,000 L/d to notify the Ministry of Environment, Conservation and Parks (MECP). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering or permanent drainage improvements. Projects assessed to be taking more than 50,000 L/d but less than 400,000 L/d of ground water can obtain a permit/permission online via the Environmental Activity and Sector Registry (EASR) system. If it is assessed that more than 400,000 L/d is required, then a Category 3 Permit-to-Take-Water (PTTW) will be required.

Based on the excavation as described above, registry on the EASR is may be required as a minimum, and once further design details are finalized, PML should be contacted to confirm the requirements and/or a site specific hydrogeological assessment in support of a PTTW or registry on the EASR system.

5.8 Pavement Design and Construction

As discussed earlier, grading has not been finalized, however given the site grade raise, the pavement subgrade is anticipated to comprise engineered fill. The following designs must be reviewed when the subgrade soil has been confirmed.

	MEDIUM DUTY	HEAVY DUTY
Asphalt (mm)	80	110
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	300	450

Subgrade is expected to comprise engineered fill. Further, preparation of subgrade can be provided once grading has been finalized.

Imported material for the granular base and subbase shall conform to OPSS gradation specifications for Granular A and Granular B, and must be compacted to 100% SPmdd. Asphalt shall be compacted in accordance with OPSS 310.

For the pavement to function properly, it is essential that provisions be made for water to drain out of and not collect in the base material. The incorporation of subdrains is not considered mandatory due to the drainage properties of the native sand. If considered, subdrains shall be installed at least 300 mm below the subgrade level. Refer to OPSD 216 Series for details regarding pipe, filter fabric or filter sock, bedding and cover material. Maintenance hole/catchbasins shall be backfilled with free draining material with frost tapers and stub drains extending out from structures. The above measures will help drain the pavement structure as well as alleviate the problems of differential frost movement between the catchbasins and pavement.

5.9 Geotechnical Review and Construction Inspection and Testing

It is recommended that the project design drawings be submitted to PML for geotechnical review for compatibility with site subsurface conditions and the recommendations contained in this report.

Earthworks operations shall be carried out with field review by PML to approve subgrade preparation, backfill materials, placement and compaction procedures and check the specified degree of compaction is achieved throughout.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions

The comments and recommendations provided in the report are based on the information revealed in all of the boreholes/test pits. Conditions away from and between boreholes/test pits may vary, which may necessitate modifications to the recommendations contained in the report and are subject to geotechnical review by PML during construction.

6. HYDROGEOLOGICAL CONSIDERATIONS

A hydrogeological investigation has also been requested for the site. The hydrogeological component includes a preliminary water quality assessment, preliminary assessment for permeability for infiltration features, ground water levels, gradient, and flow direction.

6.1 Aquifers and Local Ground Water Use

The Water Well Records (WWRs) held by the MECP within a 500 m study area are tabulated in Appendix E. A total of 10 WWRs were identified. Six records indicated the wells were for domestic use, two records were for test holes/montioring wells, one was listed as “other”, and one was listed “not in use”. Bedrock was not encoutnered in any of the WWRs.

The water supply wells ranged in depth from 22 to 27 m below the ground surface at the time of drilling, with fresh water typically encountered in the well.

It should be noted that municipal water is available in the area and the site is located within a Well Head Protection Area (WHPA), specially a WHPA Zone E. The site is located approximately 1.4 km southwest of the municipal water supply Well No. 19 and has a vulnerability score of 2.

6.2 Preliminary Infiltration Assessment

A preliminary assessment for permeability for infiltration features has been requested. In-situ borehole permeability testing was completed in all five wells, and grain size analyses testing was carried out on seven samples of the native site soils.

6.2.1 In-Situ Permeability Tests

The hydraulic conductivity (K-value, m/s), was estimated by performing slug tests in the wells. The permeability testing results were inputted into Aqtesolv where the Hvorslev (1951) expression was applied. Borehole permeability test plots are provided in Appendix B and summarized below:

BH/MW	DEPTH (m)	MATERIAL TYPE	ESTIMATED HYDRAULIC CONDUCTIVITY, K (m/sec)
1	5.7 to 7.2	Sand	7.0×10^{-5}
4	5.7 to 7.2	Sand	6.7×10^{-5}
10	3.0 to 4.5	Sand	3.5×10^{-5}
12	3.0 to 4.5	Sand	2.7×10^{-5}
13	3.0 to 4.5	Sand	3.0×10^{-5}

6.2.2 Grain Size Distribution

In addition to in-situ testing, the hydraulic conductivity of selected soil samples was estimated using the grain size distribution determined by laboratory testing and an established empirical formula by Vukovic and Soro (1992).

The results of field permeability tests as well as the estimated K-values from particle size distribution test results are summarized below:

BH/MW	SAMPLE	DEPTH (m)	MATERIAL TYPE	ESTIMATED HYDRAULIC CONDUCTIVITY FROM GRAIN SIZE DISTRIBUTION, K (m/sec)
1	4	2.3 to 2.8	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}
4	2	0.7 to 1.2	Gravelly Sand Trace Silt	10^{-4} to 10^{-5}
6	3	1.5 to 2.0	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}
10	2	0.7 to 1.2	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}
11	3	1.5 to 2.0	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}
12	3	1.5 to 2.0	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}
13	2	0.7 to 1.2	Sand Trace to Some Gravel and Silt	10^{-4} to 10^{-5}

6.3 Ground Water Sample Chemical Test Results

The laboratory certificate of chemical analyses for the analysis carried out by Caduceon on an unfiltered ground water sample from Borehole 12 in accordance with the chain-of-custody records and the protocols described in Section 2.3, are in included in Appendix C.

The unfiltered ground water sample was analyzed for the City of Barrie Storm and Sanitary Sewer Use Criteria and PWQO metals. As per the PWQO guidelines select metal parameters require field filtering and as such PML submitted one filtered metals bottle and one unfiltered metals bottle to satisfy the PWQO requirements.

The chemical test results complied with the City of Barrie Sewer Use Guidelines and PWQO standards for the parameters tested with the exception of the parameters listed below:

PARAMETER	UNITS	CITY OF BARRIE SANITARY SEWER USE GUIDELINE	CITY OF BARRIE STORM SEWER USE GUIDELINE	PWQO	MEASURED CONCENTRATION
Total Suspended Solids (TSS)	**mg/L**	350	15	--	885
Cobalt	**µg/L**	--	--	0.9	2.8
Copper	**µg/L**	--	--	5	8.9
Iron	**µg/L**	--	--	300	6,280
Vanadium	**µg/L**	--	--	6	9
Zinc	**µg/L**	--	--	4	5

The unfiltered ground water sample test results indicate that the discharge water, if untreated, is expected to exceed the Storm and Sanitary Sewer Use Bylaw Criteria for TSS and PWQO for cobalt, copper, iron, vanadium and zinc.

Based on the above, it is recommended, as a minimum, that during construction dewatering, the pumped water be treated with a form of filtration/sediment control treatment system comprising a sediment tank and silt bag, prior to being discharged to surface.

Treatment of the dewatering discharge water by filtration or sedimentation to reduce the concentration of suspended solids, is anticipated to reduce the concentrations of non-dissolved metals, however, other treatment methods may be necessary to reduce the concentration of dissolved analytes.

7. CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

Davin Power, E.I.T.
Project Supervisor, Geotechnical Services

PROFESSIONAL GEOSCIENTIST
ALICIA KIMBERLEY
PRACTISING MEMBER
2949
Mar 23, 2021
ONTARIO

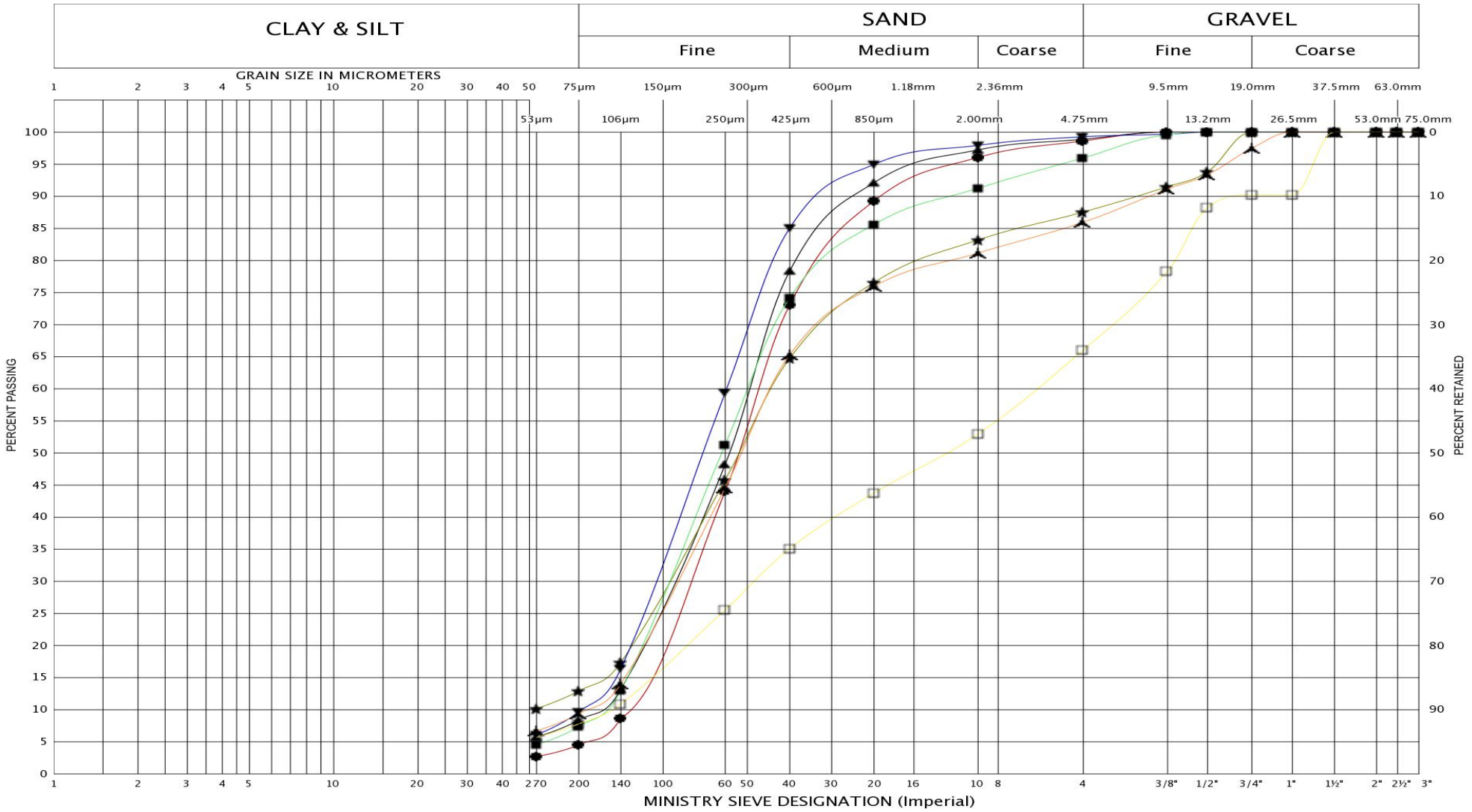
Alicia Kimberley, MSc., P.Geo.
Associate
Manager, Geoenvironmental and Hydrogeological Services

LICENSED PROFESSIONAL ENGINEER
G. R. WHITE
MARCH 23 2021
PROVINCE OF ONTARIO

Geoffrey R. White, P.Eng.
Director
Manager, Geotechnical Services

DP/AK/GRW:tc

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	1	4	6	10	11	12	13
	SAMPLE	4	2	3	2	3	3	2
	SYMBOL	●	□	⅄	▲	★	▼	■

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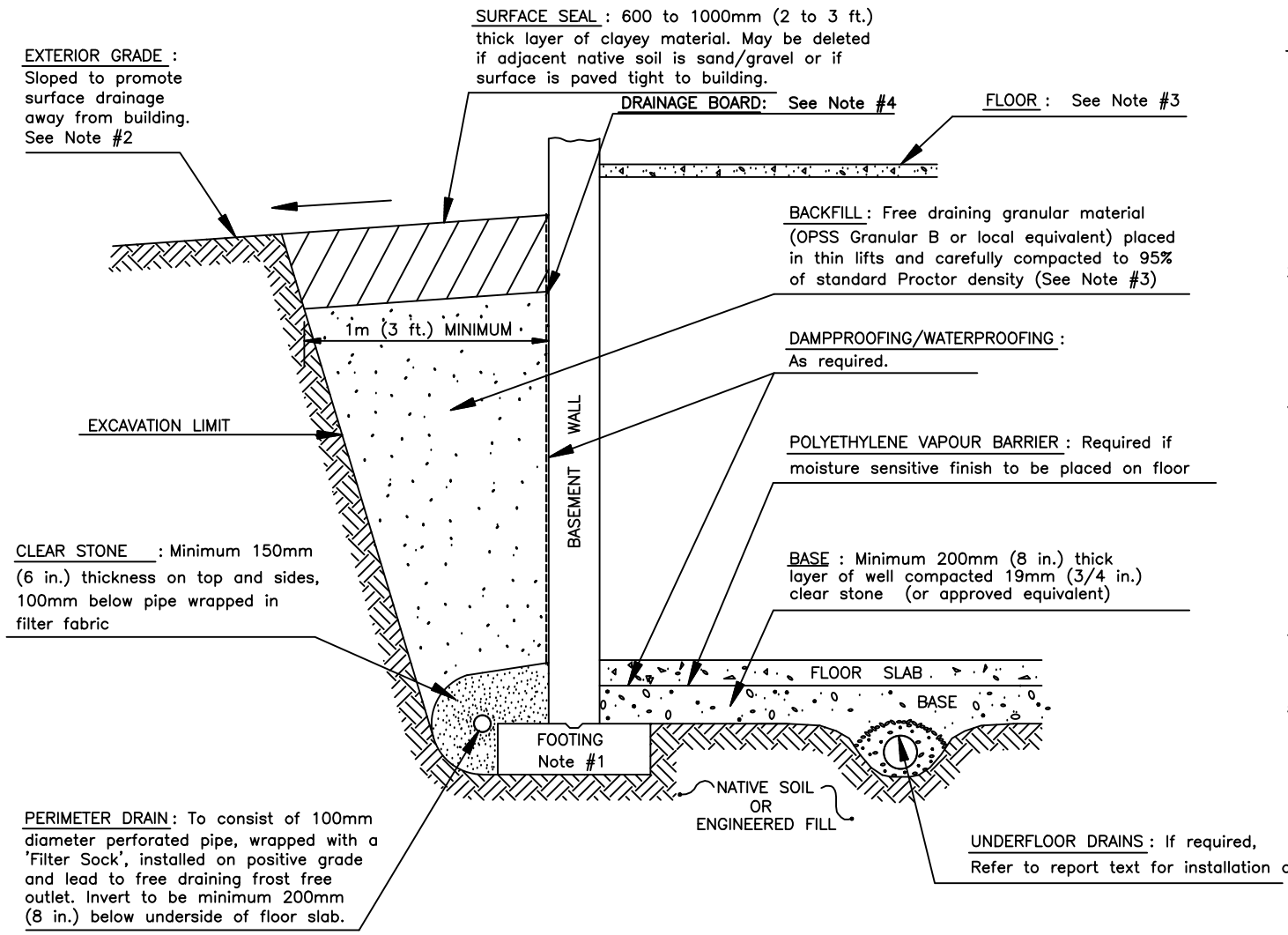
GRAIN SIZE DISTRIBUTION

GRAVELLY SAND, Trace Silt, TO SAND, Trace to Some Gravel, Trace to Some Silt

FIG No.: 1

Project No.: 21BF003



NOTES

1. Footing may be constructed by placement of structural concrete neat against natural soil. Drain to be installed in a similar manner immediately above footing maintaining 200mm (8 in.) distance between top of drain and underside of floor slab.
2. Exterior grade to be minimum 300mm (12 in.) below interior floor slab, or other means established to prevent entry of surface water into building through building openings.
3. Basement wall to be supported by floor system or interior bracing prior to commencement of backfill placement. Heavy construction equipment should not be permited within a distance from the foundation wall equivalent to half the wall height. Overcompaction of backfill to be avoided as excessive lateral earth pressure may result.
4. A proprietary drainage board product may be used with compacted native soil as backfill against the wall.
5. Refer to text for details regarding founding levels, competent bearing material and construction details specific to particular site.

STANDARD DRAWING

GENERAL RECOMMENDATIONS REGARDING DRAINAGE AND BACKFILL REQUIREMENTS FOR BASEMENT WALL AND FLOOR SLAB CONSTRUCTION

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN:	N/A	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED:	GW	MAR 2021	N.T.S.	21BF003	2
APPROVED:	GW				

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		

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

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH	Sample Advanced Hydraulically
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

17T 600878E 4911617N

PROJECT Proposed Residential Development — **PML REF.** 21BF003

LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario — **BORING DATE** February 9, 2020 — **ENGINEER** GW

BORING METHOD Continuous Flight Hollow Stem Augers — **TECHNICIAN** NG

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 238.90				
0.25 / 238.65	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	6
	SAND: Loose to dense, light brown to brown, sand, trace to some gravel and silt, moist to wet		2	SS	4
			3	SS	50/145mm
			4	SS	18
			5	SS	19
			6	SS	21
			7	SS	11
8.0 / 230.9	BOREHOLE TERMINATED AT 8.0 m		8	SS	37

ELEVATION SCALE: 238, 237, 236, 235, 234, 233, 232, 231

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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

Upon completion of augering
Water at 3.0 m
No cave
Water Level Readings:

Date	Depth	Elev.
2021-03-05	2.5	236.4
2021-03-10	2.6	236.3

NOTES

Peto MacCallum Ltd
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 2

17T 600898E 4911645N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 9, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	GAS READINGS (ppm)	GROUND WATER OBSERVATIONS AND REMARKS
		SURFACE ELEVATION 239.15							
0.0	239.15						239		
0.20	238.95	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	4			
		SAND: Loose to very dense, light brown to brown, sand, trace gravel to gravelly, trace silt, cobbles, moist to wet		2	SS	26	238		
1.0									
				3	SS	43			
2.0							237		
				4	SS	21			
3.0									
				5	SS	17	236		
4.0									First water strike at 4.0 m
							235		
				6	SS	66			
5.0							234		
6.0									
6.5	232.7	BOREHOLE TERMINATED AT 6.5 m		7	SS	11	233		
7.0									Upon completion of augering Wet cave at 3.2 m
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									
14.0									
15.0									

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 3

17T 600917E 4911627N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS (ppm)	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 239.90									
0.0	0.15 239.75	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	4					
		SAND: Loose to dense, brown, sand, trace to some gravel and silt, moist to wet		2	SS	28	239				
1.0											
				3	SS	27	238				
2.0											
				4	SS	32	237				
3.0											
				5	SS	22	236				First water strike at 4.0 m
4.0											
				6	SS	18	235				
5.0											
							234				
6.0	6.5			7	SS	24					
	233.4	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering Wet cave at 4.0 m
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 4

17T 600933E 4911657N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 9, 2020
ENGINEER GW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 239.55			
0.25	239.30	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist	1	SS	5
		SAND: Loose to dense, brown, gravelly sand, trace silt, moist to wet	2	SS	26
			3	SS	29
			4	SS	22
			5	SS	42
			6	SS	23
			7	SS	24
			8	SS	10
8.0	231.6	BOREHOLE TERMINATED AT 8.0 m			

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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

Stick-up casing
Concrete
Bentonite seal
First water strike at 4.0 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 4.0 m
No cave
Water Level Readings:

Date	Depth	Elev.
2021-03-05	3.1	236.5
2021-03-10	3.1	236.5

NOTES

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LOG OF BOREHOLE NO. 5

17T 601001E 4911680N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
0.05	240.85	SURFACE ELEVATION 240.90 TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	6	240
		SAND: Loose to dense, light brown to brown, sand, trace to some gravel and silt, cobbles, moist to wet		2	SS	7	
				3	SS	27	239
				4	SS	38	
				5	SS	43	238
							237
5.0	235.9			6	SS	34	236
		BOREHOLE TERMINATED AT 5.0 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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

Upon completion of augering
Water at 4.3 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 6

17T 601098E 4911712N

PROJECT Proposed Residential Development
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE February 8, 2020
PML REF. 21BF003
ENGINEER GW
TECHNICIAN NG

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 241.50					
0.0 / 0.10 / 241.40	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	4	241
	SAND: Loose to very dense, brown, sand, trace to some gravel and silt, cobbles, moist to wet		2	SS	14	
1.0						240
			3	SS	31	
2.0						239
			4	SS	53	
3.0						238
			5	SS	37	
4.0						237
5.0 / 5.0 / 236.5	BOREHOLE TERMINATED AT 5.0 m		6	SS	19	

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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

Stick-up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 4.0 m

Upon completion of augering
Wet cave at 4.4 m

Water Level Readings:

Date	Depth	Elev.
2021-03-05	Dry	
2021-03-10	Dry	

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 7

17T 601145E 4911727N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES
	242.00	SURFACE ELEVATION 242.00				
0.0						
0.15	241.85	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	6
		SAND: Loose to dense, brown, sand, trace to some gravel and silt, moist to wet		2	SS	7
1.0				3	SS	27
2.0				4	SS	38
3.0				5	SS	43
4.0				6	SS	34
5.0	237.0	BOREHOLE TERMINATED AT 5.0 m				
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 241, 240, 239, 238, 237

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
Wet cave at 4.4 m

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 8

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS (ppm)	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 241.05									
0.20	240.85	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	2					
		SAND: Very loose to dense, light brown to brown, sand, trace to some gravel and silt, moist to wet		2	SS	9	240				
				3	SS	35	239				
				4	SS	30					
				5	SS	33	238				
							237				First water strike at 4.0 m
5.0	236.1	BOREHOLE TERMINATED AT 5.0 m		6	SS	35					Upon completion of augering Water at 3.7 m Cave at 3.8 m

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80
PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 9

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 9, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS (ppm)	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 240.90									
0.20 240.70	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	8					
	SAND: Very loose to very dense, light brown to brown, sand, trace gravel to gravelly, trace silt, moist to wet		2	SS	3	240				
			3	SS	23	239				
			4	SS	61	238				
			5	SS	37	237				First water strike at 4.3 m
5.0 235.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	36	236				Upon completion of augering Water at 4.4 m No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80
PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 10

17T 600882E 4911695N

PROJECT Proposed Residential Development — **PML REF.** 21BF003

LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario — **BORING DATE** February 9, 2020 — **ENGINEER** GW

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** NG

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 238.50				
0.0	238.30	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	5
		SAND: Loose to dense, light brown to brown, sand, trace to some gravel and silt, cobbles, moist to wet		2	SS	6
				3	SS	33
				4	SS	30
				5	SS	23
5.0	233.5			6	SS	36
		BOREHOLE TERMINATED AT 5.0 m				

ELEVATION SCALE: 238, 237, 236, 235, 234

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up casing
Concrete

Bentonite seal

First water strike at 2.9 m

50 mm slotted pipe
Filter sand

Upon completion of augering
Wet cave at 2.4 m

Water Level Readings:

Date	Depth	Elev.
2021-03-05	2.3	236.2
2021-03-10	2.4	236.1

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 11

17T 600969E 3911770N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 239.50					
0.10 239.40	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	4	239
	SAND: Loose to very dense, light brown to brown, sand, trace gravel to gravelly, trace silt, cobbles, moist to wet		2	SS	5	
			3	AS	-	238
			4	SS	77	237
			5	SS	23	236
5.0 234.5	BOREHOLE TERMINATED AT 5.0 m		6	SS	26	235

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

First water strike at 3.4 m

Upon completion of augering
Water at 3.2 m
Cave at 3.4 m

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 12

17T 601036E 4911802N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

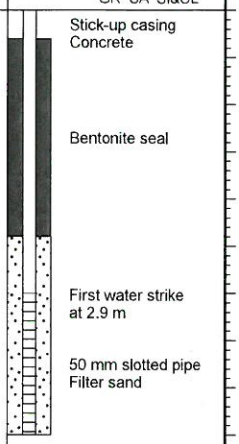
DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
0.0	238.85	SURFACE ELEVATION 238.85					
0.08	238.77	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	3	
		SAND: Very loose to dense, brown, sand, trace to some gravel and silt, moist to wet		2	SS	10	238
				3	SS	20	237
				4	SS	15	236
				5	SS	32	235
5.0	233.9	BOREHOLE TERMINATED AT 5.0 m		6	SS	27	234

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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



Upon completion of augering
Wet cave at 3.0 m

Water Level Readings:

Date	Depth	Elev.
2021-03-05	2.2	236.7
2021-03-10	2.3	236.6

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 13

17T 601132E 4911793N

PROJECT Proposed Residential Development
PML REF. 21BF003
LOCATION Ardagh Road and Summerset Drive, Barrie, Ontario
BORING DATE February 8, 2020
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN NG

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 240.00					
0.15 239.85	TOPSOIL: Dark brown, silty sand, some organics, frozen to moist		1	SS	3	
	SAND: Very loose to dense, brown, sand, trace to some gravel and silt, moist to wet		2	SS	18	239
			3	SS	26	238
			4	SS	20	
			5	SS	28	237
						236
5.0 235.0	BOREHOLE TERMINATED AT 5.0 m		6	SS	32	235

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ● Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

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

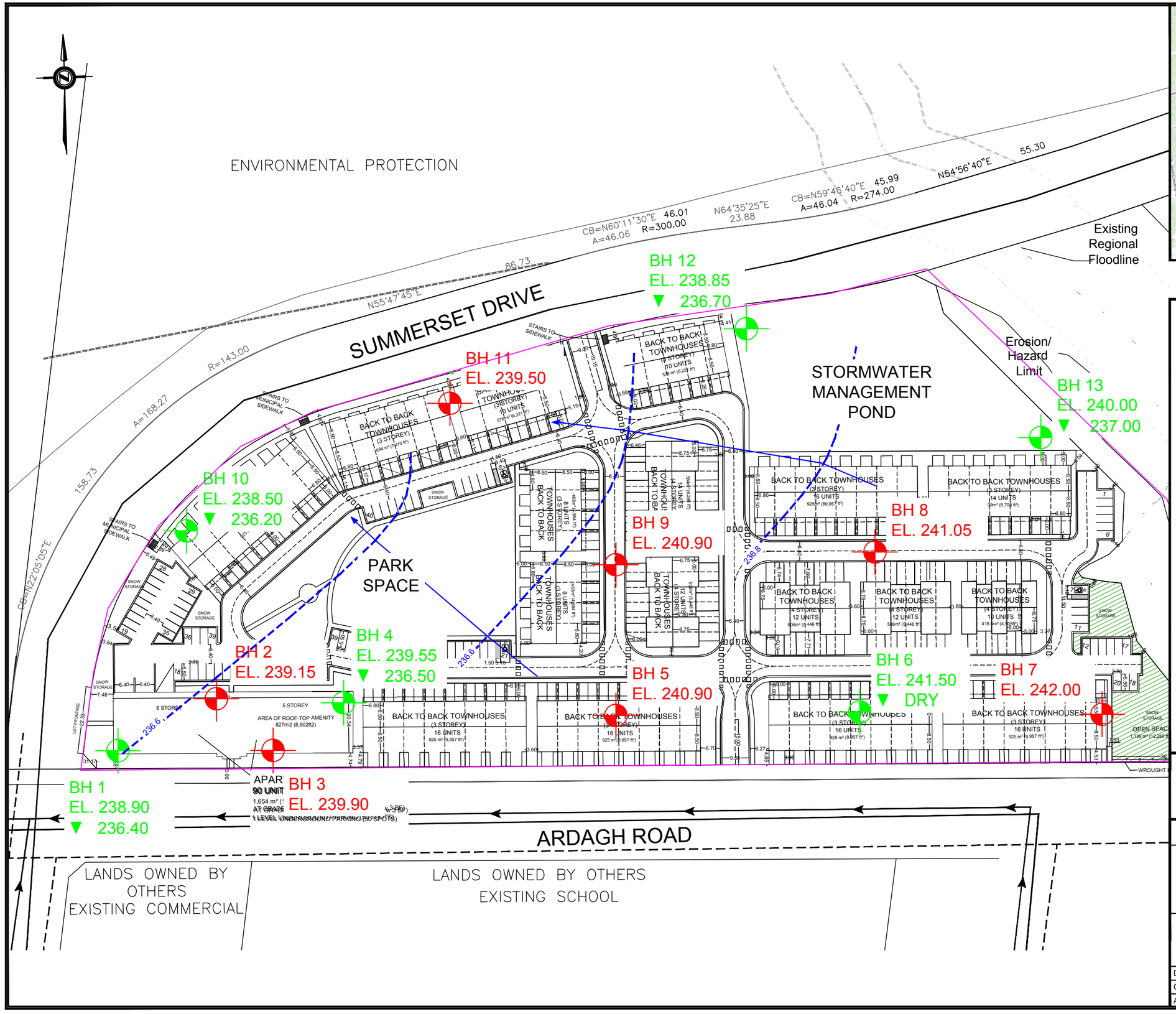
Stick-up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 4.0 m

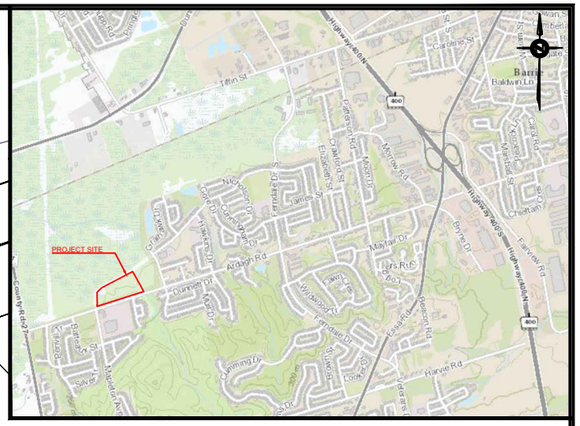
Upon completion of augering
Wet cave at 3.8 m

Water Level Readings:

Date	Depth	Elev.
2021-03-05	3.0	237.0
2021-03-10	3.0	237.0

NOTES





KEY PLAN
BARRIE, ONTARIO

LEGEND:

BH 1
EL. 238.90
▼ 236.40
BOREHOLE/MONITORING WELL LOCATION
SURFACE ELEVATION
WATER ELEVATION (2021-03-05)

BH 2
EL. 239.15
BOREHOLE LOCATION
SURFACE ELEVATION

INTERPRETED GROUND WATER CONTOURS

INFERRED GROUND WATER FLOW DIRECTION

APPROXIMATE SITE LIMITS

REFERENCE:

BASE PLAN PROVIDED BY THE CLIENT.

0m 15 30 45 60 75
SCALE

BOREHOLE/MONITORING WELL LOCATION PLAN

PROPOSED RESIDENTIAL DEVELOPMENT
ARDAGH ROAD AND SUMMERSET DRIVE
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	NG	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	AK	MAR. 2021	AS SHOWN	21BF003	1
APPROVED	GW				

APPENDIX A

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 effect 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.

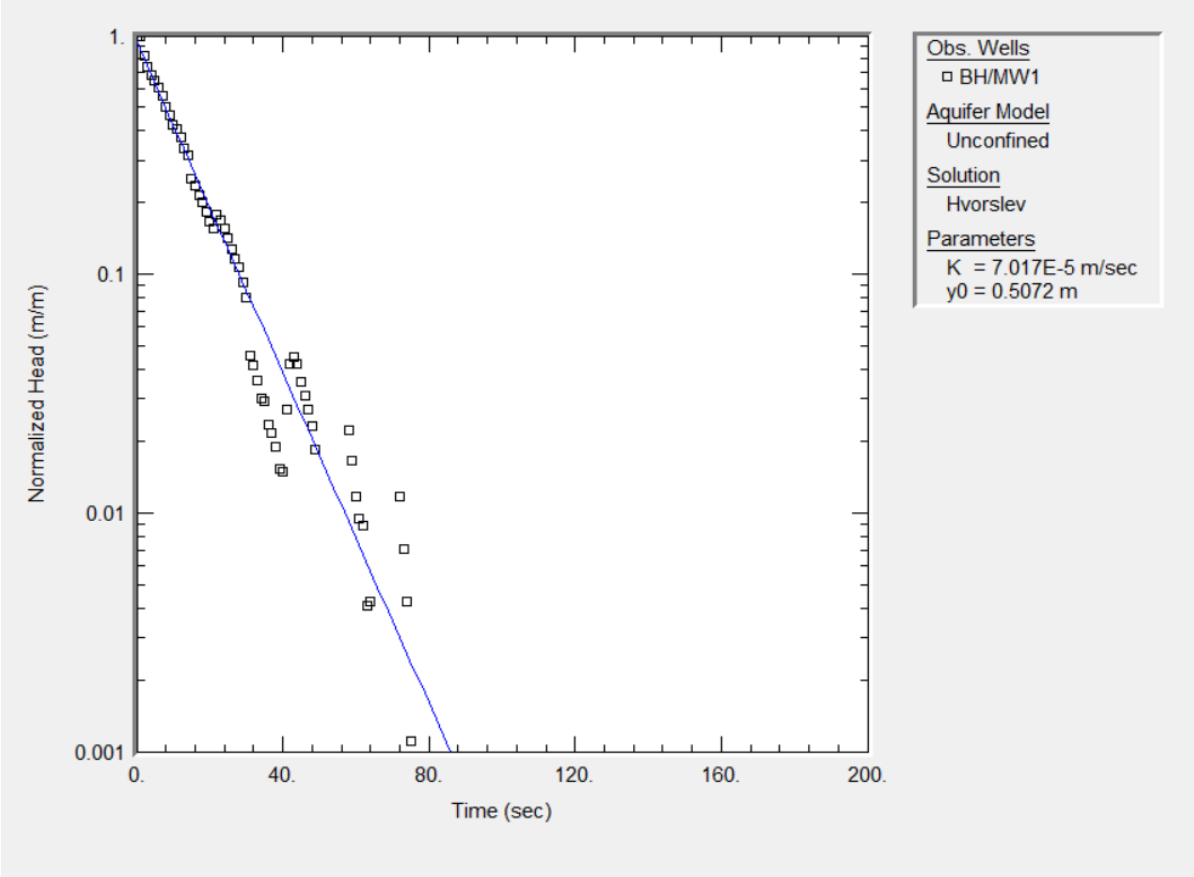
APPENDIX B

Borehole Permeability Testing

Estimation of K by Slug Test, based on Hvorslev equation

Date:	March 10, 2021
Conducted by:	S. Griffith

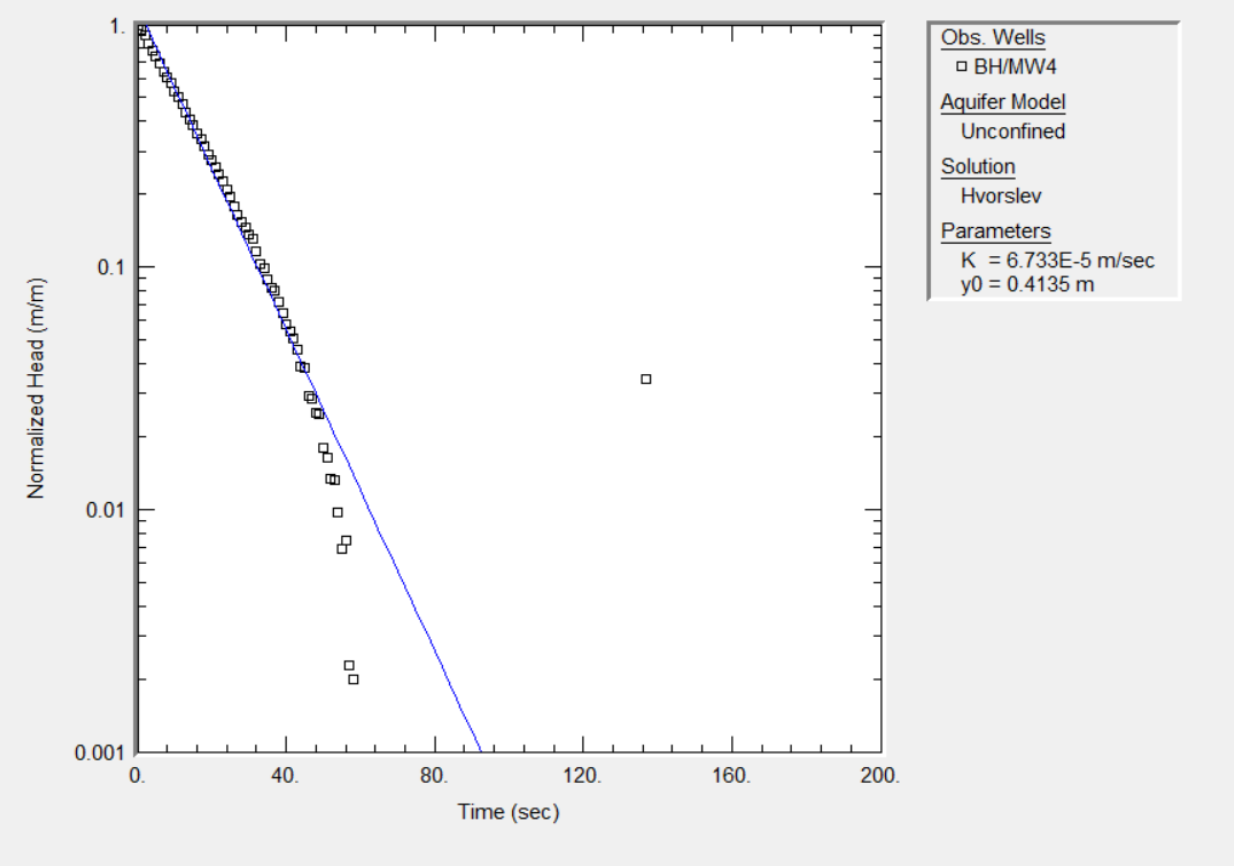
Well Number:	BH/MW1	
Well Screen Bottom:	7.20	mbgs
Top of Pipe:	0.85	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	238.90	masl
Static Water Level:	2.60	mbgs
$K = r^2 \ln(L/R)/(2LTo) =$	**7.0×10^{-5}**	m/s



Estimation of K by Slug Test, based on Hvorslev equation

Date:	March 10, 2021
Conducted by:	S. Griffith

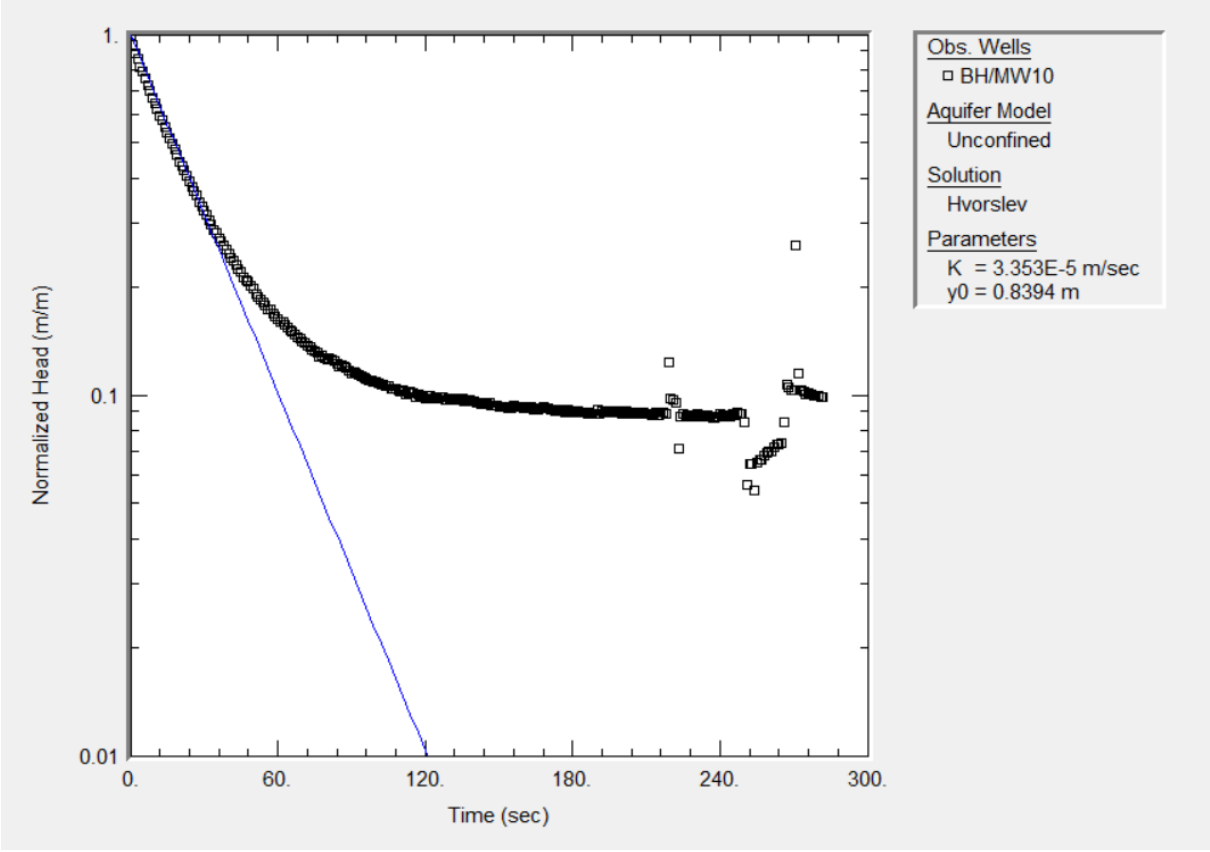
Well Number:	BH/MW4	
Well Screen Bottom:	7.20	mbgs
Top of Pipe:	0.90	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	239.55	masl
Static Water Level:	3.10	mbgs
$K = r^2 \ln(L/R)/(2LTo) =$	**6.7×10^{-5}**	m/s



Estimation of K by Slug Test, based on Hvorslev equation

Date:	March 10, 2021
Conducted by:	S. Griffith

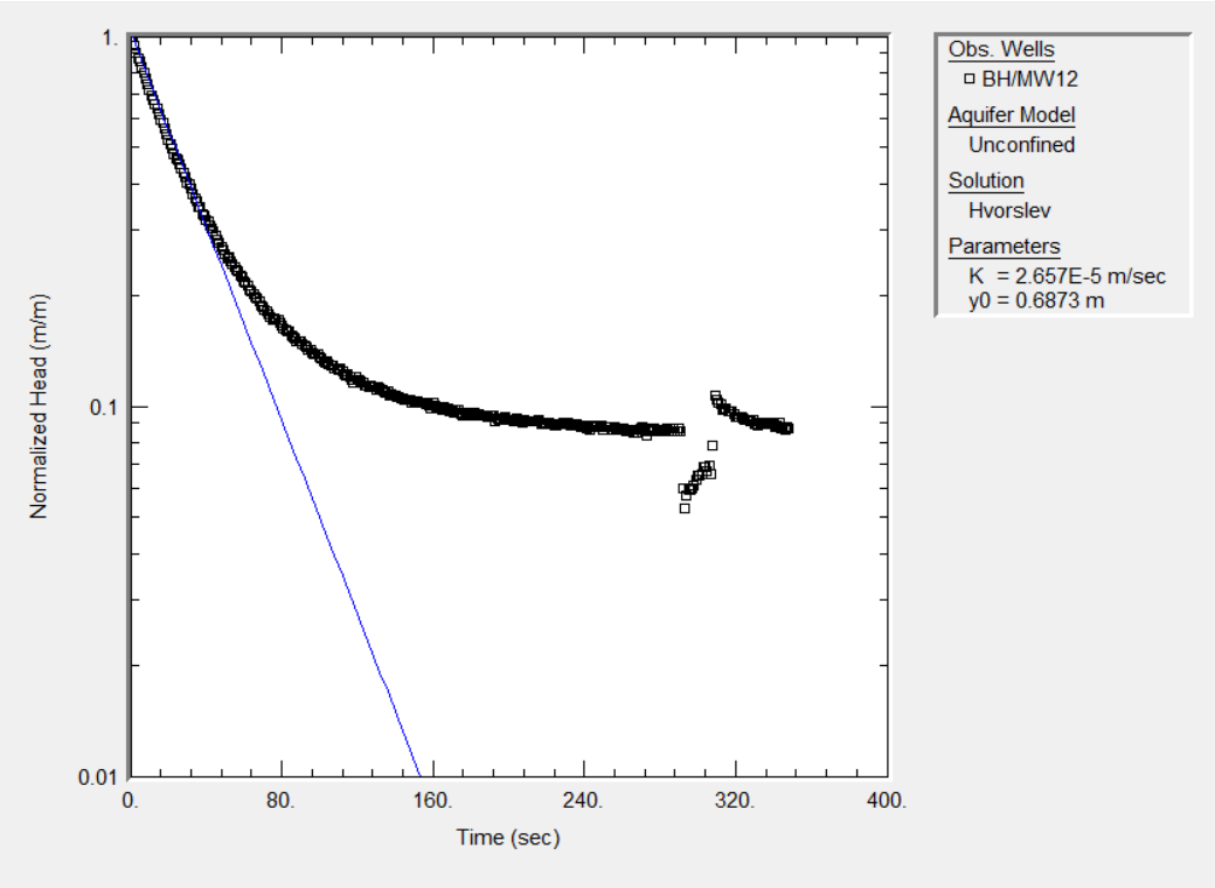
Well Number:	BH/MW10	
Well Screen Bottom:	4.50	mbgs
Top of Pipe:	0.89	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	238.50	masl
Static Water Level:	2.40	mbgs
$K = r^2 \ln(L/R)/(2LTo) =$	**3.5×10^{-5}**	m/s



Estimation of K by Slug Test, based on Hvorslev equation

Date:	March 10, 2021
Conducted by:	S. Griffith

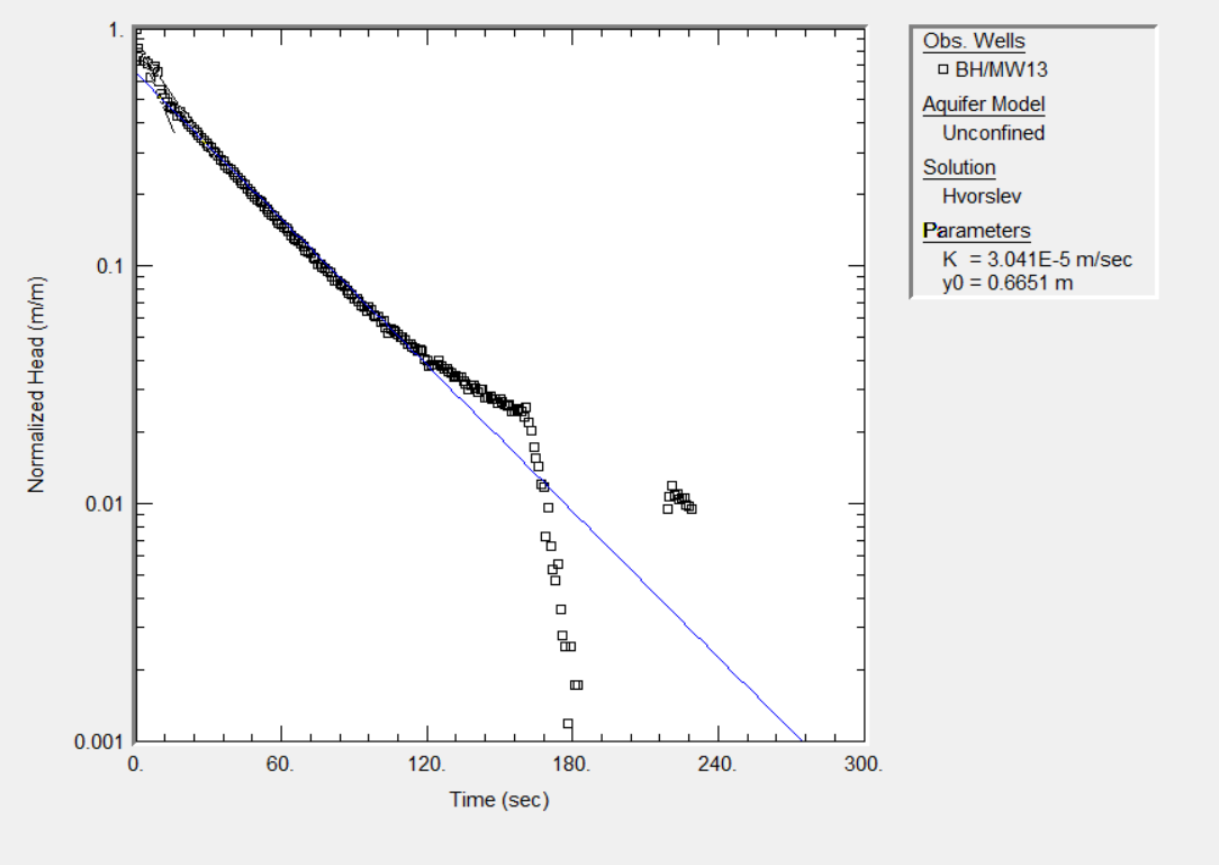
Well Number:	BH/MW12	
Well Screen Bottom:	4.50	mbgs
Top of Pipe:	0.68	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	238.85	masl
Static Water Level:	2.30	mbgs
$K = r^2 \ln(L/R)/(2LTo) =$	**2.7×10^{-5}**	m/s



Estimation of K by Slug Test, based on Hvorslev equation

Date:	March 10, 2021
Conducted by:	S. Griffith

Well Number:	BH/MW13	
Well Screen Bottom:	4.50	mbgs
Top of Pipe:	0.89	mags
Well Casing Diameter:	5.08	cm
Well Elevation:	240.00	masl
Static Water Level:	3.00	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$3.0x10^{-5}$**	m/s



APPENDIX C

Certificates of Analyses for Groundwater Chemical Testing

CADUCEON™ ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: GH0155 **REPORT No. B21-06872**

Report To:

Peto MacCallum Ltd
19 Churchill Drive,
Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:

P.O. NUMBER: 21BF003
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Cyanide	1	Kingston	US	12-Mar-21	A-CN-001 (k)	SM 4500CN
A - Wet Chem	1	Kingston	TK	16-Mar-21	A-COD K	SM5220C
Anions	1	Holly Lane	VK	16-Mar-21	A-IC-01 (o)	SM4110C
pH	1	Holly Lane	SYL	12-Mar-21	A-PH-01 (o)	SM 4500H
Sulphide	1	Kingston	TK	12-Mar-21	A-S2	SM4500-S2
A - Wet Chem	1	Kingston	KD	12-Mar-21	A-TPTKN-001 (N)(k)	E3199A.1
A - Wet Chem	1	Kingston	KD	12-Mar-21	A-TPTKN-001 (P)(k)	E3199A.1
Total Suspended Solids	1	Kingston	TK	12-Mar-21	A-TSS-001 (k)	SM2540D
BOD	1	Kingston	JWF	12-Mar-21	C-BOD-001 (k)	SM 5210B
SVOC	1	Kingston	sge	15-Mar-21	C-NAB-W-001 (k)	EPA 8270
Oil & Grease	1	Kingston	KPR	17-Mar-21	C-O&G-001 (k)	SM 5520
Phenolics (4-aap)	1	Kingston	TK	16-Mar-21	C-PHEN-01 (k)	MOEE 3179
VOC's	1	Richmond Hill	JE	12-Mar-21	C-VOC-02 (rh)	EPA 8260
Chromium (VI)	1	Holly Lane	LMG	16-Mar-21	D-CRVI-01 (o)	MOE E3056
Mercury	1	Holly Lane	PBK	15-Mar-21	D-HG-02 (o)	SM 3112 B
Metals - ICP-OES	1	Holly Lane	AHM	15-Mar-21	D-ICP-01 (o)	SM 3120
Metals-ICP-MS	1	Holly Lane	TPR	15-Mar-21	D-ICPMS Dissolved 7800	EPA 200.8
Metals - ICP-MS	1	Holly Lane	TPR	16-Mar-21	D-ICPMS-01 (o)	EPA 200.8

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: GH0155 **REPORT No. B21-06872**

Report To:

Peto MacCallum Ltd
19 Churchill Drive,
Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D.		BH/MW 12				Barrie Sanitary	
	Sample I.D.		B21-06872-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected							
Parameter	**Units**	**R.L.**						
pH @25°C	pH Units		8.05				9.5	9.5
BOD(5 day)	mg/L	3	< 3				300	15
COD	mg/L	5	5				600	
Total Kjeldahl Nitrogen	mg/L	0.1	0.2				100	
Total Suspended Solids	mg/L	3	**885**				350	15
Oil and Grease-Mineral	mg/L	1.0	< 1.0				15	
Oil and Grease-Anim/Veg.	mg/L	1.0	< 1.0				150	
Phosphorus-Total	mg/L	0.01	0.30				10	
Cyanide (Total)	mg/L	0.005	< 0.005				1.2	
Chloride	mg/L	0.5	6.1				1500	
Fluoride	mg/L	0.1	< 0.1				10	
Sulphate	mg/L	1	7				1500	
Aluminum	mg/L	0.01	0.07				50	
Aluminum (total)	mg/L	0.01	4.65				50	
Antimony	mg/L	0.0001	0.0004				5.0	
Arsenic	mg/L	0.0001	0.0008				1.0	
Barium	mg/L	0.001	0.063				5.0	
Beryllium	mg/L	0.002	< 0.002					
Boron	mg/L	0.005	0.012					
Benzene	mg/L	0.0005	< 0.0005				0.01	
Bismuth	mg/L	0.02	< 0.02				5.0	
Cadmium	mg/L	0.000015	0.000047				0.7	0.001
Chromium	mg/L	0.001	0.004				2.0	0.08
Chromium (VI)	mg/L	0.001	< 0.001					

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
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CERTIFICATE OF ANALYSIS

Final Report

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Report To:

Peto MacCallum Ltd
19 Churchill Drive,
Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D.		BH/MW 12				Barrie Sanitary	
	Sample I.D.		B21-06872-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected							
Parameter	**Units**	**R.L.**						
Cobalt	mg/L	0.0001	0.0028				5.0	
Copper	mg/L	0.0001	0.0089				2.0	0.01
Dichlorobenzene,1,2-	mg/L	0.0005	< 0.0005				0.05	
Dichlorobenzene,1,4-	mg/L	0.0005	< 0.0005				0.08	
Ethylbenzene	mg/L	0.0005	< 0.0005				0.06	
Gold	mg/L	0.0007	< 0.0007				5.0	
Hexachlorobenzene	mg/L	0.0001	< 0.0001				0.0001	
Iron	mg/L	0.005	6.28				50	
Lead	mg/L	0.00002	0.00276				0.7	0.05
Manganese (Total)	mg/L	0.001	0.311				5.0	
Dichloromethane (Methylene Chloride)	mg/L	0.005	< 0.005				0.09	
Mercury	mg/L	0.00002	< 0.00002				0.01	
Molybdenum	mg/L	0.01	< 0.01				5.0	
Nickel	mg/L	0.0002	0.0049				2.0	0.05
Total PAH	mg/L	0.0001	< 0.0001				0.005	
Acenaphthene	µg/L	0.05	< 0.05					
Acenaphthylene	µg/L	0.05	< 0.05					
Anthracene	µg/L	0.05	< 0.05					
Benzo(a)anthracene	µg/L	0.05	< 0.06					
Benzo(a)pyrene	µg/L	0.01	< 0.01					
Benzo(b+k)fluoranthene	µg/L	0.1	< 0.1					
Benzo(g,h,i)perylene	µg/L	0.05	< 0.05					
Dibenzo(a,h)anthracene	µg/L	0.05	< 0.05					

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

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CERTIFICATE OF ANALYSIS

Final Report

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Report To:

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Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D.		BH/MW 12				Barrie Sanitary	
	Sample I.D.		B21-06872-1				Barrie-Sanitary/Combined	Barrie-Storm Sewer
	Date Collected							
Parameter	**Units**	**R.L.**						
Chrysene	µg/L	0.05	< 0.05					
Fluoranthene	µg/L	0.05	< 0.05					
Fluorene	µg/L	0.05	< 0.05					
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	< 0.05					
Methylnaphthalene,1-	µg/L	0.05	< 0.05					
Methylnaphthalene,2-	µg/L	0.05	< 0.05					
Naphthalene	µg/L	0.05	< 0.06					
Phenanthrene	µg/L	0.05	< 0.05					
Pyrene	µg/L	0.05	< 0.05					
Phenolics	mg/L	0.002	< 0.002				0.1	
Platinum	mg/L	0.00004	< 0.00004				5.0	
Rhodium	mg/L	0.00002	< 0.00002				5.0	
Selenium	mg/L	0.001	< 0.001				1.0	
Silver	mg/L	0.0001	< 0.0001				0.4	
Strontium	mg/L	0.001	0.251					
Sulphide	mg/L	0.01	< 0.1				1.0	
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	< 0.0005				0.06	
Tetrachloroethylene	mg/L	0.0005	< 0.0005				0.06	
Toluene	mg/L	0.0005	< 0.0005				0.02	
Trichloroethylene	mg/L	0.0005	< 0.0005				0.05	
Xylene, m,p,o-	mg/L	0.0011	< 0.0011				0.3	
Thallium	mg/L	0.00005	0.00008					
Tin	mg/L	0.05	< 0.05				5.0	

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

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CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: GH0155 **REPORT No. B21-06872**

Report To:

Peto MacCallum Ltd
19 Churchill Drive,
Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D. / Sample I.D. / Date Collected		BH/MW 12 B21-06872-1				Barrie Sanitary	
							Barrie-Sanitary/Combined	Barrie-Storm Sewer
Parameter	**Units**	**R.L.**						
Titanium	mg/L	0.005	0.277					
Tungsten	mg/L	0.01	< 0.01					
Uranium	mg/L	0.00005	0.00026					
Vanadium	mg/L	0.005	0.009				5.0	
Zinc	mg/L	0.005	0.026				2.0	0.04
Zirconium	mg/L	0.003	0.005					

1 Elevated RL due to sample matrix interference

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

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DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

Summary of Exceedances

Sanitary/Combined Sewer Guidelines

BH/MW 12	Found Value	Limit
Total Suspended Solids (mg/L)	885	350

Storm Sewer Guidelines

BH/MW 12	Found Value	Limit
Total Suspended Solids (mg/L)	885	15

Barrie Sanitary - Barrie Sanitary & Combined and Storm
Barrie-Sanitary/Combined - Sanitary/Combined Sewer Guidelines
Barrie-Storm Sewer - Storm Sewer Guidelines

Christine Burke
Lab Manager

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Final Report

C.O.C.: GH0155

REPORT No. B21-06872 (i)

Rev. 1

Report To:

Peto MacCallum Ltd
19 Churchill Drive,
Barrie ON L4N 8Z5
Attention: Alicia Kimberley

Caduceon Environmental Laboratories
112 Commerce Park Drive
Barrie ON L4N 8W8
Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

Parameter	Qty	Site Analyzed	Analyst Initials	Date Analyzed	Lab Method	Reference Method
Chromium (VI)	1	Holly Lane	LMG	16-Mar-21	D-CRVI-01 (o)	MOE E3056
Mercury	1	Holly Lane	PBK	15-Mar-21	D-HG-02 (o)	SM 3112 B
Metals - ICP-OES	1	Holly Lane	AHM	15-Mar-21	D-ICP-01 (o)	SM 3120
Metals - ICP-MS	1	Holly Lane	TPR	16-Mar-21	D-ICPMS-01 (o)	EPA 200.8

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives

Christine Burke
Lab Manager

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Tel: 705-252-5743
Fax: 705-252-5746

DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D.		BH/MW 12				PWQO	
	Sample I.D.		B21-06872-1				Interim PWQO	PWQO
	Date Collected							
Parameter	**Units**	**R.L.**						
Aluminum	µg/L	10	70				75	75
Aluminum (total)	µg/L	10	4650					
Antimony	µg/L	0.1	0.4					20
Arsenic	µg/L	0.1	0.8				100	5
Barium	µg/L	1	63					
Beryllium	µg/L	2	< 2					11
Boron	µg/L	5	12				200	
Bismuth	µg/L	20	< 20					
Cadmium	µg/L	0.015	0.047				0.1	0.2
Chromium	µg/L	1	4					
Chromium (VI)	µg/L	1	< 1					1
Cobalt	µg/L	0.1	**2.8**					0.9
Copper	µg/L	0.1	**8.9**					5
Iron	µg/L	5	**6280**					300
Lead	µg/L	0.02	**2.76**				1	5
Manganese (Total)	µg/L	1	311					
Mercury	µg/L	0.02	< 0.02					0.2
Molybdenum	µg/L	10	< 10					40
Nickel	µg/L	0.2	4.9					25
Selenium	µg/L	1	< 1					100
Silver	µg/L	0.1	< 0.1					0.1
Strontium	µg/L	1	251					
Thallium	µg/L	0.05	0.08					0.3
Tin	µg/L	50	< 50					

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives

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Lab Manager

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SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

	Client I.D.		BH/MW 12				PWQO	
	Sample I.D.		B21-06872-1				Interim PWQO	PWQO
	Date Collected							
Parameter	**Units**	**R.L.**						
Titanium	µg/L	5	277					
Tungsten	µg/L	10	< 10					30
Uranium	µg/L	0.05	0.26					5
Vanadium	µg/L	5	**9**					6
Zinc	µg/L	5	**26**				20	30
Zirconium	µg/L	3	**5**					4

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives

Christine Burke
Lab Manager

R.L. = Reporting Limit
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DATE RECEIVED: 10-Mar-21
DATE REPORTED: 18-Mar-21
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.:
P.O. NUMBER: 21BF003
WATERWORKS NO.

Summary of Exceedances

Interim PWQO		
BH/MW 12	Found Value	Limit
Zinc (µg/L)	26	20
Lead (µg/L)	2.76	1

Provincial Water Quality Objectives		
BH/MW 12	Found Value	Limit
Zirconium (µg/L)	5	4
Vanadium (µg/L)	9	6
Iron (µg/L)	6280	300
Copper (µg/L)	8.9	5
Cobalt (µg/L)	2.8	0.9

PWQO - Provincial Water Quality Objectives
Interim PWQO - Interim PWQO
PWQO - Provincial Water Quality Objectives

Christine Burke
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
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GENERAL SAMPLE SUBMISSION FORM

CADUCEON ENVIRONMENTAL LABORATORIES

SAMPLES SUBMITTED TO: Kingston [ ] Ottawa [ ] Richmond Hill [ ] Barrie [X] London [ ] Windsor [ ]

TESTING REQUIREMENTS: [X] O'Reg 153/04 [ ] O'Reg 406/19 [ ] RPI [ ] Coarse [ ] MISA [ ] Other: | [1] Table (1 - 9) [ ] Table (1 - 9.1) [ ] ICC [ ] Medium/Fine [ ] PWQO | [ ] Record of Site [ ] SPLP Table (1 - 9.1) [ ] Agricultural [ ] O'Reg 558 TCLP [ ] Landfill Monitoring

REPORT NUMBER (Lab Use): B21-06872

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? [ ] Yes [X] No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Organization: Peto Maccallum Ltd.	Address: 19 Churchill Drive, Barrie, ON L4N 8Z5, barrie@petomaccallum.com	Invoicing Address (if different):
Contact: A. Kimberley		
Tel: 705-734-3900 / Fax: 705-734-9911		
Email: akimberley@petomaccallum.com	Quote #: YD2019	Project Name/#: 21BF003
Additional Info (email, cell, etc): gwhite@petomaccallum.com	P.O. #:	Additional Info:

ANALYSES REQUESTED: PWQO Metals; Barrie Storm & Storm; SANITARY (as per Mun sm); Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page) *Must be arranged in advance

[ ]	Platinum*	200% Surcharge
[ ]	Gold*	100% Surcharge
[ ]	Silver	50% Surcharge
[ ]	Bronze	25% Surcharge
[X]	Standard	5-7 days
[ ]	Specific Date:	

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No.	Sample Source and/or Sample Identification	S.P.L.	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	X	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered Y/N
1	BH/MW 12		GW	21-03-10	4:00:00 PM	X X				13	N
	~~Cr (VI)~~ PM										
	Cyanide → K										
	O+G → K										
	1L amber → K										
	VOC → RH										
	Gen Chem; nut → K										
	Gen chem; metals → O (+ Filtered metals)										
	Pheinol → K										
	Hg → O										
	S^{2-} → K										
	Chromium → O										

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	S Griffith	S Griffith
Sign:		
	21-03-10	21-03-10
	Date (yy-mm-dd)/Time:	Date (yy-mm-dd)/Time:

SHIPPING INFORMATION: Courier (Client account) [ ]; Courier (Caduceon account) [ ]; Drop Off [X]; Caduceon (Pick-up) [ ]; Invoice; # of Pieces

REPORTING / INVOICING: Report by Fax [ ]; Report by Email [X]; Invoice by Email [X]; Invoice by Mail [ ]

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print):	Elle	Signature:	ES
Date Received (yy-mm-dd):	21-03-10	Time Received:	16:45
Laboratory Prepared Bottles:	[X] Yes	[ ] No	
Sample Temperature °C:	7.0°C	Labeled by:	AM

Comments:

APPENDIX D

Engineered Fill

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

6. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

7. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

8. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

9. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

10. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

11. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

12. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

13. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

14. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

15. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

16. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.

APPENDIX E

MECP Water Well Records

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
INNISFIL TOWNSHIP CON 14 003	17 601514 4911873 W	1972/11 4608	30	FR 0017	16/20/2/ 0:30	DO		5709611 ()	BRWN SAND 0023
INNISFIL TOWNSHIP CON 14 003	17 601564 4911923 W	1973/08 4608	30	FR 0015	10//45/0: 30	DO		5710470 ()	BRWN CLAY 0010 GREY CLAY 0025
INNISFIL TOWNSHIP CON 14 003	17 601464 4911823 W	1984/08 1467	5	FR 0075	32/55/5/ 1:0	DO	0085 4	5719410 ()	GREY FILL STNS 0004 BRWN GRVL SAND 0029 BRWN CLAY SAND 0039 GREY CLAY 0055 GREY SAND SLTY 0062 GREY CLAY 0075 BRWN FSND 0089
INNISFIL TOWNSHIP CON 14 003	17 601714 4911923 W	1985/01 1467	5	FR 0084	30/53/5/ 3:0	DO	0084 4	5719579 ()	BLCK LOAM 0001 BRWN SAND 0026 BRWN SAND CLAY 0069 GREY CLAY GRVL 0084 BRWN SAND STNS 0088 GREY CLAY GRVL 0088
INNISFIL TOWNSHIP CON 14 003	17 601569 4911932 W	1992/03 3602	6	FR 0080	32/70/15 /1:0	DO	0082 3	5728987 (111289)	BRWN SAND 0015 BRWN CLAY STNS STNY 0019 BRWN CLAY SAND SNDY 0080 BRWN SAND WBRG 0085
INNISFIL TOWNSHIP CON 14 003	17 601534 4912006 W	1994/12 3602	6	FR 0066	33/50/20 /2:15	DO	0069 3	5731300 (148244)	BRWN SAND GRVL STNS 0021 GREY CLAY SOFT 0040 GREY CLAY STNS HPAN 0055 GREY SAND CLAY SNDY 0066 BRWN SAND CLN WBRG 0072
BARRIE CITY	17 601474 4911829 W	2010/07 7219	5		39///:	NU		7149889 (Z111899) A097054 A	
INNISFIL TOWNSHIP	17 601351 4911927 W	2017/11 7241	2			TH MO	0010 5	7303756 (Z274175) A217625	BRWN SAND 0016
BARRIE CITY (VESPRA)	17 601273 4912108 W	2017/11 7241	2			TH MO	0010 5	7303914 (Z274174) A217647	BLCK PEAT 0004 BRWN SAND 0015
INNISFIL TOWNSHIP	17 601085 4911856 W	2019/04 7314	5	FR 0001		OT	0006 2	7333788 (Z265166) A139489	BRWN LOAM WBRG 0000 BRWN FILL SLTY SNDY 0002 BRWN SAND FILL SILT 0005 BRWN SAND SILT WBRG 0006 BRWN SAND GRVL WBRG 0008