BURNSIDE

Preliminary Hydrogeological Assessment

Crown (Barrie) Developments Inc.
Barrie, Ontario

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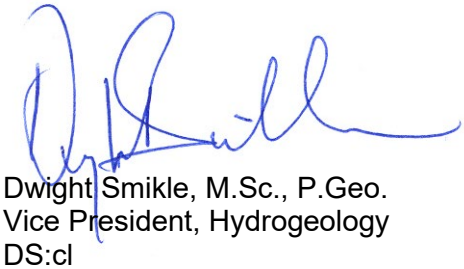

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by Crown (Barrie) Developments Inc. to complete a hydrogeological assessment for lands located at 1012 Yonge Street in Barrie. The lands associated with the assessment, herein referred to as the subject lands are located west of Yonge Street and between Mapleview Drive East and Lockhart Road (Figure 1). The subject lands are located within the Barrie Annexed Lands and the OPA 39 Hewitt's Secondary Plan Area (SPA) located on the southern boundary of the City of Barrie. In 2017, a Subwatershed Impact Study (SIS) for the Hewitt's SPA including a hydrogeological assessment (Burnside, 2016) was completed for the Hewitt's Creek Landowners Group. The SIS indicated that further studies would be required in support of development of individual properties.

The current assessment is aimed at updating information contained in the regional hydrogeological assessment and providing more detailed site-specific information for the subject lands in support of site plan application for the subject lands.

1.1 Scope of Work

The scope of work completed for the hydrogeological study was developed to build upon the regional work completed for the Hewitt's SIS (Burnside, 2016) and to address requirements for hydrogeological studies in support of site plan applications. The scope of work for the hydrogeological assessment included the review of available regional information as well as the completion of the following site-specific tasks:

1. Review of published geological and hydrogeological information: A review of background material for the area, including topography, surficial geology and bedrock geology mapping and existing geotechnical and hydrogeological reports was completed to assess the regional hydrogeological setting. The review completed included a review of previous reports completed by GHD in 2022.

2. Review of the Ministry of the Environment, Conservation and Parks (MECP) water well records: The MECP maintains a database that provides geological descriptions of formations encountered during the drilling of water supply wells in the province. A list of the available MECP water well records for local wells is provided in Appendix A and the well locations are plotted on Figure 8. It is noted that the well locations listed in the MECP records are approximations only and may not be representative of the precise well locations in the field. These well data were compiled, and the interpreted geology mapped to assist the characterization of the local groundwater conditions.

3. Groundwater monitoring network: A network of monitoring wells was installed for previous studies and data from the network was used to gain information on

groundwater distribution and fluctuations. The locations of the monitoring wells used for the current study are shown on Figure 2 and monitoring well construction details are provided on the borehole logs in Appendix B.

4. Hydraulic conductivity testing: Burnside reviewed single well response tests conducted by GHD at four onsite wells to determine soil hydraulic conductivity. The hydraulic conductivity field testing results are provided in Appendix C.

5. Monitoring of groundwater levels: Monitoring was previously completed by GHD and those data were reviewed by Burnside. To obtain up to date groundwater readings and extend the length of the record, monthly water level readings were conducted by Burnside between May and July of 2024. The groundwater monitoring data and hydrographs are provided in Appendix D.

6. Water quality testing: Water quality sampling and analyses were conducted by GHD and have been incorporated into the current study. Groundwater samples were collected from one onsite monitoring well and analyzed for numerous water quality and contamination indicator parameters. The laboratory water quality data are provided in Appendix E.

7. Water balance calculations: Pre- and post-development water balance calculations have been completed to assess the groundwater infiltration volumes for the subject lands. The local climate data and detailed water balance calculations are provided in Appendix F.

8. Data compilation, assessment of site conditions and reporting: The above data were all compiled, reviewed and assessed to develop an understanding of the site-specific hydrogeological conditions. The results of the assessment are presented in the current report.

2.0 Physical Setting

2.1 Topography and Drainage

The subject lands are located within the Lake Simcoe watershed and is in the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The subject lands are located close to the boundary of two subwatersheds: Lovers Creek Subwatershed and Hewitt's Creek Subwatershed (Figure 3). The boundary of the Hewitt's Creek Subwatershed is located along the eastern boundary of the subject lands.

The topography of the subject lands is generally flat with elevations ranging from 267 masl to 271 masl. There are no watercourses on the subject lands.

2.2 Geology

The subject lands are located in the physiographic region known as the Peterborough Drumlin Field. The region is characterized as a rolling drumlinized till plain. The drumlins through the region are comprised of highly calcareous till (Chapman & Putnam, 1984).

The overburden was deposited as a series of advances and retreats of the Simcoe glacial ice lobe. This has resulted in drumlinized sheets of glacial till (Newmarket till), stratified glaciolacustrine deposits of sand and gravel, littoral-foreshore deposits and massive-well laminated deposits of sand and gravel. A review of the quaternary geology mapping for the area (OGS, 2003) indicates that the overburden sediments of the subject lands consist of a sliver of fine grained sediments, mainly silty to sandy glacial till on the southern edge of the subject lands with an area of glaciofluvial ice contact stratified sediments of sand and gravel found across the remainder of the subject lands (Figure 4).

The bedrock underlying the subject lands is mapped as the Lindsay Formation of the Simcoe Group, which consists of limestone and shale (OGS, 2007).

2.3 Regional Hydrostratigraphy

The overburden deposits of the subject lands influence groundwater occurrence and flow. The overburden has been interpreted by regional studies such as the Tier 3 Water Balance (AquaResource, 2011) and Source Water Protection Assessment Report (LSRCA, 2012) to consist of alternating sequences of coarser-grained permeable layers (aquifers) and finer-grained less permeable layers (aquitards) of varying thicknesses. The basic hydrostratigraphic sequence that was modelled in the regional studies (AquaResource, 2011) consists of four main aquifer areas (A1-A4) and four main aquitards (C1 to C4) with a confining layer (UC) over the uppermost aquifer (A1).

A description of the interpreted regional hydrostratigraphic framework is provided below (LSRCA, 2012):

- Surficial Geology Layer – This layer represents coarse grained sediments in stream beds and at surface surficial geology areas that overly the UC. The thickness ranges from 0.1 m to 3 m.
- UC – Upper Confining Layer – Represents smaller areas of less permeable surficial material. The upper confining layer has been mapped as coarse-grained lacustrine deposits which are part of a regionally extensive sand plain (LSRCA, 2012). Regional studies such as the AquaResource (2011) report indicate that the confining layer (UC) is patchy in the area of the study area.

- A1 – Represents the uppermost aquifer. Frequently exists as a surficial unconfined aquifer and is stratigraphically equivalent to the Oak Ridges Moraine. It is generally associated with coarse grained glacial and interglacial sediments mapped as ice contact stratified drift. The majority of the local domestic wells are completed within this area. The upper aquifer A1 is reported to be present throughout the larger Barrie area, and has been interpreted to occur extensively in the study area.

- C1 – Upper aquitard. Described as varved clay and silt (LRSCA, 2012).

- A2 – Intermediate aquifer which is stratigraphically equivalent to areas within the Northern Till. The aquifer is generally described as being composed of sand with some clast rich portions (LRSCA, 2012). This area is used for the Innisfil Heights water supply.

- C2 – Intermediate aquitard.

- A3 – This area constitutes the main Barrie municipal aquifer and is the source of the Stroud water supply; it is stratigraphically equivalent to the Thorncliffe deposits in the Upland regions.

- C3 – Lower aquitard.

- A4 – Lower aquifer, thin and sometimes combined with A3 where C3 is thin or absent.

- C4 – Lower aquitard but may also represent weathered bedrock.

The above regional hydrostratigraphic sequence was supported by the work completed by Burnside in the SIS and is thought to represent the sequences encountered in the vicinity of the subject lands.

2.4 Local Stratigraphy

Boreholes and monitoring wells were drilled within the subject lands as part of a geotechnical investigation conducted by GHD in 2022. There are monitoring wells and boreholes from previous studies. Locations of the boreholes and monitoring wells that were included in the current study are shown on Figure 5 and the borehole logs are provided in Appendix B.

The boreholes indicated that the overburden stratigraphy is generally composed of layers of glacial till and sand. The till deposits were generally composed of sandy silt to silty sand with varying amounts of clay and gravel. Some lenses of finer grained sediments were encountered in the boreholes that are interpreted to be discontinuous.

Clay was encountered below the fill at MW5-21 with topsoil extending to a depth of 2.3 m. A deposit of silt was encountered at MW3-21at a depth of 3.1 to 3.8 m.

To illustrate the shallow hydrostratigraphic sequence of the subject lands, schematic geologic cross-sections have been prepared by Burnside (Figures 6 and 7) using the MECP well records (Appendix A) and the soils information collected during drilling of boreholes and monitoring wells (Appendix B). The locations of the cross-sections are illustrated on Figure 5 along with the locations of water wells and boreholes used in the construction of the cross-sections.

The cross-sections illustrate that the subject lands are underlain by a layer of silty sand till with an intermediate layer of sand. The silty sand and sand are interpreted to form the local aquifer where supply wells are completed to depths that are generally less than 20 m to 30 m below ground surface. The background studies and the borehole log MW21-1 suggest that the sand layer is underlain by a low permeability clay silt till.

3.0 Hydrogeology

The hydrogeology of the subject lands was investigated in order to determine site specific conditions and occurrences that impact the occurrence and movement of groundwater at the local scale. Various parameters were evaluated in order to develop a full understanding and interpretation of hydrogeological conditions on the subject lands. Conceptually, the information was all combined to create an understanding of the hydrogeological conditions of the subject lands that is referred to as the conceptual model. The following sections provides additional information on the interpreted conceptual model for the subject lands.

3.1 Hydraulic Conductivity

Soil hydraulic conductivity is a measure of its ability to transmit groundwater. There are various methods that can be used to assess soil hydraulic conductivity. Grainsize data and soil characteristics can be used to provide a general estimate of hydraulic conductivity. In situ bail-down or slug-testing methods are used in groundwater monitoring wells to assess site-specific hydraulic conductivity. These methods have been used to estimate the hydraulic conductivity of the soils encountered on the subject lands as discussed below.

3.1.1 Grainsize Analysis

Grainsize analysis from geotechnical investigations conducted by GHD were used to evaluate soil hydraulic conductivity for the soils encountered at various drilling depths. The grainsize curves for the sediments analyzed are provided in Appendix C.

Grainsize analyses results indicate that the sediments within the overburden range in composition from sand with silt (7% fines) to silty clay (90% fines). The amount of fines within a deposit impacts the ability of the material to transmit water and a greater amount of fines generally lowers the overall hydraulic conductivity. Groundwater flow is generally limited within fine grained sediments with lower hydraulic conductivity.

To estimate hydraulic conductivity based on grainsize analysis, an empirical formula known as the Hazen estimation is used. This method is an approximation of hydraulic conductivity based on grainsize curves for sandy soils. The approximation does not strictly apply to finer grained materials however, it is still considered useful to provide a general indication of the range of the hydraulic conductivity values.

Hydraulic conductivity values were derived empirically using the Hazen method for ten of the samples collected on the subject lands. The grainsize distribution graphs are provided in Appendix C and the calculated hydraulic conductivity values are provided in Table 1.

Table 1: Summary of Grainsize Analyses and Hydraulic Conductivity

Sample ID	Depth of Sample (mbgs)	Description	% Fines	Hydraulic Conductivity (cm/s)
BH1-SS4	1.9 – 2.9	Silty Sand with gravel	15	3.4×10^{-3}
BH1-SS9	6.0 – 6.7	Sand with silt	9	7.1×10^{-3}
BH1-SS13	12.2 – 12.8	Silt with sand	76	2.3×10^{-4}
BH2- SS7	4.6 – 5.2	Sandy silt	61	6.8×10^{-4}
BH2-SS12	10.7 – 11.3	Silty sand	39	1.4×10^{-3}
BH3-SS10	7.6 – 8.2	Sand with silt	9	6.4×10^{-3}
BH3-SS13	12.2 – 12.8	Sand with silt	7	9.4×10^{-3}
BH4-SS3	1.5 – 2.1	Silty sand with gravel	26	9.0×10^{-6}
BH4-SS9	6.1 – 6.7	Silt with sand	74	1.3×10^{-5}
BH5-SS10	10.7 – 11.3	Sand with silt	9	6.4×10^{-3}

Grainsize analysis completed on the subject lands illustrates the range of sediments and associated hydraulic conductivity that are found on the subject lands. It is noted that there are some sediments with lower hydraulic conductivity, but the majority of the sediments are sand and silty sand. The hydraulic conductivities based on grainsize analyses are estimated in the range of 10^{-3} to 10^{-6} cm/sec.

3.1.2 Single Well Response Tests

To assess the in situ hydraulic conductivity of the sediments screened by the monitoring wells, single well response tests (falling head tests) were conducted at four monitoring

wells (MW1-21, MW2-21, MW4-21 and MW5-21). The results from the tests were plotted (Appendix C) and analyzed to calculate hydraulic conductivity. A summary of the calculated hydraulic conductivities is provided below in Table 2.

Table 2: Single Well Response Testing Results

Monitoring Well	Screen Interval (mbgs)*	Formation Screened	Hydraulic Conductivity (cm/sec)
MW1-21	8.5 – 11.5	Sand and silty sand	1.2×10^{-4}
MW2-21	8.2 – 11.2	Sand, trace to some silt	1.1×10^{-5}
MW4-21	7.5 – 10.5	Silt with Sand	1.1×10^{-4}
MW5-21	7.5 – 10.5	Sand	8.9×10^{-3}

*metres below ground surface

The single well response test analyses resulted in hydraulic conductivities ranging from 10^{-3} to 10^{-5} cm/sec and represents the properties of the formation at the interval screened by the monitoring well. Overall, the hydraulic conductivity of the overburden sediments on the subject lands consisting of sand and clay/silt till is interpreted to range from 10^{-3} cm/sec (high) to 10^{-5} cm/sec (moderate).

It is noted that infiltration tests (using Guelph Permeameter) are proposed to be conducted at intervals that correspond to the elevation at the base of proposed infiltration facilities.

3.2 Local Groundwater Use

The City of Barrie obtains its water from a combination of groundwater and surface water based supplies. The City of Barrie groundwater supply wells are located in deep aquifers (A3 and A4 in the regional hydrostratigraphy). These aquifers are interpreted to be found at elevations of 150 masl to 195 masl and 115 masl to 160 masl respectively (AquaResource et al. 2011) and are significantly below the surficial layer found on the subject lands and separated from any potential impact due to the proposed development. There are no municipal water supply wells located close to the subject lands; the municipal water supply wells are located on the west and northern sides of the City more than 5 km from the subject lands. The subject lands do not fall within any wellhead protection areas or intake protection zones associated with the City of Barrie water supply systems (LSRCA, 2012).

Municipal servicing is assumed to be available for lands within the municipal boundary, however, municipal water service does not extend along Yonge Street in the vicinity of the subject lands. Adjacent properties along Yonge Street are known to be serviced by private supply wells. In the vicinity of the subject lands, servicing is not available and therefore properties are assumed to have private water supply wells.

3.2.1 Water Supply Wells

The area surrounding the subject lands is not currently serviced and residences are supplied by private wells. A review of MECP well records within 300 m of the subject lands identified 9 water supply well records with depths ranging from 11 m to 28 m (Appendix A). Two of the water well records are for wells on the subject property that will be decommissioned.

A door-to-door well survey was conducted by Burnside for residences and buildings within 300 m of the subject lands. The objective of the survey was to determine the status of private water supply wells and obtain information about the wells (e.g. well type, depth, age, etc.). The survey was completed on June 24, 2024. If a homeowner was not present at the time of the survey, a copy of the survey was left for the property owner with a letter explaining the purpose of the survey and a postage paid self-addressed envelope so that the resident can mail back their response.

There are six properties on Yonge Street with potential private water supply wells within 300 m of the subject lands. Surveys were delivered to each of these properties.

The locations of the MECP water well records are shown on Figure 8.

3.3 Water Level Monitoring Results

Groundwater level data for onsite wells and wells in the vicinity of the subject lands are provided in tables and hydrographs in Appendix D. Groundwater elevations are plotted with daily precipitation data obtained from a nearby climate station – Barrie-Oro (Climate Station ID# 6117700) – which is the closest station with daily precipitation values for monitoring period. Water level data from a water well nest (RS-3s/d) on the adjacent property in the vicinity of the subject lands collected between 2017 and 2020 is provided in Figure D-9, Appendix D.

The groundwater monitoring data show the following (refer to Figure 2 for the monitoring locations and the data tables and hydrographs in Appendix D):

- Typically, in shallow wells in southern Ontario, a pattern of seasonal groundwater fluctuations is apparent with highest levels occurring in the spring, levels declining throughout the summer and early fall and then rising again in the late fall/early winter. Water levels collected between May and July 2024 show a seasonal groundwater level high in May (Figures D-1 to D-8) followed by a gradual decline. As part of the current assessment, monthly groundwater level readings will continue to be obtained to capture groundwater levels for a full four seasons (twelve month) period.

- Groundwater elevations recorded on the subject lands ranged from 263.45 masl to 265.04 masl.

- BH1, screened in sand at a depth of 7.7 m had water levels observed from 7.4 m to 7.6 m bgs and was also observed to be dry (Figure D-1, Appendix D).

- Monitoring well BH2 with a depth of 6.2 m bgs was screened in sand above the water table and was dry for the monitoring period (Figure D-2, Appendix D).

- BH4, screened in sand at a depth of 7.6 m had water levels observed from 6.7 m to 7.1 m bgs (Figure D-3, Appendix D).

- Monitoring well BH5 with a depth of 6.1 m bgs was screened in sand and had water levels ranging from 4.6 m to 4.9 m bgs (Figure D-4, Appendix D).

- Monitoring wells MW1-21 and MW2-21 with depths of 11.5 m and 11.2 m respectively and screened in silty sand and sand had water levels ranging from 3.8 m to 4.7 m bgs (Figures D-5 and D-6, Appendix D).

- Monitoring well MW4-21, screened in silt with sand with a depth of 10.5 m bgs had water levels ranging from 6.1 m to 6.9 m bgs (Figure D-7, Appendix D).

- Monitoring well MW5-21 screened at depth of 10.5 m within sand underlying silty sand till had water levels ranging from 6.8 m to 7.4 m bgs (Figure D-8, Appendix D).

- The hydrograph for RS-3s/d (Figure D-9, Appendix D) shows that water levels respond slightly to individual precipitation events. Water levels at RS-3s/d show a seasonal trend with water levels highest in the spring and a seasonal variation of about 0.5 m to 1.0 m. The lack of gradient observed between the shallow and deep wells suggests that lateral flow is greater than vertical flow.

3.4 Interpreted Groundwater Flow Pattern

Groundwater flow within the shallow overburden is interpreted to be influenced by the surface topography with groundwater flow from the topographically higher areas towards topographically lower areas and surface water features. The subject lands are located at the topographic high and near the watershed boundaries of the Hewitt's and Lover's Creeks. Groundwater flow is interpreted to be from west to east following topography.

3.5 Recharge and Discharge Conditions

Areas where water from precipitation infiltrates into the ground and moves downward (i.e., areas of downward hydraulic gradients) are known as recharge areas. These

areas are generally found at relatively higher topographic elevation. Areas where groundwater moves upward to discharge at surface (i.e., areas of upward hydraulic gradients) are discharge areas and these generally occur in areas of relatively lower topographic elevation, such as along watercourses. Based on data available for the subject lands, groundwater recharge conditions are interpreted as occurring across the subject lands. The subject lands are located along the subwatershed boundary at the apex of the drainage system and discharge zones are not anticipated in this area.

3.5.1 Significant Groundwater Recharge Areas and Ecologically Significant Groundwater Recharge Areas

Significant Groundwater Recharge Areas (SGRAs) can be described as areas that can effectively move water from the surface through the unsaturated soil zone to replenish available groundwater resources (LSRCA, 2012). SGRAs were mapped by the Source Water Protection Assessment Report (LSRCA, 2012) as a requirement of the Clean Water Act, 2006 and based on guidance provided by the MECP. The delineation of these areas was completed using numerical models and analyses that included the evaluations of numerous factors including precipitation, temperature and other climate data along with land use, soil type, topography and vegetation to predict groundwater recharge, runoff and evapotranspiration.

SGRAs represent areas where the annual recharge rate is greater than 115% of the average recharge of 164 mm/year across the Lake Simcoe watershed (or greater than the threshold recharge rate of 189 mm/year) (LSRCA, 2012). SGRAs within the subject lands are mapped on Figure 8. The SGRAs generally correspond to areas that are mapped as coarse-grained sediments in the surficial geology mapping.

Ecologically Significant Groundwater Recharge Areas (ESGRAs) were delineated for the Barrie Creek, Lover's Creek and Hewitt's Creek subwatersheds by Earthfx (2012) using the groundwater model developed by AquaResources for the Source Protection studies. ESGRAs were identified as areas of land that are assumed to support groundwater systems or environmentally sensitive features like lakes, cold water streams and wetlands (Earthfx, 2012). ESGRAs were delineated by identifying pathways in which recharge, if it occurred, would reach an ecologically significant feature. Ecologically significant features used for the delineation of the ESRGAs included headwater streams, cold water fisheries, wetlands, and brook trout and sculpin capture sites. ESGRAs were only identified within the LSRCA jurisdiction. Our review of the available mapping indicates ESGRAs on the extreme eastern edge of the subject lands (Figure 10), directly along the subwatershed boundary.

3.6 Aquifer Vulnerability

Aquifer vulnerability refers to the susceptibility of the aquifer to potential contamination. Some degree of protection for aquifers is offered by the nature of the soil above the

water table. The degree of protection is dependent on the depth to water table or the depth to the aquifer and the type of soil above the water table or aquifer. Generally greater depths provide better protection and finer deposits (clays and silts) provide better protection than sands and gravels. Aquifer vulnerability has been mapped across the province as part of source water protection area assessment reports and expressed as high, medium and low. Aquifers ranked as high are mapped as Highly Vulnerable Aquifers in the MECP's Source Protection Information Atlas. Based on the available mapping, the subject lands are mapped as a highly vulnerability aquifer (HVA) area (Source Protection Information Atlas, 2024).

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. For groundwater, generally, with the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater transport through the soils. The potential for effects on local groundwater quality from infiltration in the urban areas is therefore expected to be limited.

4.0 Water Quality

4.1 Groundwater Quality

Water quality data was collected from one onsite monitoring well to typify the groundwater quality on the subject lands. Groundwater sampling was completed on July 21, 2021 at MW5-21 and samples were submitted to an accredited certified laboratory for analyses of City of Barrie sewer use by-law parameters as well as selected indicator parameters. The groundwater testing results from the analytical laboratory are provided in Appendix E and discussed below.

For evaluation purposes, the water quality was compared to the Ontario Drinking Water Quality Standards and the Provincial Water Quality Objectives (PWQO). The PWQO provides an indication of whether the groundwater on the subject lands could be discharged to surface water should pumping associated to construction be required.

- The results showed that the water generally met the Ontario Drinking Water Quality Standards (ODWQS). The water also met the standards for Barrie sanitary and storm sewers.

- The unfiltered sample showed exceedances of the PWQO for aluminum, cobalt and iron. There were also exceedances of the PWQO for phosphorus and total suspended solids. These exceedances in the unfiltered sample suggest that the sediment entrained in the water is responsible for the noted concentrations. The filtered samples did not show exceedances for the metal parameters.

- Nitrate was slightly elevated at 3.64 mg/L. Nitrate in this aquifer may originate from previous agricultural activities in the area of the subject lands.

- Total phosphorus was reported with a concentration of 0.015 mg/L. This is below the PWQO of 0.03 mg/L. Phosphorus is another nutrient that is an indicator that suggests the groundwater has been impacted by previous agricultural activities.

5.0 Water Balance

In order to assess potential land development impacts on the local groundwater conditions, a detailed water balance analysis has been completed to determine the pre-development recharge volumes (based on existing land use conditions). The detailed water balance calculations are provided in Appendix F.

5.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + ET + R + I$$

Where:

P	=	precipitation
S	=	change in groundwater storage
ET	=	evapotranspiration/evaporation
R	=	surface water runoff
I	=	infiltration

The components of the water balance vary in space and time and depend on local climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, is more prominent during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of the water balance components is difficult due to their spatial and temporal variations and as such, approximations and simplifications are made to characterize the water balance of an area. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The groundwater balance components for the subject lands are discussed below:

Precipitation (P)

The long-term average annual precipitation for the subject lands is 933 mm based on data from the Environment Canada Barrie WPCC (Station 6110557, 44°22'33.012" N,

79°41'23.010" W, elevation 221.0 masl) for the period between 1981 and 2010. The climate station is located 6 km northwest of the subject lands. Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (Appendix F).

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the PET and AET have been calculated using a soil-moisture balance approach.

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to the groundwater table (referred to as recharge) and a second component that moves laterally through the topsoil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short time following cessation of precipitation. As opposed to the “direct” component of surface runoff that occurs during precipitation or snowmelt events, interflow becomes an “indirect” component of runoff. The interflow component of surface runoff is not accounted for in the water balance equation cited above since it is often difficult to distinguish between interflow and direct (overland) runoff, however both interflow and direct runoff together form the total surface water runoff component.

5.2 Approach and Methodology

The analytical approach to calculate the water balance used in this study involves monthly soil-moisture balance calculations using a spreadsheet algorithm to determine the pre-development (based on existing land use) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists. During wetter periods, any excess of precipitation over

evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

The soil moisture storage component of the water balance was determined based on land cover and soil type for the subject lands. A soil moisture storage capacity of 75 mm was used to represent urban lawns on the subject lands in the post-development scenario (Table F-2, Appendix F). Tables F-1 and F-2 in Appendix F detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The MECP SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff coefficient was calculated for the soil moisture storage conditions. The calculated water balance components from this table are then used to assess the pre-development and post development volumes for runoff and infiltration as presented on Tables F-3a, F-3b and F-3c in Appendix F.

5.3 Water Balance Component Values

The detailed monthly calculations of the water balance components are provided in Tables F-1 and F-2 in Appendix F. For these calculations, it has been assumed that sandy loam soils are representative for the subject lands for estimating the soil infiltration factor. The calculations show that a water surplus is generally available from November to May. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables F-1 and F-2, Appendix F). A summary of these values is provided in Table 3.

Table 3: Water Balance Component Values

Water Balance Component	Agricultural Lands	Urban Lawn
Average Precipitation	933 mm/year	933 mm/year
Actual Evapotranspiration	593 mm/year	555 mm/year
Water Surplus	340 mm/year	378 mm/year
Infiltration	238 mm/year	265 mm/year
Runoff	102 mm/year	113 mm/year

5.4 Pre-Development Water Balance (Existing Conditions)

Based on the water balance component values calculated in Table F-1 (Appendix F), an estimate of the total pre-development groundwater infiltration volume within the subject

lands was calculated to be about 10,930 m^3/year across the three phases of development (Tables F-3a, F-3b and F-3c, Appendix F).

5.5 Potential Urban Development Impacts to Water Balance

Development of an area affects the natural water balance through the modification of land cover and slopes in some cases. The most significant impact of land development is due to the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (about 64% of precipitation across the subject lands). The net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff. The natural infiltration components (interflow and deep recharge) are reduced.

A water balance calculation of the potential water surplus for impervious areas is shown at the bottom of Table F-1 in Appendix F. There is an evaporation component from impervious surfaces, and this is typically estimated to be between about 10% and 20% of the total precipitation. For the purposes of the calculations in this study, the evaporation has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there is a potential water surplus from impervious areas of 793 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and wastewater services. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent.

5.6 Post-Development Water Balance with No Mitigation

To assess potential development impacts on infiltration, the post-development infiltration volumes have been calculated based on the proposed post-development land uses on Tables F-3a, F-3b and F-3c in Appendix F. The total areas for the proposed land uses and the associated percentage impervious factors were provided by the project design engineers.

The infiltration and runoff components for the post-development land uses have been calculated using the MOE SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Tables F-1and F-2 in Appendix F. From these tables the total calculated post-development infiltration volume

(without LID measures) for three phases of development on the subject lands is about 3,280 m^3/year.

Comparing the pre- and post-development infiltration volumes shows that development has the potential to reduce the average infiltration on the subject lands as outlined in Table 4 below.

Table 4: Summary of Water Balance Deficits in Post-Development

	Pre-Development Infiltration (m^3/yr)	Post-Development Infiltration (m^3/yr)	Post-Development Deficit (m^3/yr)	Post-Development Reduction in Infiltration (%)
Phase 1	3,990	1,300	2,690	68
Phase 2	3,370	1,110	2,260	67
Phase 3	3,570	870	2700	76
TOTAL	**10,930**	**3,280**	**7,650**	**70%**

These calculations assume no low impact development (LID) measures for stormwater management are in place.

5.7 Water Balance Mitigation Measures

Where feasible, LID measures for SWM will be incorporated into the development design to minimize development impacts on the natural water balance and control runoff. The basic premise for LID is to manage stormwater to minimize the runoff of rainfall and increase the potential for infiltration through the use of various design techniques.

As outlined in the SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide published by the CVC and TRCA (2010), there are a suite of LID techniques that can be considered to increase the potential for post-development infiltration and mitigate the reductions in recharge that may occur with urban land development.

Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards open space areas throughout the development, where possible (e.g., yards, boulevards, landscaped areas, swales, green space in parking lots, etc.), can increase recharge in the developed area. Where possible, increasing topsoil depths in the pervious areas to retain more water in storage can also assist to reduce runoff volumes and increase the potential for infiltration. Other engineered LID measures such as infiltration and/or exfiltration trenches, HDFs, enhanced grass swales, and bioswales can be used to reduce runoff volumes and increase the potential for infiltration.

Given the soil conditions and groundwater levels observed on the subject lands, infiltration based LIDs are considered feasible in certain areas. Infiltration rates of soils in the area of proposed LIDs should be confirmed with in-situ testing as part of later submissions. Details of the proposed SWM strategy are included in a separate document.

6.0 Development Considerations

6.1 Construction Below the Water Table

Based on groundwater level data collected as part of this study, water levels on the subject lands can range from 3.8 m bgs to 7.8 m bgs.

The construction of buried services below the water table has the potential to capture and redirect groundwater flow through more permeable fill materials typically placed in the base of excavations. Groundwater may also infiltrate into joints in storm sewers and manholes. Over the long-term, these impacts can lower the groundwater table across the development area. To mitigate this effect, services to be installed below the water table should be constructed to prevent redirection of groundwater flow. This will involve the use of anti-seepage collars or clay plugs surrounding the pipes to provide barriers to flow and prevent groundwater flow along granular bedding material and erosion of the backfill materials.

Due to the potential for encountering the water table during construction, the dewatering of local aquifers may be required as part of construction of underground parking garages and installation of services. The undertaking of dewatering according to industry standards and in accordance with a MECP processes will ensure that adequate attention is paid to potential adverse impacts to the environment. Currently the MECP allows for construction dewatering of less than 400,000 L/d to proceed under the Environmental Activity Sector Registry (EASR) process. If dewatering is to be above this threshold, then the standard Permit to Take Water (PTTW) process applies. In both cases, a scientific study is required in support of EASR registration or PTTW application. This scientific study must review the potential for environmental impacts and provide mitigation and monitoring measures to the satisfaction of the MECP or other review agency. The requirements for construction dewatering will be confirmed as part of later submissions.

6.2 Local Groundwater Supply Wells

The area surrounding the subject lands is not currently serviced and residences are supplied by private wells. The Burnside well records review indicated nine water well records within 300 m of the subject lands. Further review of the information from the water well records as well as information received from the well survey indicated that some wells are shallow (less than 10 m deep) and potentially vulnerable to shallow

aquifer conditions. A summary of the survey results is provided in Table G-1, Appendix G.

Burnside has been conducting groundwater monitoring at residential wells in the Hewitt's Creek area since 2019. This monitoring is part of a long-term monitoring plan by the Hewitt's Creek Landowners Group as part of due diligence and determination of impacts due to construction activities. Over the period of monitoring, Burnside has confirmed that shallow dug wells (generally less than 10 to 12 m deep) are the most vulnerable to impacts and reducing precipitation amounts is regarded as a big contributor to low groundwater levels in wells. Based on the presence of dug wells within the 300 m radius of the subject lands, a monitoring program is recommended to be implemented during all phases of construction.

6.3 Well Decommissioning

Prior to or during construction, it is necessary to ensure that all inactive wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. This regulation applies to private domestic wells and to the groundwater observation wells installed for this study unless they are maintained throughout the construction for monitoring purposes.

7.0 Monitoring and Mitigation

Baseline monitoring has been ongoing in the area of the subject lands since 2014 as part of the SIS and then as part of this current study in support of draft plan. These data provide a sufficient baseline against which future impacts can be analyzed.

The water well survey conducted by Burnside identified some private water wells that may be vulnerable to potential impacts from construction. In order to determine potential impacts a monitoring program that includes select private wells is recommended. Contingent on property owner approval and access, select wells should be equipped with automatic water level recorders for groundwater monitoring during construction. In addition to monitoring during construction, it is important to monitor if dewatering is required. It is recommended that, prior to the start-up of any dewatering activities, local residents within the 300 m radius be advised of the proposed activity and that an interference response procedure be established. The interference response procedure should include contact information that a resident can use to report an impact at their well. Impacts should also be reported to the MECP and replacement drinking water supplied until the cause of the impact has been determined.

If the cause of the impact is related to the work being undertaken, the contractor responsible for the work will be responsible for providing a replacement water supply for the duration of the impact. Should a permanent impact be determined then a permanent replacement supply will be required. It is noted that a monitoring program for high-risk

wells (shallow wells) has been commissioned by the Hewitt's Landowner Group and monitoring for this program is ongoing. The plan provides a mechanism for interference complaints to be investigated and for a temporary alternate water supply to be provided. It is recommended that any future monitoring plan for the subject lands be coordinated with the overall monitoring for the Hewitt's Lands.

8.0 References

AquaResource et al. 2011. City of Barrie Tier Three Water Balance and Local Area Risk Assessment Groundwater Flow Model, AquaResource, Golder and IWC, 2011.

Burnside, 2016. Hewitt's Secondary Plan Area Hydrogeological Assessment, Hewitt's Landowners Group, R.J. Burnside & Associates Limited, June 2016.

Burnside, 2019. Hewitt's SPA Lands Well Survey Report, Hewitt's Creek Landowners Group, Barrie, Ontario. R.J. Burnside & Associates Limited, January 2019 (Revised June 2019).

Chapman, L.J. and D.F. Putnam, 1984. The Physiography of Southern Ontario, Third Edition; Ontario Geological Survey, Special Volume 2, 270p. Accompanied by Map 2715.

Earthfx, 2012. Barrie, Lovers, and Hewitt Creeks – Ecologically Significant Groundwater Recharge Area Assessment and Sensitivity Analysis, Earthfx Incorporated, June 2012.

GHD, 2022. Hydrogeological Assessment, Proposed Mixed-Use Condominium Development, 1012 Yonge Street, Barrie, Ontario. GHD, September 21, 2022.

LSRCA, 2012. The Barrie Creeks, Lovers Creek and Hewitt's Creek Subwatershed Plans, Lake Simcoe Region Conservation Authority, 2012.

LSRCA, 2015. Lake Simcoe Region Conservation Authority – Approved Assessment Report; Lake Simcoe and Couchiching- Black River Source Protection Area, Part 1 Lake Simcoe Watershed, January 2015.

Ontario Geological Survey 2010. Surficial geology of southern Ontario; OGS, Miscellaneous Release-Data 128-Revised.

OGS, 2007. Paleozoic Geology of Southern Ontario; Ontario Geological Society, Miscellaneous Release – Data 219, 2007.

Ontario Ministry of the Environment, Conservation and Parks, Water Well Records.

Ontario Ministry of the Environment, Parks and Conservation, Source Protection Information Atlas.

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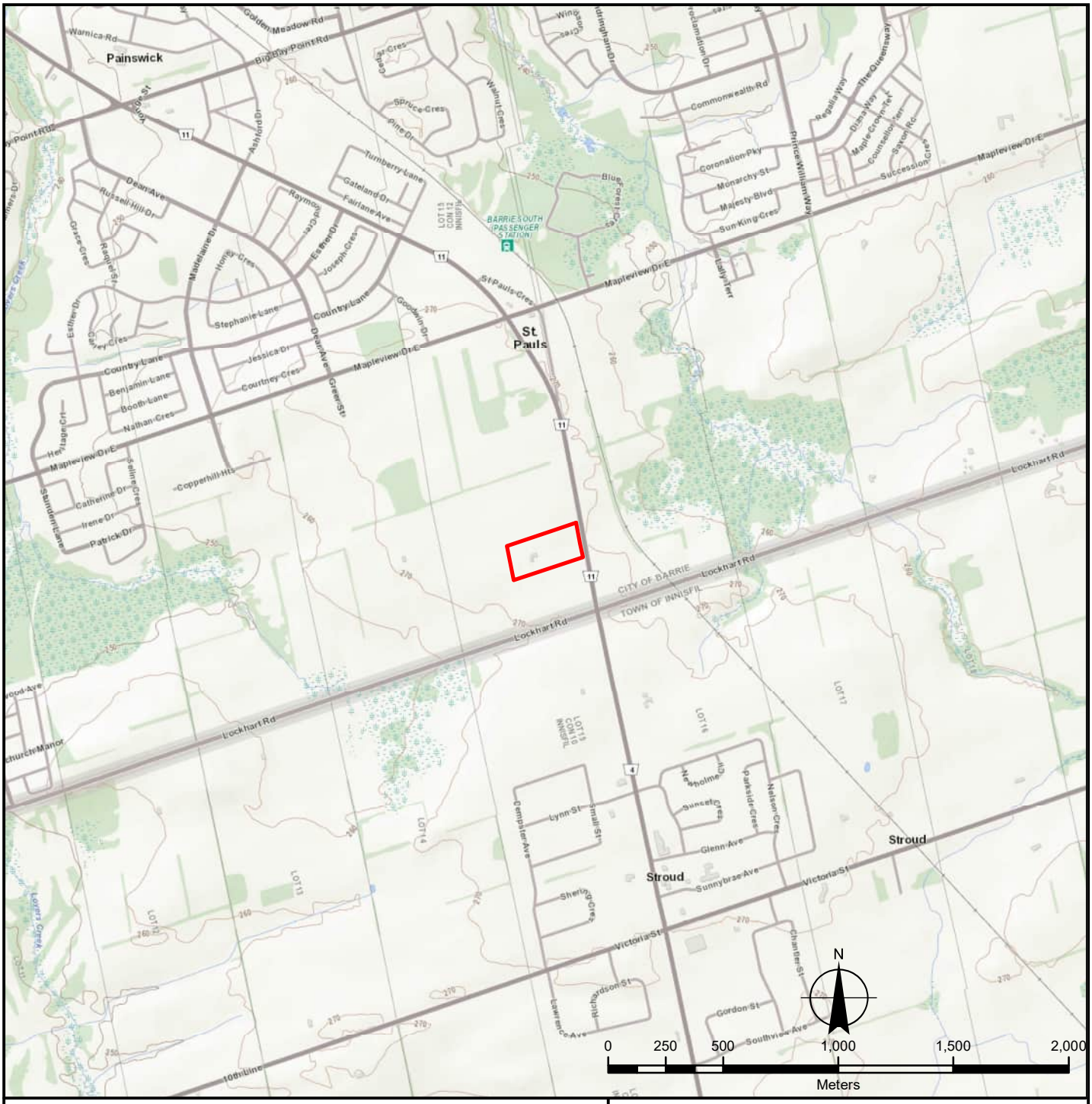
Figures



LEGEND

SUBJECT LANDS

BURNSIDE

Client / Report

CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title:

SITE LOCATION

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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LEGEND

- SUBJECT LANDS
- PHASE BOUNDARY
- MONITORING WELL (GHD, 2021)
- MONITORING WELL (SOIL ENG., 2022)
- MONITORING WELL (RJB, 2017)

0 40 80 120 160
Metres

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title

SITE PLAN AND MONITORING LOCATIONS

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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LEGEND

- SUBJECT LANDS
- PHASE BOUNDARY
- SUBWATERSHED BOUNDARY
- CONTOUR (1m intervals - masl)

0 50 100 200
Meters

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title:

TOPOGRAPHY AND DRAINAGE

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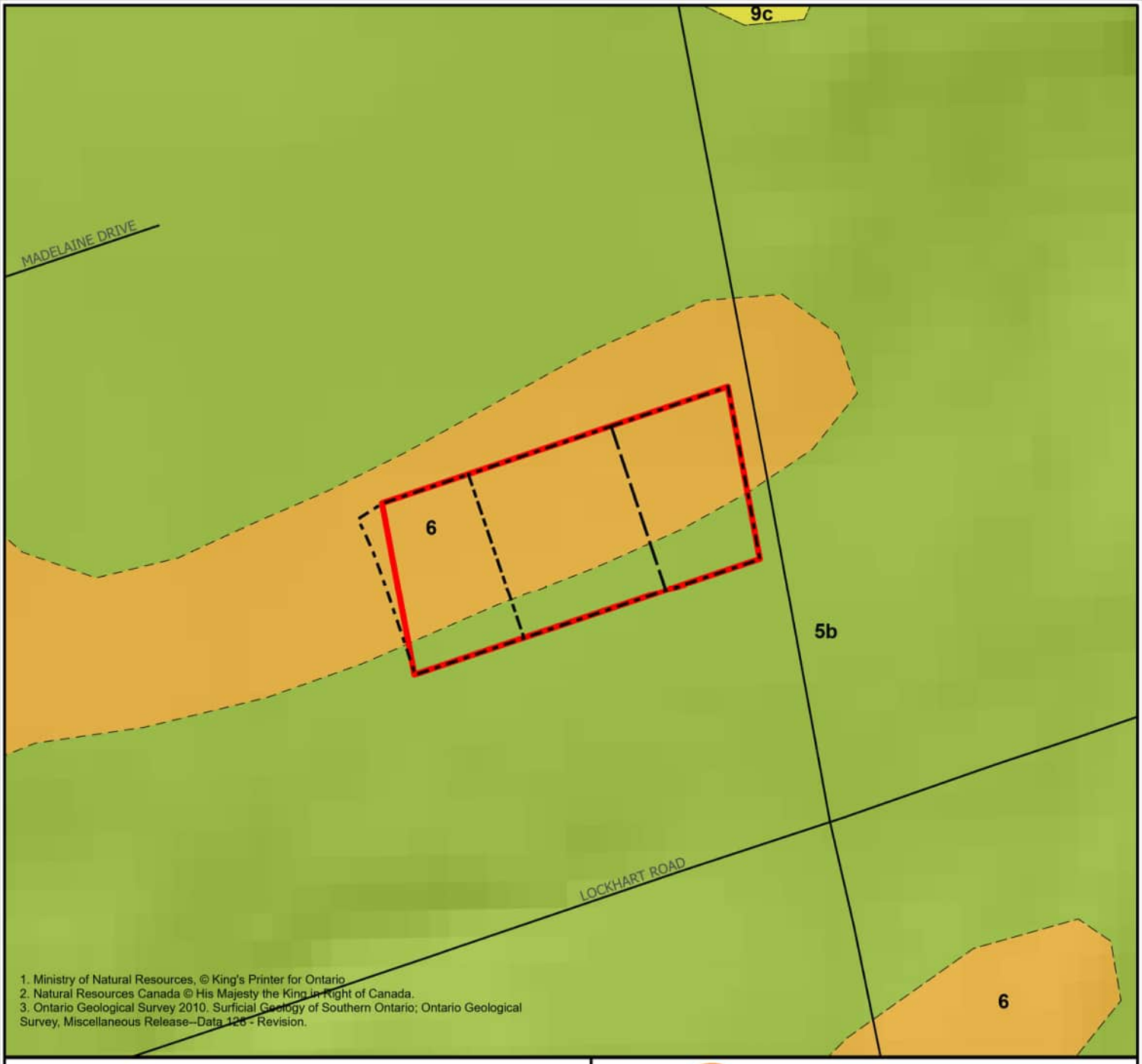

Legend

- PHASE BOUNDARY
- SUBJECT LANDS
- 5b: Till: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 9c: Coarse-textured glaciolacustrine deposits: Foreshore-basinal deposits

0 50 100 150 200 250 300 350
Metres

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Map Title

SURFICIAL GEOLOGY

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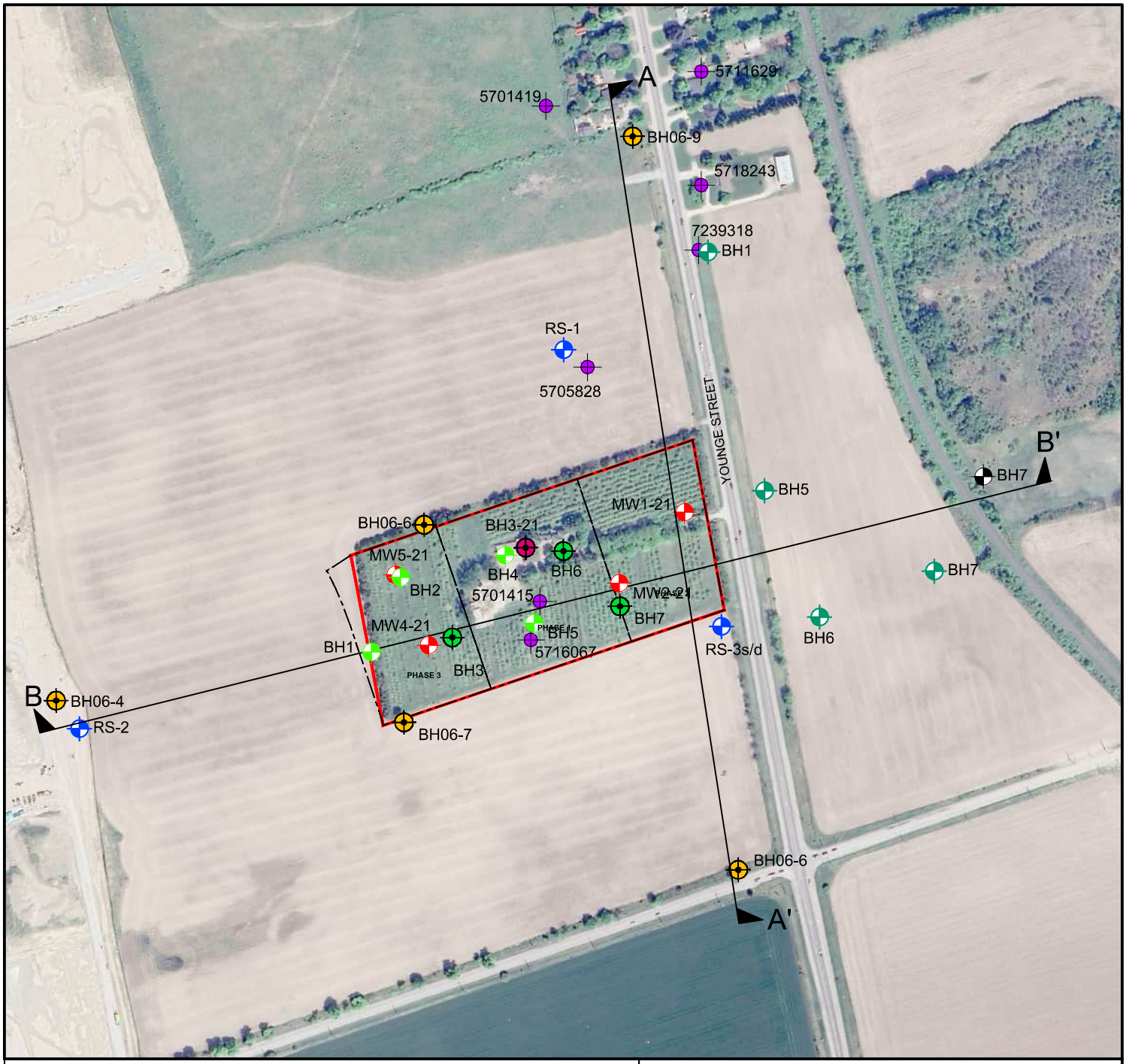

LEGEND

- SUBJECT LANDS
- PHASE BOUNDARY
- MONITORING WELL (GHD, 2021)
- MONITORING WELL (SOIL ENG., 2022)
- MONITORING WELL (RJB, 2017)
- MONITORING WELL (SOIL ENG., 2017)
- MONITORING WELL (MCR, 2018)
- BOREHOLE (GHD, 2021)
- BOREHOLE (SOIL ENG., 2022)
- BOREHOLE (GOLDER, 2006)
- MECP WELL RECORD LOCATION
- A A' CROSS-SECTION LOCATION KEY

0 40 80 120 160
Metres

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title

BOREHOLE, WELL AND CROSS-SECTION LOCATION PLAN

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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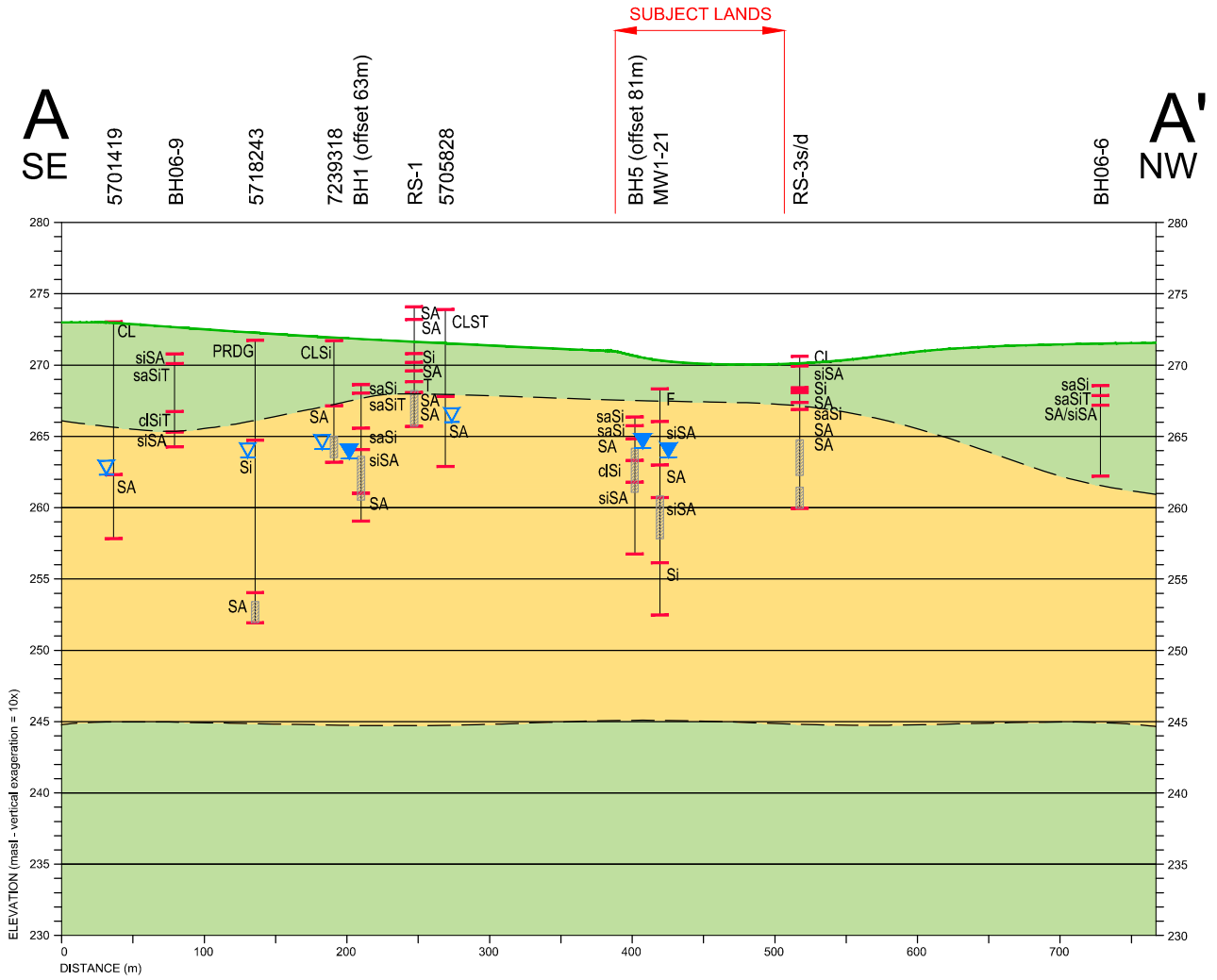

LEGEND

BH1 — WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

MEASURED WATER LEVEL (May 31, 2024)

STATIC WATER LEVEL (MECP WELL RECORD)

WELL SCREEN

INTERPRETED STRATIGRAPHY

si	SILTY
sa	SANDY
cl	CLAYEY
F	FILL
TS	TOPSOIL
GR	GRAVEL
SA	SAND
Si	SILT
CL	CLAY
T	TILL
PRDG	PREDUG

SAND / SILT

SILT / CLAY / TILL

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION A-A'

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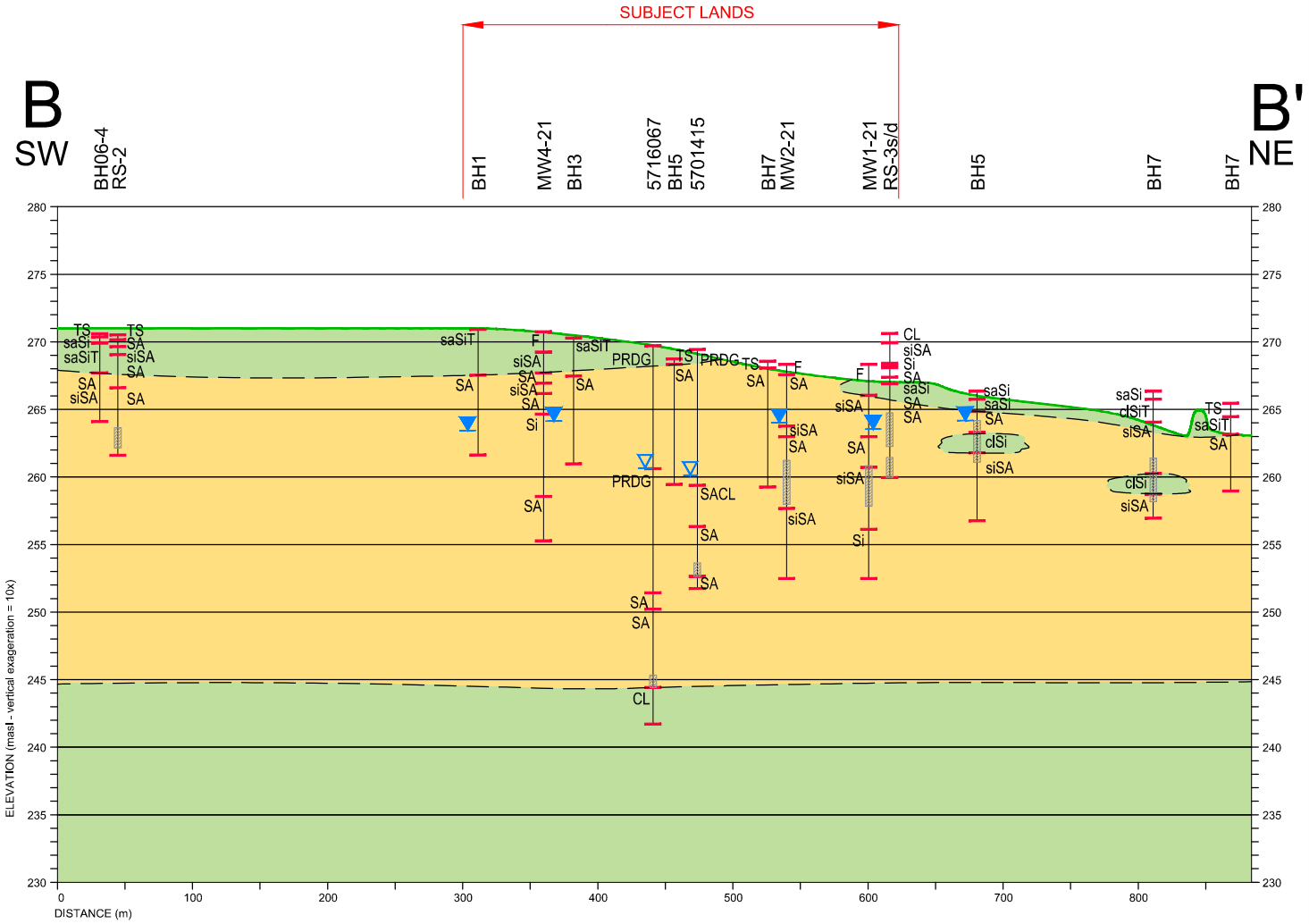

LEGEND

BH1 — WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

MEASURED WATER LEVEL (May 31, 2024)

STATIC WATER LEVEL (MECP WELL RECORD)

WELL SCREEN

INTERPRETED STRATIGRAPHY

si	SILTY
sa	SANDY
cl	CLAYEY
F	FILL
TS	TOPSOIL
GR	GRAVEL
SA	SAND
Si	SILT
CL	CLAY
T	TILL
PRDG	PREDUG

SAND / SILT

SILT / CLAY / TILL

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION B-B'

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LEGEND

- SUBJECT LANDS
- PHASE BOUNDARY
- BUFFER (300m)

Well Status:

- WATER SUPPLY
- MONITORING AND TEST HOLE
- ABANDONED - SUPPLY
- UNKNOWN

0 50 100 200 300 400
Meters

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Figure Title:

MECP WELL LOCATIONS

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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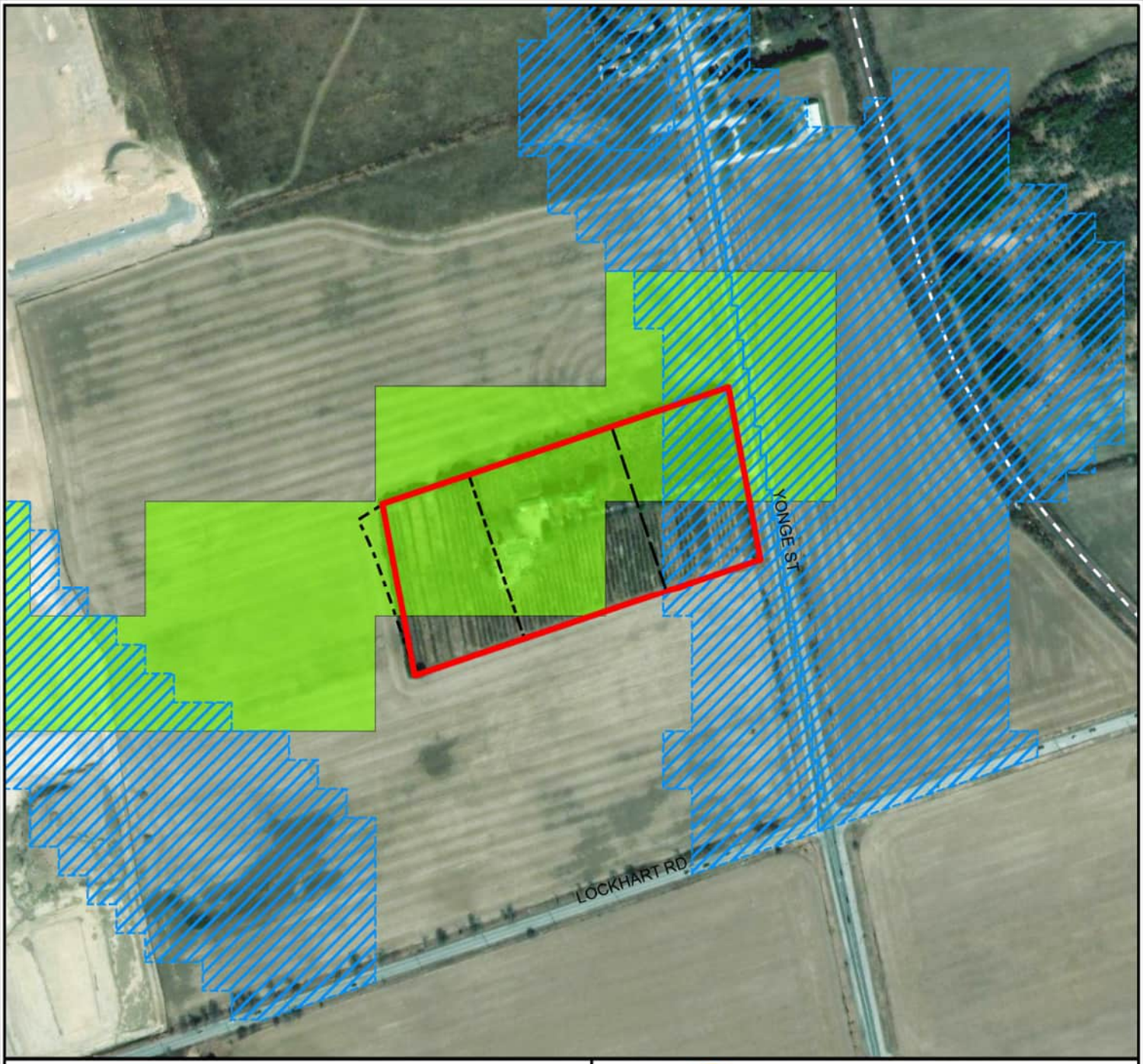

Legend

- SUBJECT LANDS
- PHASE BOUNDARY
- ENVIRONMENTALLY SIGNIFICANT GROUNDWATER RECHARGE AREA
- SIGNIFICANT GROUNDWATER RECHARGE AREA

0 50 100 150 200 250 300 350

Metres

N

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CROWN (BARRIE) DEVELOPMENTS INC.
BARRIE, ONTARIO

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Map Title

RECHARGE AREAS

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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Appendix A

MECP Well Records

Water Well Records

Wednesday, August 14, 2024
11:21:48 AM

TOWNSHIP CON L	UTM	DATE CN	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
INNISFIL TOWNSHIP	17 609712 4910766 W	2014/04 6809	2			TH	0022 5	7239318 (Z175927) A152307	BRWN CLAY SILT 0015 BRWN CSND 0028
INNISFIL TOWNSHIP CON 11 015	17 609376 4910783 L	2004/04 2513				NU		5738722 (Z00200) A000104 A	
INNISFIL TOWNSHIP CON 11 015	17 609376 4910783 L	2004/04 2513	6.28	FR 0085	36/55/2/1:0	DO	0086 6	5738721 (Z00199) A000103	BRWN SAND SILT STNS 0014 YLLW SAND 0062 BLUE SAND SILT CLAY 0085 GREY SAND SILT CMTD 0092
INNISFIL TOWNSHIP CON 11 015	17 609623 4910934 W	1999/03 2513	6	FR 0064	26/58/9/1:0	DO	0060 6	5734439 (195331)	LOAM 0001 YLLW SAND 0004 YLLW SILT 0018 YLLW SAND 0027 YLLW SAND SILT CLAY 0052 YLLW SAND 0064 YLLW CLAY 0064
INNISFIL TOWNSHIP CON 11 015	17 609564 4910423 W	1979/04 3203	6 5	FR 0060	30/75/2/6:10	DO	0080 3	5716067 ()	PRDG 0030 PRDR 0060 BRWN SAND CLAY 0064 GREY SAND CLAY LYRD 0083 GREY CLAY 0092
INNISFIL TOWNSHIP CON 11 015	17 609614 4910663 W	1968/09 4608	30	FR 0025	26///:	DO		5705828 ()	BRWN CLAY STNS 0020 MSND 0036
INNISFIL TOWNSHIP CON 11 015	17 609575 4910893 W	1967/01 4608	30	FR 0035	35//2/:	DO		5701419 ()	BRWN CLAY 0035 MSND 0050
INNISFIL TOWNSHIP CON 11 015	17 609572 4910457 W	1965/08 2514	6	FR 0043	30/52/3/2:30	ST DO	0052 3	5701415 ()	PRDG 0033 MSND CLAY 0043 MSND 0055 FSND 0058
INNISFIL TOWNSHIP CON 11 016	17 609836 4910312 W	2017/11 6032						7309125 (C36812) A202508 P	
INNISFIL TOWNSHIP CON 11 016	17 609714 4910823 W	1983/08 2514	6 5	FR 0060	27/70/6/1:30	DO	0071 4	5718813 ()	FILL 0003 BRWN CLAY SAND 0040 YLLW SAND CLAY GRVL 0060 GREY FSND VERY 0075
INNISFIL TOWNSHIP CON 11 016	17 609714 4910823 W	1982/11 3660	5	FR 0058	21/45/6/2:0	DO	0062 3	5718243 ()	PRDG 0023 BRWN SILT 0058 GREY MSND 0065
INNISFIL TOWNSHIP CON 11 016	17 609714 4910923 W	1974/10 3203	5	FR 0023	23/44/7/1:0	DO		5711629 ()	LOAM 0002 BRWN CLAY 0016 BRWN SAND CLAY 0023 GREY SAND 0058

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only

1. Core Material and Descriptive t

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

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Borehole Logs

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
271.0	Ground Surface							
0.3	**25 cm TOPSOIL**	1	DO	6	0		21	
	ploughed Brown, compact to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	11	1		15	
		3	DO	50/15			7	
		4	DO	91/24	2		7	
267.6		5	DO	87/24	3		12	
3.4	Brown, very dense **SAND** fine to medium grained occ. silt seams and gravel	6	DO	50/12	4		4	
		7	DO	70/28	6		3	
		8	DO	50/10	7		17	
261.7		9	DO	50/12	9		16	
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 7.6 m completed with 3.1 m screen Sand backfill from 2.9 m to 7.6 m Bentonite seal from 0.0 m to 2.9 m Provided with a momument steel casing				10 11 12			

W.L. @ El. of 263.4 m upon completion of drilling.

Well was dry on March 25, 2020
W.L @ El. of 263.66 m on April 22, 2020.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
271.2	Ground Surface				
	30 cm TOPSOIL	1	DO	6	0
0.3	ploughed Brown, compact to dense				
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	19	1
		3	DO	44	2
268.8		4	DO	50/8	
2.4	Brown, very dense **SAND** medium grained occ. silt seams and gravel	5	DO	67	3
		6	DO	50/12	4
		7	DO	50/12	5
		8	DO	50/10	6
		9	DO	50/12	7
261.9					8
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 m to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a momument steel casing				9 10 11 12

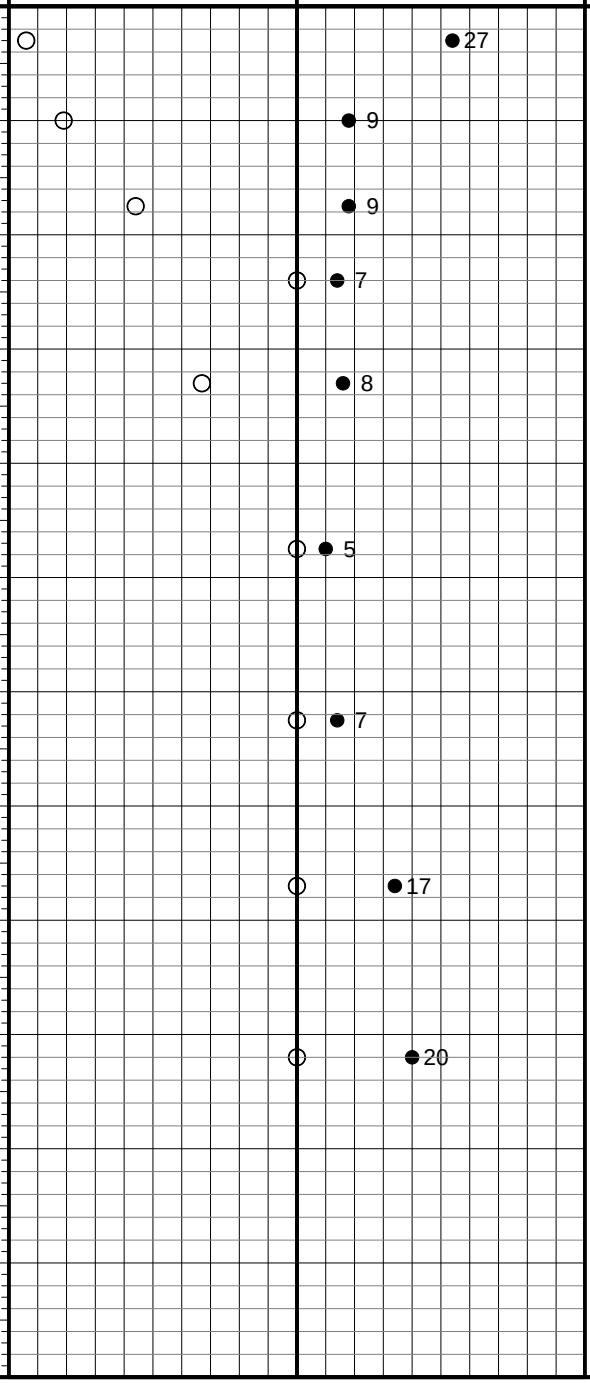
Dynamic Cone (blows/30 cm) 10 30 50 70 90

Shear Strength (kN/m²) 50 100 150 200

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

Atterberg Limits PL LL

Moisture Content (%) 10 20 30 40



WATER LEVEL

W.L. @ El. of 263.9 m upon completion of drilling.

Well was dry on March 25, 2020 and April 22, 2020

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
270.2	Ground Surface							
0.3	**25 cm TOPSOIL**	1	DO	8	0		16	
	Brown, loose to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	8	1		13	
		3	DO	20	2		11	
267.4		4	DO	73/25			8	
2.8	Brown, very dense	5	DO	78/23	3		7	
	SAND fine to medium grained occ. cobbles and boulders	6	DO	50/8	4		3	
		7	DO	50/15	5		10	
		8	DO	50/15	6		15	
260.9		9	DO	50/15	7		18	
9.3	**END OF BOREHOLE**				8			
					9			
					10			
					11			
					12			

W.L. @ El. of 264.4m upon completion of drilling.
Cave-in @ El. of 264.1 m upon completion of drilling.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 12, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
271.7	Ground Surface							
	33 cm TOPSOIL	1	DO	4	0		40	
0.3	ploughed Brown, loose to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	2	DO	9	1		11	
		3	DO	29	2		8	
		4	DO	67			7	
268.8					3			
2.9	Brown, very dense	5	DO	50/12			3	
	SAND fine to medium grained traces of silt and gravel occ. cobbles and boulders				4			
		6	DO	50/10	5		4	
					6			
		7	DO	50/15			3	
					7			
		8	DO	50/10			12	
					8			
262.4		9	DO	50/15	9		15	
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 7.6 m completed with 3.1 m screen Sand backfill from 2.9 m to 7.6 m Bentonite seal from 0.0 m to 2.9 m Provided with a momument steel casing				10			
					11			
					12			

W.L @ El. of 264.63 m on March 24, 2020.
W.L @ El. of 264.96 m on April 22, 2020.
W.L. @ El. of 262.6 m upon completion of drilling.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 17, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
268.8	Ground Surface				
	36 cm TOPSOIL	1	DO	2	0
0.4	ploughed Brown, loose very dense				
	SAND fine to medium grained a trace of silt occ. gravel	2	DO	24	1
		3	DO	57	2
		4	DO	72	
		5	DO	91/28	3
		6	DO	50/15	4
		7	DO	50/8	5
		8	DO	50/15	6
					7
					8
259.5		9	DO	50/15	9
9.3	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 m to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a momument steel casing				10
					11
					12

Dynamic Cone (blows/30 cm) 10 30 50 70 90

Shear Strength (kN/m²) 50 100 150 200

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

Atterberg Limits PL LL

Moisture Content (%) 10 20 30 40

WATER LEVEL

W.L. @ El. of 264.1 m upon completion of drilling.

W.L @ El. of 264.07 m on March 24, 2020.
W.L @ El. of 264.19 m on April 22, 2020.

Soil Engineers Ltd.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 19, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
269.9	Ground Surface							
	36 cm TOPSOIL	1	DO	4	0		16	
0.4	ploughed Brown, loose to compact							
	SAND fine grained a trace of silt	2	DO	15	1		4	
		3	DO	15	2		11	
267.8								
2.1	Brown, compact to very dense							
	SANDY SILT TILL traces of clay and gravel occ. sand seams and layers, cobbles and boulders	4	DO	29	3		9	
266.5		5	DO	67			7	
3.4	Brown, very dense				4			
	SAND fine grained occ. silt seams and gravel	6	DO	57	5		5	
		7	DO	50/12	6		8	
		8	DO	50/8	7		18	
					8			
260.6		9	DO	50/10	9		22	
9.3	**END OF BOREHOLE**				10			
					11			
					12			

W.L. @ El. of 263.5 m upon completion of drilling.
Cave-in @ El. of 263.2 m upon completion of drilling.

JOB NO.: 2002-S036

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Auger

PROJECT LOCATION: 1012 Yonge Street, City of Barrie

DRILLING DATE: March 18, 2020

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
268.1	Ground Surface							
	45 cm TOPSOIL	1	DO	2	0		14	W.L. @ El. of 264.0 m upon completion of drilling. Cave-in @ El. of 263.8 m upon completion of drilling.
0.5	Brown, loose to very dense ploughed							
	SAND fine to medium grained traces of silt and gravel occ. cobbles and boulders	2	DO	6	1		14	
		3	DO	41	2		4	
		4	DO	45			2	
		5	DO	65	3		3	
		6	DO	50/12	4		12	
		7	DO	50/28	5		16	
		8	DO	50/8	6		18	
258.8		9	DO	50/12	7		18	
9.3	**END OF BOREHOLE**				8			
					9			
					10			
					11			
					12			

Soil Engineers Ltd.

REFERENCE No.: 11226647 ENCLOSURE No.: 1

GHD

BOREHOLE No.: MW1-21
ELEVATION: 268.23 m

BOREHOLE REPORT

Page: 1 of 2

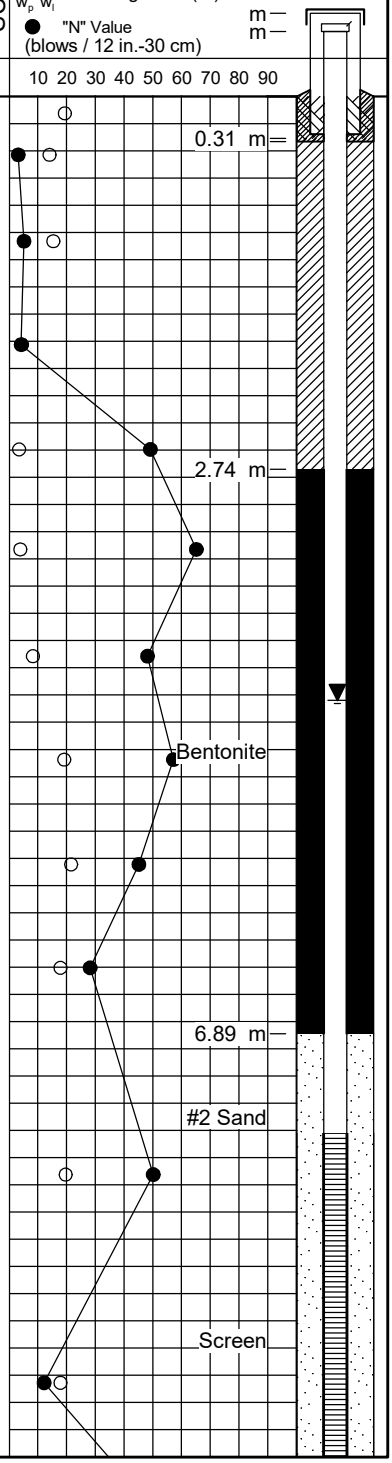
CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 13, 2021 DATE (FINISH): July 14, 2021

LEGEND
SS - SPLIT SPOON
ST - SHELBY TUBE
AU - AUGER PROBE
▼ - WATER LEVEL

NORTHING: 4910545.39 EASTING: 609712.088

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		268.23		GROUND SURFACE				%		
0				TOPSOIL : 250 mm		SS1A		19	--	--
1	0.25	267.98		FILL : SANDY SILT, trace clay, rootlets, brown, moist, very loose to loose		SS1B	100	14	1-1-2-2	3
3	1.0					SS2	92	15	2-3-2-3	5
6	2.0					SS3	83	4	2-2-2-4	4
7	2.29	265.94		NATIVE : SM-SILTY SAND with gravel, light brown, moist, dense Gravel : 22%, Sand : 63%, Clay : 2%, Silt : 13%		SS4	75	3	8-14-35-40	49
10	3.0			very dense		SS5	100	4	20-30-35-50/ 100mm	65
13	4.0			moist to wet, dense		SS6	75	8	12-20-28-40	48
15				very dense		SS7	83	19	10-22-35-45	57
17	5.0									
18	5.34	262.89		SP-SM-SAND with silt, poorly graded, trace gravel, light brown, wet, dense		SS8	83	21	10-20-25-28	45
20	6.0			compact Gravel : 0%, Sand : 91%, Clay : 0%, Silt : 9%		SS9		18	3-8-20-45	28
23	7.0									
25	7.62	260.61		SM-SILTY SAND, trace clay, light brown, wet, very dense		SS10	75	20	15-20-30-35	50
27	8.0									
29	9.0									
30				trace gravel, wet, compact		SS11		18	2-4-8-16	12
32										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)
m m
10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 1

BOREHOLE No.: MW1-21
ELEVATION: 268.23 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 13, 2021 DATE (FINISH): July 14, 2021

NORTHING: 4910545.39 EASTING: 609712.088

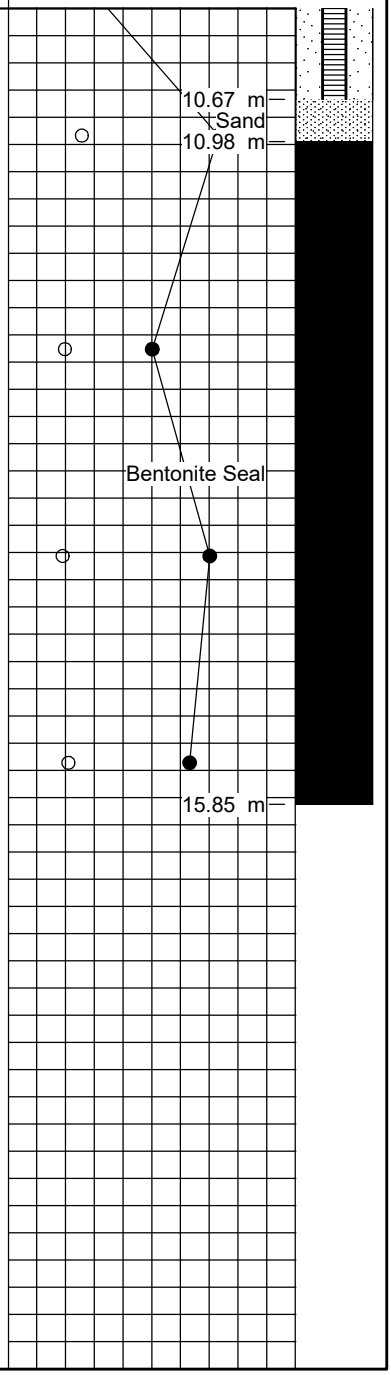
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		268.23		GROUND SURFACE				%		
	11.0			brown, very dense		SS12	67	26	14-25-48-50/ 75mm	73
	12.0									
	12.20	256.03		ML-SILT with sand, trace clay, wet, very dense Gravel : 0%, Sand : 24%, Clay : 3%, Silt : 73%		SS13	75	20	10-20-30-48	50
	13.0									
	14.0			very dense		SS14	67	19	20-30-40-50/ 50mm	70
	15.0									
				trace clay, grey		SS15		21	15-28-35-48	63
	15.85	252.38								
	16.0			**END OF BOREHOLE :** **NOTE :** - End of Borehole at 15.85 m bgs - 50 mm diameter monitoring well installed at 10.67 m bgs - Ground water level found at 4.27 m bgs - Groundwater level found at 4.44 m on Aug 18, 2021 - bgs denotes 'below ground surface'						
	17.0									
	18.0									
	19.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 2

BOREHOLE No.: MW2-21
ELEVATION: 268.24 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 10, 2021 DATE (FINISH): July 11, 2021

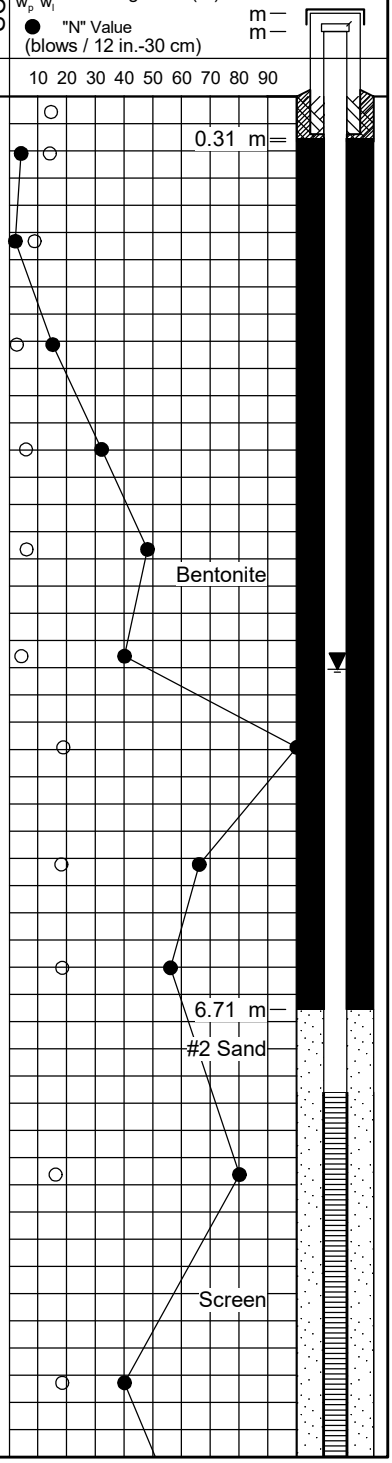
NORTHING: 4910481.407 EASTING: 609652.447

LEGEND
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content %	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		268.24		GROUND SURFACE						
0				TOPSOIL : 225 mm		SS1A		14	--	--
1	0.23	268.01		FILL : SANDY SILT, trace clay, occasional rootlets, brown, moist, loose		SS1B	83	14	1-2-2-2	4
2	0.76	267.48		SAND, some silt, light brown, moist, very loose		SS2	83	9	1-1-1-1	2
3	1.0			compact		SS3	75	3	2-7-8-8	15
4										
5										
6	2.0			dense		SS4	75	6	3-12-20-40	32
7										
8										
9						SS5	100	6	10-18-30-35	48
10	3.0									
11										
12						SS6	75	4	10-20-20-30	40
13	4.0									
14										
15	4.57	263.67		NATIVE : ML-SANDY SILT, trace clay, brown, wet, very dense		SS7	94	19	15-35-50/ 125mm	100
16				Gravel : 0%, Sand : 39%, Clay : 3%, Silt : 58%						
17	5.0									
18	5.34	262.90		SAND, trace to some silt, brown, wet, very dense		SS8	79	18	20-28-38-45	66
19										
20	6.0									
21						SS9	83	18	10-12-44-50/ 150mm	56
22										
23	7.0									
24										
25										
26	8.0					SS10	75	16	28-38-42-45	80
27										
28										
29	9.0									
30				dense						
31						SS11	75	18	15-20-20-55	40
32										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)
m
m

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 2

BOREHOLE No.: MW2-21
ELEVATION: 268.24 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 10, 2021 DATE (FINISH): July 11, 2021

LEGEND

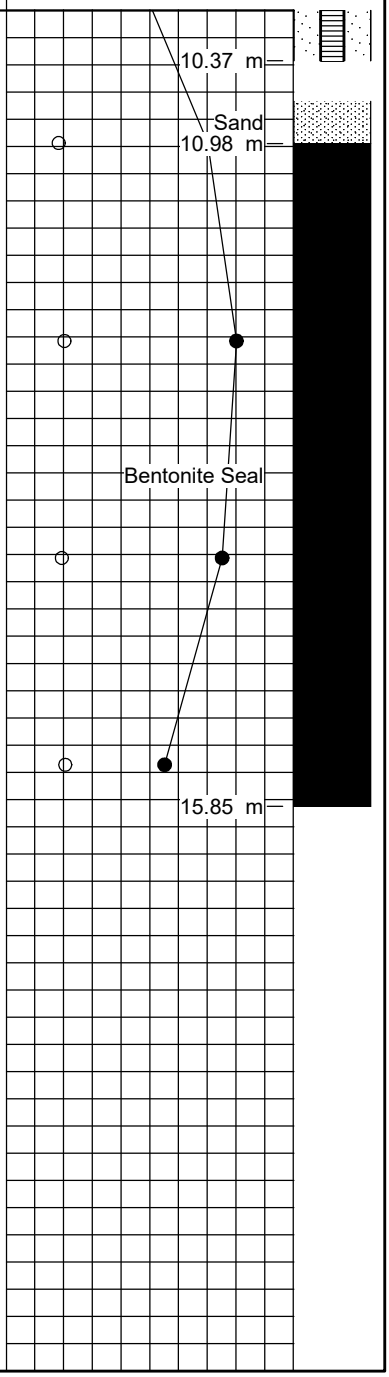
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

NORTHING: 4910481.407 EASTING: 609652.447

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		268.24		GROUND SURFACE				%		
	10.67	257.57		SILTY SAND, trace clay, brown, wet, very dense Gravel : 0%, Sand : 61%, Clay : 4%, Silt : 35%		SS12	83	18	15-30-40-50	70
	11.0									
	12.0					SS13	75	20	20-30-50/ 150mm	80
	13.0									
	14.0					SS14	75	19	15-35-40-50/ 150mm	75
	15.0									
						SS15	67	20	16-25-30-50/ 150mm	55
	15.85	252.39		**END OF BOREHOLE :** **NOTE :** - End of Borehole at 15.85 m bgs - 50 mm diameter monitoring well installed at 10.37 m bgs - Ground water level found at 4.57 m bgs - Groundwater level found at 4.21 m on Aug 18, 2021 - bgs denotes 'below ground surface'						
	16.0									
	17.0									
	18.0									
	19.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 3

GHD

BOREHOLE No.: MW3-21

ELEVATION: 270.66 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Crown Barrie Developments Inc.

PROJECT: Geotechnical Investigation - Hydrogeological Investigation

LOCATION: 1012 Yonge Street, Barrie, Ontario

DESCRIBED BY: C. Radway CHECKED BY: P. Verma

DATE (START): July 9, 2021 DATE (FINISH): July 9, 2021

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

NORTHING: 4910514.329 EASTING: 609567.975

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		270.66		GROUND SURFACE				%		
0				TOPSOIL : 200 mm		SS1A		22	--	--
1	0.20	270.46		FILL : SANDY SILT, trace clay, trace rootlets, brown, moist, loose		SS1B	92	18	1-1-2-1	3
2	0.76	269.90		NATIVE : SM-SILTY SAND, trace to some gravel, trace clay, light brown, moist, loose		SS2	92	7	1-2-3-4	5
3	1.0									
4	1.52	269.14		SM-SILTY SAND TILL, trace to some gravel, trace clay, brown, moist, compact		SS3	83	4	3-10-16-20	26
5	2.0									
6				dense		SS4	83	5	4-16-20-45	36
7										
8	3.0									
9	3.05	267.61		ML-SILT with sand, some clay, brown, moist, dense Gravel : 0%, Sand : 26%, Clay : 15%, Silt : 59%; NP		SS5	79	8	16-20-22-36	42
10	3.81	266.85		SM-SILTY SAND TILL, trace clay and gravel, brown, moist, dense		SS6	92	7	6-15-20-26	35
11	4.0									
12				very dense		SS7	94	4	10-40-50/ 125mm	100
13	5.0									
14	5.34	265.32		SP-SAND, trace silt and gravel, brown, moist, very dense		SS8	100	4	20-40-50/ 0mm	100
15	6.0					SS9	100	8	20-30-50/ 100mm	100
16										
17	7.0									
18	7.62	263.04		SW-SM-SAND with silt, well graded, trace clay and gravel, brown, moist, very dense Gravel : 1%, Sand : 90%, Clay : 3%, Silt : 6%		SS10	75	17	15-55-35-48	90
19	8.0									
20	9.0									
21				dense		SS11	79	19	12-13-34-45	47

Shear test (Cu) △ Field ☐ Lab
Sensitivity (S)
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11226647 ENCLOSURE No.: 3

BOREHOLE No.: MW3-21
ELEVATION: 270.66 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 9, 2021 DATE (FINISH): July 9, 2021

NORTHING: 4910514.329 EASTING: 609567.975

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		270.66		GROUND SURFACE				%		
	10.67	259.99		SM-SILTY SAND, trace gravel, brown, wet, very dense		SS12		19	8-25-50/ 150mm	100
	12.20	258.46		SP-SM-SAND with silt, poorly graded, trace clay and gravel, brown, wet, loose Gravel : 1%, Sand : 92%, Clay : 2%, Silt : 5%		SS13	75	20	1-2-2-6	4
				very dense		SS14	100	21	20-50/ 75mm	100
						SS15	100	22	22-40-50/ 100mm	100
	15.64	255.02		**END OF BOREHOLE :**						

NOTE :

- End of Borehole at 15.64 m bgs
- Ground water level found at 4.12 m bgs
- bgs denotes 'below ground surface'
- NP denotes 'non-plastic'

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

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REFERENCE No.: 11226647 ENCLOSURE No.: 4

BOREHOLE No.: MW4-21
ELEVATION: 270.91 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 7, 2021 DATE (FINISH): July 8, 2021

LEGEND
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

NORTHING: 4910426.121 EASTING: 609478.918

Depth Feet	Depth Metres	Elevation (m) BGS 270.91	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content %	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
				GROUND SURFACE						
0				TOPSOIL : 325 mm		SS1A		18	--	--
1	0.33	270.58		FILL : SANDY SILT, trace clay, trace rootlets, brown, moist, very loose		SS1B	58	14	0-1-1-1	2
2				occasional organic matter, loose						
3	1.0					SS2	75	13	1-2-3-3	5
4										
5	1.52	269.39		NATIVE : SM-SILTY SAND with gravel, trace clay, light brown, moist, compact		SS3	67	8	2-5-8-15	13
6	2.0			Gravel : 22%, Sand : 52%, Clay : 9%, Silt : 17%						
7				dense						
8						SS4	67	9	16-20-20-22	40
9										
10	3.0									
	3.05	267.86		SP-SAND, some silt, trace gravel, brown, moist, dense		SS5	75	2	10-20-30-40	50
12										
	3.81	267.10		SM-SILTY SAND, trace clay, brown, wet, dense		SS6	75	19	20-22-15-15	37
14	4.0									
15	4.57	266.34		SP-SAND, trace silt and gravel, brown, moist to wet, very dense		SS7		3	10-30-36-58/ 150mm	66
16	5.0									
17						SS8	55	3	17-50/ 150mm	100
18										
19										
20	6.0									
	6.10	264.81		ML-SILT with sand, trace clay and gravel, brown, moist to wet, very dense		SS9	100	21	22-29-50/ 125mm	100
22				Gravel : 4%, Sand : 25%, Clay : 8%, Silt : 63%						
23	7.0									
24										
25										
26	8.0					SS10	75	18	22-29-50/ 125mm	100
27										
28										
29										
30	9.0									
31						SS11	75	21	20-30-50/ 150mm	100
32										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

m
m

0.31 m
6.72 m
Bentonite
7.01 m
#2 Sand
Screen

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REFERENCE No.: 11226647 ENCLOSURE No.: 4

GHD

BOREHOLE No.: MW4-21

ELEVATION: 270.91 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Crown Barrie Developments Inc.

PROJECT: Geotechnical Investigation - Hydrogeological Investigation

LOCATION: 1012 Yonge Street, Barrie, Ontario

DESCRIBED BY: C. Radway CHECKED BY: P. Verma

DATE (START): July 7, 2021 DATE (FINISH): July 8, 2021

LEGEND

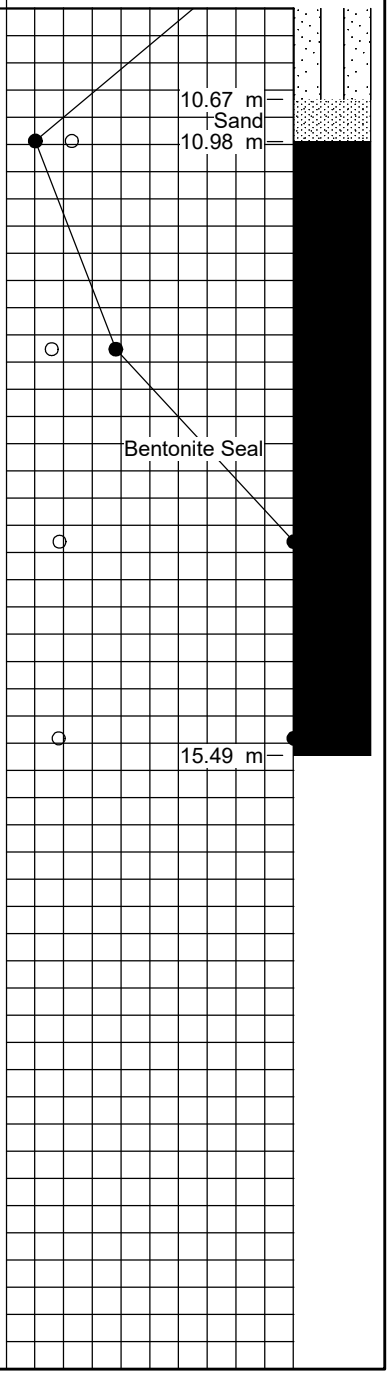
- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

NORTHING: 4910426.121 EASTING: 609478.918

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		270.91		GROUND SURFACE				%		
	11.0			compact		SS12	67	23	2-4-6-12	10
	12.0									
	12.20	258.71		SAND, some silt, trace gravel, brown, wet, dense		SS13	75	16	10-18-20-36	38
	13.0									
	14.0			very dense		SS14	100	18	12-48-50/ 100mm	100
	15.0									
	15.49	255.42				SS15	100	18	35-50/ 100mm	100
	16.0			**END OF BOREHOLE :**						
	17.0			**NOTE :** - End of Borehole at 15.49 m bgs - 50 mm diameter monitoring well installed at 10.67 m bgs - Ground water level found at 3.05 m bgs - Groundwater level found at 6.60 m on Aug 18, 2021 - bgs denotes 'below ground surface'						
	18.0									
	19.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 5

BOREHOLE No.: MW5-21
ELEVATION: 271.09 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 6, 2021 DATE (FINISH): July 6, 2021

NORTHING: 4910490.177 EASTING: 609448.749

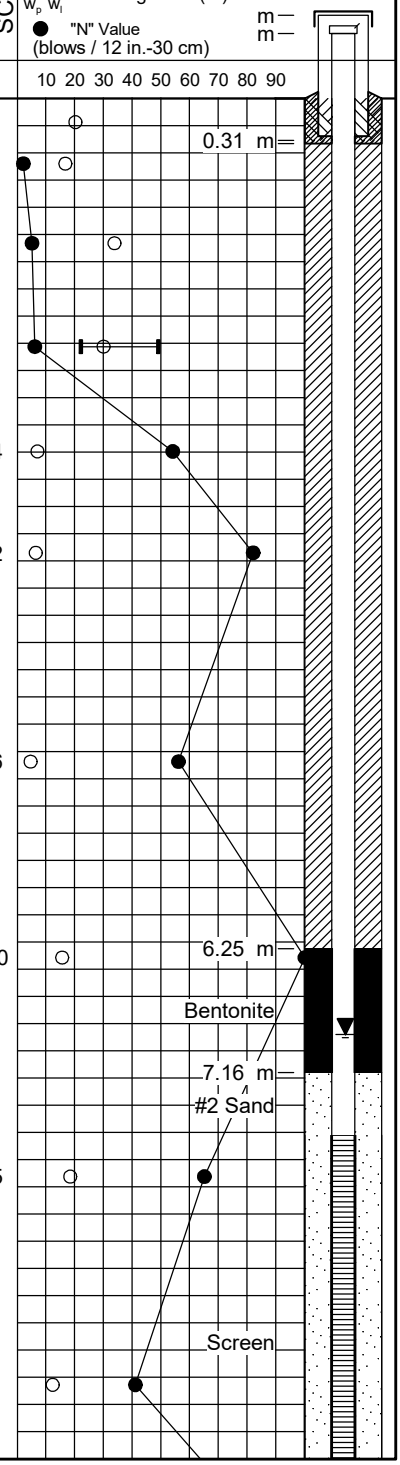
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		271.09		GROUND SURFACE				%		
0				TOPSOIL : 350 mm		SS1A		20	--	--
1	0.35	270.74		FILL : SANDY SILT, trace gravel, trace rootlets, brown, moist, very loose		SS1B	83	17	1-1-1-1	2
3	1.0			trace clay, loose		SS2	75	34	1-2-3-4	5
5	1.52	269.57		NATIVE : CL-CLAY with silt, trace sand, brown, moist, firm		SS3	83	30	1-2-4-5	6
7	2.0			Gravel : 0%, Sand : 10%, Clay : 58%, Silt : 32%						
8	2.29	268.80		SILTY SAND TILL, trace gravel, brown, moist, very dense		SS4	83	7	6-24-30-45	54
10	3.0					SS5	92	6	20-38-44-50/ 125mm	82
13	4.0									
16	5.0					SS6	83	5	12-18-38-50	56
20	6.0					SS7	94	16	17-20-50/ 125mm	100
23	7.0									
25	7.62	263.47		SAND, some silt, trace gravel, brown, moist, very dense		SS8	83	18	25-30-35-35	65
26	8.0									
29	9.0			trace silt and clay, wet, dense		SS9	83	12	10-16-25-50/ 125mm	41
32										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
Atterberg limits (%) W_p W_l
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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REFERENCE No.: 11226647 ENCLOSURE No.: 5

BOREHOLE No.: MW5-21
ELEVATION: 271.09 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Crown Barrie Developments Inc.
PROJECT: Geotechnical Investigation - Hydrogeological Investigation
LOCATION: 1012 Yonge Street, Barrie, Ontario
DESCRIBED BY: C. Radway CHECKED BY: P. Verma
DATE (START): July 6, 2021 DATE (FINISH): July 6, 2021

NORTHING: 4910490.177 EASTING: 609448.749

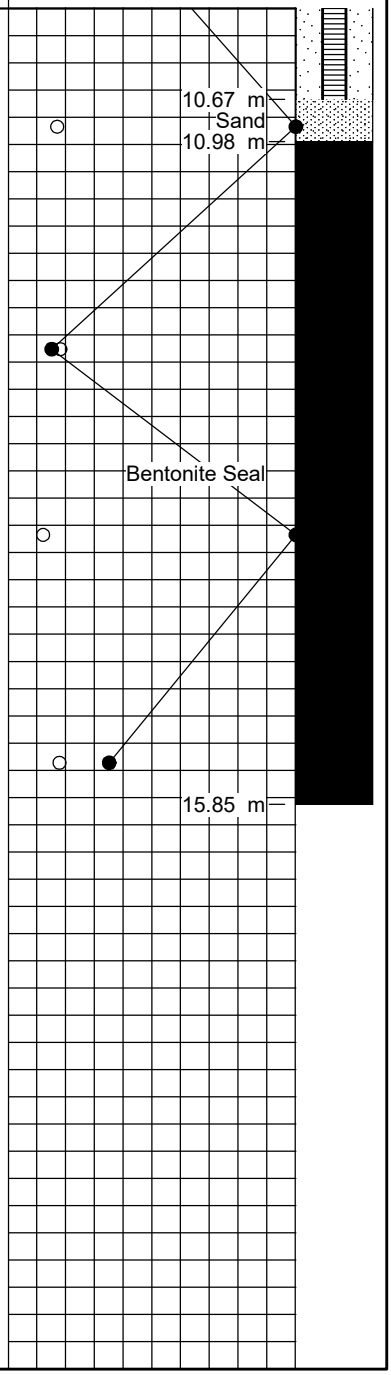
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m) BGS	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery/ TCR(%)	Moisture Content	Blows per 15cm/ RQD(%)	'N' Value/ SCR(%)
		271.09		GROUND SURFACE				%		
	10.67	260.42		SILTY SAND, trace clay, brown, moist, very dense Gravel : 0%, Sand : 91%, Clay : 2%, Silt : 7%		SS10	75	17	15-40-50/ 100mm	100
	12.0			compact		SS11		18	5-7-8-10	15
	14.0			some gravel, very dense		SS12		12	28-50/ 150mm	100
	15.0			dense		SS13		18	10-15-20-21	35
	15.85	255.24		**END OF BOREHOLE :** **NOTE :** - End of Borehole at 15.85 m bgs - 50 mm diameter monitoring well installed at 10.67 m bgs - Ground water level found at 6.40 m bgs - Groundwater level found at 6.88 m on Aug 18, 2021 - bgs denotes 'below ground surface'						

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



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BURNSIDE

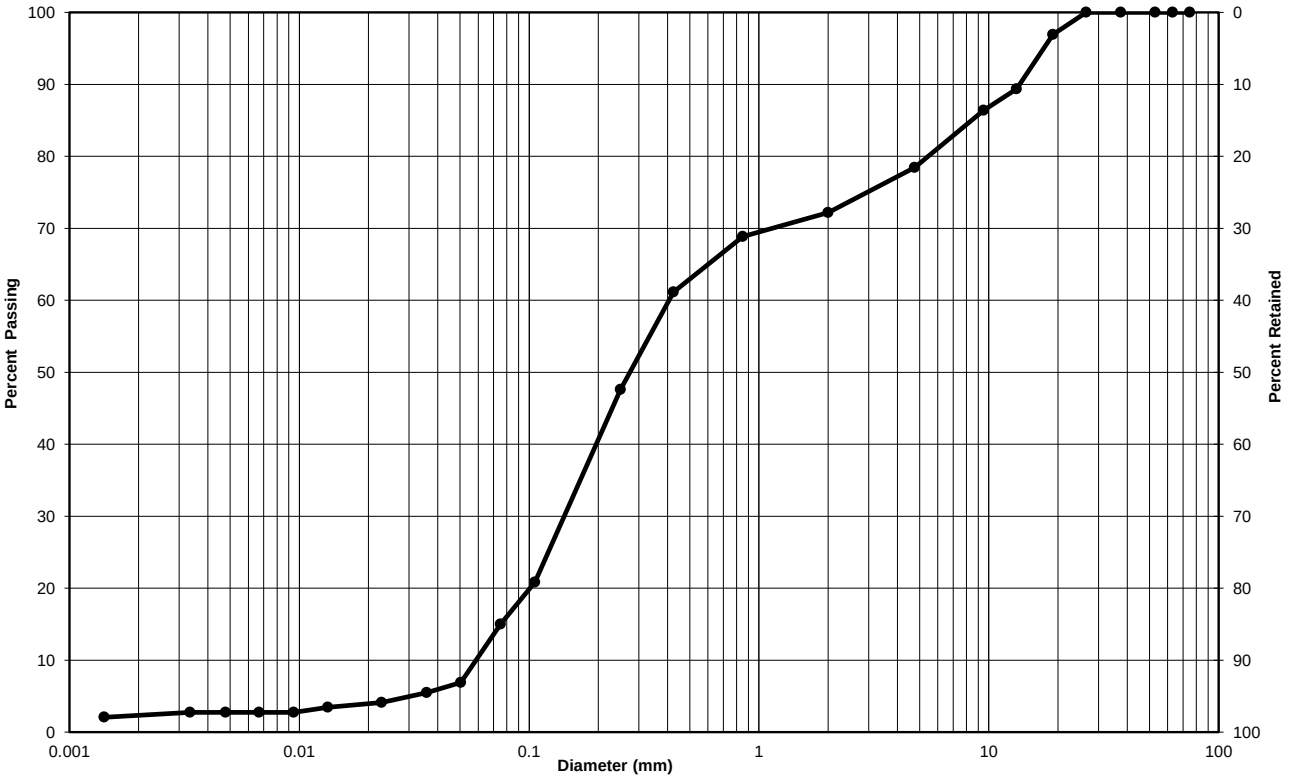
[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Hydraulic Conductivity Data

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647
Borehole no.:	BH1	Sample no.:	SS4
Depth:	7.5'-9.5'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand with gravel (SM)	22	63	15
Silt-size particles (%):	13		
Clay-size particles (%) (<0.002mm):	2		

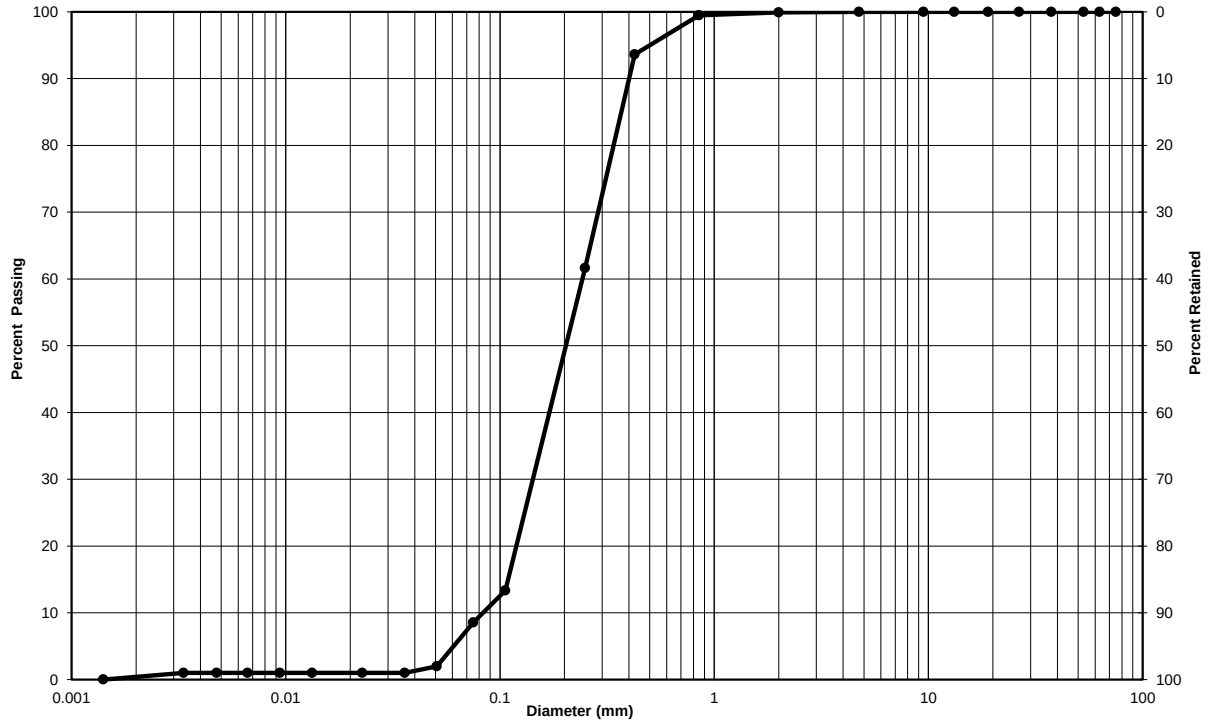
Remarks:

Performed by:	M.Chan	**Date:**	July 26, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH1	Sample no.:	SS9
Depth:	20'-22'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Poorly graded sand with silt (SP-SM)	0	91	9
Silt-size particles (%):	9		
Clay-size particles (%) (<0.002mm):	0		

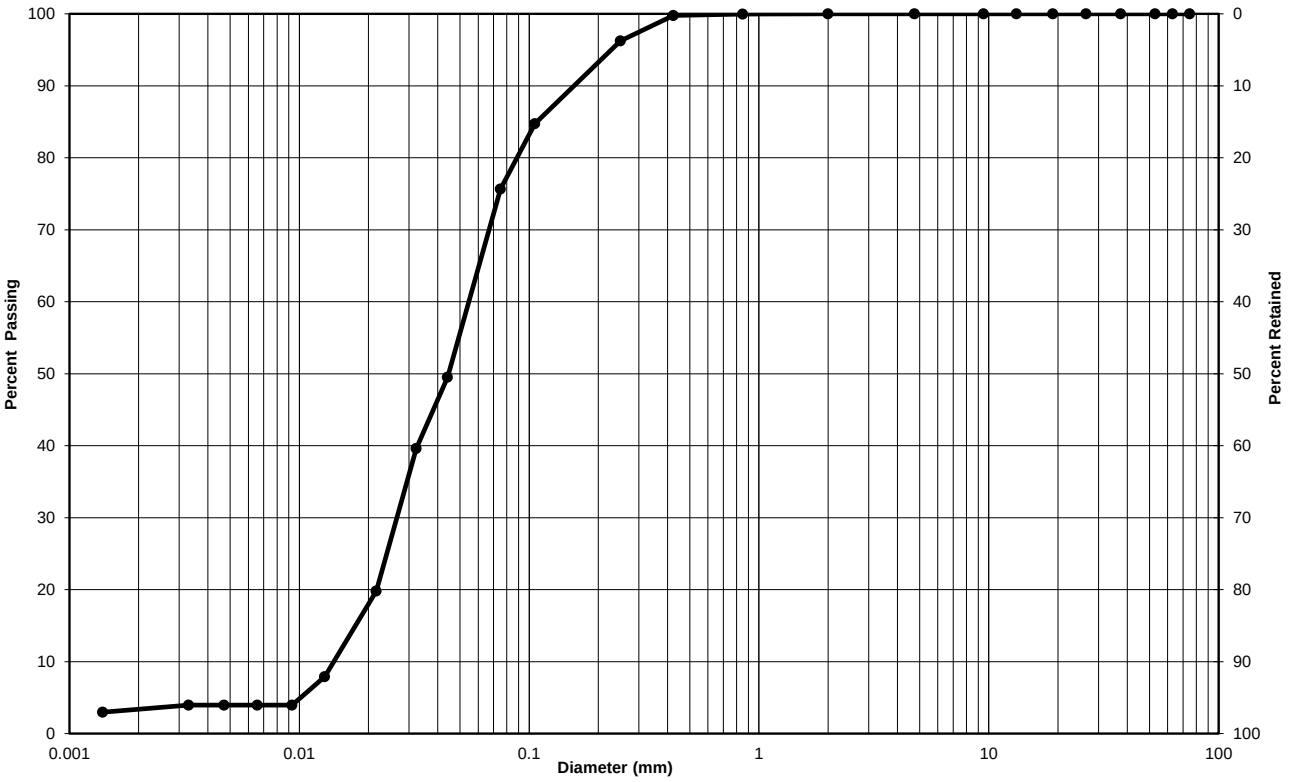
Remarks:

Performed by:	M.Chan	**Date:**	July 26, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH1	Sample no.:	SS13
Depth:	40'-42'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

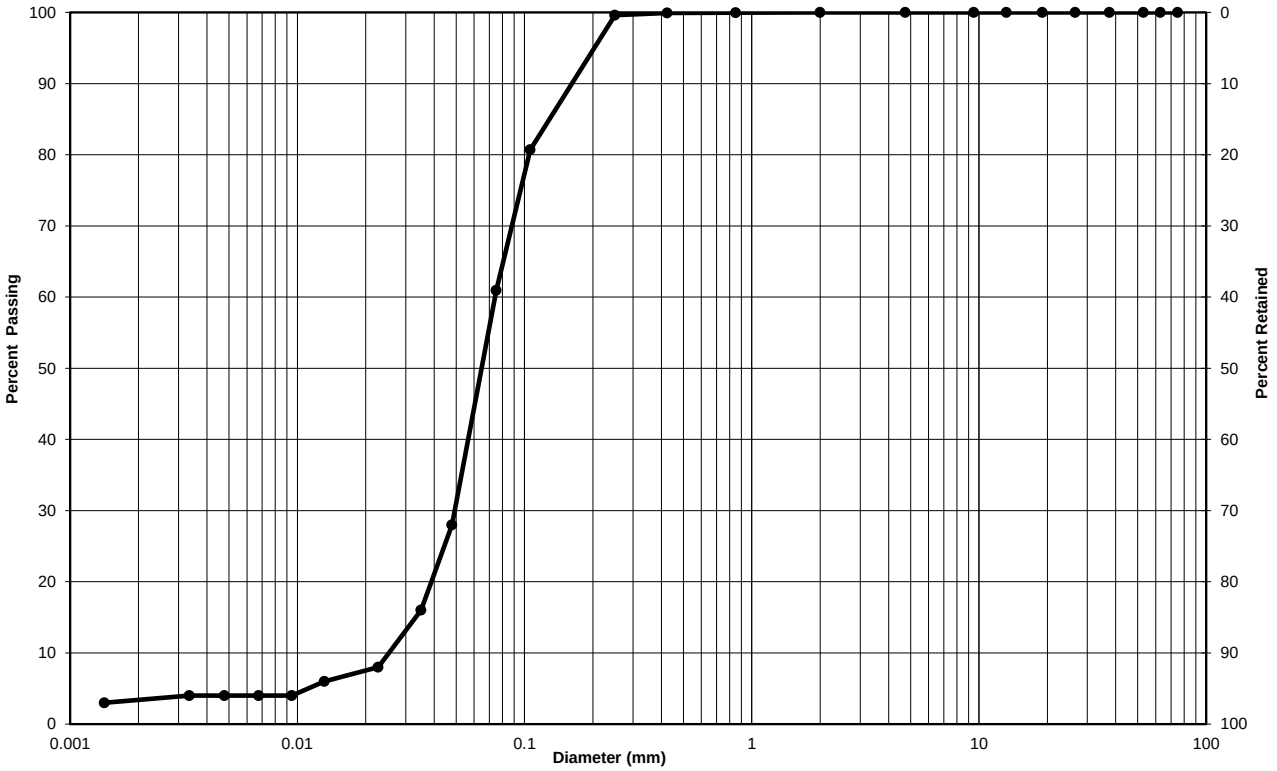
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt with sand (ML)	0	24	76
Silt-size particles (%):	73		
Clay-size particles (%) (<0.002mm):	3		

Remarks:

Performed by:	M.Chan	**Date:**	July 26, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647
Borehole no.:	BH2	Sample no.:	SS7
Depth:	15'-17'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

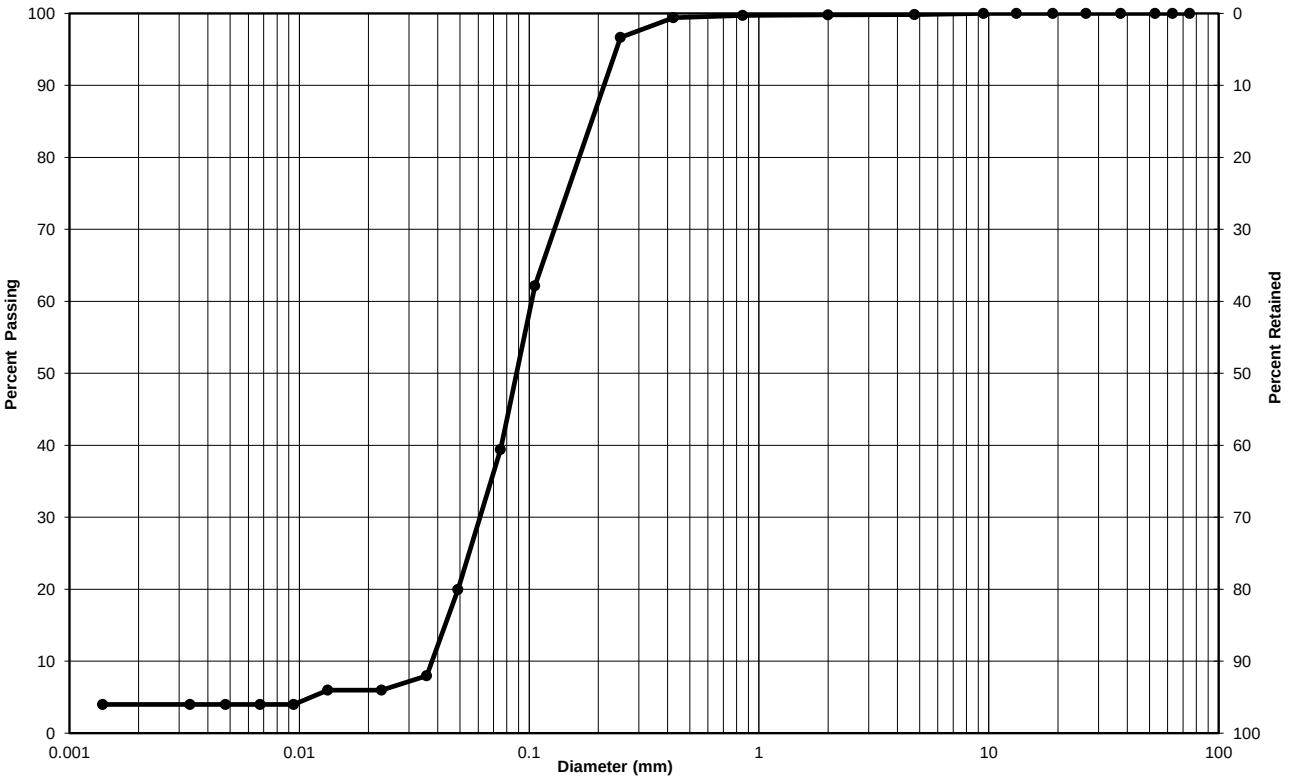
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy silt (ML)	0	39	61
Silt-size particles (%):	58		
Clay-size particles (%) (<0.002mm):	3		

Remarks:

Performed by:	M.Chan	**Date:**	July 26, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Communities Development Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647
Borehole no.:	BH2	Sample no.:	SS12
Depth:	35'-37'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand (SM)	0	61	39
Silt-size particles (%):	35		
Clay-size particles (%) (<0.002mm):	4		

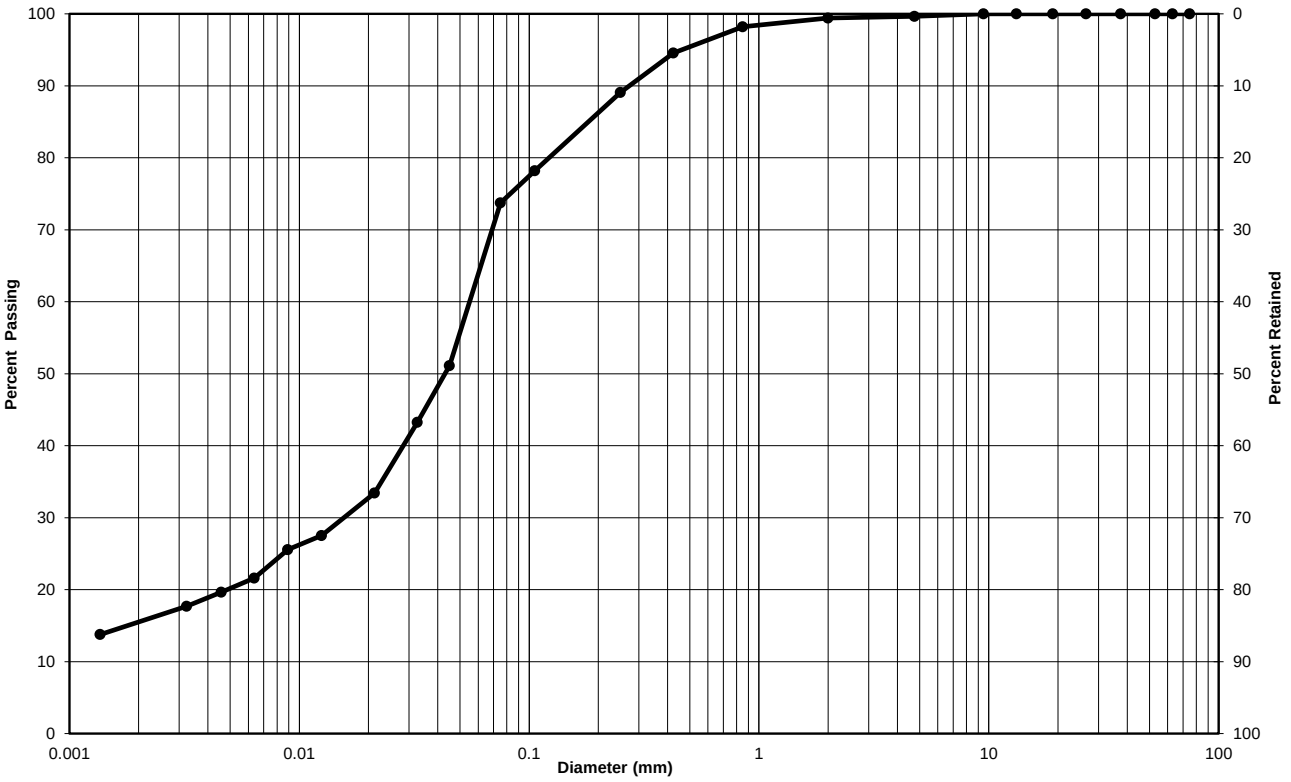
Remarks:

Performed by:	M.Chan	**Date:**	July 26, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH3	Sample no.:	SS5
Depth:	10'-12'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt with sand (ML)	0	26	74
Silt-size particles (%):	59		
Clay-size particles (%) (<0.002mm):	15		

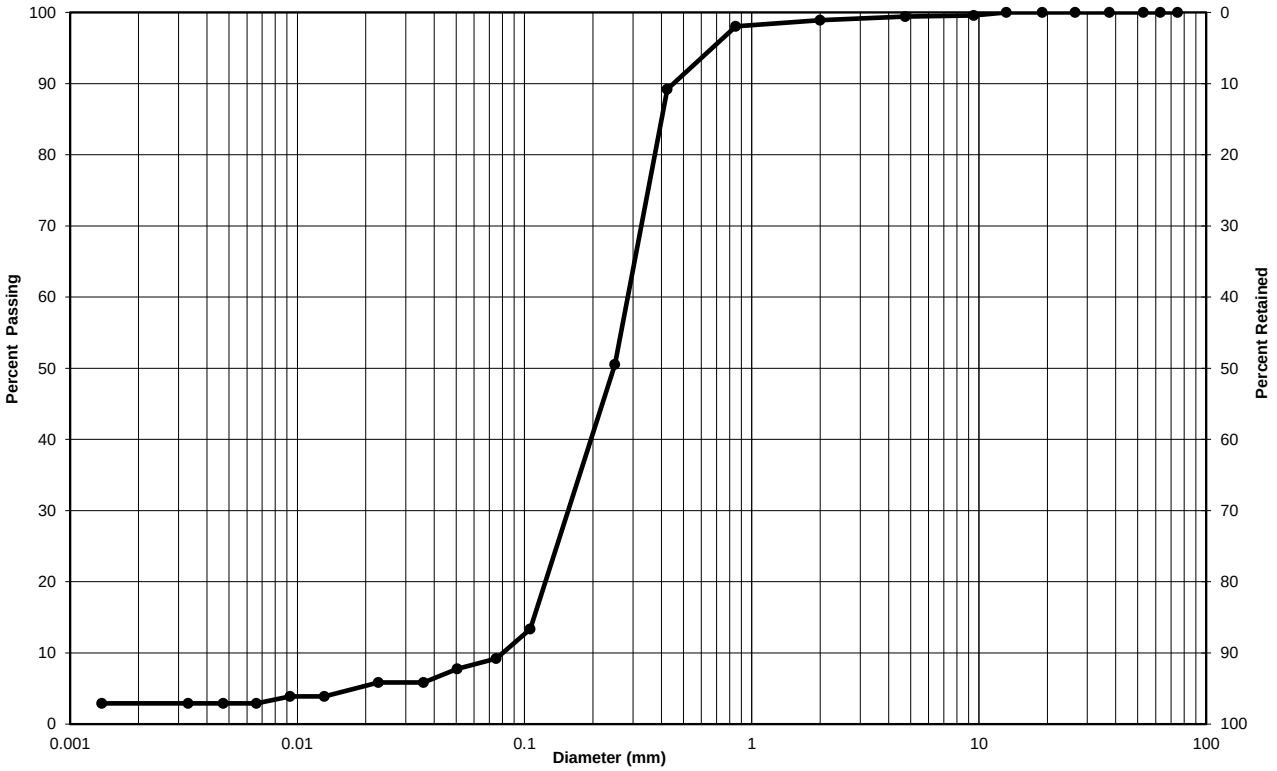
Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH3	Sample no.:	SS10
Depth:	25'-27'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Well graded sand with silt (SW-SM)	1	90	9
Silt-size particles (%):	6		
Clay-size particles (%) (<0.002mm):	3		

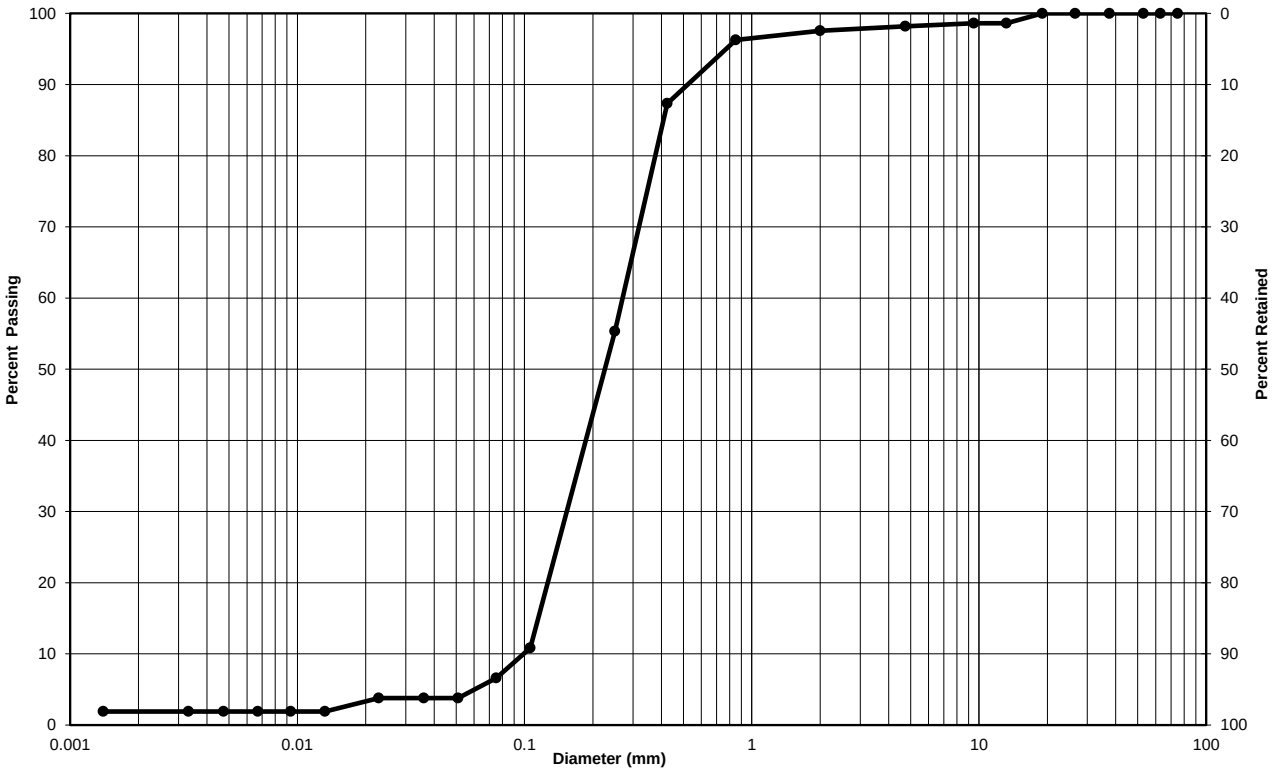
Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH3	Sample no.:	SS13
Depth:	40'-42'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

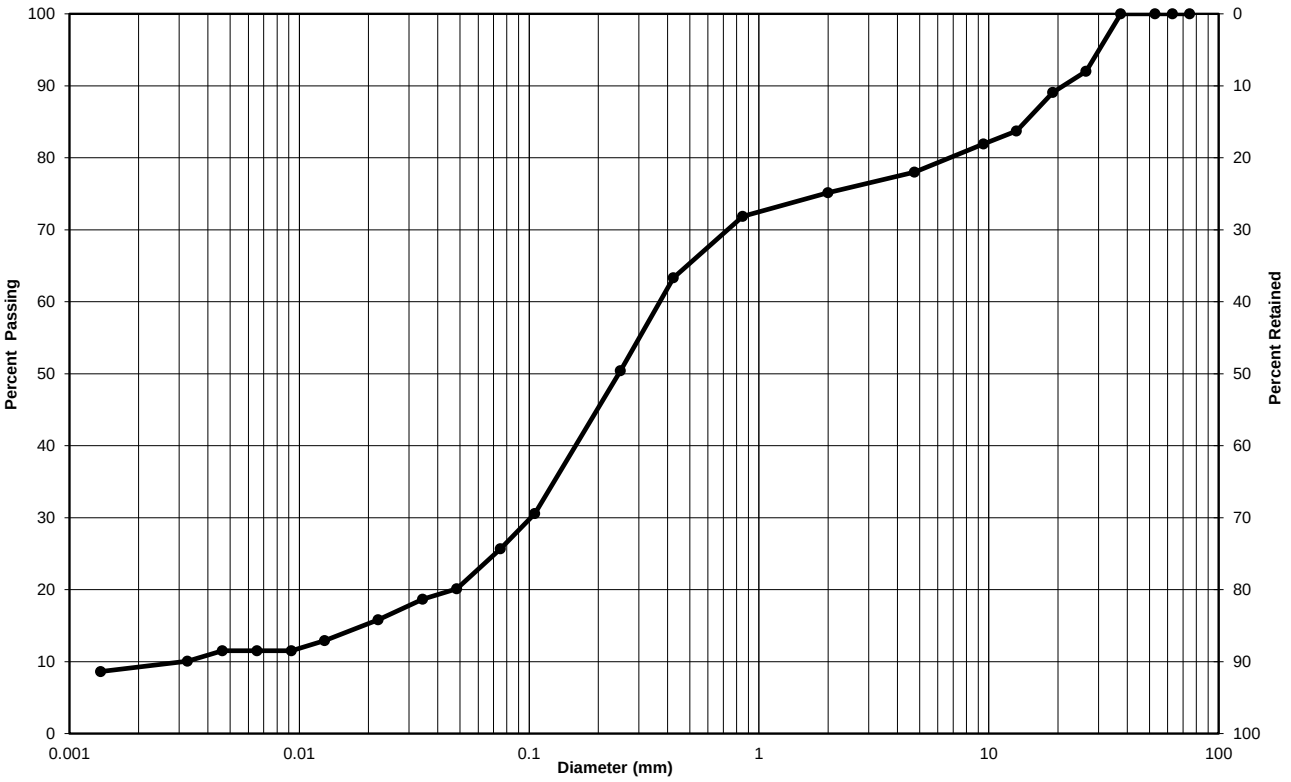
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Poorly graded sand with silt (SP-SM)	1	92	7
Silt-size particles (%):	5		
Clay-size particles (%) (<0.002mm):	2		

Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647
Borehole no.:	BH4	Sample no.:	SS3
Depth:	5'-7'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand with gravel (SM)	22	52	26
Silt-size particles (%):	17		
Clay-size particles (%) (<0.002mm):	9		

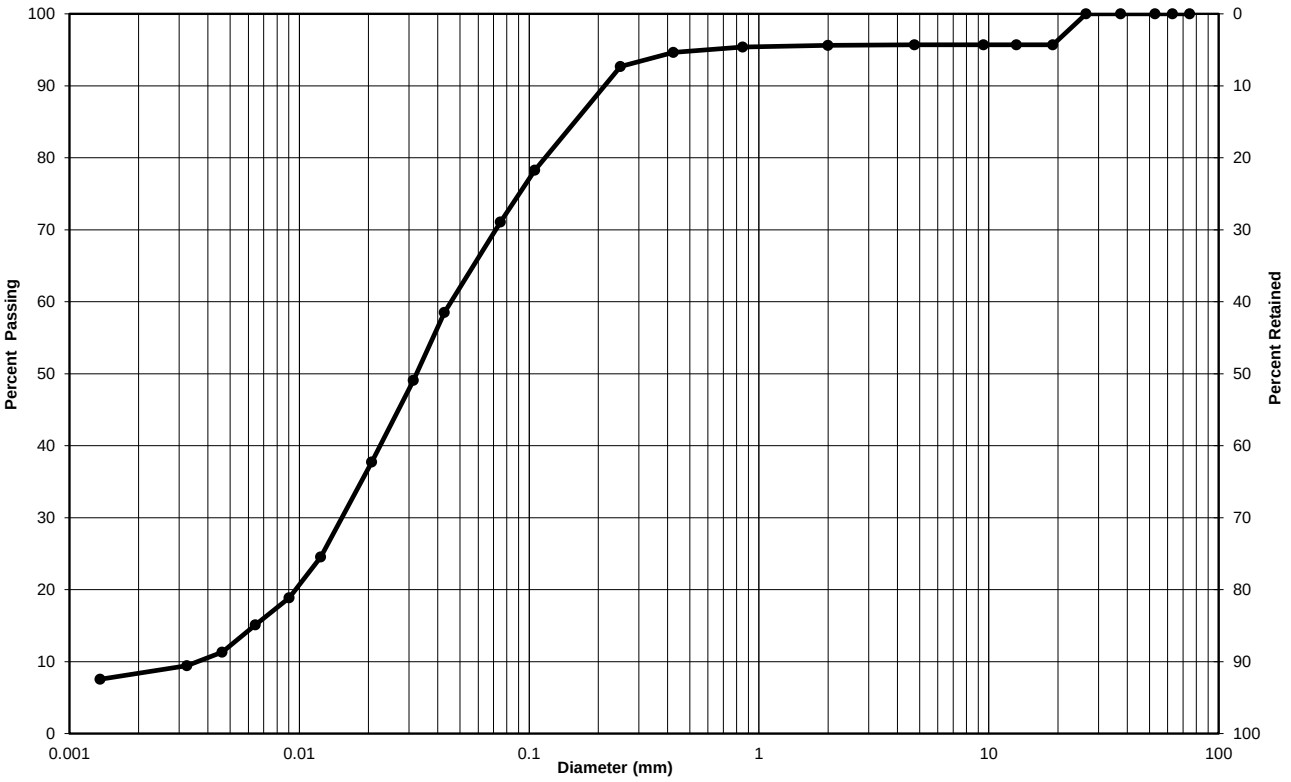
Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH4	Sample no.:	SS9
Depth:	20'-22'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt with sand (ML)	4	25	71
Silt-size particles (%):	63		
Clay-size particles (%) (<0.002mm):	8		

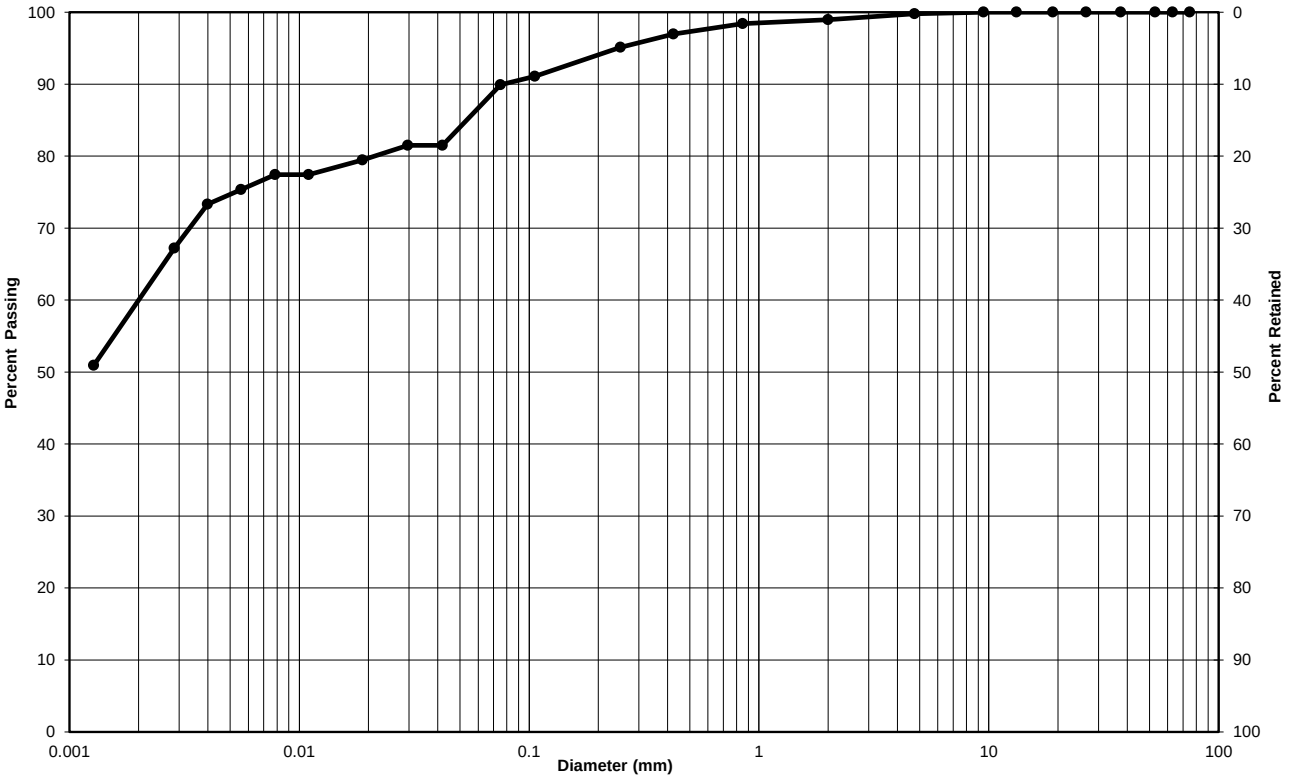
Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Development Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH5	Sample no.:	SS3
Depth:	5'-7'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty Clay trace Sand	0	10	90
Silt-size particles (%):	32		
Clay-size particles (%) (<0.002mm):	58		

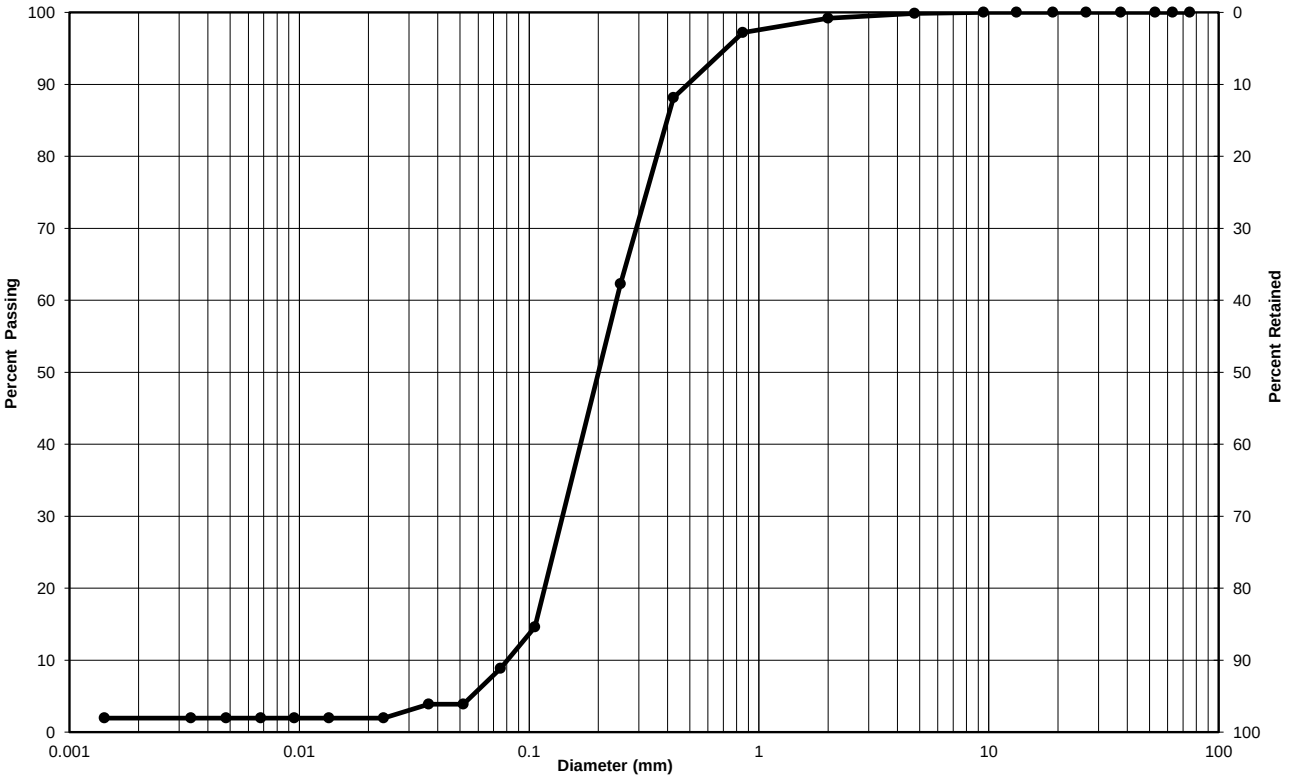
Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Crown Barrie Developments Inc.	**Lab No.:**	SS-D-21-23
Project/Site:	Proposed Mix Use Condominium Development	**Project No.:**	11226647

Borehole no.:	BH5	Sample no.:	SS10
Depth:	35'-37'	Enclosure:	

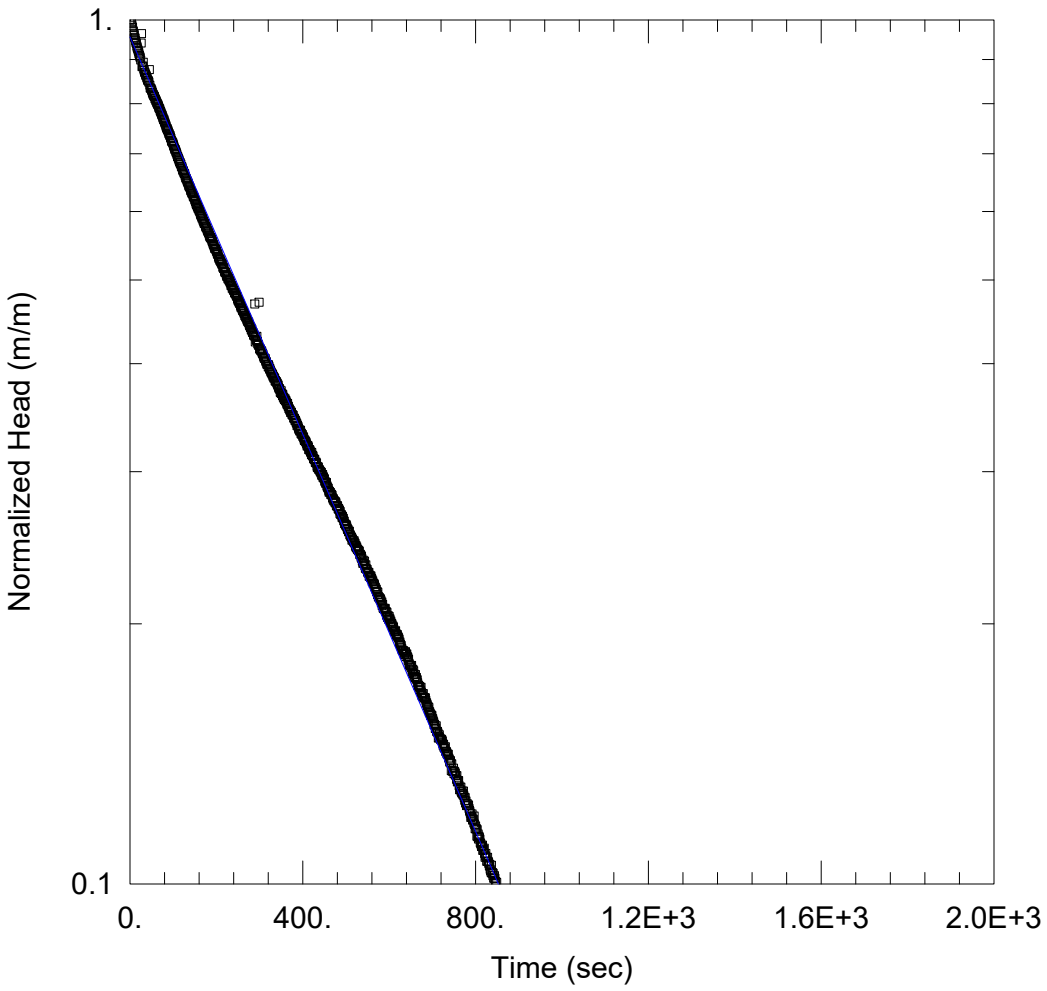


Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Poorly graded sand with silt (SP-SM)	0	91	9
Silt-size particles (%):	7		
Clay-size particles (%) (<0.002mm):	2		

Remarks:

Performed by:	M.Chan	**Date:**	July 27, 2021
Verified by:	Joe Sullivan	**Date:**	August 5, 2021



MW1-21 FALLING HEAD

Data Set: N:\...\MW1-21 FH BR.aqt
Date: 11/08/21 Time: 16:14:57

PROJECT INFORMATION

Company: GHD Limited
Project: 11226647
Location: 1012 Yonge Street, Barrie, ON
Test Well: MW1-21
Test Date: July 22, 2021

AQUIFER DATA

Saturated Thickness: 6.98 m Anisotropy Ratio (Kz/Kr): 1.

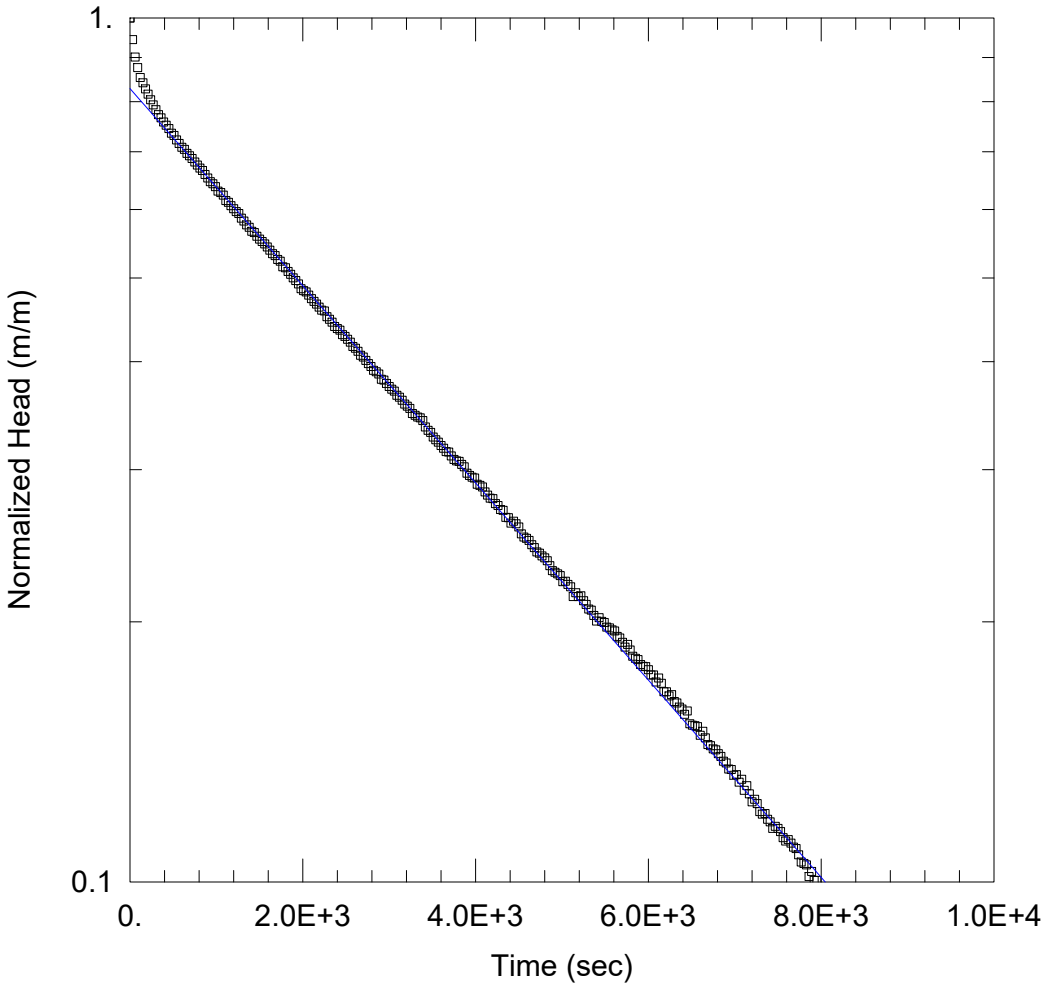
WELL DATA (MW1-21)

Initial Displacement: 0.4481 m
Total Well Penetration Depth: 6.98 m
Casing Radius: 0.025 m
Static Water Column Height: 6.98 m
Screen Length: 3.05 m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001148 cm/sec y0 = 0.4282 m



MW2-21 FALLING HEAD

Data Set: N:\...\MW2-21 FH BR.aqt
Date: 11/08/21 Time: 16:15:51

PROJECT INFORMATION

Company: GHD Limited
Project: 11226647
Location: 1012 Yonge Street, Barrie, ON
Test Well: MW2-21
Test Date: July 22, 2021

AQUIFER DATA

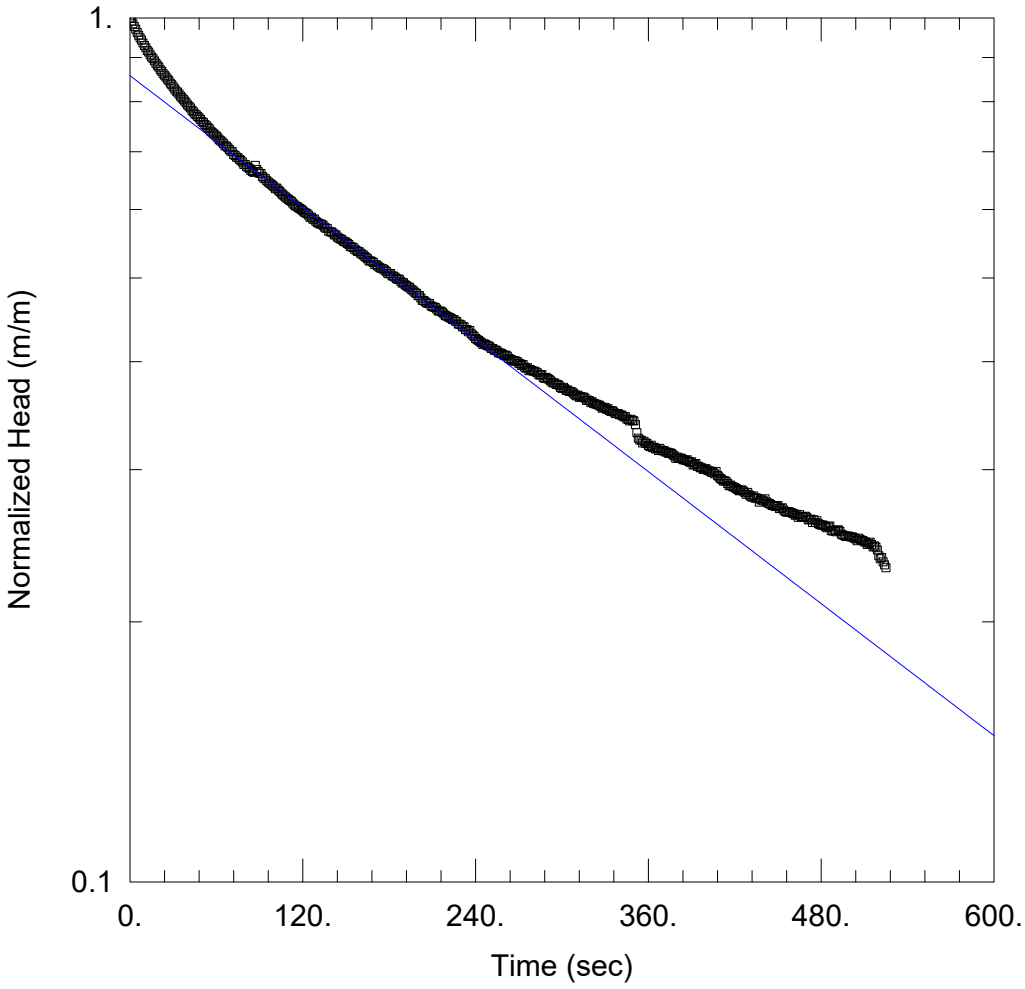
Saturated Thickness: 7.04 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW2-21)

Initial Displacement: 0.4959 m
Total Well Penetration Depth: 7.04 m
Casing Radius: 0.025 m
Static Water Column Height: 7.04 m
Screen Length: 3.05 m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.141E-5 cm/sec
y0 = 0.4108 m



MW4-21 FALLING HEAD

Data Set: N:\...\MW4-21 FH BR.aqt
Date: 11/08/21 Time: 16:16:24

PROJECT INFORMATION

Company: GHD Limited
Project: 11226647
Location: 1012 Yonge Street, Barrie, ON
Test Well: MW4-21
Test Date: July 22, 2021

AQUIFER DATA

Saturated Thickness: 3.23 m Anisotropy Ratio (Kz/Kr): 1.

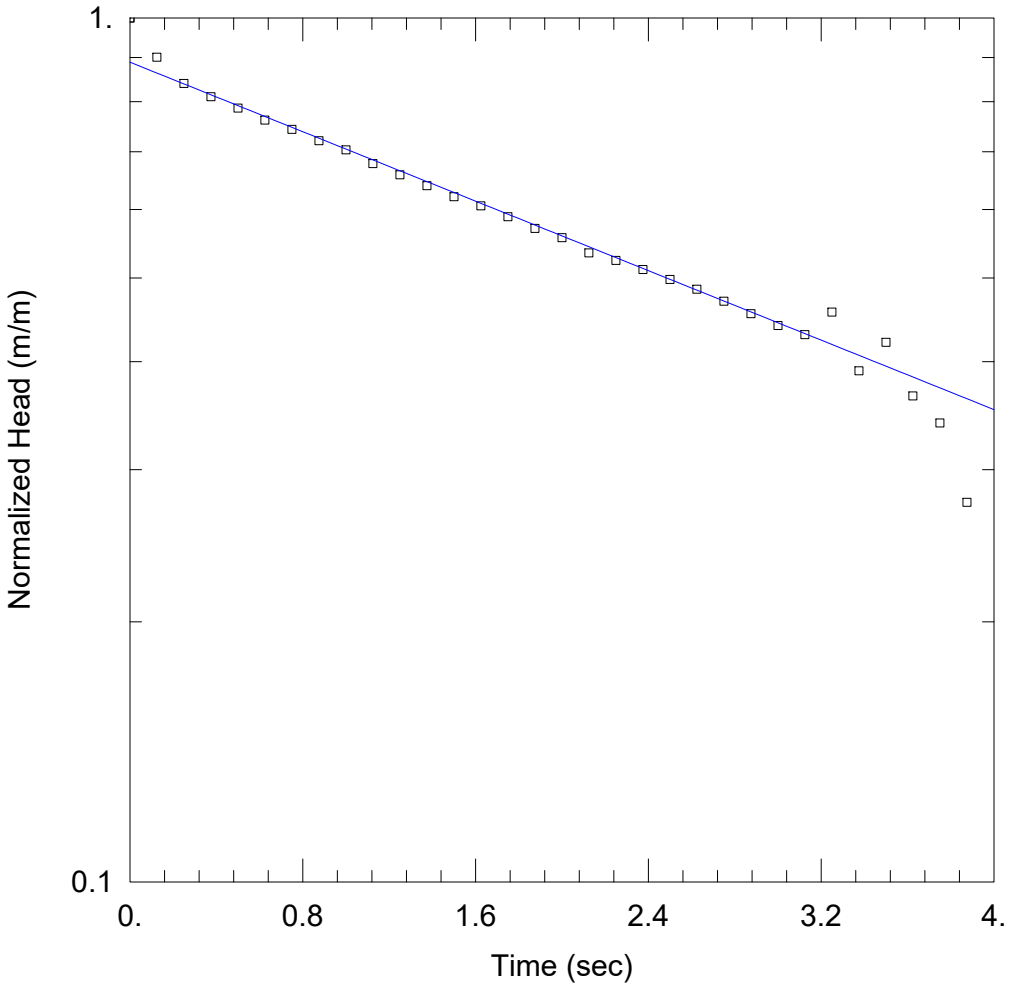
WELL DATA (MW4-21)

Initial Displacement: 0.4129 m
Total Well Penetration Depth: 3.23 m
Casing Radius: 0.025 m
Static Water Column Height: 3.23 m
Screen Length: 3.05 m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001124 cm/sec y0 = 0.354 m



MW5-21 FALLING HEAD

Data Set: N:\...\MW5-21 FH BR.aqt
Date: 11/08/21 Time: 16:16:59

PROJECT INFORMATION

Company: GHD Limited
Project: 11226647
Location: 1012 Yonge Street, Barrie, ON
Test Well: MW5-21
Test Date: July 22, 2021

AQUIFER DATA

Saturated Thickness: 3.45 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5-21)

Initial Displacement: 0.1498 m
Total Well Penetration Depth: 3.45 m
Casing Radius: 0.025 m
Static Water Column Height: 3.45 m
Screen Length: 3.05 m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.008977 cm/sec
y0 = 0.1331 m

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Groundwater Level Data

Table D-1
Groundwater Elevations - Monitoring Wells

Monitoring Well	Well Depth (mbgl)	Ground Elevation (masl)	24-Mar-20		22-Apr-20		25-May-20		21-Jan-21	
			Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)
BH1	**7.69**	**271.00**	Dry	Dry	7.34	263.66	7.41	263.59	Dry	Dry
BH2	**6.17**	**271.20**	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
BH4	**7.59**	**271.70**	7.07	264.63	6.74	264.96	6.77	264.93	7.11	264.59
BH5	**6.07**	**268.80**	4.73	264.07	4.61	264.19	4.70	264.10	4.97	263.83
MW1-21	**11.51**	**268.23**	-	-	-	-	-	-	-	-
MW2-21	**11.19**	**268.24**	-	-	-	-	-	-	-	-
MW4-21	**10.46**	**270.91**	-	-	-	-	-	-	-	-
MW5-21	**10.53**	**271.09**	-	-	-	-	-	-	-	-

mbgl - metres below ground level

masl - metres above sea level

' - ' - instrument not installed

' -- ' - data that was not collected

Underlined - ground elevation extracted from borehole log

Table D-1
Groundwater Elevations - Monitoring Wells

Monitoring Well	Well Depth (mbgl)	Ground Elevation (masl)	19-Jul-21		22-Jul-21		21-Sep-21		19-Oct-21	
			Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)
BH1	**7.69**	**271.00**	--	--	7.47	263.53	7.43	263.57	7.45	263.55
BH2	**6.17**	**271.20**	--	--	Dry	Dry	Dry	Dry	Dry	Dry
BH4	**7.59**	**271.70**	--	--	6.96	264.74	6.88	264.82	6.96	264.74
BH5	**6.07**	**268.80**	--	--	4.67	264.13	4.82	263.98	4.86	263.94
MW1-21	**11.51**	**268.23**	4.19	264.04	4.20	264.03	4.40	263.83	4.41	263.82
MW2-21	**11.19**	**268.24**	3.75	264.49	3.80	264.44	3.98	264.26	4.02	264.22
MW4-21	**10.46**	**270.91**	6.16	264.75	6.11	264.80	6.18	264.73	6.24	264.67
MW5-21	**10.53**	**271.09**	6.87	264.22	6.86	264.23	6.78	264.31	6.87	264.22

mbgl - metres below ground level

masl - metres above sea level

' - ' - instrument not installed

' -- ' - data that was not collected

Underlined - ground elevation extracted from borehole log

Table D-1
Groundwater Elevations - Monitoring Wells

Monitoring Well	Well Depth (mbgl)	Ground Elevation (masl)	02-May-24		31-May-24		24-Jun-24		30-Jul-24	
			Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)	Water Level (mbgl)	Water Elevation (masl)
BH1	**7.69**	**271.00**	7.54	263.46	7.55	263.45	7.55	263.45	7.55	263.45
BH2	**6.17**	**271.20**	6.16	265.04	Dry	Dry	6.17	265.03	Dry	Dry
BH4	**7.59**	**271.70**	7.02	264.68	6.84	264.86	6.90	264.80	6.99	264.71
BH5	**6.07**	**268.80**	4.64	264.16	4.60	264.20	4.70	264.10	4.77	264.03
MW1-21	**11.51**	**268.23**	4.45	263.78	4.46	263.77	4.59	263.64	4.67	263.56
MW2-21	**11.19**	**268.24**	4.21	264.03	4.20	264.04	4.31	263.93	4.40	263.84
MW4-21	**10.46**	**270.91**	6.80	264.11	6.72	264.19	6.82	264.09	6.88	264.03
MW5-21	**10.53**	**271.09**	7.35	263.74	7.18	263.91	7.25	263.84	7.30	263.79

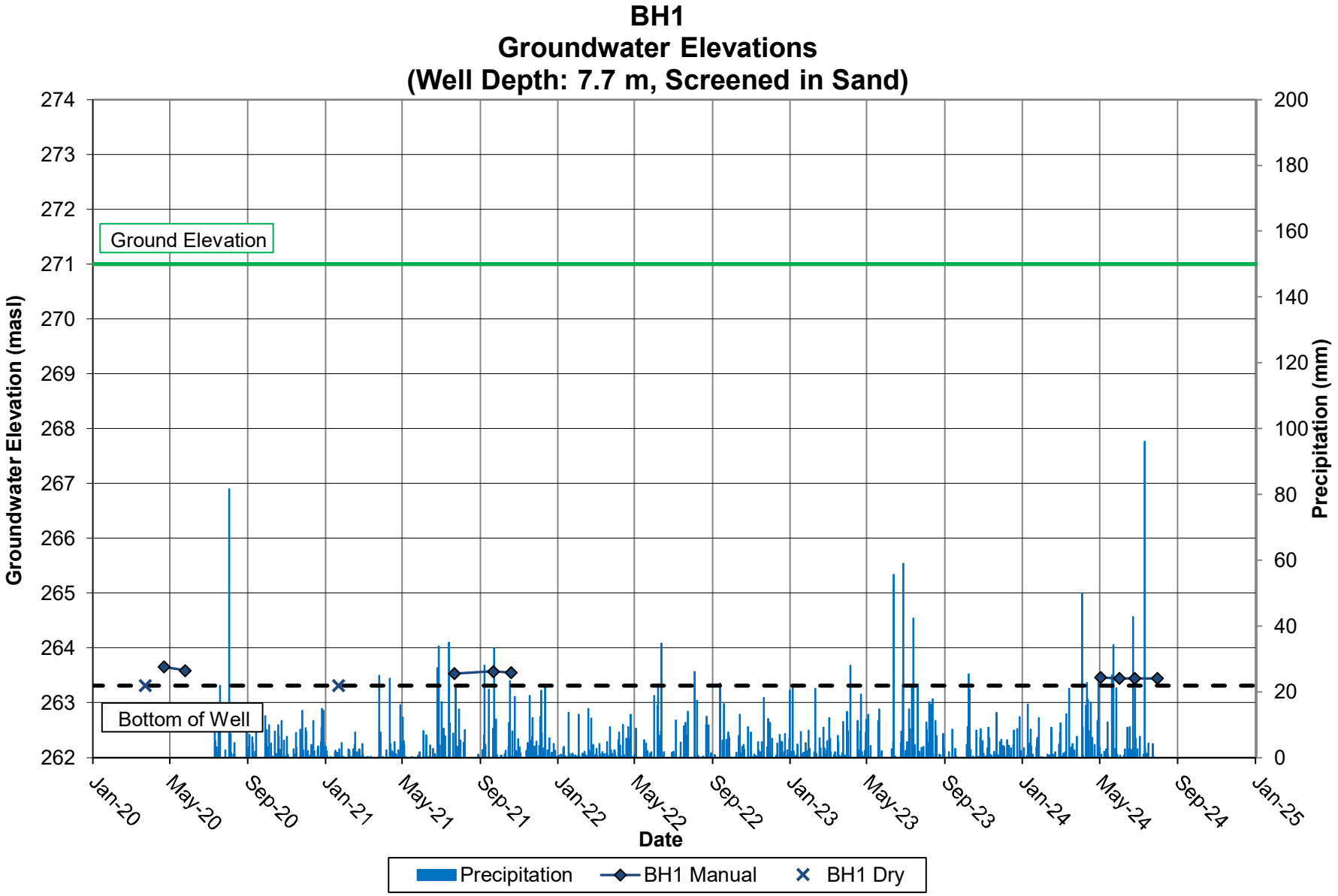
mbgl - metres below ground level

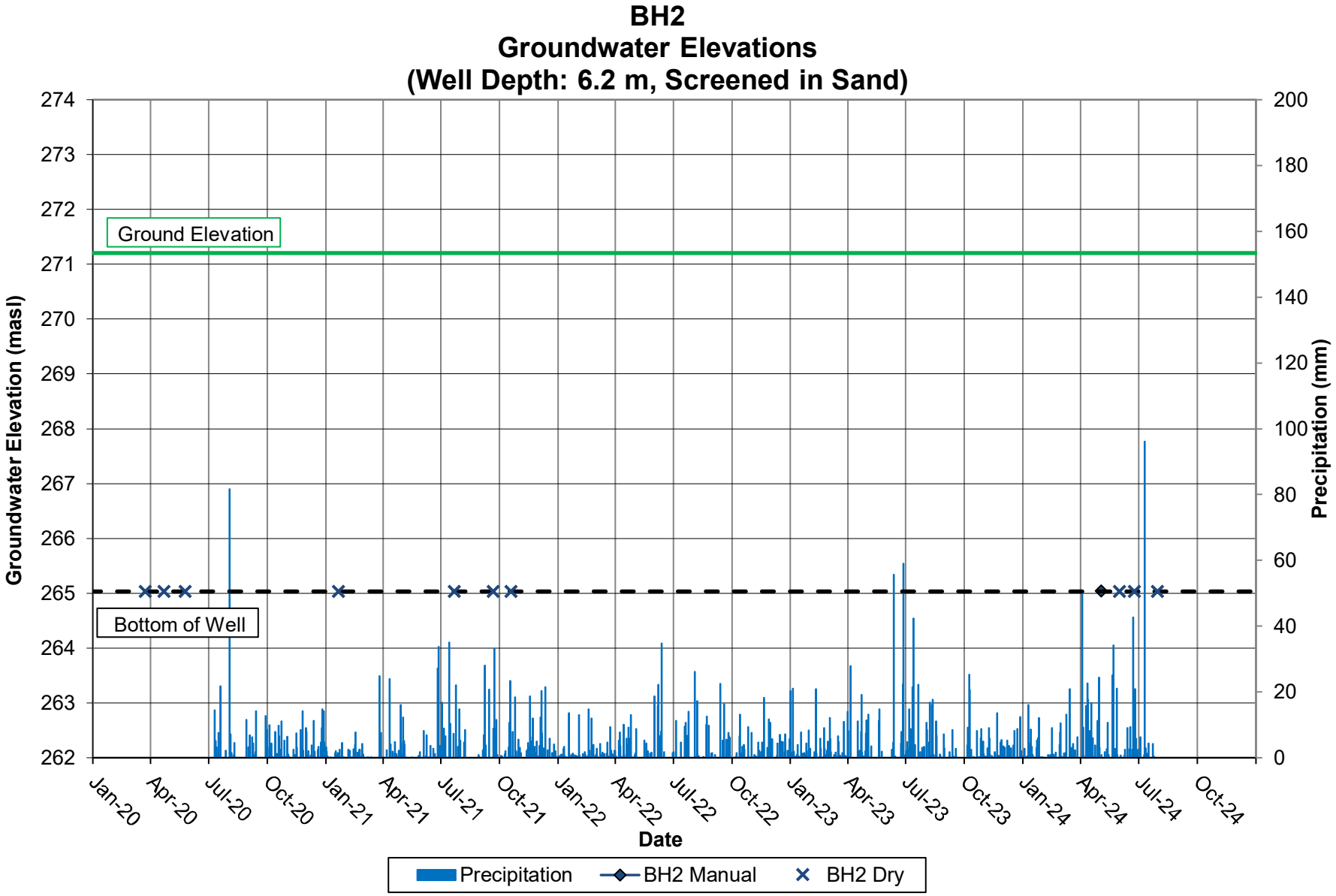
masl - metres above sea level

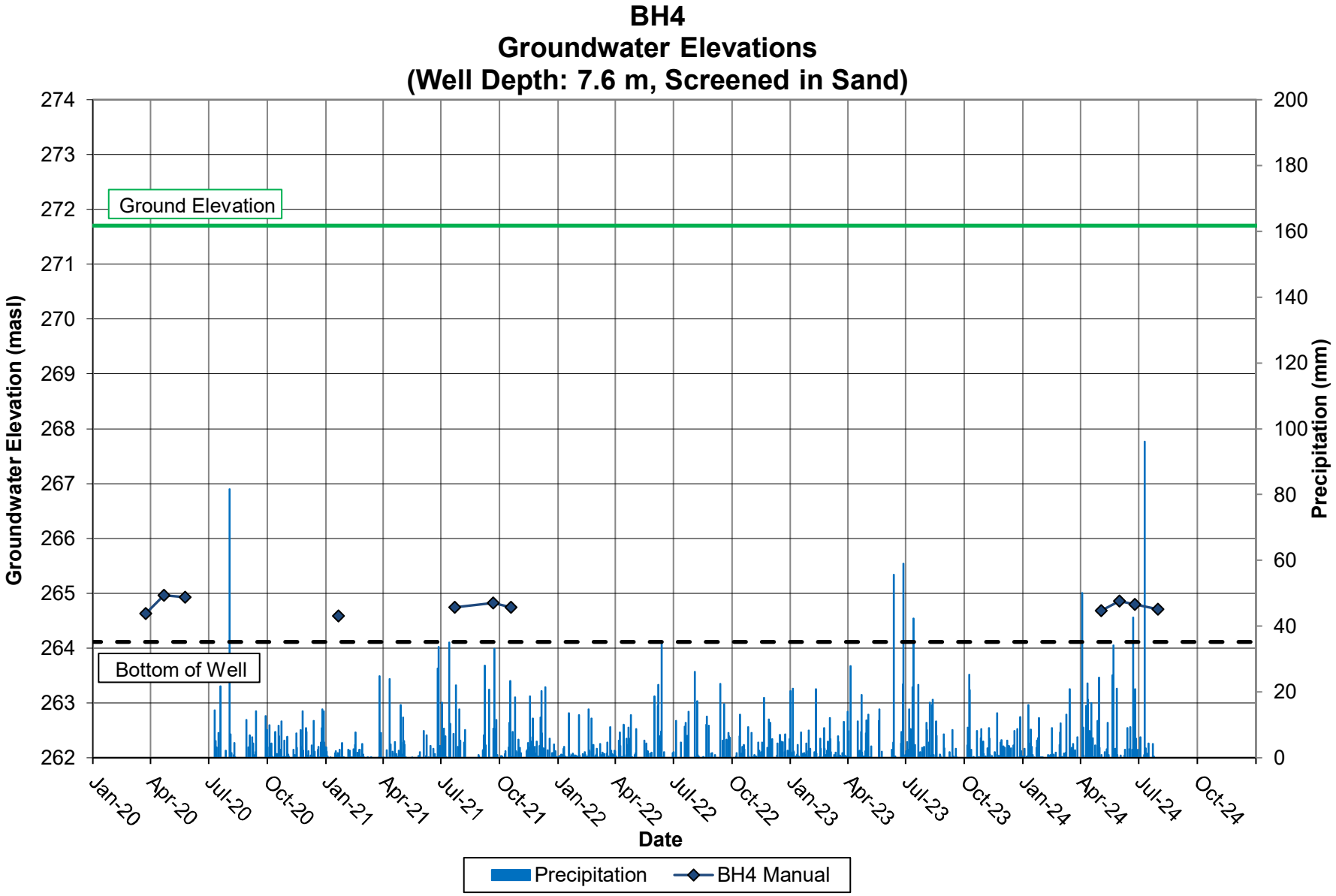
' - ' - instrument not installed

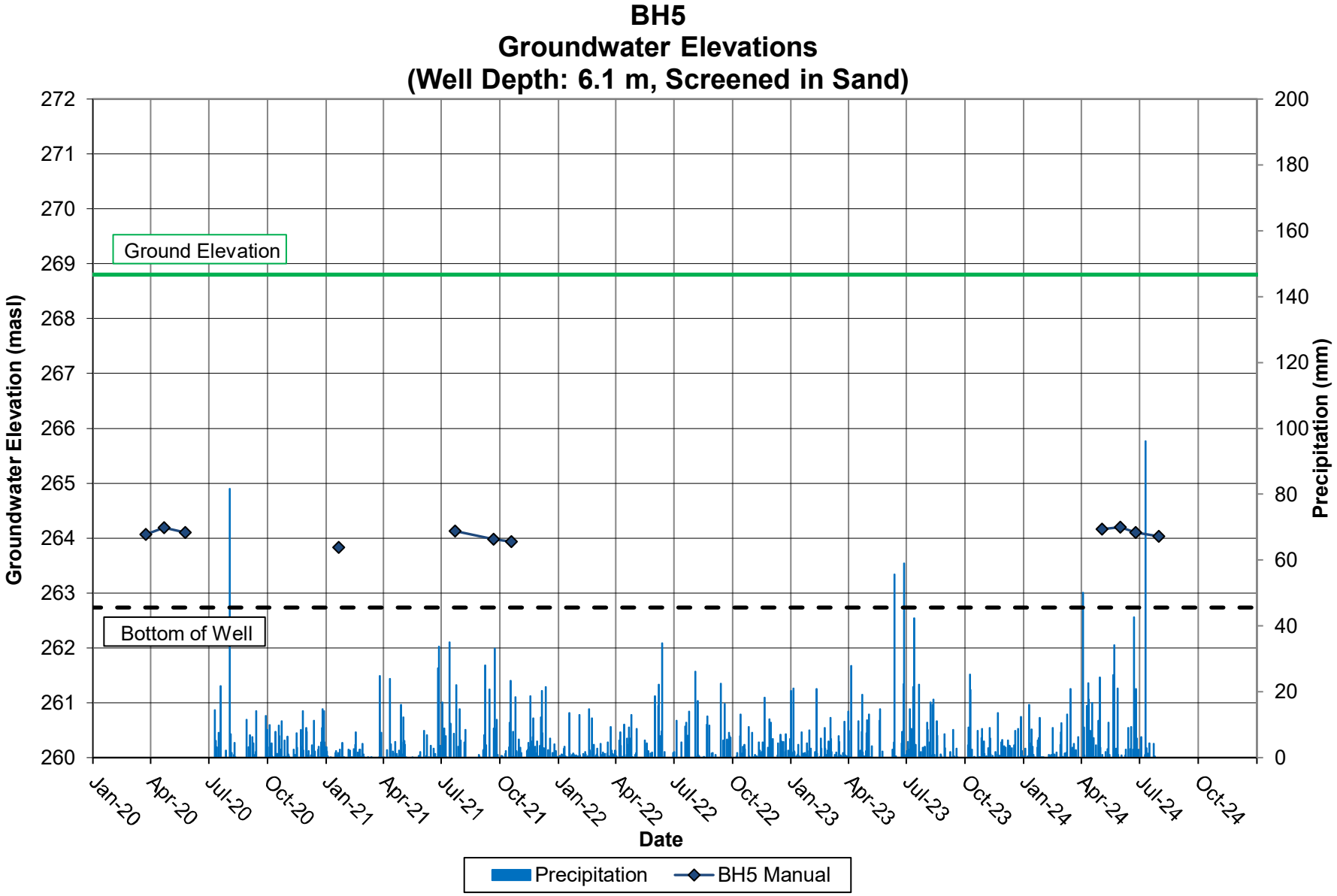
' -- ' - data that was not collected

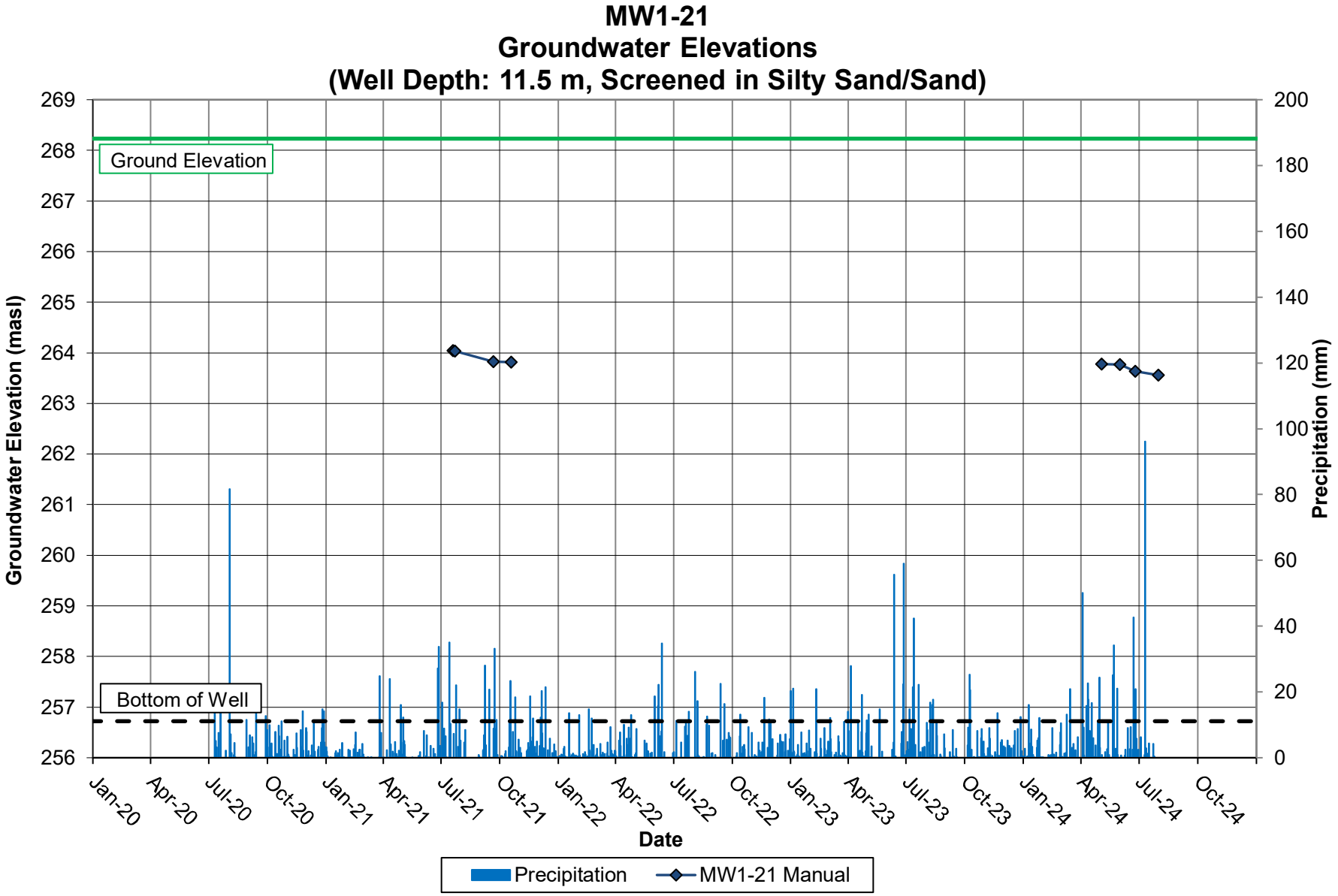
Underlined - ground elevation extracted from borehole log

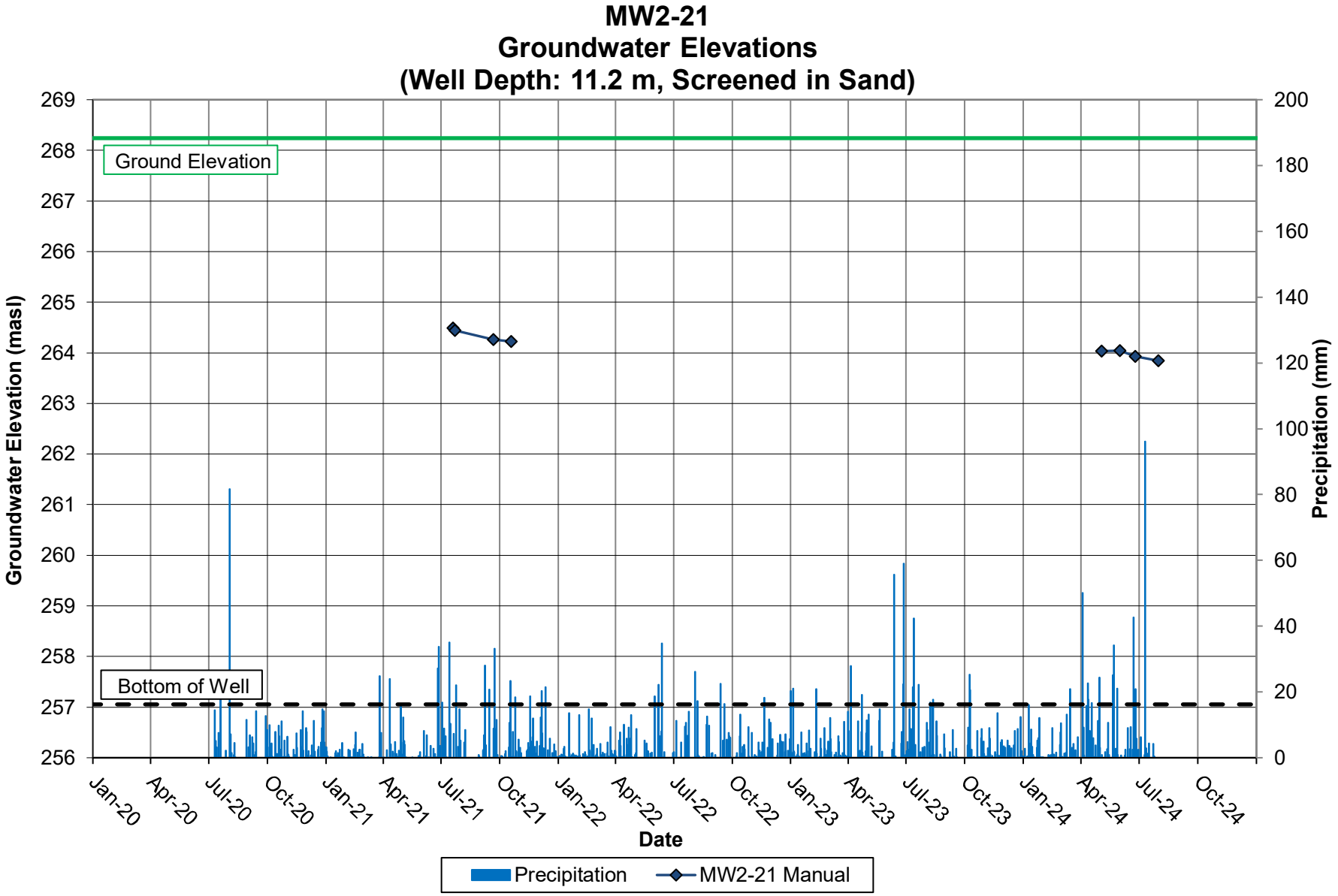

BH1
Groundwater Elevations
(Well Depth: 7.7 m, Screened in Sand)
Groundwater Elevation (masl)
Precipitation (mm)
Ground Elevation
Bottom of Well
274
273
272
271
270
269
268
267
266
265
264
263
262
200
180
160
140
120
100
80
60
40
20
0
Jan-20
May-20
Sep-20
Jan-21
May-21
Sep-21
Jan-22
May-22
Sep-22
Jan-23
May-23
Sep-23
Jan-24
May-24
Sep-24
Jan-25
Date
Precipitation
BH1 Manual
BH1 Dry


BH2
Groundwater Elevations
(Well Depth: 6.2 m, Screened in Sand)
Groundwater Elevation (masl)
Precipitation (mm)
Ground Elevation
Bottom of Well
274
273
272
271
270
269
268
267
266
265
264
263
262
200
180
160
140
120
100
80
60
40
20
0
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
Jul-22
Oct-22
Jan-23
Apr-23
Jul-23
Oct-23
Jan-24
Apr-24
Jul-24
Oct-24
Date
Precipitation
BH2 Manual
BH2 Dry

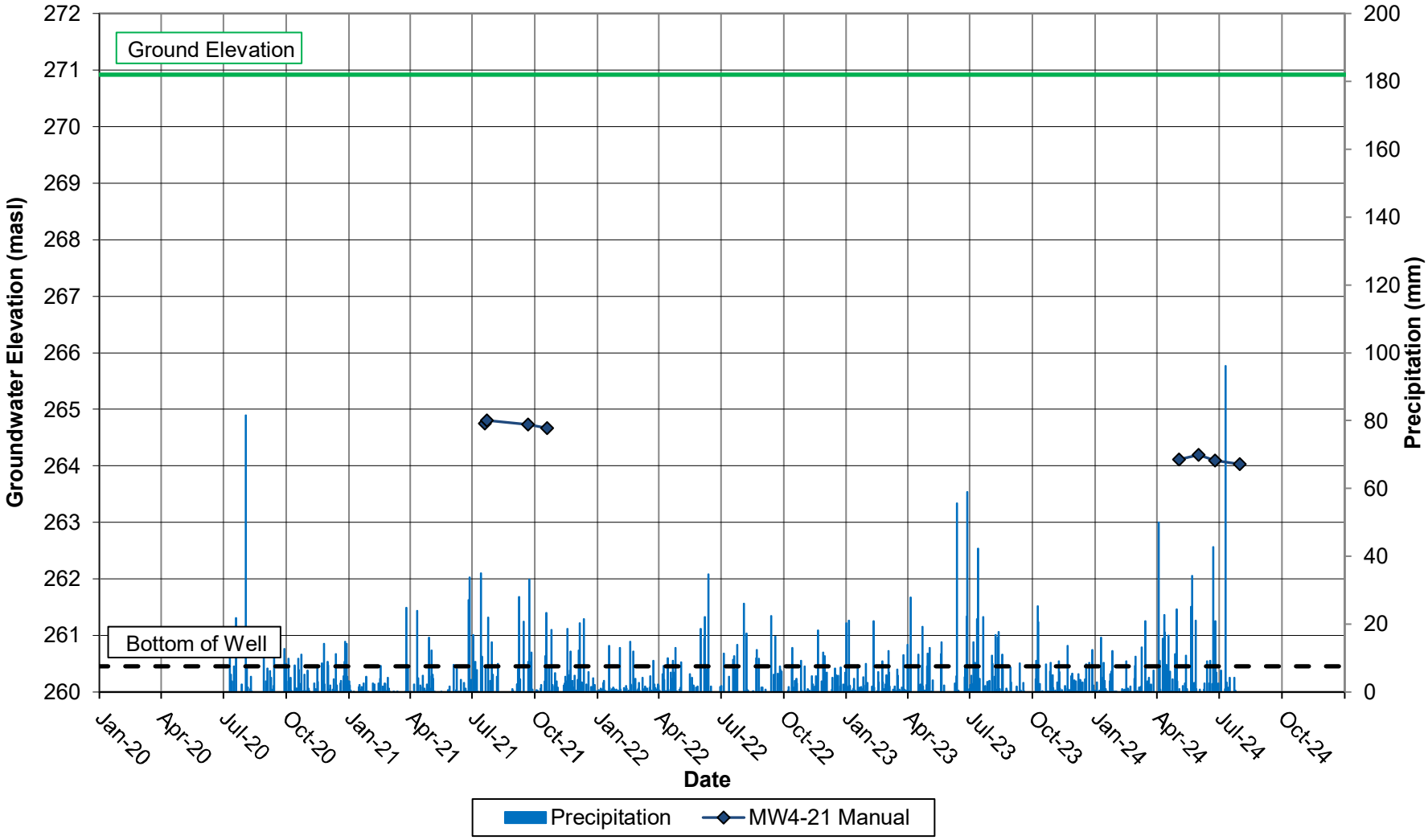

BH4
Groundwater Elevations
(Well Depth: 7.6 m, Screened in Sand)
Groundwater Elevation (masl)
Precipitation (mm)
Ground Elevation
Bottom of Well
274
273
272
271
270
269
268
267
266
265
264
263
262
200
180
160
140
120
100
80
60
40
20
0
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
Jul-22
Oct-22
Jan-23
Apr-23
Jul-23
Oct-23
Jan-24
Apr-24
Jul-24
Oct-24
Date
Precipitation
BH4 Manual

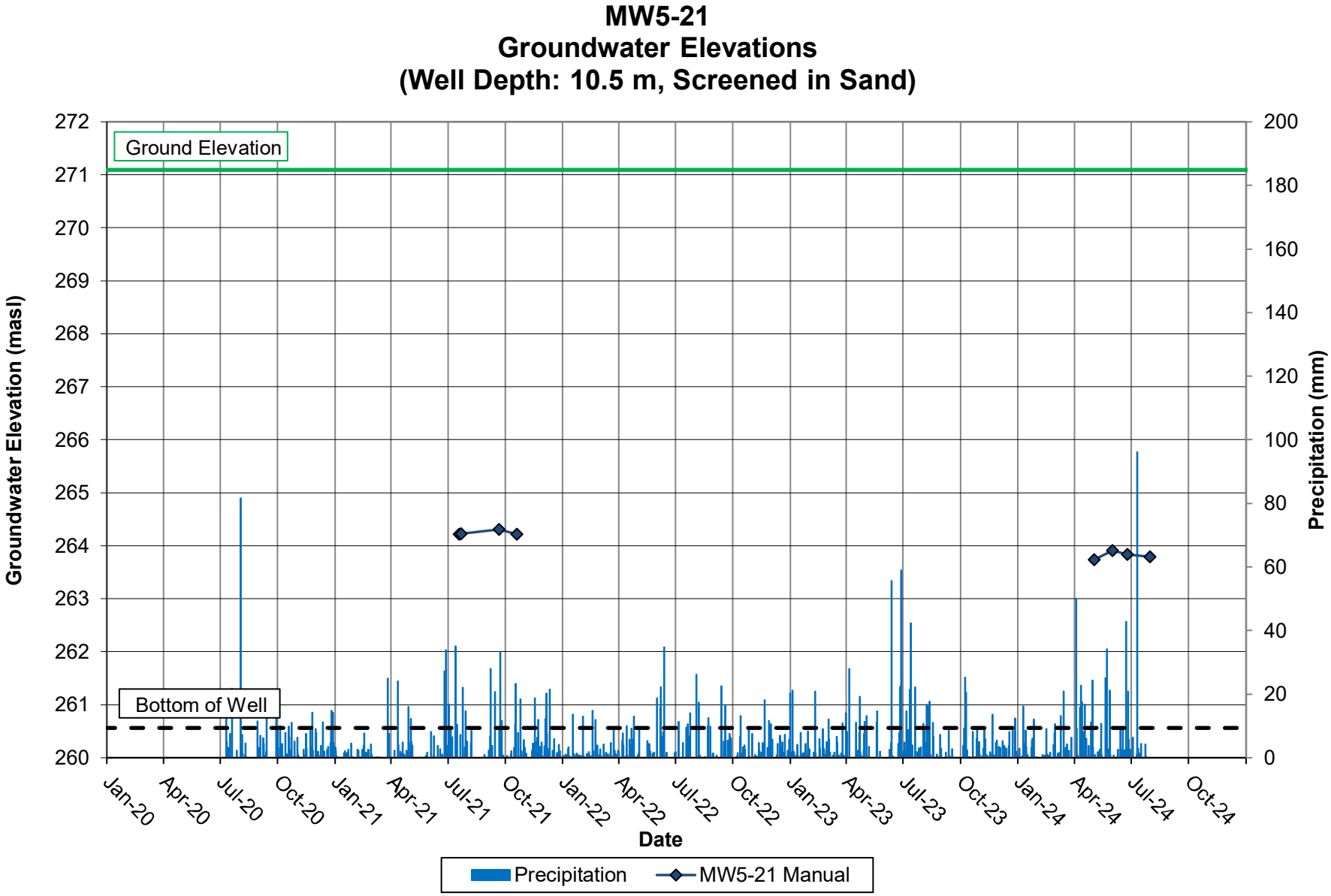

BH5
Groundwater Elevations
(Well Depth: 6.1 m, Screened in Sand)
Groundwater Elevation (masl)
Precipitation (mm)
Ground Elevation
Bottom of Well
Date
Precipitation
BH5 Manual

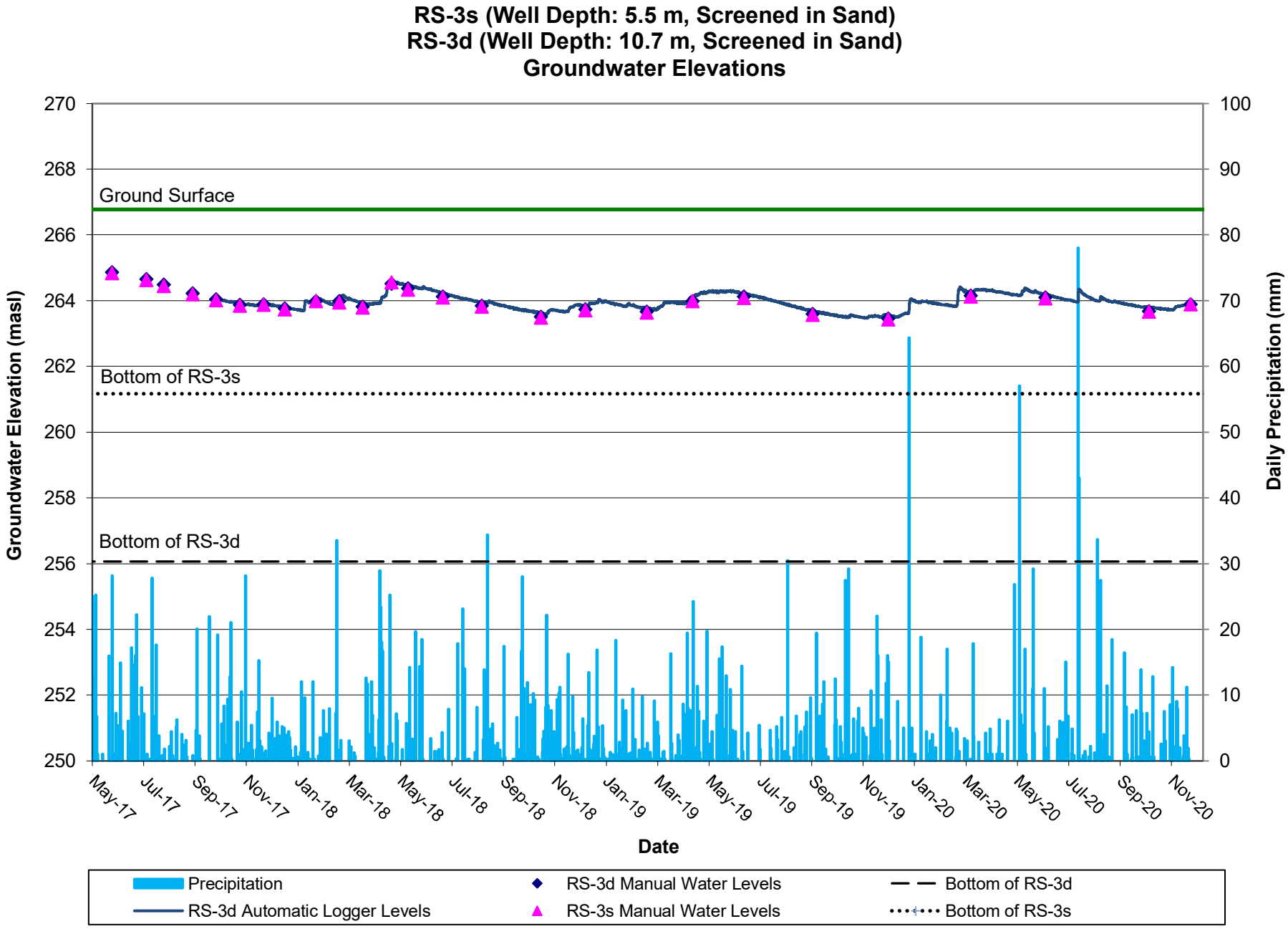

MW1-21
Groundwater Elevations
(Well Depth: 11.5 m, Screened in Silty Sand/Sand)
Ground Elevation
Bottom of Well
Groundwater Elevation (masl)
Precipitation (mm)
Date
269
268
267
266
265
264
263
262
261
260
259
258
257
256
200
180
160
140
120
100
80
60
40
20
0
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
Jul-22
Oct-22
Jan-23
Apr-23
Jul-23
Oct-23
Jan-24
Apr-24
Jul-24
Oct-24
Precipitation
MW1-21 Manual


MW2-21
Groundwater Elevations
(Well Depth: 11.2 m, Screened in Sand)
Ground Elevation
Bottom of Well
Groundwater Elevation (masl)
Precipitation (mm)
Date
269
268
267
266
265
264
263
262
261
260
259
258
257
256
200
180
160
140
120
100
80
60
40
20
0
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
Jul-22
Oct-22
Jan-23
Apr-23
Jul-23
Oct-23
Jan-24
Apr-24
Jul-24
Oct-24
Precipitation
MW2-21 Manual

MW4-21
Groundwater Elevations
(Well Depth: 10.5 m, Screened in Silt with Sand)




MW5-21
Groundwater Elevations
(Well Depth: 10.5 m, Screened in Sand)
Ground Elevation
Bottom of Well
Groundwater Elevation (masl)
Precipitation (mm)
Date
272
271
270
269
268
267
266
265
264
263
262
261
260
200
180
160
140
120
100
80
60
40
20
0
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
Jul-22
Oct-22
Jan-23
Apr-23
Jul-23
Oct-23
Jan-24
Apr-24
Jul-24
Oct-24
Precipitation
MW5-21 Manual


RS-3s (Well Depth: 5.5 m, Screened in Sand)
RS-3d (Well Depth: 10.7 m, Screened in Sand)
Groundwater Elevations
Groundwater Elevation (masl)
Daily Precipitation (mm)
Ground Surface
Bottom of RS-3s
Bottom of RS-3d
270
268
266
264
262
260
258
256
254
252
250
100
90
80
70
60
50
40
30
20
10
0
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19
Jan-20
Mar-20
May-20
Jul-20
Sep-20
Nov-20
Date
Precipitation
RS-3d Automatic Logger Levels
RS-3d Manual Water Levels
RS-3s Manual Water Levels
Bottom of RS-3d
Bottom of RS-3s

BURNSIDE

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Appendix E

Water Quality Data

Table 4.3

Groundwater Analytical Results Summary
Hydrogeological Assessment
Crown Barrie Developments Inc
1012 Yonge Street, Barrie, ON

Sample Location:						**MW5**	**MW5**	**MW5**
Sample ID:						**GW-11226647-072121-DB-MW5**	**GW-11226647-072221-DB-MW5-D-METALS**	**GW-11226647-072221-DB-MW5-SEWERUSE**
Sample Date:						**07/21/2021**	**07/22/2021**	**07/22/2021**
Field SDG:						**C1K4167**	**C1K6265**	**C1K6179**
Parameters	**Units**	**BARRIE Sanitary a**	**BARRIE Storm b**	**ODWS c**	**PWQO d**			
Volatile Organic Compounds								
1,1,1,2-Tetrachloroethane	mg/L	-	-	-	0.02	--	--	ND(0.01)
1,1,1-Trichloroethane	mg/L	-	-	-	0.01	--	--	ND(0.004)
1,1,2,2-Tetrachloroethane	mg/L	0.06	-	-	0.07	--	--	ND(0.008)
1,1,2-Trichloroethane	mg/L	-	-	-	0.8	--	--	ND(0.008)
1,1-Dichloroethane	mg/L	-	-	-	0.2	--	--	ND(0.004)
1,1-Dichloroethene	mg/L	-	-	0.014	0.04	--	--	ND(0.004)
1,2-Dibromoethane (Ethylene dibromide)	mg/L	-	-	-	0.005	--	--	ND(0.0038)
1,2-Dichlorobenzene	mg/L	0.05	-	0.2	0.0025	--	--	ND(0.008)
1,2-Dichloroethane	mg/L	-	-	0.005	0.1	--	--	ND(0.0098)
1,2-Dichloropropane	mg/L	-	-	-	0.0007	--	--	ND(0.004)
1,3-Dichlorobenzene	mg/L	-	-	-	0.0025	--	--	ND(0.008)
1,4-Dichlorobenzene	mg/L	0.08	-	0.005	0.004	--	--	ND(0.008)
2-Butanone (Methyl ethyl ketone) (MEK)	mg/L	-	-	-	0.4	--	--	ND(0.2)
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	mg/L	-	-	-	-	--	--	ND(0.1)
Acetone	mg/L	-	-	-	-	--	--	ND(0.2)
Benzene	mg/L	0.01	-	0.001	0.1	--	--	ND(0.004)
Bromodichloromethane	mg/L	-	-	-	0.2	--	--	ND(0.01)
Bromoform	mg/L	-	-	-	0.06	--	--	ND(0.02)
Bromomethane (Methyl bromide)	mg/L	-	-	-	0.0009	--	--	ND(0.01)
Carbon tetrachloride	mg/L	-	-	0.002	-	--	--	ND(0.0038)
Chlorobenzene	mg/L	-	-	-	0.015	--	--	ND(0.004)
Chloroethane	mg/L	-	-	-	-	--	--	ND(0.02)
Chloroform (Trichloromethane)	mg/L	-	-	-	-	--	--	ND(0.004)
Chloromethane (Methyl chloride)	mg/L	-	-	-	0.7	--	--	ND(0.1)
cis-1,2-Dichloroethene	mg/L	-	-	-	0.2	--	--	ND(0.01)
cis-1,3-Dichloropropene	mg/L	-	-	-	-	--	--	ND(0.006)
Dibromochloromethane	mg/L	-	-	-	0.04	--	--	ND(0.01)
Dichlorodifluoromethane (CFC-12)	mg/L	-	-	-	-	--	--	ND(0.02)
Ethylbenzene	mg/L	0.06	-	0.14	0.008	--	--	ND(0.004)
Hexane	mg/L	-	-	-	-	--	--	ND(0.02)
m&p-Xylenes	mg/L	-	-	-	0.002	--	--	ND(0.004)
Methyl tert butyl ether (MTBE)	mg/L	-	-	-	0.2	--	--	ND(0.01)
Methylene chloride	mg/L	0.09	-	0.05	0.1	--	--	ND(0.04)
o-Xylene	mg/L	-	-	-	0.04	--	--	ND(0.004)
Styrene	mg/L	-	-	-	0.004	--	--	ND(0.008)
Tetrachloroethene	mg/L	0.06	-	0.01	0.05	--	--	ND(0.004)
Toluene	mg/L	0.02	-	0.06	0.0008	--	--	ND(0.004)
trans-1,2-Dichloroethene	mg/L	-	-	-	0.2	--	--	ND(0.01)
trans-1,3-Dichloropropene	mg/L	-	-	-	0.007	--	--	ND(0.008)
Trichloroethene	mg/L	0.05	-	0.005	0.02	--	--	ND(0.004)
Trichlorofluoromethane (CFC-11)	mg/L	-	-	-	-	--	--	ND(0.01)
Trihalomethanes	mg/L	-	-	0.1	-	--	--	ND(0.02)
Vinyl chloride	mg/L	-	-	0.001	0.6	--	--	ND(0.004)
Xylenes (total)	mg/L	0.03	-	0.09	-	--	--	ND(0.004)
Semi Volatile Organic Compounds								
1-Methylnaphthalene	mg/L	-	-	-	0.002	--	--	ND(0.00005)
2-Methylnaphthalene	mg/L	-	-	-	0.002	--	--	ND(0.00005)

Table 4.3

Groundwater Analytical Results Summary
Hydrogeological Assessment
Crown Barrie Developments Inc
1012 Yonge Street, Barrie, ON

Sample Location:						**MW5**	**MW5**	**MW5**
Sample ID:						**GW-11226647-072121-DB-MW5**	**GW-11226647-072221-DB-MW5-D-METALS**	**GW-11226647-072221-DB-MW5-SEWERUSE**
Sample Date:						**07/21/2021**	**07/22/2021**	**07/22/2021**
Field SDG:						**C1K4167**	**C1K6265**	**C1K6179**
Parameters	**Units**	**BARRIE Sanitary**	**BARRIE Storm**	**ODWS**	**PWQO**			
Acenaphthene	mg/L	-	-	-	-	--	--	ND(0.00005)
Acenaphthylene	mg/L	-	-	-	-	--	--	ND(0.00005)
Anthracene	mg/L	-	-	-	0.0000008	--	--	ND(0.00005)
Benzo(a)anthracene	mg/L	-	-	-	0.0000004	--	--	ND(0.00005)
Benzo(a)pyrene	mg/L	-	-	0.00001	-	--	--	ND(0.000009)
Benzo(b)fluoranthene/Benzo(j)fluoranthene	mg/L	-	-	-	-	--	--	ND(0.00005)
Benzo(g,h,i)perylene	mg/L	-	-	-	0.00000002	--	--	ND(0.00005)
Benzo(k)fluoranthene	mg/L	-	-	-	0.0000002	--	--	ND(0.00005)
Chrysene	mg/L	-	-	-	0.0000001	--	--	ND(0.00005)
Dibenz(a,h)anthracene	mg/L	-	-	-	0.000002	--	--	ND(0.00005)
Fluoranthene	mg/L	-	-	-	0.0000008	--	--	ND(0.00005)
Fluorene	mg/L	-	-	-	0.0002	--	--	ND(0.00005)
Indeno(1,2,3-cd)pyrene	mg/L	-	-	-	-	--	--	ND(0.00005)
Naphthalene	mg/L	-	-	-	0.007	--	--	ND(0.00005)
Phenanthrene	mg/L	-	-	-	0.00003	--	--	ND(0.00003)
Pyrene	mg/L	-	-	-	-	--	--	ND(0.00005)
Total PAH	mg/L	0.05	-	-	-	--	--	ND(0.0002)
Metals (Total)								
Aluminum	mg/L	50	-	-	0.075	**0.34[d]**	--	**0.125[d]**
Antimony	mg/L	5	-	0.006	0.02	ND(0.0005)	--	0.000109
Arsenic	mg/L	1	-	0.01	0.005	ND(0.001)	--	0.000231
Barium	mg/L	5	-	1	-	0.05	--	0.0498
Beryllium	mg/L	-	-	-	0.011	ND(0.0004)	--	--
Bismuth	mg/L	5	-	-	-	--	--	ND(0.00001)
Boron	mg/L	-	-	5	0.2	0.026	--	--
Cadmium	mg/L	0.7	0.001	0.005	0.0002	ND(0.00009)	--	ND(0.000005)
Chromium	mg/L	2	0.08	0.05	0.001	ND(0.005)	--	0.00025
Cobalt	mg/L	5	-	-	0.0009	**0.0012[d]**	--	0.000873
Copper	mg/L	2	0.01	-	0.005	0.0015	--	0.00071
Gold	mg/L	5	-	-	-	--	--	ND(0.0001)
Iron	mg/L	50	-	-	0.3	**0.43[d]**	--	0.0736
Lead	mg/L	0.7	0.05	0.01	0.005	ND(0.0005)	--	0.000093
Manganese	mg/L	5	-	-	-	0.14	--	0.124
Mercury	mg/L	0.01	-	0.001	0.0002	--	--	ND(0.00010)
Molybdenum	mg/L	5	-	-	0.04	0.0076	--	0.00738
Nickel	mg/L	2	0.05	-	0.025	0.0019	--	0.0017
Phosphorus	mg/L	10	-	-	0.01	--	--	0.0061
Platinum	mg/L	5	-	-	-	--	--	ND(0.0001)
Rhodium	mg/L	5	-	-	-	--	--	ND(0.0005)
Selenium	mg/L	1	-	0.05	0.1	ND(0.002)	--	0.000097
Silver	mg/L	0.4	-	-	0.0001	ND(0.00009)	--	ND(0.00001)
Sodium	mg/L	-	-	-	-	14	--	--
Thallium	mg/L	-	-	-	0.0003	ND(0.00005)	--	--
Tin	mg/L	5	-	-	-	--	--	0.00025
Tungsten	mg/L	-	-	-	0.03	ND(0.001)	--	--
Uranium	mg/L	-	-	0.02	0.005	0.00078	--	--
Vanadium	mg/L	5	-	-	0.006	0.0011	--	0.00033
Zinc	mg/L	2	0.04	-	0.03	ND(0.005)	--	0.0018
Zirconium	mg/L	-	-	-	0.004	ND(0.001)	--	--

Table 4.3

Groundwater Analytical Results Summary
Hydrogeological Assessment
Crown Barrie Developments Inc
1012 Yonge Street, Barrie, ON

Sample Location:						**MW5**	**MW5**	**MW5**
Sample ID:						**GW-11226647-072121-DB-MW5**	**GW-11226647-072221-DB-MW5-D-METALS**	**GW-11226647-072221-DB-MW5-SEWERUSE**
Sample Date:						**07/21/2021**	**07/22/2021**	**07/22/2021**
Field SDG:						**C1K4167**	**C1K6265**	**C1K6179**
Parameters	**Units**	**BARRIE Sanitary**	**BARRIE Storm**	**ODWS**	**PWQO**			
Metals (Dissolved)								
Aluminum (dissolved)	mg/L	50	-	-	0.075	--	ND(0.0049)	--
Antimony (dissolved)	mg/L	5	-	0.006	0.02	--	ND(0.0005)	--
Arsenic (dissolved)	mg/L	1	-	0.01	0.005	--	ND(0.001)	--
Barium (dissolved)	mg/L	5	-	1	-	--	0.046	--
Beryllium (dissolved)	mg/L	-	-	-	0.011	--	ND(0.0004)	--
Bismuth (dissolved)	mg/L	5	-	-	-	--	ND(0.001)	--
Boron (dissolved)	mg/L	-	-	5	0.2	--	0.011	--
Cadmium (dissolved)	mg/L	0.7	0.001	0.005	0.0002	--	ND(0.00009)	--
Calcium (dissolved)	mg/L	-	-	-	-	100	100	--
Chromium (dissolved)	mg/L	2	0.08	0.05	0.001	--	ND(0.005)	--
Cobalt (dissolved)	mg/L	5	-	-	0.0009	--	0.00076	--
Copper (dissolved)	mg/L	2	0.01	-	0.005	--	ND(0.0009)	--
Iron (dissolved)	mg/L	50	-	-	0.3	--	ND(0.1)	--
Lead (dissolved)	mg/L	0.7	0.05	0.01	0.005	--	ND(0.0005)	--
Lithium (dissolved)	mg/L	-	-	-	-	--	ND(0.005)	--
Magnesium (dissolved)	mg/L	-	-	-	-	11	11	--
Manganese (dissolved)	mg/L	5	-	-	-	--	0.12	--
Mercury (dissolved)	mg/L	0.01	-	0.001	0.0002	--	--	ND(0.0001)
Molybdenum (dissolved)	mg/L	5	-	-	0.04	--	0.007	--
Nickel (dissolved)	mg/L	2	0.05	-	0.025	--	0.0016	--
Phosphorus (dissolved)	mg/L	10	-	-	0.01	--	ND(0.1)	--
Potassium (dissolved)	mg/L	-	-	-	-	1.6	1.6	--
Selenium (dissolved)	mg/L	1	-	0.05	0.1	--	ND(0.002)	--
Silicon (dissolved)	mg/L	-	-	-	-	--	6.8	--
Silver (dissolved)	mg/L	0.4	-	-	0.0001	--	ND(0.00009)	--
Sodium (dissolved)	mg/L	-	-	-	-	14	13	--
Strontium (dissolved)	mg/L	-	-	-	-	--	0.22	--
Tellurium (dissolved)	mg/L	-	-	-	-	--	ND(0.001)	--
Thallium (dissolved)	mg/L	-	-	-	0.0003	--	ND(0.00005)	--
Tin (dissolved)	mg/L	5	-	-	-	--	ND(0.001)	--
Titanium (dissolved)	mg/L	-	-	-	-	--	ND(0.005)	--
Tungsten (dissolved)	mg/L	-	-	-	0.03	--	ND(0.001)	--
Uranium (dissolved)	mg/L	-	-	0.02	0.005	--	0.0008	--
Vanadium (dissolved)	mg/L	5	-	-	0.006	--	ND(0.0005)	--
Zinc (dissolved)	mg/L	2	0.04	-	0.03	--	ND(0.005)	--
Zirconium (dissolved)	mg/L	-	-	-	0.004	--	ND(0.001)	--
Pesticides								
Hexachlorobenzene	mg/L	0.0001	-	-	0.0000065	--	--	ND(0.000005)
General Chemistry								
%difference/ion balance	%	-	-	-	-	0.890	--	--
Alkalinity, bicarbonate (calculated)	mg/L	-	-	-	-	290	--	--
Alkalinity, carbonate (calculated)	mg/L	-	-	-	-	1.9	--	--
Alkalinity, total (as CaCO3)	mg/L	-	-	-	-	290	--	--
Ammonia-N	mg/L	-	-	-	-	ND(0.050)	--	--
Biochemical oxygen demand (total BOD5)	mg/L	-	-	-	-	--	--	ND(2)
Chemical oxygen demand (COD)	mg/L	600	-	-	-	--	--	ND(4.0)

Table 4.3

Groundwater Analytical Results Summary
Hydrogeological Assessment
Crown Barrie Developments Inc
1012 Yonge Street, Barrie, ON

Sample Location:						**MW5**	**MW5**	**MW5**
Sample ID:						**GW-11226647-072121-DB-MW5**	**GW-11226647-072221-DB-MW5-D-METALS**	**GW-11226647-072221-DB-MW5-SEWERUSE**
Sample Date:						**07/21/2021**	**07/22/2021**	**07/22/2021**
Field SDG:						**C1K4167**	**C1K6265**	**C1K6179**
Parameters	**Units**	**BARRIE Sanitary**	**BARRIE Storm**	**ODWS**	**PWQO**			
Chloride (dissolved)	mg/L	1500	-	-	-	8.1	--	6.7
Color	TCU	-	-	-	-	ND(2)	--	--
Cyanide (total)	mg/L	1.2	-	0.2	0.005	--	--	ND(0.0050)
Cyanide, weak acid dissociable	mg/L	-	-	-	-	--	--	ND(0.001)
Dissolved organic carbon (DOC) (dissolved)	mg/L	-	-	-	-	1.3	--	--
Fluoride	mg/L	10	-	1.5	-	0.12	--	ND(0.10)
Hardness	mg/L	-	-	-	-	300	--	--
Hydroxide (as CaCO3)	mg/L	-	-	-	-	ND(1.0)	--	--
Nitrate (as N)	mg/L	-	-	10	-	3.64	--	--
Nitrite (as N)	mg/L	-	-	1	-	0.022	--	--
Nitrite/Nitrate	mg/L	-	-	-	-	3.66	--	--
Nitrogen	mg/L	-	-	-	-	3.8	--	--
Nitrogen, organic	mg/L	-	-	-	-	0.15	--	--
Oil and grease	mg/L	-	-	-	-	--	--	ND(0.50)
Oil and grease, animal	mg/L	150	-	-	-	--	--	ND(0.50)
Oil and grease, mineral/synthetic	mg/L	15	-	-	-	--	--	ND(0.50)
Orthophosphate	mg/L	-	-	-	-	ND(0.050)	--	--
pH, field	s.u.	-	6.0-9.5	-	6.5-8.5	7.36	--	--
pH, lab	s.u.	6.0-9.5	6.0-9.5	-	6.5-8.5	7.85	--	7.89
Phenolics (total)	mg/L	0.1	-	-	0.001	--	--	ND(0.0010)
Phosphorus	mg/L	10	-	-	0.01	**0.015**[d]	--	--
Sulfate (dissolved)	mg/L	1500	-	-	-	21	--	22
Sulfide	mg/L	1	-	-	-	ND(0.020)	--	ND(0.020)
Temperature, field	Deg C	60	30	-	-	17.12	--	--
Total dissolved solids (TDS)	mg/L	-	-	-	-	330	--	--
Total kjeldahl nitrogen (TKN)	mg/L	100	-	-	-	0.15	--	ND(0.10)
Total suspended solids (TSS)	mg/L	350	15	-	-	**28**[b]	--	14
Turbidity	NTU	-	-	-	-	28	--	--
Un-ionized ammonia	mg/L	-	-	-	0.02	ND(0.00061)	--	--

Footnotes:
ND- Not detected at the associated reporting limit.

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix F

Water Balance Calculations

WATER BALANCE CALCULATIONS
Crown (Barrie) Developments Inc.
Hydrogeological Study
Barrie, ON
PROJECT No.300057940

BURNSIDE

TABLE F-1

Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 150 mm (pasture and shrubs in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-57	-27	17	39	58	0	**0**
Soil Moisture Storage max 150 mm	150	150	150	150	150	121	64	37	53	92	150	150	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
Soil Moisture Deficit max 150 mm	0	0	0	0	0	29	86	113	97	58	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	22	74	**340**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	58	43	41	24	5	0	0	0	0	0	16	52	**238**
Potential Direct Surface Water Runoff (independent of temperature)	25	19	17	10	2	0	0	0	0	0	7	22	**102**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 150 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations
topography - rolling land (avg slope ~ 1%) 0.2 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - sandy loam 0.4 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - predominantly cultivated land 0.1 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor **0.7**

Latitude of site (or climate station) 44 ° N.

WATER BALANCE CALCULATIONS
Crown (Barrie) Developments Inc.
Hydrogeological Study
Barrie, ON
PROJECT No.300057940

BURNSIDE

TABLE F-2

Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 75 mm (urban lawn in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-46	0	17	39	19	0	**0**
Soil Moisture Storage max 75 mm	75	75	75	75	75	46	0	0	17	56	75	75	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	123	90	77	38	9	0	**555**
Soil Moisture Deficit max 75 mm	0	0	0	0	0	29	75	75	58	19	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	60	74	**378**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	58	43	41	24	5	0	0	0	0	0	42	52	**265**
Potential Direct Surface Water Runoff (independent of temperature)	25	19	17	10	2	0	0	0	0	0	18	22	**113**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 75 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations
topography - rolling land 0.2 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - sandy loam 0.4 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn 0.1 <-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor **0.7**

Latitude of site (or climate station) 44 ° N.

WATER BALANCE CALCULATIONS
Crown (Barrie) Developments Inc.
Hydrogeological Study
Barrie, ON
PROJECT No.300057940

BURNSIDE

TABLE F-3a

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)
Phase 1

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use												
Agricultural	16,787	0.00	0	0.793	0	16,787	0.102	1,711	0.238	3,992	1,711	3,992
Buildings and Driveway	2,913	1.00	2,913	0.793	2,310	0	0.102	0	0.238	0	2,310	0
TOTAL PRE-DEVELOPMENT	**19,700**		**2,913**		**2,310**	**16,787**		**1,711**		**3,992**	**4,021**	**3,992**
Post-Development Land Use (with no LID measures in place)												
Buildings	6,200	1.00	6,200	0.793	4,916	0	0.113	0	0.265	0	4,916	0
Sidewalk	2,800	1.00	2,800	0.793	2,220	0	0.113	0	0.265	0	2,220	0
Driveway and Surface Parking	4,700	1.00	4,700	0.793	3,727	0	0.113	0	0.265	0	3,727	0
Outdoor Amenity	1,100	1.00	1,100	0.793	872	0	0.113	0	0.265	0	872	0
Pervious Area Above Underground Parking	4,100	0.00	0	0.793	0	4,100	0.113	465	0.265	1,085	465	1,085
Remaining Pervious Area	800	0.00	0	0.793	0	800	0.113	91	0.265	212	91	212
TOTAL POST-DEVELOPMENT	**19,700**		**14,800**		**11,736**	**4,900**		**556**		**1,297**	**12,292**	**1,297**
										% Change from Pre to Post	306	68
										Effect of development (with no mitigation)	3.1 times increase in runoff	68% reduction of infiltration

* data provided by Burnside, July 2024

** figures from Tables F-1 and F-2.

To balance pre- to post-,
the infiltration target (m^3/a)= **2,696**

WATER BALANCE CALCULATIONS
Crown (Barrie) Developments Inc.
Hydrogeological Study
Barrie, ON
PROJECT No.300057940

BURNSIDE

TABLE F-3b

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)
Phase 2

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use												
Agricultural	14,180	0.00	0	0.793	0	14,180	0.102	1,445	0.238	3,372	1,445	3,372
Buildings and Driveway	420	1.00	420	0.793	333	0	0.102	0	0.238	0	333	0
TOTAL PRE-DEVELOPMENT	**14,600**		**420**		**333**	**14,180**		**1,445**		**3,372**	**1,778**	**3,372**
Post-Development Land Use (with no LID measures in place)												
Buildings	6,700	1.00	6,700	0.793	5,313	0	0.113	0	0.265	0	5,313	0
Sidewalk	1,600	1.00	1,600	0.793	1,269	0	0.113	0	0.265	0	1,269	0
Driveway and Surface Parking	1,600	1.00	1,600	0.793	1,269	0	0.113	0	0.265	0	1,269	0
Outdoor Amenity	500	1.00	500	0.793	396	0	0.113	0	0.265	0	396	0
Pervious Area Above Underground Parking	3,700	0.00	0	0.793	0	3,700	0.113	420	0.265	979	420	979
Remaining Pervious Area	500	0.00	0	0.793	0	500	0.113	57	0.265	132	57	132
TOTAL POST-DEVELOPMENT	**14,600**		**10,400**		**8,247**	**4,200**		**476**		**1,111**	**8,723**	**1,111**
									% Change from Pre to Post		490	67
									Effect of development (with no mitigation)		4.9 times increase in runoff	67% reduction of infiltration

* data provided by Burnside, July 2024

** figures from Tables F-1 and F-2.

To balance pre- to post-,
the infiltration target (m^3/a)= **2,261**

WATER BALANCE CALCULATIONS
Crown (Barrie) Developments Inc.
Hydrogeological Study
Barrie, ON
PROJECT No.300057940

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TABLE F-3c

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)
Phase 3

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use												
Agricultural	15,026	0.00	0	0.793	0	15,026	0.102	1,531	0.238	3,573	1,531	3,573
Buildings and Driveway	74	1.00	74	0.793	59	0	0.102	0	0.238	0	59	0
TOTAL PRE-DEVELOPMENT	**15,100**		**74**		**59**	**15,026**		**1,531**		**3,573**	**1,590**	**3,573**
Post-Development Land Use (with no LID measures in place)												
Buildings	3,400	1.00	3,400	0.793	2,696	0	0.113	0	0.265	0	2,696	0
Sidewalk	1,800	1.00	1,800	0.793	1,427	0	0.113	0	0.265	0	1,427	0
Driveway and Surface Parking	3,400	1.00	3,400	0.793	2,696	0	0.113	0	0.265	0	2,696	0
Outdoor Amenity	2,800	1.00	2,800	0.793	2,220	0	0.113	0	0.265	0	2,220	0
ST Townhouses	400	1.00	400	0.793	317	0	0.113	0	0.265	0	317	0
Pervious Area Above Underground Parking	2,600	0.00	0	0.793	0	2,600	0.113	295	0.265	688	295	688
Remaining Pervious Area	700	0.00	0	0.793	0	700	0.113	79	0.265	185	79	185
TOTAL POST-DEVELOPMENT	**15,100**		**11,800**		**9,357**	**3,300**		**374**		**873**	**9,731**	**873**
										% Change from Pre to Post	612	76
										Effect of development (with no mitigation)	6.1 times increase in runoff	76% reduction of infiltration

* data provided by Burnside, July 2024

** figures from Tables F-1 and F-2.

To balance pre- to post-,
the infiltration target (m^3/a)= **2,700**

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix G

Well Survey Results

Table G-1: Water Well Survey Results

Address	Mapped MECP Well Record(s)	Survey Response	Notes from Survey
971 Yonge Street	5718813 (75 feet)	Mailed in survey form received.	Drilled well. (Depth 60 to 75 feet). No issues with water quality or quantity.
965 Yonge Street	5718243 (65 feet)	Left letter. No response.	
961 Yonge Street		Left letter. No response.	Dug well.
957 Yonge Street	5711629 (58 feet)	Spoke to resident. Well survey not filled out.	Resident indicated that they have a well that is used. Water quality is fine. Having issues with water levels since construction began.
962 Yonge Street	5701419 (35 feet)	Left letter. No response.	Dug well observed in the front yard.
958 Yonge Street		Mailed in survey form received	Drilled well. 20 feet deep. No issues with water quality or quantity.

WATER WELL SURVEY

Well Address 958 YONGE ST, BARRIE, ON L9J0E7 Date: JULY 16, 2024
(Lot, Con., Twp., Street & No., etc.)

[redacted]

WELL INFORMATION

Water source (if known): Overburden _____ Bedrock _____

Construction Method: Drilled ✓ Dug _____

Date completed: 1998

Well depth 20' (please indicate feet or metres)

Well casing diameter: _____

Type of Casing: _____

Casing Height: 0-15cm 15-40cm >40 cm above grade

Casing Condition: GOOD.

Access: FRONT LAWN - EASY TO ACCESS

Drainage away from well?: LEVEL.

Is well part of an ongoing monitoring program? _____

WATER USE

Is well in use? YES

Domestic (residential) Livestock supply

Commercial or Industrial Other uses

General Water Quality (odour, colour): NO ODOUR CLEAN & CLEAR.

Have you had any bacteria problems with the water? NO

Has your well previously been impacted by low water level/dry conditions? NO

WELL LOCATION

Hand Held GPS: (NAD 83) Northing: _____ Easting: ✓

Distance to septic system: 50-60'

Distance to road, feed lot, manure storage, other potential contaminant sources: 50' TO ROAD.

Other Comments: _____

SKETCH OF WELL LOCATION

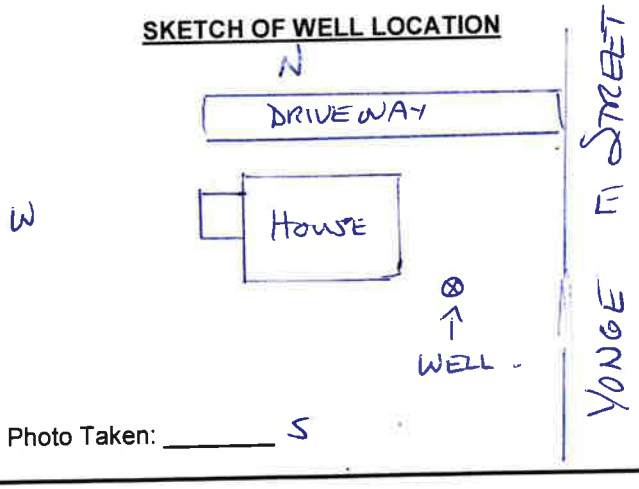

Photo Taken: _____ S

Signed: _____ (Owner/Tenant) Date: July 16/24.

WATER WELL SURVEY

Well Address 971 Yonge St. Barrie (Lot, Con., Twp., Street & No., etc.) Date: July 15 / 24

[redacted]

WELL INFORMATION

Water source (if known): Overburden ✓ Bedrock ✓

Construction Method: Drilled ✓ Dug ____

Date completed: Aug 23, 1983
Well depth 60-75 ft (please indicate feet or metres)
Well casing diameter: 6 1/4"
Type of Casing: steel
Casing Height: 0-15cm 15-40cm >40 cm above grade
Casing Condition: ____
Access: ____
Drainage away from well?: ____

Is well part of an ongoing monitoring program? no

WATER USE

Is well in use? yes

Domestic (residential) ✓ Livestock supply

Commercial or Industrial Other uses

General Water Quality (odour, colour): good

Have you had any bacteria problems with the water? no

Has your well previously been impacted by low water level/dry conditions? never

WELL LOCATION

Hand Held GPS: (NAD 83) Northing: I think Easting: ____

Distance to septic system: 100' - at back of house

Distance to road, feed lot, manure storage, other potential contaminant sources: 140 feet

Other Comments: well is at front of house, septic at back.
Never had any problems.

SKETCH OF WELL LOCATION

Photo Taken: ____

Signed: ____ (Owner/Tenant) Date: July 15/24.

I have sent a copy of this survey before to Burnside + Ass. It should be on file

R.J. Burnside & Associates Limited