BURNSIDE

Archerhill Court Hydrogeological Assessment

Highfair Investments Inc.
Aurora, Ontario

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Aurora, Ontario

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August 2021
300052893.0000

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Record of Revisions

Revision	Date	Description
-	August 11, 2021	Initial Submission to Highfair Investments Inc.

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Highfair Investments Inc. to complete a hydrogeological assessment for a proposed redevelopment (herein referred to as the subject lands) located in the Town of Aurora (Figure 1). The subject lands are approximately 17 ha and currently consists of 14 residential lots located on Archerhill Court at the northwest corner of Vandorf Sideroad and Bayview Avenue in Aurora, Ontario. The proposed redevelopment will include 147 residential lots.

The subject lands are located within a physiographic region known as the Oak Ridges Moraine. The Oak Ridges Moraine Conservation Plan ("ORMCP") was established by the Ontario government as part of the Oak Ridges Moraine Conservation Act (2001) to provide land use and resource management direction for the land and water within the Moraine. The Plan divides the Moraine into four land use designations, which include: *Natural Core Areas*, *Natural Linkage Areas, Countryside Areas*, and *Settlement Areas*. The subject lands are within lands designated within a 'Settlement Area' in the ORMCP. Urban uses as set out in Municipal Official Plans are permitted subject to the provisions of the ORMCP.

In compliance with hydrogeological conditions in the ORMCP, the hydrogeological study has been designed to characterize the geological and hydrogeological conditions on the subject lands, identify potential development impacts on the local groundwater and surface water conditions, and to complete a water balance assessment to determine the pre- and post-development groundwater recharge volumes. The water balance calculations provide input to the stormwater management plans to be developed for the property by SCS Consulting Group Limited and provide recharge targets for the design of Low Impact Development (LID) measures to maintain, where possible, the key hydrogeological functions when the property is redeveloped.

1.1 Previous Studies

Previous studies have been completed on the subject lands and in the vicinity of the subject lands. The studies completed that are relevant to the current assessment include the following:

- Geotechnical investigations were completed by Exp Services Inc. (Exp) for the subject lands (January 2021 and May 2021). The investigations included eight boreholes with four completed as monitoring wells. The locations of the monitoring wells are shown on Figure 2 and the borehole logs are included in Appendix A.

- A hydrogeological assessment for the Colyton Farms property north of the subject lands was completed by Burnside in 2011. The study included monitoring along the watercourse that crosses the northeast corner of the subject lands.

- A monitoring report for a closed landfill site located southeast of the subject lands completed by Conestoga-Rovers & Associates in 2011 was reviewed. The report included borehole logs and groundwater levels within the vicinity of the subject lands.

1.2 Scope of Work

The key tasks for the hydrogeology assessment include:

1. Review of the Ministry of the Environment, Conservation and Parks (MECP) well records: The MECP maintains a database that provides geological records of water supply wells drilled in the province. A list of the available MECP water well records for local wells is provided in Appendix B and the well locations are shown 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.

2. Review of background geological and hydrogeological information: A review of background material for the area including topography, surficial geology and bedrock geology mapping and available geotechnical and hydrogeological reports was completed to assess the regional hydrogeological setting.

3. Review of soils data: Geotechnical investigation on the subject lands conducted by Exp included nine boreholes across the subject lands and the installation of four monitoring wells. Burnside installed two monitoring wells in 2021 (MW1 and BH2d). The locations of these boreholes and monitoring wells are shown on Figure 5. The borehole logs (Appendix A) were reviewed to characterize the surficial sediments and stratigraphy.

4. Installation of drive-point piezometers: Four piezometers (two nests of two piezometers installed at different depths) were installed along a watercourse north of the subject lands and in the wetland in the northeast corner of the subject lands to investigate the shallow groundwater conditions. The locations of the piezometers are shown on Figure 2.

5. Grainsize analyses: During the drilling investigations completed in 2021, soil samples were collected, and three representative samples were submitted for analysis of grainsize distribution. The results of the soil grainsize analyses are provided in Appendix C and have been used to characterize the surficial sediments and estimate the hydraulic conductivity of the soils encountered.

6. Hydraulic conductivity testing: Single well response tests were completed at five monitoring wells to characterize the soil conductivity. The hydraulic conductivity field testing results are provided in Appendix C.

7. Groundwater levels: Groundwater level measurements in on-site monitoring wells have been collected monthly since March 2021 and will continue to March 2022. Automatic water level recorders (dataloggers) have been installed in monitoring well BH2s and piezometers PZ1s, PZ1d and PZ2d to record continuous water level fluctuations. A barologger has also been installed to compensate the groundwater level data collected for effects of barometric variations. Groundwater levels collected at monitoring wells are provided in Appendix D.

8. Surface water monitoring: Surface water monitoring is completed monthly at two monitoring stations along the watercourse that flows through the northeast corner of the subject lands (Figure 2). The stations are inspected for water depths and flow on each site visit and used in the evaluation of groundwater/surface water interactions. Flow monitoring data collected from March 2021 to July 2021 is provided in Appendix E.

9. Water quality sampling and analysis: Water samples were collected in June 2021 from selected monitoring wells and surface water locations to characterize the baseline water quality (two groundwater and one surface water sample). The water samples were submitted to an accredited laboratory for analyses of selected water quality indicator parameters including basic ions (including chloride and nitrate), TDS (groundwater), TSS (surface water) and selected metals. The water quality results are provided in Appendix F.

10. Water balance calculations: Pre-development water balance calculations (based on existing land use conditions) and post-development water balance calculations (based on the proposed development concept for the subject lands) were completed to assess the potential impacts of land development on the local groundwater recharge conditions. The local climate data and detailed water balance calculations are provided in Appendix G.

2.0 Physical Setting

2.1 Physiographic Setting

The subject lands are located within a physiographic region known as the Oak Ridges Moraine (Chapman and Putnam, 1984). The Oak Ridges Moraine is a 160 km long, east-west oriented ridge of sand, silt and gravel deposits that forms a divide between the Lake Ontario and Lake Simcoe watersheds.

2.2 Topography

Analysis of the detailed topographical mapping shows the highest elevations occur in the south and south west portion of the property where the ground reaches about

279 metres above sea level (masl) and the lowest elevations are found along northern boundary and the wetland in the northeast corner of the subject lands, where elevations are in the 266 to 267 masl range (Figure 3). The maximum relief amplitude across the property is 12 m.

2.3 Drainage

The subject lands are located in the East Holland River watershed. A tributary to the Holland River East Branch located west of the subject lands flows south to north (herein referred to as the West Tributary). A smaller watercourse flowing east to west intercepts the northeast corner of the subject lands (herein referred to as the North Tributary). The North Tributary flows into the West Tributary just north of the subject lands (Figure 3). Wetlands have been mapped along both of these watercourses, with a wetland area staked in the northeast corner of the subject lands along the North Tributary (Figure 3).

Drainage on the subject lands is divided into three catchment areas (Figure 3). The western portion of the subject lands (Catchment 101) drains southwest towards the West Tributary and surrounding wetland area. The central portion of the subject lands (Catchment 102) drains towards the center along Archerhill Court and then north towards the North Tributary. The northeast portion of the subject lands (Catchment 103) drains towards the northeast wetland and the portion of the North Tributary that flows though the subject lands.

To characterize the surface water flow conditions of the watercourses in the vicinity of the subject lands, monitoring locations were established at three monitoring locations, SS1 (in Catchment 103), SS2 (in Catchment 101) and SS3 (in Catchment 102) (refer to Figure 3). Surface water conditions were inspected during each monitoring event. When flow was present, spot flow measurements of flow rates were completed. Flow monitoring data obtained monthly since March 2021 are provided in Table E-1, Appendix E.

SS1 and SS3 are located along the North Tributary. SS1 is located along Bayview Avenue where the tributary enters the subject lands and SS3 is located downstream of SS1, north of the subject lands (Figure 3). Flow monitoring completed as part of a hydrogeological study for the lands north of the subject lands showed flow rates in the watercourse were relatively low, ranging from 1 L/s to 6 L/s and suggested that there is some seasonal discharge to the watercourse (Burnside, 2011). Flow monitoring for this study to date have recorded flows in the watercourse ranging from <0.05 L/s to 2 L/s. An increase in flows is observed at SS3 compared to SS1 consistent with the previous interpretation that there may be groundwater discharge along the watercourse.

Surface water monitoring station SS2 is located along the West Tributary (Figure 3). Flow monitoring at SS2 showed flow rates ranging from 31.4 L/s to 70.5 L/s.

2.4 Surficial Geology

Regional surficial geology mapping published by the Ontario Geological Survey (2003) shows that the entire property is covered by low permeability clay and silt glaciolacustrine deposits (Figure 4). Ice-contact stratified deposits are mapped south of the subject lands and modern alluvial deposits are mapped along the West Tributary.

Drilling investigations on the subject lands included nine boreholes (Figure 5) with depths ranging from 6.7 m to 20 m below ground surface (bgs). The borehole logs from the drilling investigations (Appendix A) confirm the regional surficial geology mapping. The logs show the subject lands are underlain by silty clay with a thickness of up to 20 m. Fill was encountered at some of the boreholes overtop of the native sediments with thicknesses of 0.5 m to 3.6 m.

To characterize the surficial sediments in the wetland area in the northeast corner of the subject lands, Burnside completed three hand augured holes along the feature referred to as AG1, AG2 and AG3 (locations are shown on Figure 5). The holes were augured to depths of 1 m to 1.48 m bgs. The sediments encountered were generally fine grained clayey silt with some sand. At AG1, the soils were grey wet clayey silt with some sand to 1 m. At AG2, there was 0.4 m of topsoil overlying clayey silt with some sand to 1.0 m. A sand lense was encountered at AG2 from 1.0 m to 1.1 m. At AG3, sandy silt with trace clay was encountered from 0.18 m to 0.4 m and brown clayey silt from 0.4 m bgs to 1.48 m bgs. Both AG2 and AG3 were dry at completion.

2.5 Bedrock Geology

Bedrock mapping of the region shows that the subject lands are underlain by shale bedrock of the Blue Mountain Formation. Bedrock topography mapping of the area (Holden, et al, 1992) shows that the bedrock surface generally slopes from the east to the west in the area and that the top of bedrock is at an elevation of approximately 100 masl at the property, or more than 150 m below ground surface. A review of MECP well records in the vicinity of the subject lands indicates that the bedrock is approximately 100 m below ground surface.

2.6 Stratigraphy

To illustrate the geological conditions, two schematic cross-sections through the subject lands have been prepared using the information from the borehole logs and MECP well records (refer to Appendix A and B). The cross-section locations are shown on Figure 5 and the interpreted cross-sections are shown on Figures 6 and 7. On the cross-sections, an interpretation of the major layers or stratigraphic units has been made based on the overall sediment characteristics. The cross-sections show that the subject lands are underlain by a thick layer of low permeability silty clay sediments. A sand layer is encountered at elevations from 250 masl to 230 masl. As discussed below in Section 3.1, this sand layer is interpreted to be part of the Thorncliffe Aquifer.

2.7 Hydraulic Conductivity

There are various methods that may be applied to assess soil hydraulic conductivity, i.e., the ability of the soil to transmit groundwater. Grainsize data and soil characteristics can be utilized to provide a general estimate of hydraulic conductivity. Single well response tests, such as bail-down and slug tests, are used in groundwater monitoring wells to assess in situ hydraulic conductivity of the soils represented across the screened interval of the well. The estimated hydraulic conductivity values may then be used to estimate infiltration rates based on their approximate relationship (as presented in the TRCA Stormwater Management Criteria, 2012). It is also possible to directly assess soil infiltration rates at surface using infiltrometer tests.

2.7.1 Soil Grainsize Analysis

During drilling completed by Burnside in April 2021, three representative soil samples were collected and submitted to a laboratory for grainsize distribution (Appendix C).

To estimate hydraulic conductivity based on grainsize analysis, an empirical formula method 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 in some cases to provide a general indication of the range of the hydraulic conductivity values. Grainsize distribution data were available for three samples obtained from on-site wells and the grainsize distribution graphs are provided in Appendix C. The results confirm that the sediments within the overburden are fine grained and comprised of 85% to 99% fines. The greater amounts of fines within a deposit impacts the ability of the material to transmit water and generally lowers the overall hydraulic conductivity. Groundwater flow is generally limited by fine grained sediments with lower hydraulic conductivity. The hydraulic conductivity based on grainsize analyses for the sediments is estimated in the range of 10^{-6} cm/sec or less.

2.7.2 In Situ Well Tests

To estimate the in situ, saturated hydraulic conductivity of the overburden sediments, single well response tests were completed in April and June 2021. The results of the single well response tests are included in Appendix C and summarized in Table 1 below.

Table 1: Estimated Hydraulic Conductivity and Infiltration Rate from In Situ Tests

Location	Soil Description	Well Screen Depth (m bgs)	Hydraulic Conductivity (cm/sec) In Situ Test	Estimated Infiltration Rate* (mm/hr)
BH2s	Silty Clay	4 – 7.6	2.9×10^{-6}	12
BH5	Silty Clay	4 – 7.2	1.8×10^{-4}	50
BH6	Silty Clay	4 – 7.5	9.4×10^{-7}	12
BH2d	Silty Clay	10.4 – 12.2	8.2×10^{-6}	12
MW1	Topsoil and Silty Clay	4.3 – 6.1	1.0×10^{-3}	75

*From Table C2 in Appendix C: Toronto and Region Conservation Authority Stormwater Management Criteria, 2012.

The results show that the fine-grained silty clay soils on the subject lands generally have low hydraulic conductivity in the range of 10^{-6} to 10^{-7} cm/sec, however, more moderate values were found at BH5 and MW1, where the calculated hydraulic conductivity values were in the range of 10^{-3} to 10^{-4} cm/sec. The higher hydraulic conductivity value observed at BH5 may be due to fractures in the silty clay deposits. At MW1, the well screen and sand pack intersect the topsoil layer with overlying fill.

3.0 Hydrogeology

3.1 Local Aquifers

Regional cross-sections are provided in the East Holland River Subwatershed Plan. These cross-sections show three major overburden aquifer systems within the East Holland Watershed. These are described in order of increasing depth as the Oak Ridges Aquifer Complex (upper aquifer), the Thorncliffe Formation (middle aquifer) and the Scarborough Formation (lower aquifer). The elevation ranges for these aquifers in the vicinity of the subject property are as follows:

- Oak Ridges Aquifer Complex: 270 masl – 280 masl
- Thorncliffe Formation: 230 masl – 255 masl
- Scarborough Formation: 150 masl – 160 masl

Based on these general elevation ranges and the interpretation of the local well record information as shown on Figures 6 and 7, it is concluded that the sandy layer mapped below the subject property represents the Thorncliffe Aquifer and the Oak Ridges Aquifer Complex is not present.

3.2 Local Groundwater Use

The municipal water supply for the Town of Aurora is obtained from groundwater supply wells completed in the deep Yonge Street Aquifer. Aurora supply wells No. 1, 2, 3 and 4 are located about 2.2 km northwest of the subject lands, near Yonge Street and Wellington Street East (Figure 11). The subject lands are located within the wellhead protection areas WHPA-D (25 year capture zone) and WHPA-Q1/Q2 for Aurora Wells No. 1, 2, 3 and 4 (Figure 11).

Although, the proposed development will be municipally serviced, there may be properties in the vicinity of the subject lands that use private water supply wells. A review of MECP water well records (Appendix A) within 500 m of the subject lands identified 12 water supply well records, 12 abandonment records, and 13 monitoring and test wells (Figure 8). The water supply wells range in depths from 14.6 m to 54.9 m and are overburden wells. The area immediately surrounding the subject lands is now serviced with municipal water, and as a consequence, the published well records no longer imply groundwater usage in the area.

A door-to-door survey was conducted in 2011 as part of the hydrogeology study for the Colyton Farm property north of the subject lands (Burnside, 2011) to verify that all of the local residents are on municipal water. The survey confirmed that there were no private wells in use within 500 m of the property.

3.3 Groundwater Monitoring

Six groundwater monitoring wells, including one “nest” of two wells installed adjacent to each other at different depths, are located on the subject lands (refer to Appendix B for the well logs and Figure 2 for the well locations). Groundwater levels have been collected at the groundwater monitoring wells monthly from March 2021 to July 2021. Groundwater levels from January 2021 reported by Exp have also been included in our analysis. The groundwater levels from the monitoring wells are provided in Table D-1 in Appendix D and plotted on hydrographs as Figures D-1 to D-5, Appendix D. The groundwater monitoring data show the following (refer to Figure 2 for the monitoring locations and hydrographs in Appendix D):

- The groundwater table is interpreted to be dependent on the topography and local geological conditions. From January 2021 to July 2021, groundwater elevations in the monitoring wells ranged from 269.0 masl to 277.4 masl and the groundwater levels depths ranged from above ground to 5.8 m bgs. The interpreted depth to the seasonally high groundwater levels across the subject lands is shown on Figure 13. This figure shows that shallow (i.e., within 1 m of existing ground surface) groundwater levels are found in the northeastern, central and western portions of the subject lands. Groundwater levels are deeper (i.e., more than 2 m below existing ground surface) in the northwestern, north central and southern portions of the subject lands.

- BH101 is screened at a depth of 16 m bgs to 19.5 m bgs within the silty clay layer within a topographic low. Water levels at this well in the spring exhibited potentiometric (pressure) heads that are near or above grade (Figure D-5, Appendix D). A drop of 5.4 m in water levels at the well occurred in July 2021. The rapid drop in water level is likely related to the on-going construction being completed at the intersection of Vandorf Sideroad and Bayview Avenue immediately south of the subject lands.

- Typically, in shallow wells in southern Ontario, a seasonal groundwater level pattern is apparent with highest levels occurring in the spring, declining throughout the summer and early fall and then rising again in the late fall/early winter. The data collected to date show water levels highest during the spring months of March and April and water levels declining from May to July. Seasonal variations range from 1 m up to 6 m.

- One well nest was installed on the subject lands (BH2s/d) in order to determine the vertical hydraulic gradient. The water level measurements in the nested well location show that the water elevations in BH2s are higher than in the deeper BH2d (Figure D-2, Appendix D). These data indicate a downward hydraulic gradient and groundwater recharge conditions.

3.3.1 Groundwater/Surface Water Interactions

To assess shallow groundwater conditions and gradients near the North Tributary and surrounding wetlands, two drive-point piezometer nests were monitored. Piezometer nest PZ1s/d is located near SS1 within the wetland on the northeast corner of the subject lands (Figure 2). Water levels in the deep piezometer are higher than in the shallow piezometer and above grade suggesting an upward gradient and potential for discharge conditions (Figure D-6, Appendix D). PZ2s/d is located north of the subject lands along the North Tributary. Monitoring at PZ2s/d also shows higher levels in the deep piezometer and an upward gradient at this location (Figure D-7, Appendix D).

3.4 Groundwater Flow

Groundwater elevation data obtained from the monitoring wells are shown on Figure 9, along with the interpreted groundwater elevation contours for the area. Arrows perpendicular to the groundwater elevation contours illustrate the interpreted direction of the shallow groundwater movement.

The interpretation is that the water table reflects the general surface topography, i.e., the shallow groundwater flow patterns will mimic the surface water flow patterns. There is a groundwater divide in the central portion of the property, which roughly corresponds with the surface water divide (compare Figures 3 and 9). Groundwater in the west portion of the subject lands flows to the west/southwest towards the watercourse valley west of the subject lands. Groundwater on the central portion of the subject lands flows north and groundwater on the northeast portion of the subject lands flows to the northeast towards northeast wetland (Figure 9).

3.5 Recharge and Discharge Conditions

As noted in Section 3.3, water levels in the well nest (BH2s/d) located in the central portion of the subject lands indicate a downward gradient at this location. Above grade water levels at BH101 located in the topographic low on the northeast border of the subject lands suggests an upward gradient near the wetlands and watercourse at the northeast corner of the subject lands. Water levels in PZ1s/d also suggest discharge conditions in the wetland in the northeast corner of the subject lands. It is interpreted that in the upland areas recharge conditions are present with discharge occurring in the low wetlands. Additional monitoring will confirm whether discharge occurs seasonally.

Significant Groundwater Recharge Areas (SGRAs) mapped by the LSRCA are shown on Figure 10. Review of this mapping shows that southeast of the subject lands is mapped as an SGRA. This is consistent with the area southeast of the subject lands shown to have surficial ice contact sand and gravel on the provincial surficial geology map (OGS, 2010, Figure 4). The subject lands are not mapped as a SGRA.

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, there are no highly vulnerability aquifer (HVA) area mapped on the subject lands (Source Protection Information Atlas, 2021).

4.0 Water Quality

4.1 Groundwater Quality

Water quality data were collected for selected monitoring wells to typify the groundwater quality on the subject lands. Groundwater sampling was completed on June 3, 2021 at two groundwater monitoring wells (BH2s and BH2d). The water samples were submitted to an accredited laboratory for analyses of general water quality indicators (e.g., pH, hardness, and conductivity), basic ions (including chloride and nitrate) and selected metals to characterize the background water quality.

For comparison purposes, the Ontario Drinking Water Quality Standards (ODWQS) and the Provincial Water Quality Objectives (PWQO) are provided with the results on Table F-1, Appendix F. The groundwater will not be used for drinking water, however, the ODWQS provides an indication of acceptable concentrations for potable water. The PWQO provide an indication of whether the groundwater on the subject lands could be discharged to surface water should pumping associated with construction be required. The groundwater testing results from the analytical laboratory are provided in Table F-1, Appendix F and discussed below.

- The results show that the groundwater generally meets the Ontario Drinking Water Quality Standards (ODWQS) with the exception of total hardness, turbidity, iron and aluminum at BH2s.

- Both wells exceeded the ODWQS for total hardness (100 mg/L) with values of 252 mg/L (BH2d) and 356 mg/L (BH2s). Hardness in groundwater is caused by dissolved calcium and magnesium and is typically a result of the geologic material of the aquifer.

- All wells exceeded the ODWQS for turbidity (5 NTU) with values of 197 NTU (BH2s) and 224,000 NTU (BH2d). This is likely a result of high silt content in the samples.

- Total phosphorus was reported as 0.07 mg/L at BH2s and <0.02 mg/L at BH2d. The sample taken at BH2s exceeded the PWQO for total phosphorus (0.03 mg/L). Total phosphorus is a measure of all forms of phosphorus (dissolved or particulate) that are found in the water sample. There was no dissolved phosphorus (Ortho-phosphate as P) reported suggesting the reported concentration at BH2s was from particulates in the sample.

- The results show that the groundwater samples met the Provincial Water Quality Objectives with the exception of iron, total phosphorus and aluminum at BH2s.

4.2 Surface Water Quality

A surface water sample was collected June 2, 2021 at SS3 to characterize the surface water quality of the North Tributary. The water sample was analyzed for pH, conductivity, basic ions and selected metals and compared to the Provincial Water

Quality Objectives (PWQO). The laboratory results are summarized in Table F-2, Appendix F.

- The results show that the surface water sample met all of the Provincial Water Quality Objectives.
- A chloride concentration of 558 mg/L was reported at SS3 suggesting that the water has been affected by road salt.
- Total phosphorus, nitrate, nitrite and ammonia were not detected in the surface water sample.

5.0 Water Balance

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 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, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a study 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 water balance components for the subject lands are discussed below:

Precipitation (P)

The long-term average annual precipitation for the area is 786 mm based on data from the Environment Canada King Smoke Tree climate station (Station 6154141 - 44°01’00.000” N, 79°31’00.000” W, elevation 352 masl) for the period between 1981 and 2010. The climate station is located 6.6 km northwest of the subject lands. Average monthly records of precipitation and temperature from this station have been used for the water balance component calculations in this study (Tables G-1 and G-2, Appendix G).

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)/Evaporation (E)

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 often less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the monthly PET and AET have been calculated using a soil-moisture balance approach, using average temperature data and climate information adjusted to the local latitude (refer to Tables G-1 and G-2, Appendix G).

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 and the remainder infiltrates the surficial soil.

The infiltration is comprised of two end member components: One component that moves vertically downward to the groundwater table (typically referred to as percolation, deep infiltration or net recharge) and a second component that moves laterally through the 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 overland during precipitation or snowmelt events, shallow interflow becomes an “indirect” component of runoff. The interflow component of surface water 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, but both interflow and direct runoff contribute to the overall surface water runoff component.

5.1 Approach and Methodology

Water balance calculations were completed for the subject lands using a soil-moisture balance approach, which 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.

A soil moisture storage capacity of 125 mm was selected as a representative value for residential lawns and soil conditions and a soil moisture storage capacity of 400 mm was selected for the wooded and wetland areas within the subject lands. Table G-1 (for 125 mm retention) and Table G-2 (for 400 mm retention) in Appendix G detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculates 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 component was calculated for the soil moisture storage conditions. The calculated water balance components from this table were then used to estimate the pre-development infiltration and runoff volumes for the subject lands.

5.2 Water Balance Components

The monthly water balance calculations show that a water surplus is generally available from January to May (Tables G-1 and G-2, Appendix G). Infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. In winter climates, frozen conditions may affect when the actual infiltration will occur, however, the monthly balance calculations show the potential volumes available for this water balance component. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables G-1 and G-2, Appendix G). A summary of these values is provided in Table 2.

Table 2: Water Balance Component Values

Water Balance Component	Urban Lawn	Wooded/Wetland Area
Average Precipitation	858 mm/year	858 mm/year
Actual Evapotranspiration	592 mm/year	592 mm/year
Water Surplus	226 mm/year	226 mm/year
Infiltration	106 mm/year	133 mm/year
Runoff	160 mm/year	133 mm/year

Single values are used for the water balance calculations however, the infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized; however, for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions.

5.3 Pre-Development Water Balance (Existing Conditions)

The subject lands have been divided into catchment areas that drain to surface water features as illustrated in Figure 3. Based on the water balance component values calculated in Tables G-1 and G-2 (Appendix G), an estimate of the total pre-development groundwater infiltration volume for each catchment within the subject lands area was calculated as presented in Tables G-3, G-4 and G-5, Appendix G. In order to assess the runoff volumes, the runoff volumes from the subject lands draining to the West Tributary were calculated as presented in Table G-6, Appendix G. For the North Tributary and northeast wetland area runoff from the portion of the surface water catchment west of Bayview Avenue (extending outside of the subject lands) (Figure 3) was calculated as presented in Tables G-7 and G-8. The summary of the pre-development infiltration and runoff volumes are provided below in Table 3.

Table 3: Summary of Pre-Development Infiltration Values

Surface Water (Catchment)	Infiltration Catchment Area (ha)	Pre-Development Infiltration Volume (m^3/year)	Runoff Catchment Area (ha)*	Pre-Development Runoff Volume (m^3/year)
West Tributary (101)	2.37	2,928	2.38	3,540
North Tributary (102)	8.16	7,162	11.35	27,438
NE Wetland (103)	1.75	2,169	3.27	6,987

"*" the runoff catchment includes all upstream catchment area to the feature

5.4 Potential Urban Development Impacts to Water Balance

Development of an area affects the natural water balance. The most significant difference is 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 (about 69% of precipitation in the study area). So, 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, and the infiltration is reduced.

A calculation of the potential water surplus for impervious areas is shown at the bottom of Table G-1 (Appendix G). For the purposes of the calculations in this study, the evaporation from impervious surfaces 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 729 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and waste water 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.

5.5 Post-Development Water Balance with No Mitigation

In order to assess the potential development impact on infiltration and runoff, the post-development infiltration volumes have been calculated for the catchment areas for the West Tributary (Catchment 101), the northern Tributary (Catchment 102) and the northeast wetland (Catchment 103) on Tables G-3, G-4 and G-5, respectively. For these calculations, it was assumed that the post-development groundwater catchment to these features would not change from the pre-development catchments. Refer to Figure 3 for pre-development catchment areas used overlain on the development concept plan. In order to calculate the post-development runoff volumes, the post-development drainage catchments were used, as shown on Figure 12. The post development runoff volumes have been calculated for the same features on Tables G-6, G-7 and G-9, respectively. These calculations assume no LID measures for stormwater management are in place.

The total areas for the proposed land use in each catchment have been estimated based on the proposed redevelopment concept. The infiltration and runoff components for the post-development land uses have been calculated using the MECP SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Tables G-1 and G-2 in Appendix G. The total calculated post-development infiltration and runoff volumes (without mitigation) and percent change from the pre-development scenario are summarized in Table 4 below.

Table 4: Summary of Post-Development Infiltration and Runoff Volumes Without Mitigation

Surface Water Catchment	Estimated Infiltration Volume (m^3/year)	% Change from Pre-Development	Estimated Runoff Volume (m^3/year)	% Change from Pre-Development
West Tributary	2,261	-23%	3,479	-2%
North Tributary	3,624	-49%	52,151	190%
NE Wetland	2,145	-1%	5,949	-15%

5.6 Water Balance Mitigation Strategies

The proposed LID measures were developed in conjunction with SCS and are indicated in the Functional Servicing and Stormwater Management Report (2021) for the subject lands. Based on preliminary design information from SCS, it is our understanding that the proposed LID measures will include, but may not be limited to:

- Directing roof leaders from select detached homes to grassed areas;
- Rear yard infiltration trenches; and
- Bioswales.

The depth to groundwater table below existing ground based on seasonal high groundwater elevations is shown on Figure 13. It is noted that the interpreted groundwater conditions show the seasonally high groundwater levels to be quite shallow in the topographic lows on the subject lands. The depth to groundwater should be re-evaluated based on detailed final grading plans. Also, as discussed in Section 3.3, seasonal groundwater level fluctuations ranging between about 1 m and 5 m have been observed. As such, trenches may be feasible in most areas recognizing that their function may be seasonal.

The trenches will be completed in silty clay, which, as discussed in Section 2.6 is expected to have a hydraulic conductivity of 10^{-6} cm/s to 10^{-7} cm/s, which corresponds with an infiltration rate of 12 mm/hour (based on Table C1 in Appendix C: Credit Valley Conservation and Toronto and Region Conservation Authority Low Impact Development Stormwater Management Planning and Design Guide document, 2010).

Based on the preliminary LID strategy provided by SCS calculations have been completed to assess the potential effectiveness of the proposed LID measures on reducing the infiltration deficit as shown on Tables G-9 (West Tributary), G-10 (North Tributary) and G-11 (NE Wetland) in Appendix G. Comparing the pre-development infiltration volumes to the post-development infiltration volumes with LID measures in place, the calculations suggest that the pre-development infiltration volumes for the catchments within the subject lands may be maintained or exceeded by implementing the proposed LID strategy. The estimated infiltration volumes with the implementation of the proposed LID strategy are summarized below in Table 5.

Table 5: Summary of Pre- and Post-Development Infiltration (with LID Measures)

Surface Water Catchment	Estimated Infiltration Volume ($m^{3/}$year)		Change in Infiltration ($m^{3/}$year)
	Existing	Post-Development	
West Tributary (101)	2,928	4,611	+1,683
North Tributary (102)	7,162	14,288	+7,126
NE Wetland (103)	2,169	2,538	+370

Calculations have also been completed to assess the impact of the proposed LID measures on runoff to the features as shown on Tables G-12 (West Tributary) and G-13

(North Tributary) in Appendix G. There are no LID measures proposed for the NE wetland post-development Catchment 103.

The estimated runoff volumes for the surface water catchments with the implementation of the proposed LID strategy are summarized below in Table 6.

Table 6: Summary of Pre- and Post-Development Runoff (with LID Measures)

Surface Water Catchment	Estimated Runoff Volume (m^3/year)		Change in Runoff (m^3/year)	Change in Runoff (%)
	Existing	Post-Development		
West Tributary	3,540	1,941	-1,599	-45%
North Tributary	27,438	39,524	+12,086	144%
NE Wetland	6,987	5,949	-1,038	-15%

Comparing the pre-development runoff volumes to the post-development runoff volumes with LID measures in place, indicate a decrease in runoff to the West Tributary and NE Wetland and an increase in runoff to the North Tributary.

6.0 Development Considerations

6.1 Construction Below the Water Table

Based on groundwater level data collected as part of this study, the water table on the subject lands ranges from above grade to greater than 4 m below ground surface. Should excavations during construction of servicing extend below the water table the local soils may need to be dewatered. Due to the low hydraulic conductivity of the surficial soils significant groundwater flows are not anticipated.

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.

Should excavations below the water table be required during construction, dewatering of may be required. 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 depend on various parameters including the hydraulic conductivity of the materials encountered, the elevation of the services to be installed, the length of trench that will be open at any time and the proposed method for pumping water. This information is necessary in order for estimates of dewatering volume to be prepared. Based on the final design considerations for the site, it is recommended that a dewatering assessment be conducted.

6.2 Source Water Protection

The subject lands are located within the Lake Simcoe/Couchiching, Black River Source Protection Area for which policies in the South Georgian Bay Lake Simcoe Source Protection Plan (SPP) apply. Since the subject lands are located within the wellhead protection areas WHPA-D (25 year capture zone) and WHPA-Q1/Q2 for Aurora Wells No. 1, 2, 3 and 4 (Figure 11) the proposed development will be subject to policies if activities include any of the prescribed drinking water threats (Clean Water Act, 2006) that would be a significant drinking water threat. The prescribed drinking water threats include:

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

11. The handling and storage of pesticide.

12. The application of road salt.

13. The handling and storage of road salt.

14. The storage of snow.

15. The handling and storage of fuel.

16. The handling and storage of a dense nonaqueous phase liquid.

17. The handling and storage of an organic solvent.

18. The management of runoff that contains chemicals used in the deicing of aircraft.

19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.

20. An activity that reduces the recharge of an aquifer.

21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.

The Table of Drinking Water Threats (Clean Water Act, 2006) provides the circumstances for which a prescribed threat may be considered a concern for each vulnerable area and ranks the threats as low, moderate or significant based on the vulnerability of the area and the threat rating. The Table of Drinking Water Threats was reviewed to identify potential significant drinking water threats associated with the proposed development. There are no drinking water quality threats that may be significant within a WHPA-D.

Within Wellhead Protection Areas Q1 and Q2 (WHPA-Q1 and WHPA-Q2) policies related to water quantity threats may apply. The proposed residential development is expected to result in a reduction of recharge and as a result the proposed development is considered a drinking water threat and subject to SPP Policy LUP-12. A reduction of recharge is considered to be a conversion of open land to impervious surface such as buildings or paved parking lots which reduce the capacity of a site to infiltrate water into the ground and provide recharge to the aquifer.

Policy LUP-12 specifies that new major developments (developments that exceed 500 square meters of impervious surfaces) be permitted where it can be demonstrated through the submission of a hydrogeological study that the existing water balance can be maintained through the use of best management practices such as low impact development measures. As discussed in Section 5.6, with the implementation of the LID strategy proposed by SCS, the water balance calculations show that the existing water balance can be maintained post-development.

Because the subject lands are located within a WHPA-D, the Region of York may also require that a Source Water Impact Assessment and Mitigation Plan (SWIAMP) be submitted for the proposed development as per Section 7.3,39 of the York Region Official Plan. The Region of York Risk Management Official office should be contacted to confirm this requirement.

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 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 References

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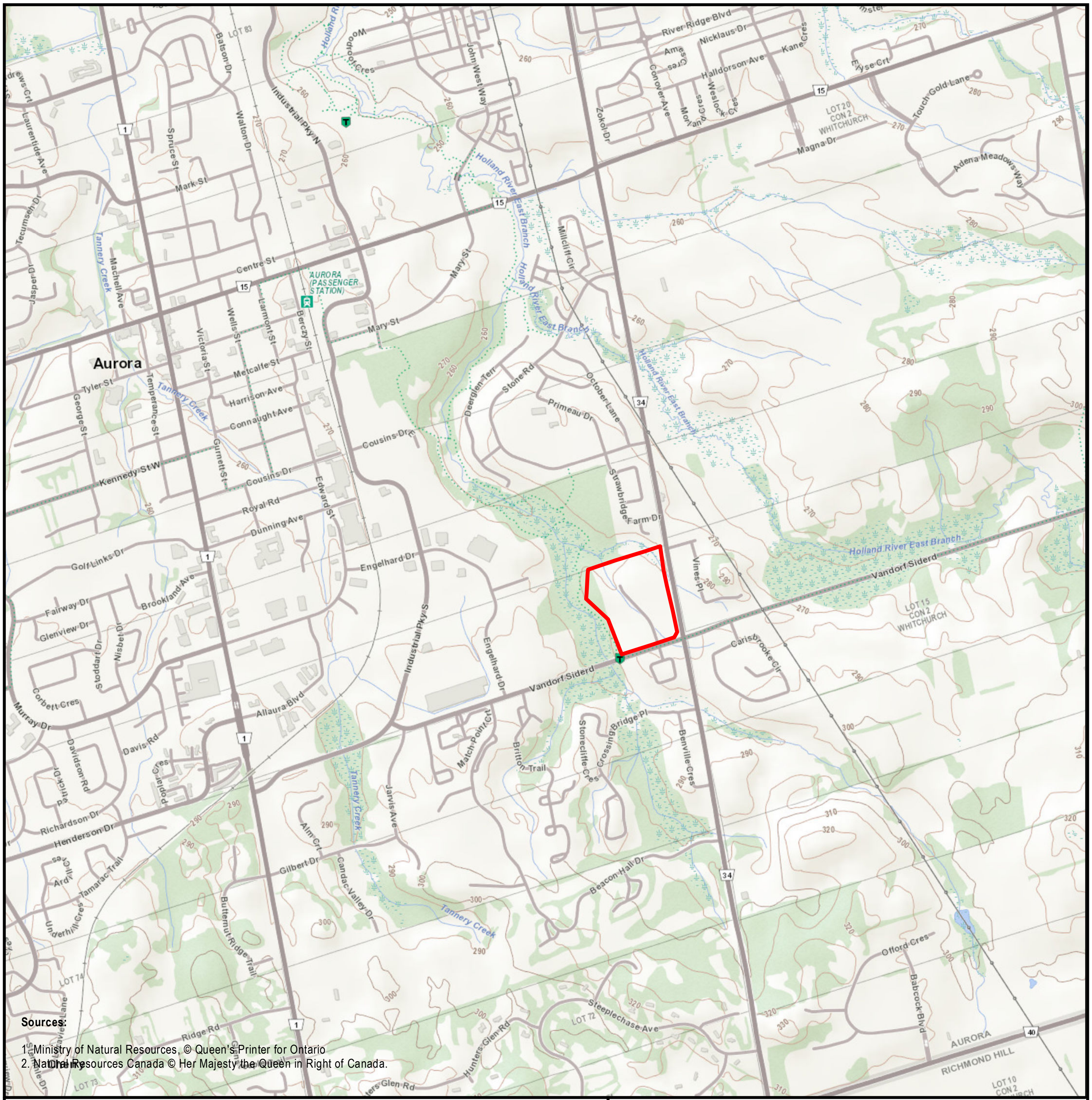
[The Difference is our People]

Figures



Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
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LEGEND

🟥 SUBJECT LANDS

0 250 500 1,000 1,500 2,000
Meters

N

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AURORA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT

Figure Title:

SITE LOCATION

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	1
Scale		Project No.	
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File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 Site Location.mxd

LEGEND

🟥	SUBJECT LANDS
═	WATERCOURSE
⊕	MONITORING WELL (RJB, 2021)
⊕	MONITORING WELL (EXP, 2021)
●	DRIVEPOINT PIEZOMETER
▲	SURFACE WATER MONITORING LOCATION

0 25 50 100 150 200
Meters

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Figure Title:

MONITORING LOCATIONS

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	2
Scale		Project No.	
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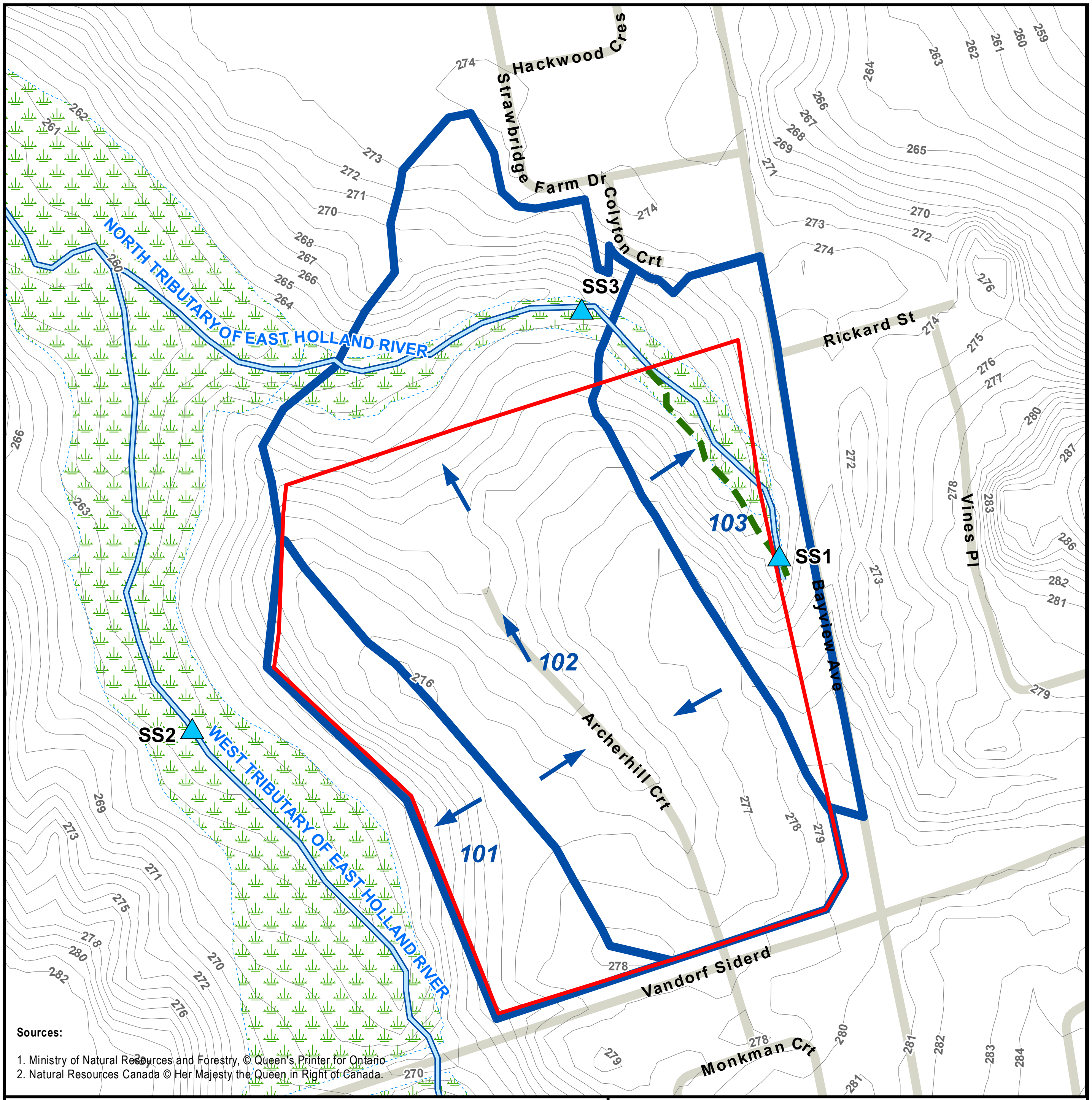

Sources:

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LEGEND

- 🟥 SUBJECT LANDS
- 🟦 PRE-DEVELOPMENT DRAINAGE BOUNDARY
- WATERCOURSE
- CONTOUR (1m intervals - masl)
- ROADWAY
- WETLAND
- STAKED WETLAND (LSRCA, 2020)
- ▲ SURFACE WATER MONITORING LOCATION
- → SURFACE WATER FLOW DIRECTION

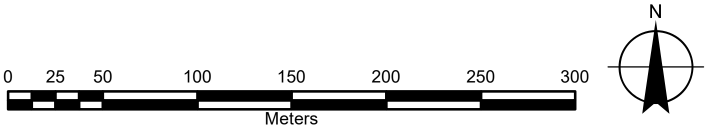

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Figure Title:

TOPOGRAPHY AND DRAINAGE

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Scale		Project No.	
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File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 Topography & Drainage.mxd

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada
3. Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised.

LEGEND

▭ SUBJECT LANDS
═ WATERCOURSE
▬ ROADWAY
🟨 6: Ice-contact stratified deposits: sand
🟦 8a: Fine-textured glaciolacustrine deposits: silt and clay, massive-well laminated
🟫 19: Modern alluvial deposits

0 25 50 100 150 200
Meters

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HYDROGEOLOGICAL ASSESSMENT

Figure Title:

SURFICIAL GEOLOGY

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	4
Scale		Project No.	
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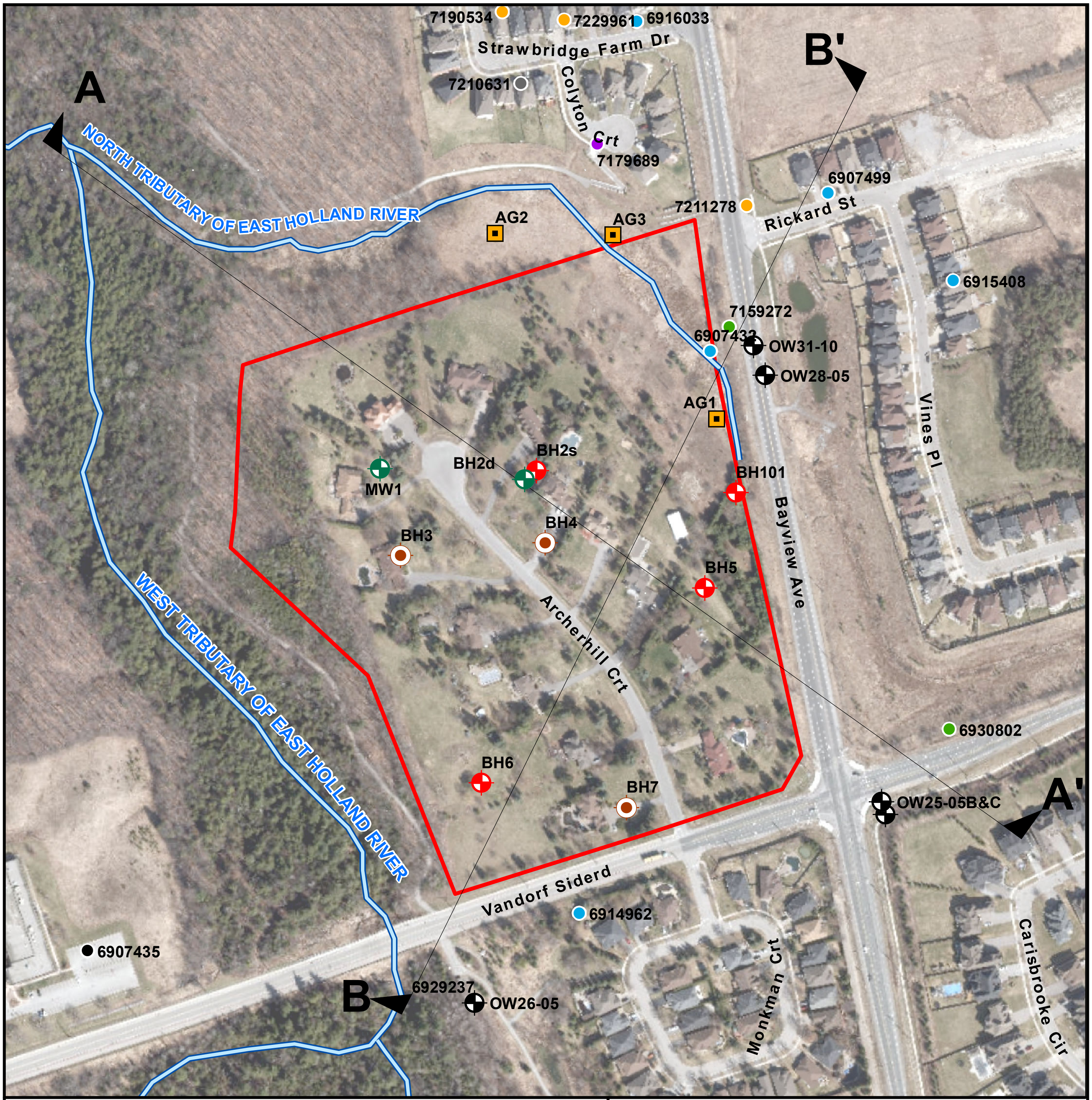

LEGEND

🟥 SUBJECT LANDS

═ WATERCOURSE

⊕ MONITORING WELL (RJB, 2021)

⊕ MONITORING WELL (EXP, 2021)

⊕ MONITORING WELL (CRA, 2005, 2010)

◉ BOREHOLE (EXP, 2021)

▣ HAND AUGER LOCATION

⌴ CROSS-SECTION LOCATION KEY

MECP WELL CATEGORY:

- ● WATER SUPPLY
- ● OBSERVATION WELL
- ● MONITORING & TESTHOLE
- ● TEST HOLE
- ● ABANDONED - OTHER
- ● UNKNOWN

0 25 50 100 150 200 250 300

Meters

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HYDROGEOLOGICAL ASSESSMENT

Figure Title:

BOREHOLE, WELL AND CROSS-SECTION LOCATIONS

Drawn	Checked	Date	Figure No.
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Scale		Project No.	
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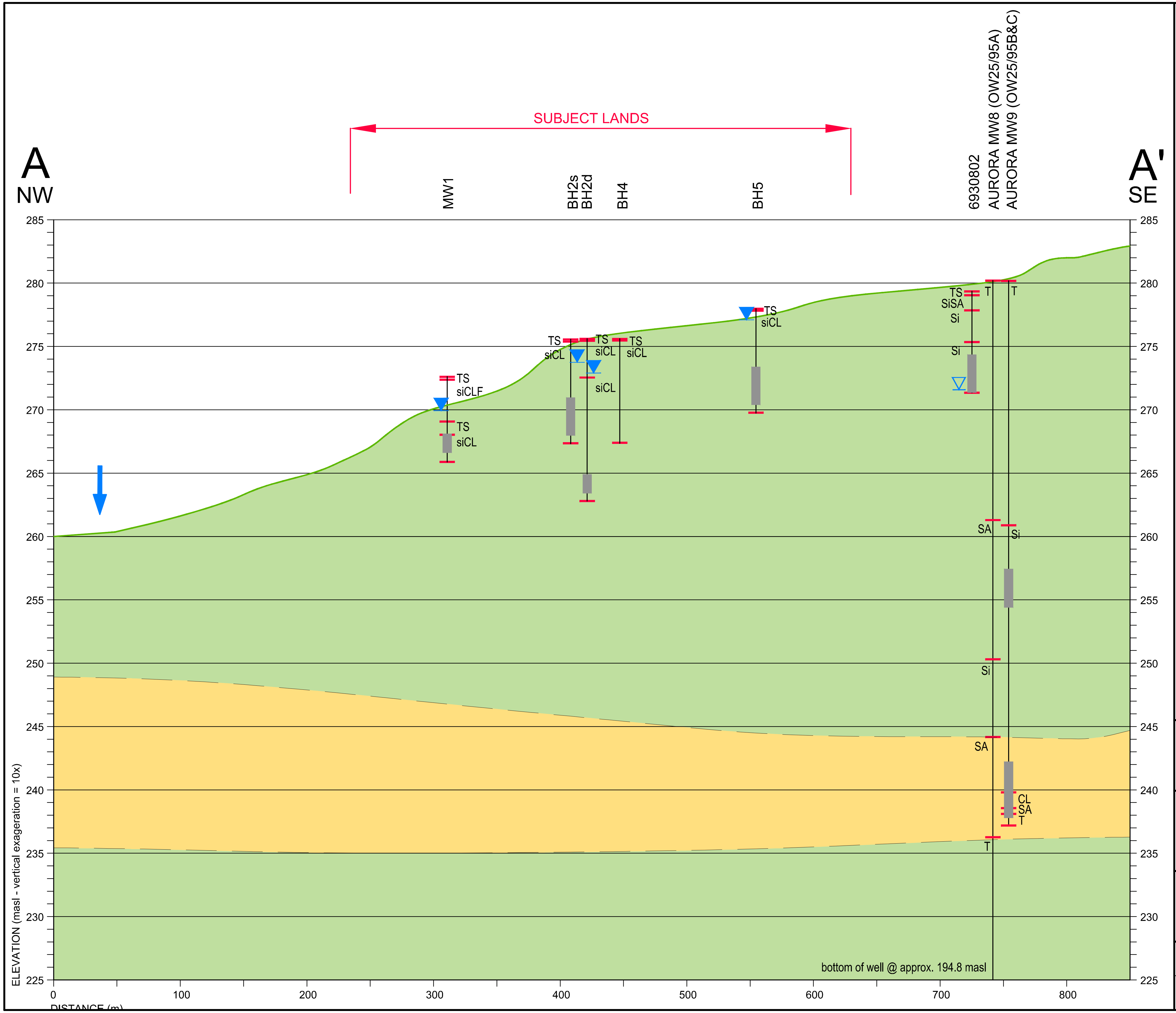

LEGEND

BH1 WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

▼ MEASURED WATER LEVEL (MAY, 2021)

▽ STATIC WATER LEVEL (MECP WELL RECORD)

▮ WELL SCREEN

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

↓ WATERCOURSE CROSSING

- - - - INTERPRETED STRATIGRAPHY

🟨 SAND / SILT / GRAVEL

🟩 SILT CLAY TILL

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Figure Title

INTERPRETED GEOLOGICAL CROSS-SECTION A-A'

Drawn	Checked	Date	Figure No.
SK	SC	AUGUST 2021	6
Scale		Project No.	
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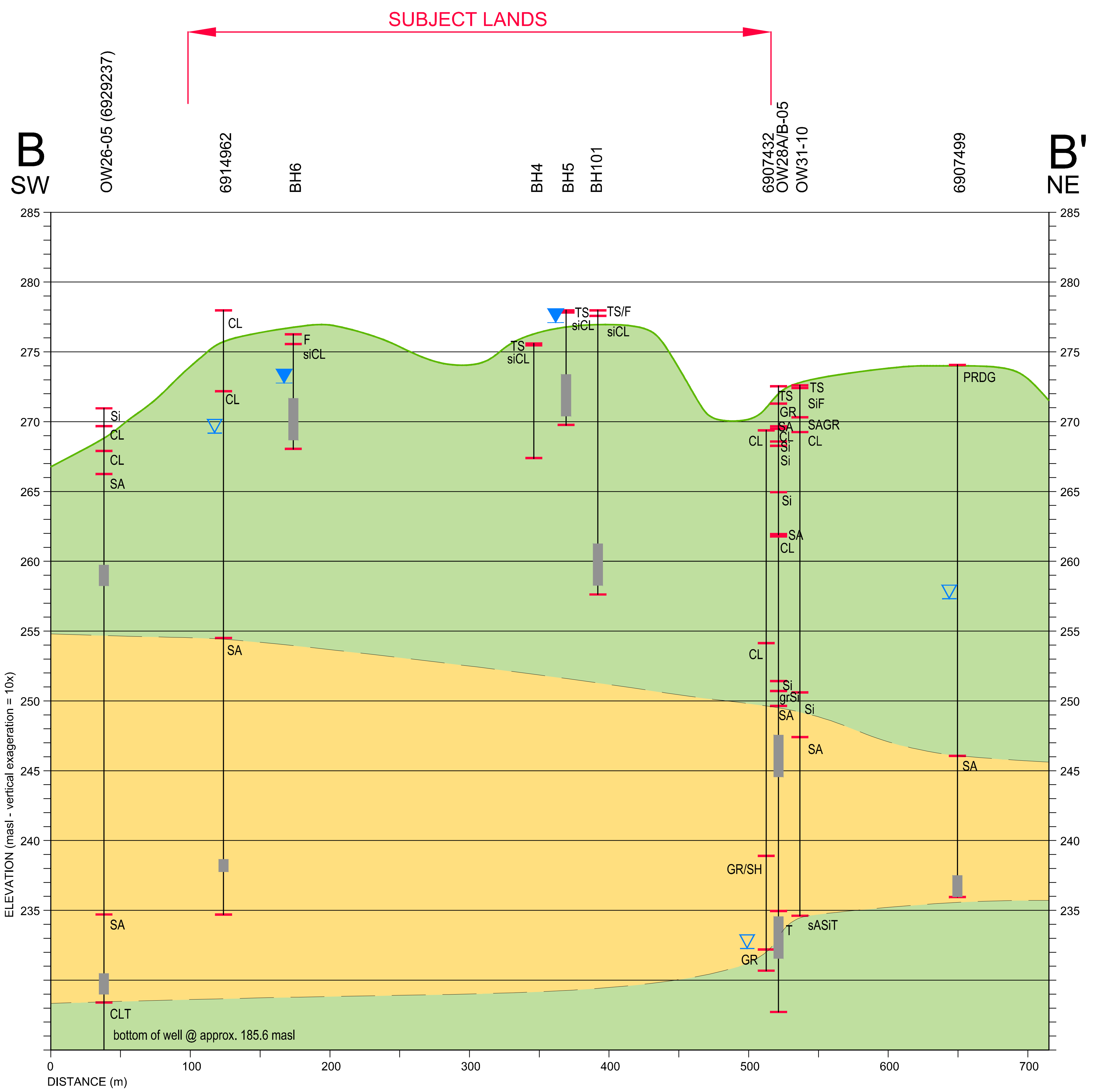

LEGEND

BH1 WELL NUMBER / ID

EXISTING GROUND PROFILE

GEOLOGICAL CONTACT

▼ MEASURED WATER LEVEL (MAY, 2021)

▽ STATIC WATER LEVEL (MECP WELL RECORD)

▮ WELL SCREEN

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

↓ WATERCOURSE CROSSING

- - - - INTERPRETED STRATIGRAPHY

🟨 SAND / SILT / GRAVEL

🟩 SILT CLAY TILL

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HYDROGEOLOGICAL ASSESSMENT

Figure Title
INTERPRETED GEOLOGICAL CROSS-SECTION B-B'

Drawn	Checked	Date	Figure No.
SK	SC	AUGUST 2021	7
Scale		Project No.	
1:3,000		300052893	

File Name:Nigel/Shared Work Areas/052893 Archerhill/02_Production/ 052893 Cross-Sections.dwg Date Plotted: August 4, 2021 - 12:49 PM

LEGEND

🟥 SUBJECT LANDS

▭ 500m WELL SURVEY

MECP WELL CATEGORY:

- ● WATER SUPPLY
- ● OBSERVATION WELL
- ● MONITORING AND TEST
- ● TEST HOLE
- ● ABANDONED - OTHER
- ● UNKNOWN

0 100 200 400 600

Meters

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HYDROGEOLOGICAL ASSESSMENT

Figure Title:

MECP WELL RECORD LOCATIONS

Drawn	Checked	Date	Figure No.
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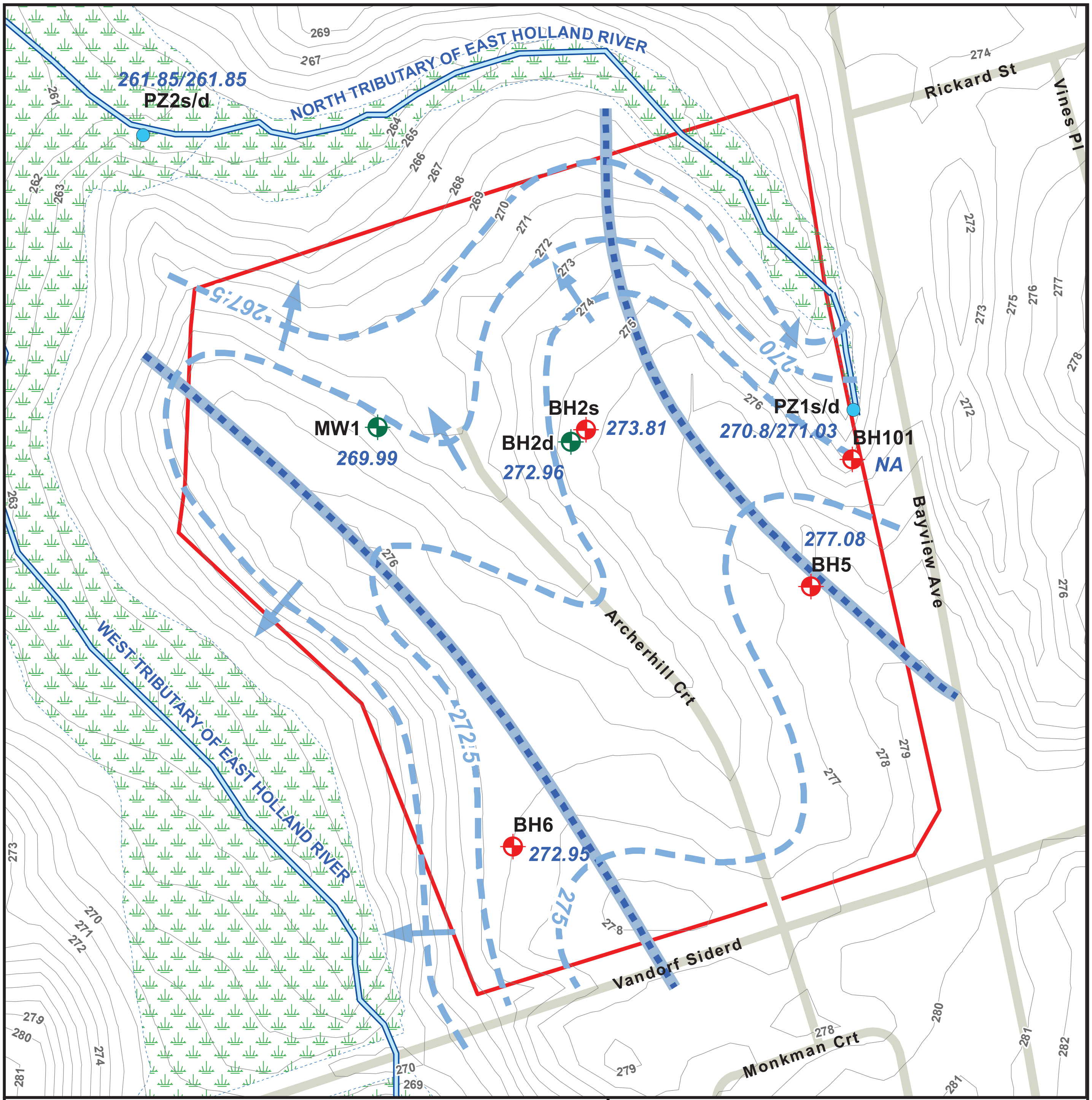

LEGEND

🟥	SUBJECT LANDS
▬	ROADWAY
—	CONTOUR (1m intervals - masl)
═	WATERCOURSE
🟩	WETLAND (MNRF, 2017)
⊕	MONITORING WELL (RJB, 2021)
⊕	MONITORING WELL (EXP, 2021)
●	DRIVEPOINT PIEZOMETER
■■■■	INTERPRETED GROUNDWATER DIVIDE
▬ ▬	INTERPRETED GROUNDWATER CONTOUR (masl)
→	INTERPRETED GROUNDWATER FLOW DIRECTION
177.95	MEASURED WATER LEVEL (MAY, 2021)

0 25 50 100 150 200
Meters

N

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HYDROGEOLOGICAL ASSESSMENT

Figure Title:
INTERPRETED GROUNDWATER FLOW

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	9
Scale		Project No.	
1:3,000		300052893	

File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 Archerhill 052893 Groundwater Flow.mxd

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LEGEND

🟥 SUBJECT LANDS

▨ SIGNIFICANT GROUNDWATER RECHARGE

0 100 200 400 600 800
Meters

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HYDROGEOLOGICAL ASSESSMENT

Figure Title:

SIGNIFICANT RECHARGE AREAS

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	10
Scale		Project No.	
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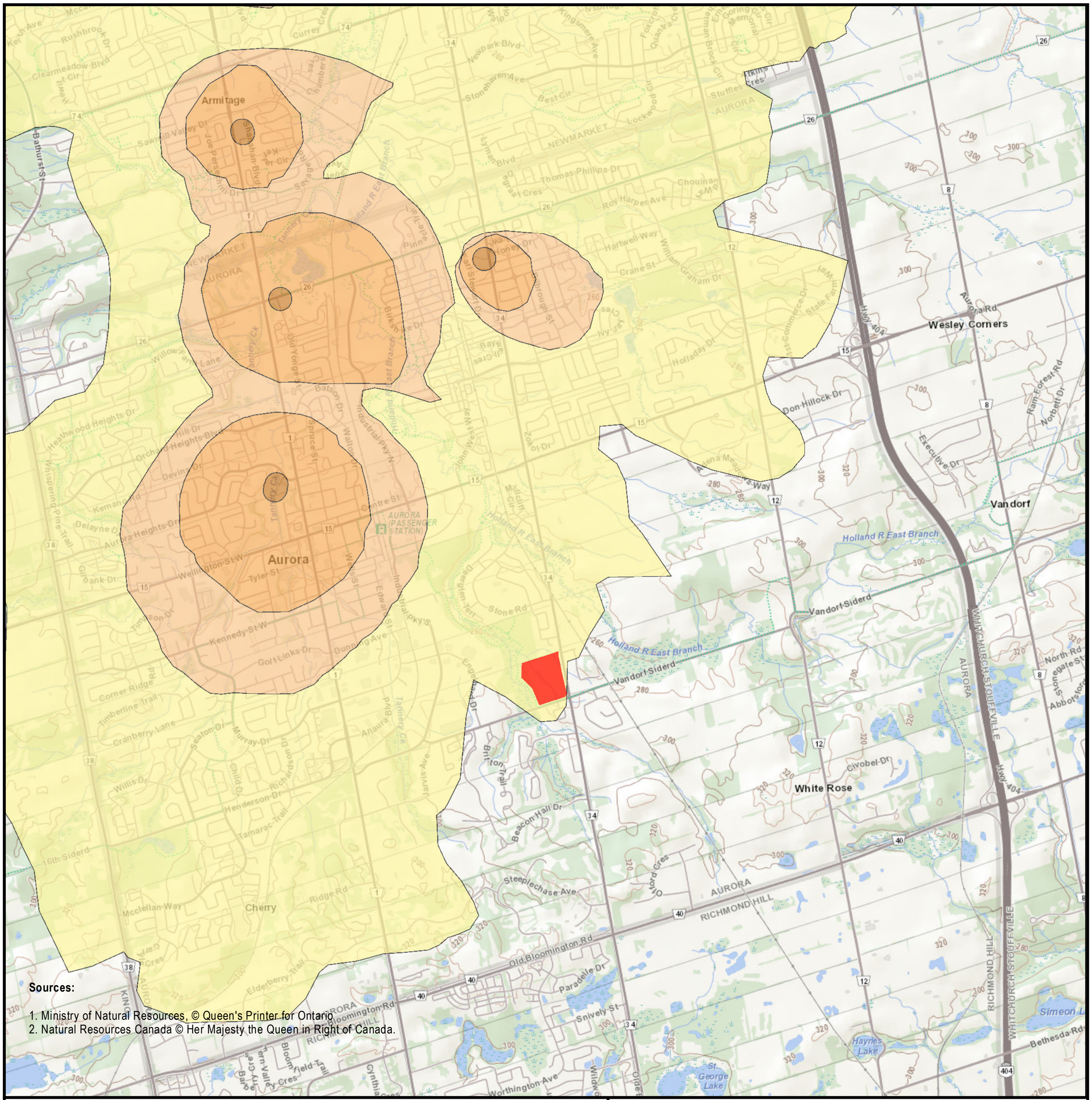

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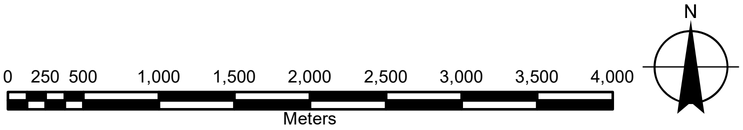
LEGEND

🟥 SUBJECT LANDS
🟫 100m/WHPA-A
🟧 2 Year Zone/WHPA-B
▨ 5 Year Zone/WHPA-C
▨ 5 Year Zone/WHPA-C1
🟨 25 Year Zone/WHPA-D



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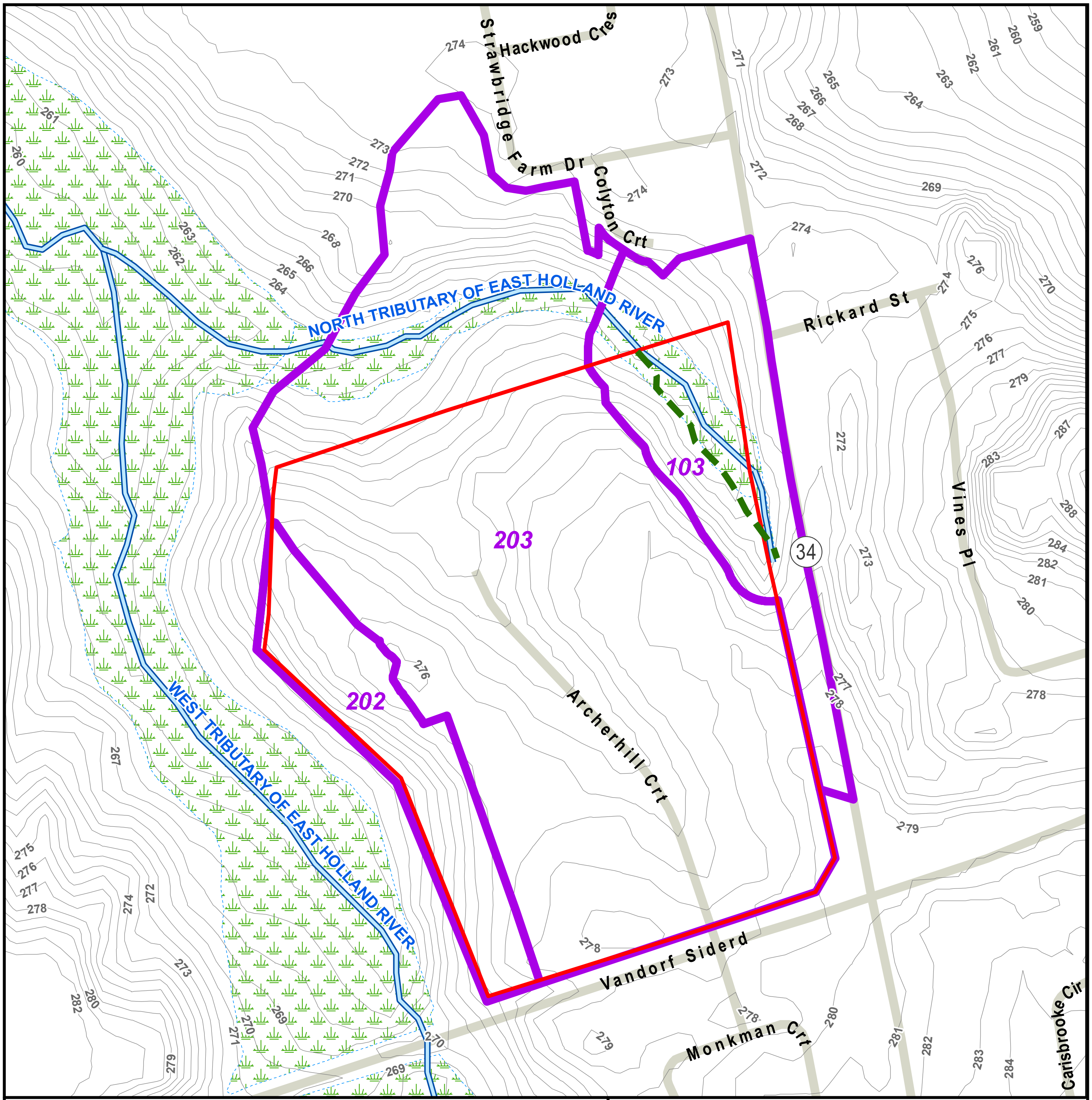
HYDROGEOLOGICAL ASSESSMENT

Figure Title:

WELLHEAD PROTECTION AREAS

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	11
Scale		Project No.	
1:50,000		300052893	

File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 WHPA.mxd



LEGEND

🟥 SUBJECT LANDS

🟪 POST-DEVELOPMENT DRAINAGE BOUNDARY

═ WATERCOURSE

— CONTOUR (1m intervals - masl)

▬ ROADWAY

▨ WETLAND (MNRF, 2017)

▬ ▬ STAKED WETLAND (LSRCA, 2020)

0 25 50 100 150 200 250 300
Meters

N

BURNSIDE

Client / Report

HIGHFAIR INVESTMENTS INC
AURORA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT

Figure Title:

POST-DEVELOPMENT CATCHMENTS

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	12
Scale		Project No.	
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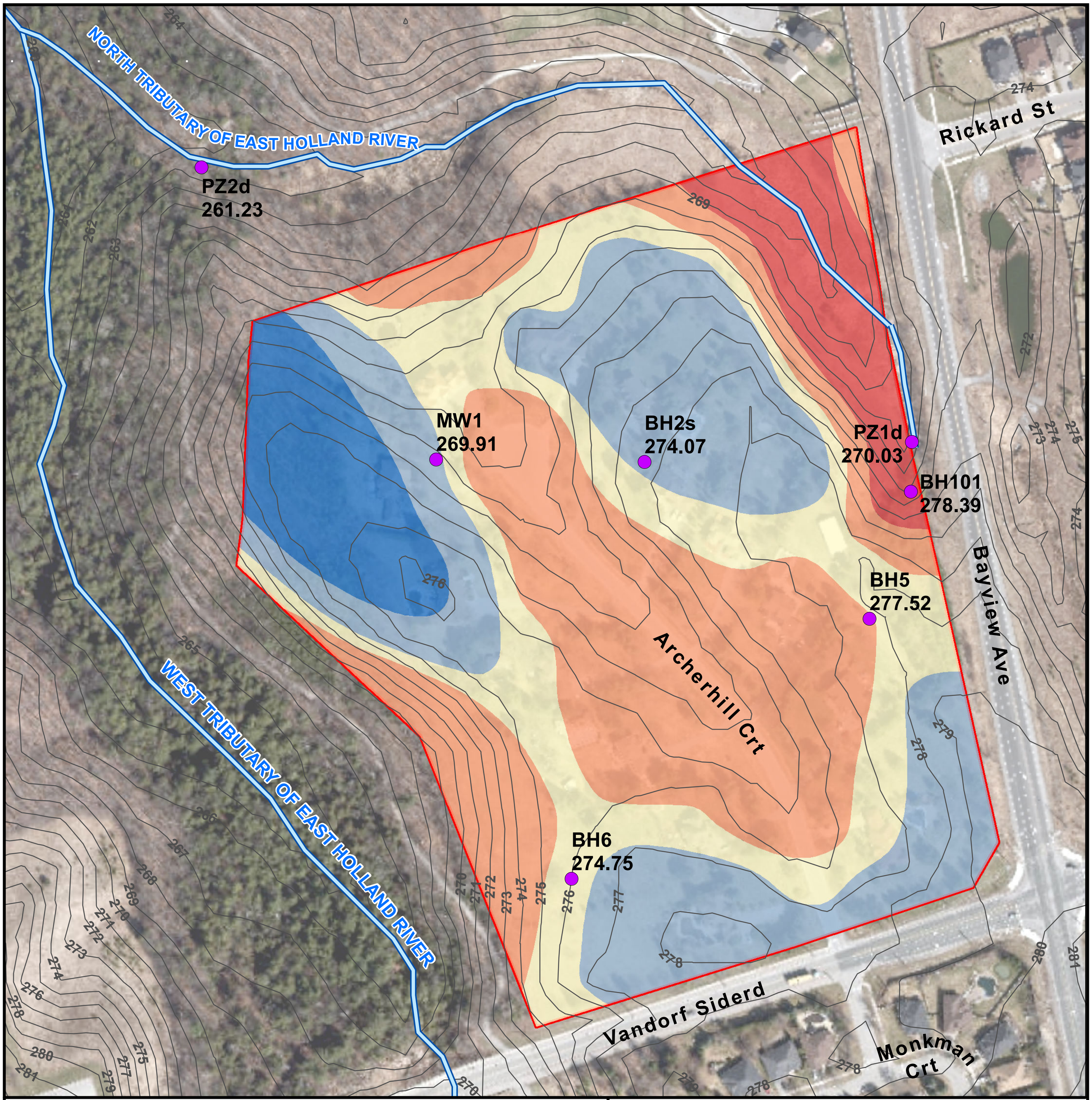
File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 Post-Development Catchments.mxd



LEGEND

▭	SUBJECT LANDS	**BH6**	WELL ID.
═	WATERCOURSE	**274.75**	MEASURED WATER LEVEL (masl)
●	MONITORING POINT		

DEPTH TO GROUNDWATER (SEASONAL HIGH MEASURED WATER LEVEL)

🟥	0m AND ABOVE
🟧	0 TO 1m BELOW GRADE
🟨	1 TO 2m BELOW GRADE
🟦	2 TO 4m BELOW GRADE
🟦	>4m BELOW GRADE

0 25 50 100 150 200
Meters

N

BURNSIDE

Client / Report

HIGHFAIR INVESTMENTS INC
AURORA, ONTARIO

HYDROGEOLOGICAL ASSESSMENT

Figure Title:

DEPTH TO GROUNDWATER

Drawn	Checked	Date	Figure No.
SK	JS	AUGUST 2021	**13**
Scale		Project No.	
1:3,000		300052893	

File Path: Nigel/Shared Work Areas/052893 Archerhill/06_GIS/052893 Depth to Groundwater - Measured Water Level.mxd

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Appendix A

Borehole Logs

Log of Borehole 1

Project No. BRM-21000267-A0

Drawing No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Archerhill Court, Aurora

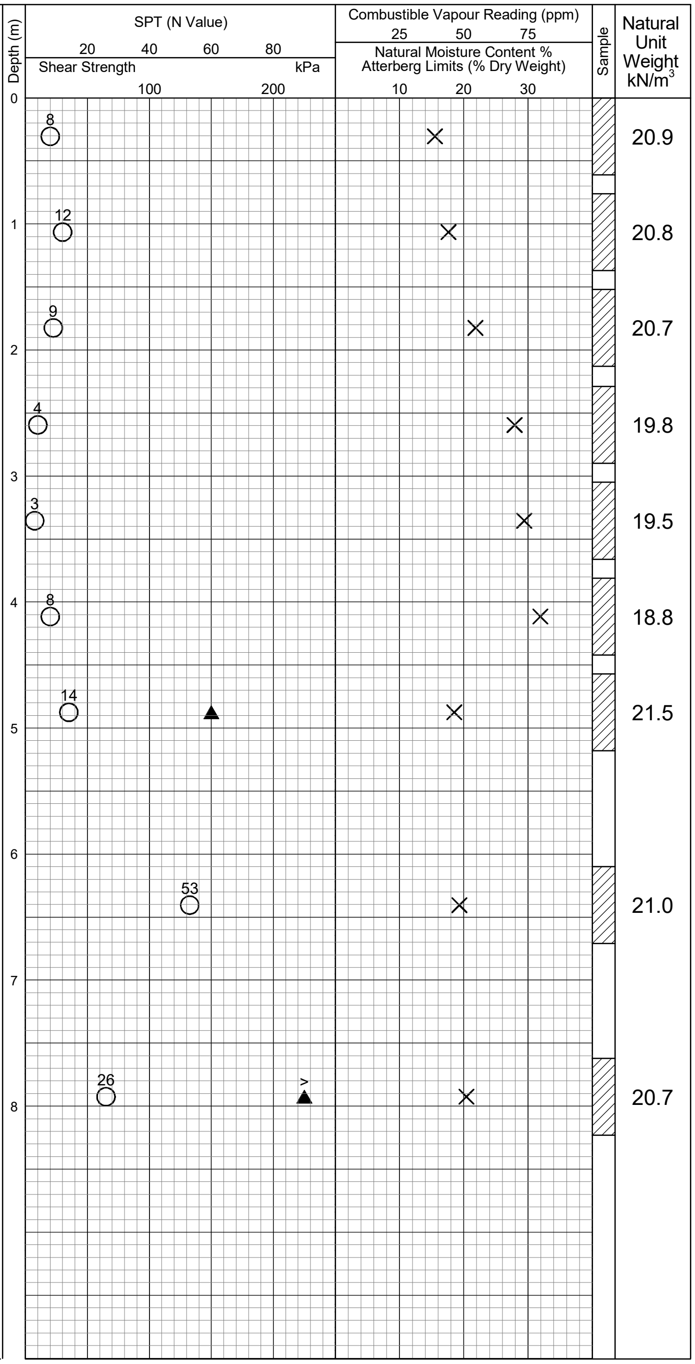
Date Drilled: January 8, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├—○
Undrained Triaxial at % Strain at Failure	⊕
Penetrometer	▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m
			272.06
		~ 175 mm **TOPSOIL** over	~271.9
		FILL: silty clay, trace sand, brown, moist (reworked parent material)	
		TOPSOIL	~268.5
		SILTY CLAY: trace sand, silt partings, brown, moist, stiff	~267.8
		- Becoming grey, wet, hard	
		END OF BOREHOLE	~263.8



EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 1/21/21

Date	Water Level (m)	Hole Open to (m)
On Completion	3.05	Open

Log of Borehole 2

Project No. BRM-21000267-A0

Drawing No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

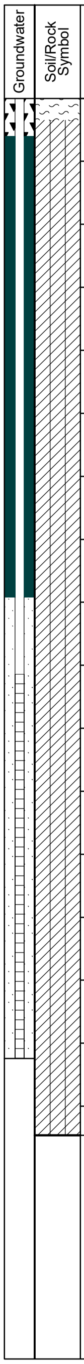
Location: Archerhill Court, Aurora

Date Drilled: January 8, 2021

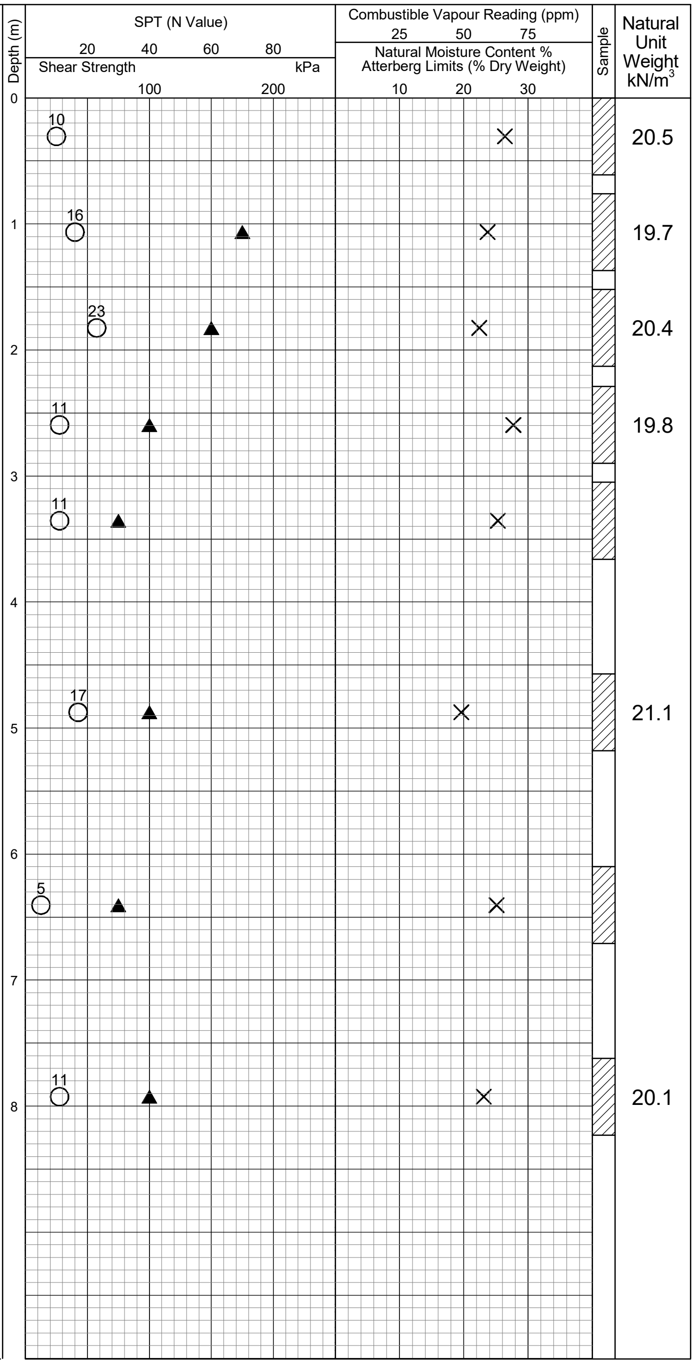
Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├──○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



Soil Description	ELEV. m
	275.61
~ 175 mm **TOPSOIL** over	~275.4
SILTY CLAY: trace sand, silt partings, brown, moist, stiff to very stiff	
- Becoming grey, wet, firm to stiff	
END OF BOREHOLE	~267.4



Date	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open
January 20, 2021	2.24	

exp.

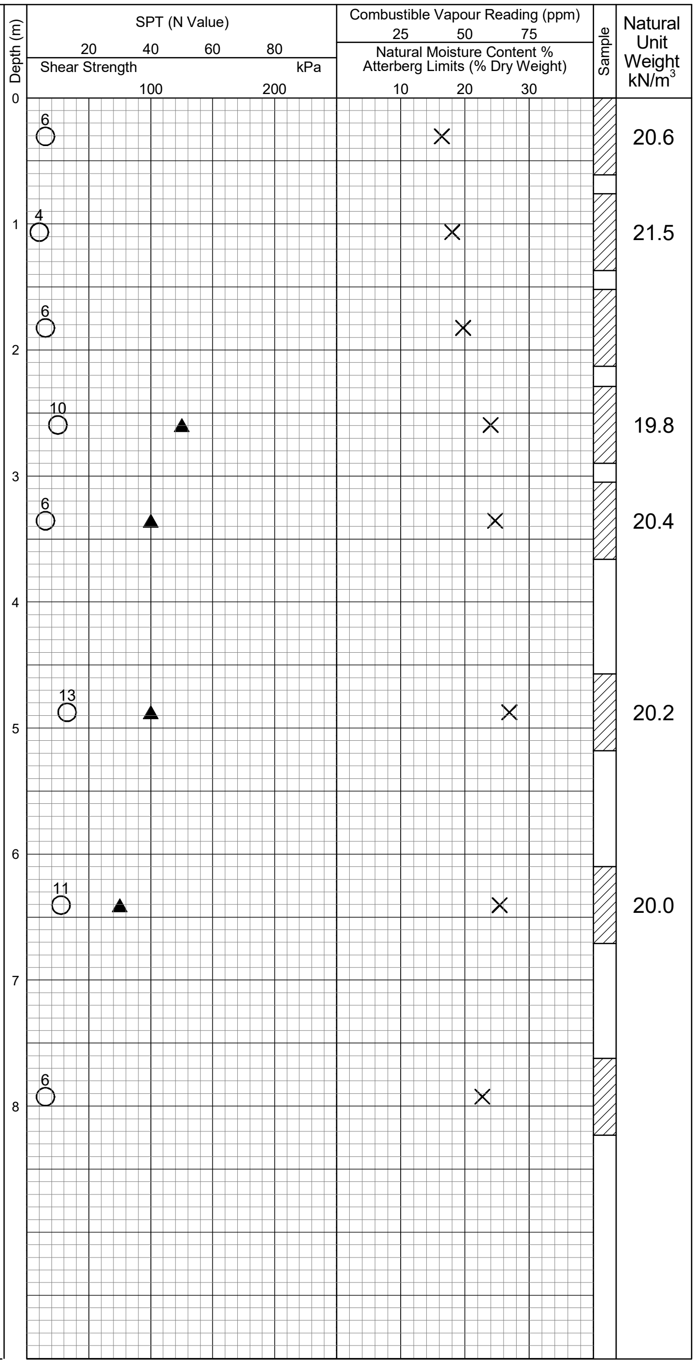
Log of Borehole 3

Project No. BRM-21000267-A0
Drawing No. 4
Project: Geotechnical Investigation
Sheet No. 1 of 1
Location: Archerhill Court, Aurora

Date Drilled: January 8, 2021
Drill Type: CME 75 Track
Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Combustible Vapour Reading	□
Natural Moisture	×
Plastic and Liquid Limit	├──○
Undrained Triaxial at % Strain at Failure	⊕
Penetrometer	▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m
			275.28
		~ 125 mm **TOPSOIL** over	~275.2
		FILL: brown silty clay, trace sand, trace gravel, occasional rootlets, moist	
		SILTY CLAY: trace sand, silt partings, brown, moist, stiff	~273.1
		- Becoming wet, firm	
		- Becoming grey, soft	
		END OF BOREHOLE	~267.1



Date	Water Level (m)	Hole Open to (m)

Log of Borehole 4

Project No. BRM-21000267-A0

Drawing No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Archerhill Court, Aurora

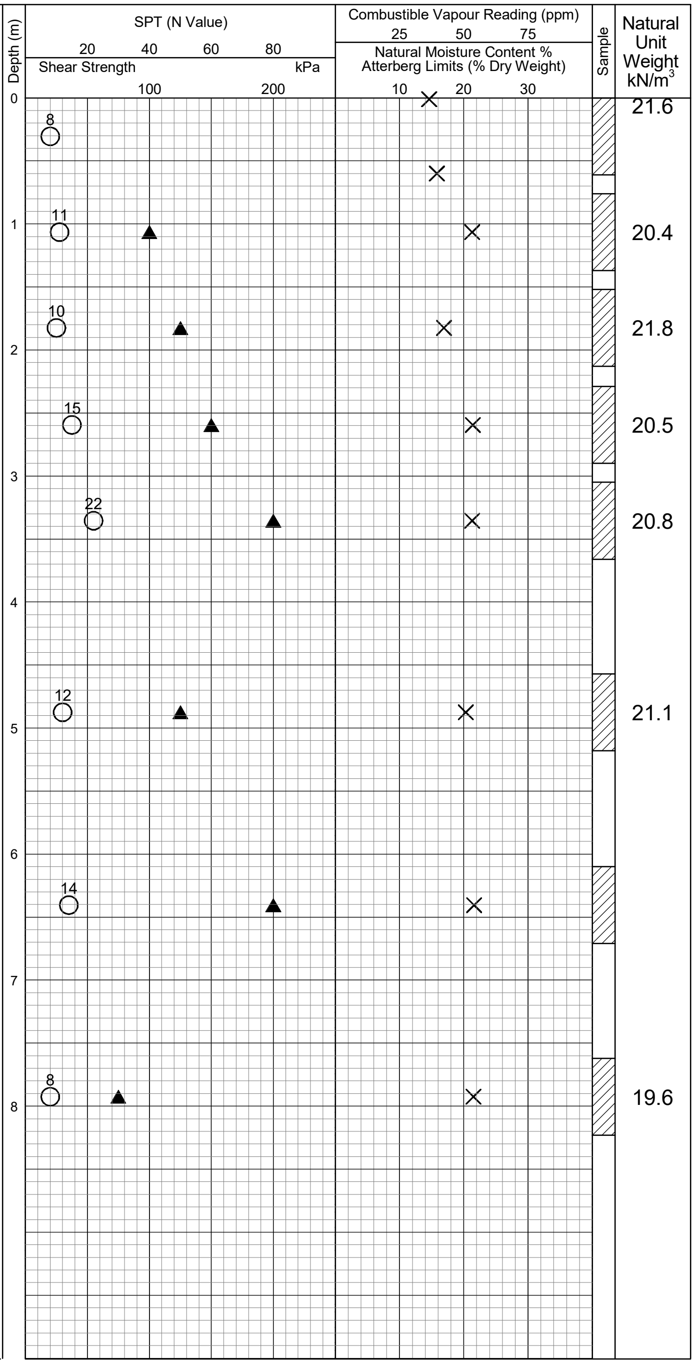
Date Drilled: January 7, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	I——○
Undrained Triaxial at % Strain at Failure	⊕
Penetrometer	▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m
			275.63
		~ 125 mm **TOPSOIL** over **SILTY CLAY:** trace sand, silt partings, brown, moist, stiff to very stiff	~275.5
		- Trace gravel	
		- Becoming grey	
		- Becoming wet	
		- Becoming firm	
		END OF BOREHOLE	~267.4



Date	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open

Log of Borehole 5

Project No. BRM-21000267-A0

Drawing No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

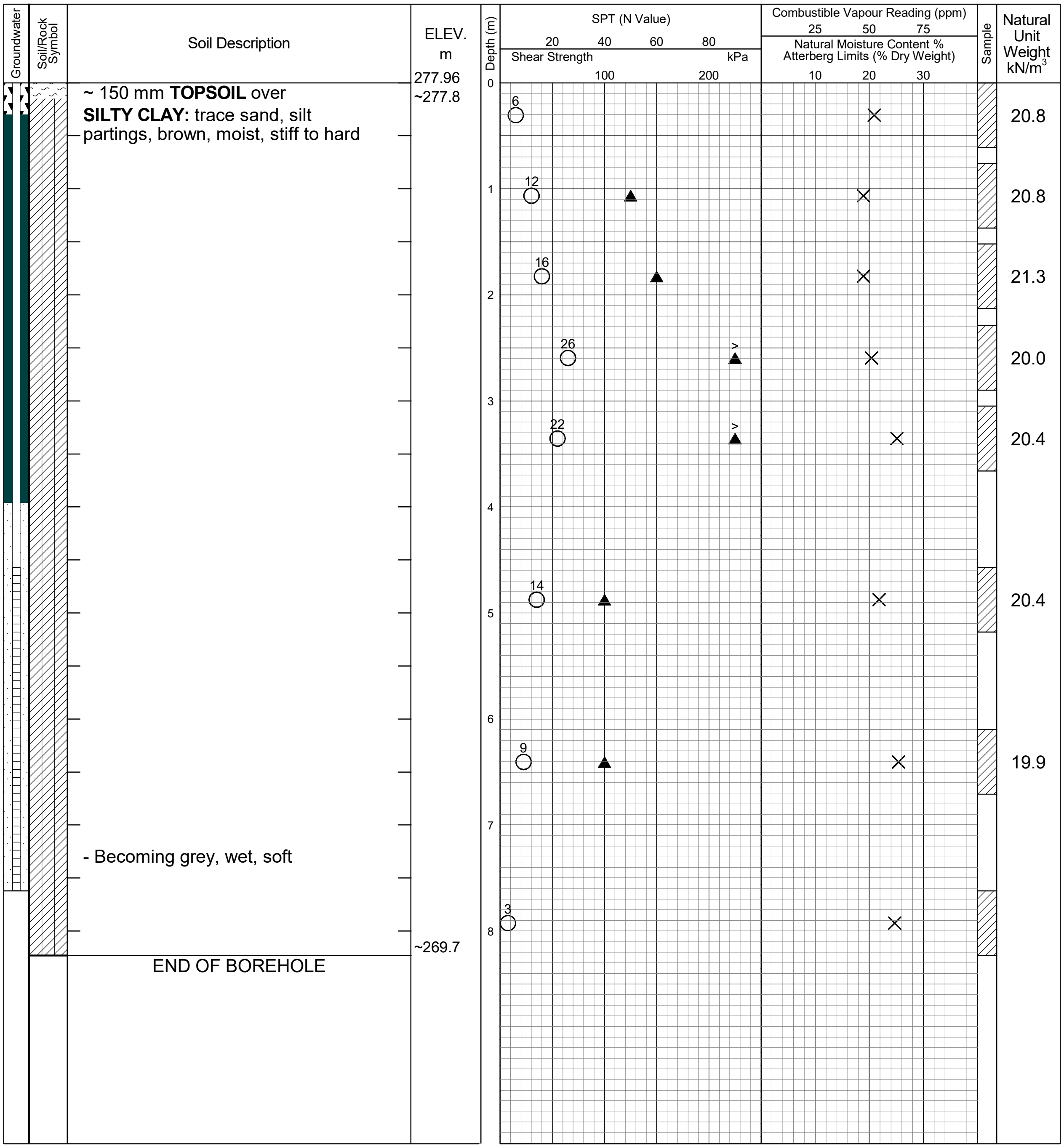
Location: Archerhill Court, Aurora

Date Drilled: January 7, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├─○
Undrained Triaxial at % Strain at Failure	⊕
Penetrometer	▲



~ 150 mm **TOPSOIL** over

SILTY CLAY: trace sand, silt partings, brown, moist, stiff to hard

- Becoming grey, wet, soft

END OF BOREHOLE

Date	Water Level (m)	Hole Open to (m)
On Completion	4.27	Open
January 20, 2021	0.67	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 1/21/21

Log of Borehole 6

Project No. BRM-21000267-A0

Drawing No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

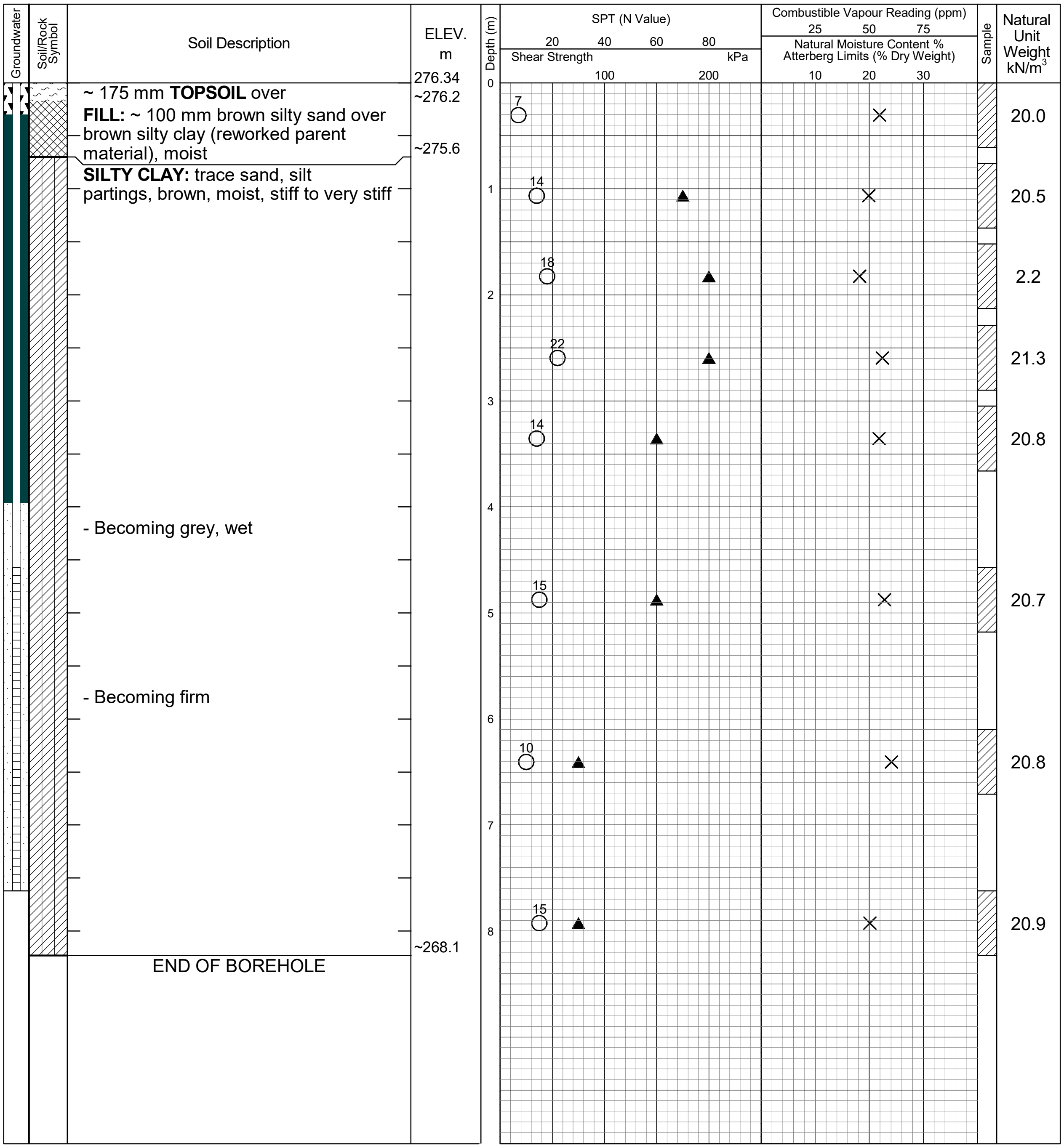
Location: Archerhill Court, Aurora

Date Drilled: January 7, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├──○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



ELEV. m	Soil Description
276.34 ~276.2	~ 175 mm **TOPSOIL** over
~275.6	**FILL:** ~ 100 mm brown silty sand over brown silty clay (reworked parent material), moist
	SILTY CLAY: trace sand, silt partings, brown, moist, stiff to very stiff
	- Becoming grey, wet
	- Becoming firm
~268.1	END OF BOREHOLE

Date	Water Level (m)	Hole Open to (m)
On Completion	7.01	Open
January 20, 2021	3.55	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 1/21/21

exp.

Log of Borehole 7

Project No. BRM-21000267-A0

Drawing No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: Archerhill Court, Aurora

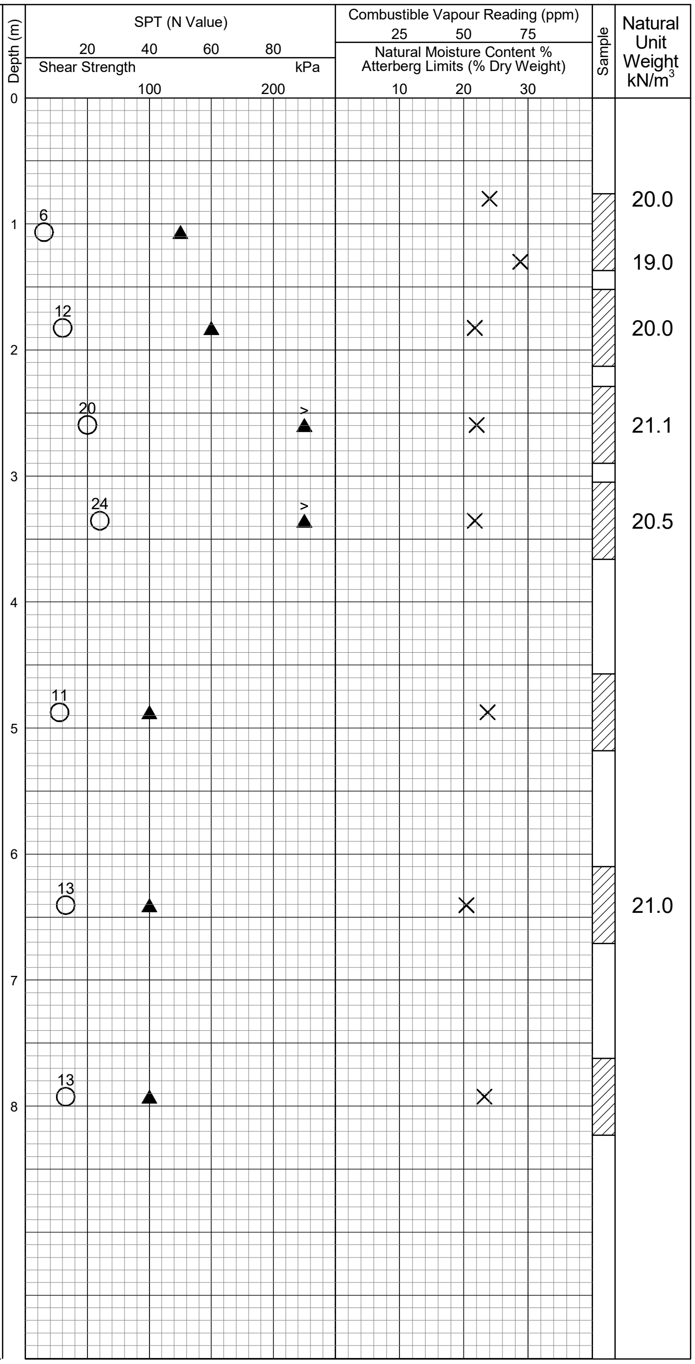
Date Drilled: January 7, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Combustible Vapour Reading	☐
Natural Moisture	×
Plastic and Liquid Limit	├—○
Undrained Triaxial at % Strain at Failure	⊕
Penetrometer	▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m
			277.88
		~ 225 mm **TOPSOIL** over	~277.7
		FILL: mix of silty clay and topsoil, brown to dark brown, moist	
		SILTY CLAY: trace sand, silt partings, brown, moist stiff to hard	~276.8
		- Becoming grey, wet, firm	
		END OF BOREHOLE	~269.7



Date	Water Level (m)	Hole Open to (m)
On Completion	Dry	Open

Log of Borehole 101

Project No. BRM-21000267-A0

Drawing No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 2

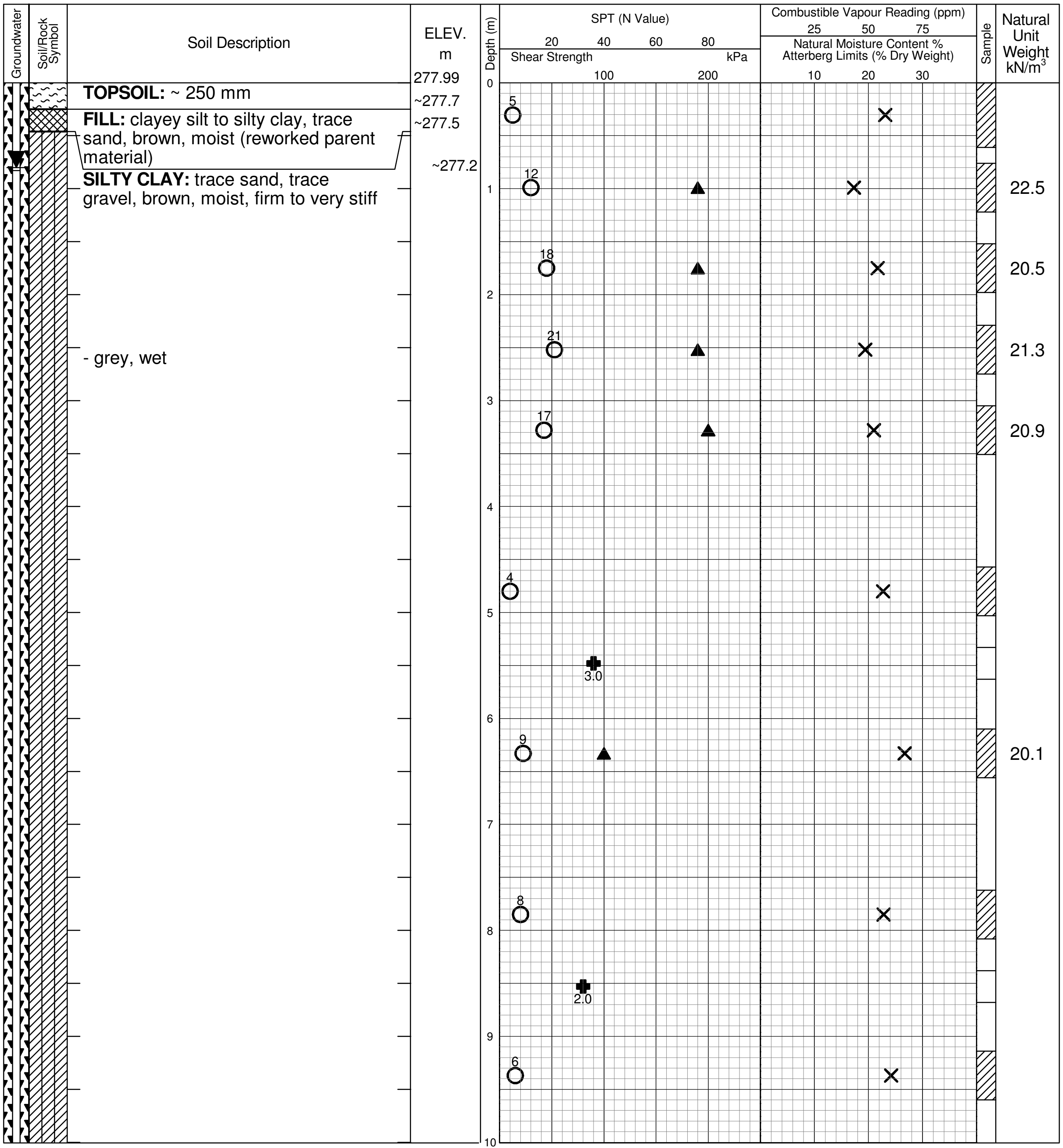
Location: Archerhill Court, Aurora

Date Drilled: April 15, 2021

Drill Type: CME 75 Track

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	✚ S	Penetrometer	▲



Soil Description	ELEV. m	Natural Unit Weight kN/m³
	277.99	
TOPSOIL: ~ 250 mm	~277.7	
FILL: clayey silt to silty clay, trace sand, brown, moist (reworked parent material)	~277.5	
SILTY CLAY: trace sand, trace gravel, brown, moist, firm to very stiff	~277.2	22.5
		20.5
- grey, wet		21.3
		20.9
		20.1

Continued Next Page

Date	Water Level (m)	Hole Open to (m)
April 23, 2021	0.83	

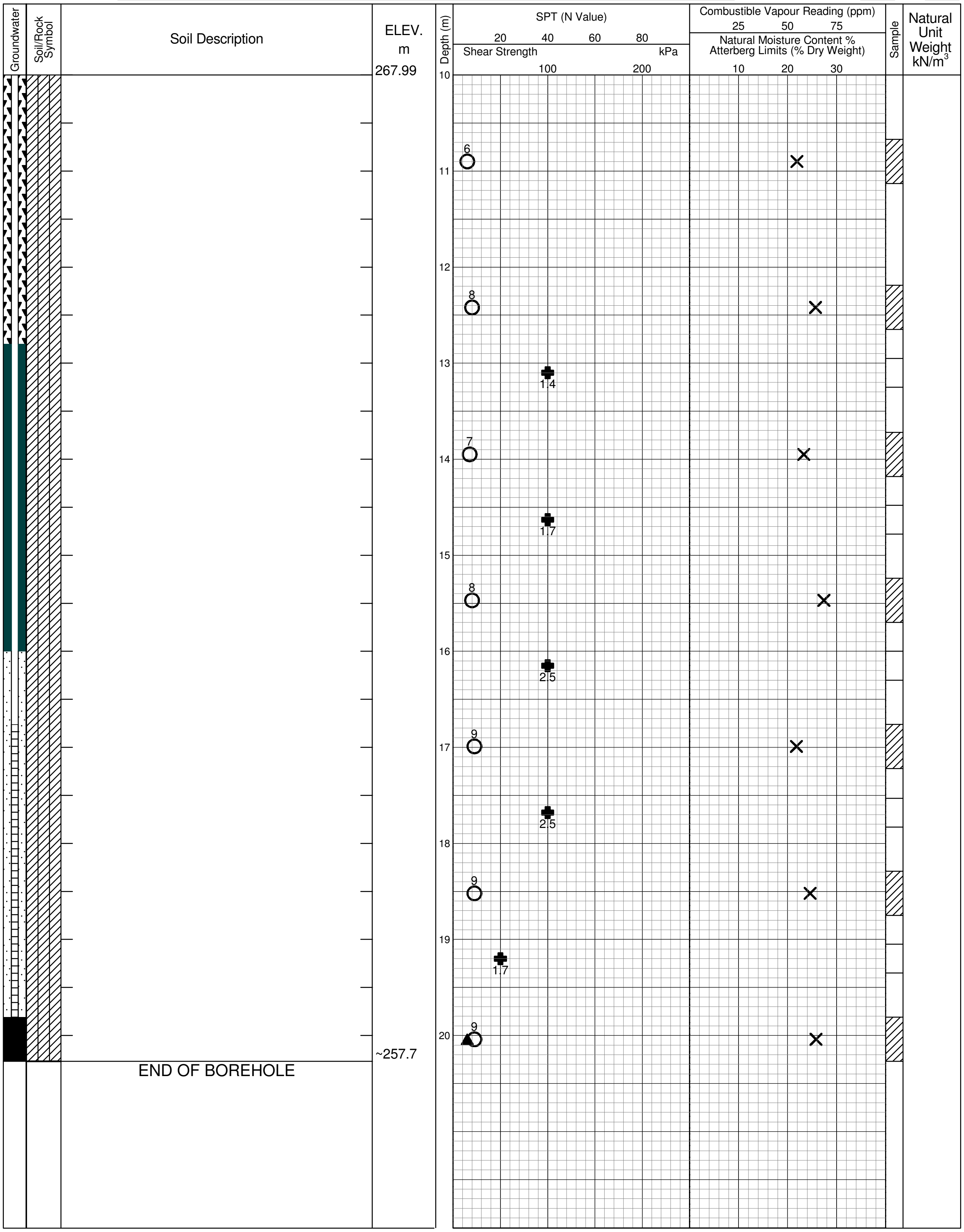
Log of Borehole 101

Project No. BRM-21000267-A0

Drawing No. 9

Project: Geotechnical Investigation

Sheet No. 2 of 2



Date	Water Level (m)	Hole Open to (m)
April 23, 2021	0.83	

LOG OF DRILLING OPERATIONS

BH2d

BURNSIDE
R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477

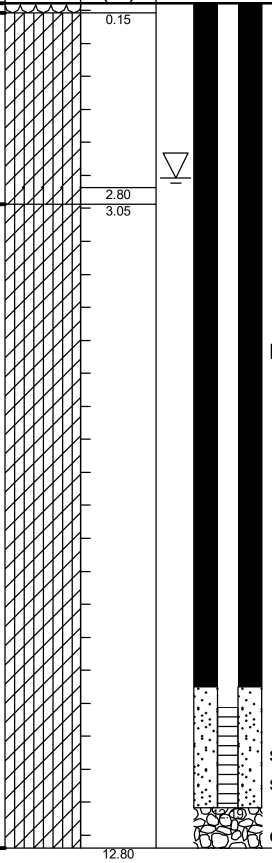
Page 1 of 1

Client: **Highfair Investments Inc.**	Project Name: **ArcherHill Court**	Logged by: **A.Brock**
Project No.: **300052893.0000**	Location: **ArcherHill Court, Aurora Ontario**	Ground (m amsl): **275.61**
Drilling Co.: **Geo-Environmental Drilling Inc.**	Date Started: **4/28/2021**	Static Water Level Depth (m): **2.65**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/28/2021**	Sand Pack Depth (m) : **10.39-12.19**

Surface Elevation (m): **275.61**

Depth (m)	Stratigraphic Description
0.15	TOPSOIL Dark brown, moist, roots and organics
2.80 3.05	SILTY CLAY Brown, moist, soft to firm, trace sand, some oxidation Turning Grey @ 2.80m
12.80	SILTY CLAY Grey, wet, very soft, medium to high plasticity

End of Hole



Depth Scale (ft): 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0
Depth Scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0

SAMPLE Num.	Type	Int.	
1	SS	☒	10
2	SS	☒	13
3	SS	☒	18
4	SS	☒	9
5	SS	☒	8
6	SS	☒	9
7	SS	☒	7
8	SS	☒	10
9	SS	☒	15
10	SS	☒	10
11	SS	☒	5

Prepared By: **A. Brock** Checked By: Date Prepared: **6/1/2021**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level -

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE				
AC	Auger Cutting		SS ☒	Split Spoon
CS	Continuous		AR ☐	Air Rotary
RC	Rock Core		WC	Wash Cuttings

BHLOG ORANGEVILLE C:\USERS\ABROCK\ONEDRIVE - RJB\PROJECTS\ARCHERHILL\ARCHERHILL COURT BH LOGS.GPJ RJB_BOREHOLE1.GDT 6/4/21

LOG OF DRILLING OPERATIONS

MW1

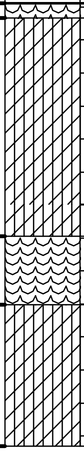
BURNSIDE
R.J. Burnside & Associates Limited
292 Speedvale Avenue West, Guelph, Ontario N1H 1C4
telephone (519) 823-4995 fax (519) 836-5477

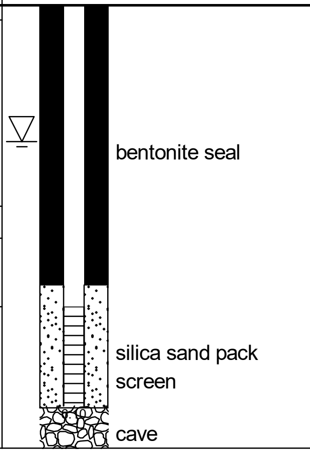
Page 1 of 1

Client: **Highfair Investments Inc.**	Project Name: **ArcherHill Court**	Logged by: **A.Brock**
Project No.: **300052893.0000**	Location: **ArcherHill Court, Aurora Ontario**	Ground (m amsl): **272.06**
Drilling Co.: **Geo-Environmental Drilling Inc.**	Date Started: **4/28/2021**	Static Water Level Depth (m): **2.07**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/28/2021**	Sand Pack Depth (m) : **4.27-6.10**

Surface Elevation (m): **272.06**

Stratigraphic Description	Depth (m)
TOPSOIL Dark Brown, moist, roots and organics	0.23
SILTY CLAY FILL Brown, some grey, moist, trace gravel, firm to stiff Turns Grey @3.05m	3.05
TOPSOIL Dark brown, moist, grass and organics	3.53
SILTY CLAY Grey, wet, medium plasticity, stiff to hard	4.57
End of Hole	6.71





SAMPLE Num.	Type	Int.	
1	SS	☒	9
2	SS	☒	13
3	SS	☒	9
4	SS	☒	3
5	SS	☒	3
6	SS	☒	21
7	SS	☒	35

Depth Scale (ft) (m): 1.0, 5.0, 2.0, 10.0, 3.0, 4.0, 15.0, 5.0, 20.0, 6.0

Prepared By: **A. Brock** Checked By: Date Prepared: **6/1/2021**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND	MONITORING WELL DATA	SAMPLE TYPE
▼ Water found @ time of drilling	Pipe: **51 mm dia. PVC**	AC Auger Cutting; SS ☒ Split Spoon
▽ Static Water Level -	Screen: **51 mm dia. PVC #10 slot**	CS Continuous; AR Air Rotary
		RC Rock Core; WC Wash Cuttings

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Appendix B

MECP Water Well Records

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
AURORA TOWN	17 625342 4871967 W	2010/02 7215				TH	0002 15	7141715 (Z110081) A095316	BRWN LOAM SOFT 0004 BRWN CLAY SOFT 0010 GREY CLAY SILT WBRG 0017
AURORA TOWN (WHITCHU	17 625397 4871914 W	2006/03 6607	2.00	FR 0015		NU	0010 10	6930271 (Z44244) A041017	BRWN SAND GRVL 0020
AURORA TOWN (WHITCHU	17 625605 4871711 W	2005/01 1129	1.97	FR 0005			0073 10	6929235 (Z27861) A026651	OBDN 0010 BRWN SAND GRVL 0020 BRWN SAND SILT GRVL 0029 GREY SILT SAND 0032 GREY SAND GRVL 0033 GREY SILT FSND 0039 GREY FSND SILT LOOS 0083 GREY SILT TILL STNS 0084
AURORA TOWN (WHITCHU	17 624882 4871421 W	2005/02 1129	5.11 1.97	FR 0090			0270 5	6929237 (Z27863) A026653	BRWN SILT CLAY GRVL 0004 BRWN CLAY SOFT 0010 GREY CLAY SILT DNSE 0015 GREY SAND SILT LOOS 0119 GREY FSND LOOS 0140 GREY CLAY TILL SILT 0177 GREY SILT TILL GRVL 0249 GREY CSND SILT CGVL 0280
AURORA TOWN (WHITCHU	17 625212 4871611 W	2006/10 6607	3.5	FR 0026			0016 10	6930802 (Z54984) A033984	BRWN LOAM 0001 BRWN SILT SAND 0005 BRWN SILT 0013 GREY SILT 0026
AURORA TOWN (WHITCHU	17 625059 4871891 W	7423	1.92 1.92 5.71 6.30				0247 5	7159272 (Z128437) A077785	BRWN SAND GRVL FILL 0011 GREY CLAY SILT GRVL 0065 GREY SAND GRVL CLAY 0072 GREY SILT CLAY GRVL 0083 GREY SAND SILT CLAY 0125 GREY SILT SAND CLAY 0157 GREY SILT CLAY GRVL 0174 GREY CLAY SILT SAND 0198 GREY GRVL SAND SILT 0208 GREY SAND SILT GRVL 0259
AURORA TOWN (WHITCHU	17 625448 4871236 W	7423	2.00 2.00			MO	0079 6	7160861 (Z128409) A085902	BRWN SILT LOAM CLAY 0001 BRWN SILT CLAY SAND 0008 BRWN CLAY SILT SAND 0027 BRWN SAND SILT CLAY 0040 BRWN SILT SAND CLAY 0060 GREY SAND SILT WBRG 0120 GRNT 0122 GREY TILL SILT SAND 0130
AURORA TOWN (WHITCHU	17 624858 4872122 W	2010/09 7230						7163459 (M08071) A106810 P	
AURORA TOWN (WHITCHU	17 624967 4872018 W	2012/03 7247	2	FR 0029		MT	0025 10	7179689 (Z140554) A132600	LOAM 0008 BRWN CLAY SILT HARD 0010 GREY CLAY SILT HARD 0015 GREY CLAY SILT HARD 0035
AURORA TOWN (WHITCHU	17 624901 4872110 W	2012/05 7219	36		4///:	NU		7190534 (Z144156) A127166 A	
AURORA TOWN (WHITCHU 02 015	17 625382 4871436 W	2007/06 7219	6		35///:	NU		7046741 (Z57609) A060381 A	
AURORA TOWN (WHITCHU 02 015	17 625407 4871421 W	2007/06 7219	36		40///:	NU		7046743 (Z57613) A060380 A	

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
AURORA TOWN (WHITCHU 02 015	17 625384 4871442 W	2007/06 7219	37.7		31///:	NU		7046740 (Z57608) A060379 A	
AURORA TOWN (WHITCHU 02 016	17 625393 4871912 W	2006/02 6607	0.75	FR 0003			0010 10	6930225 (Z44233) A041062	BRWN LOAM 0000 BRWN SAND SILT 0015 GREY CLAY SILT 0020
AURORA TOWN (WHITCHU CON 02 015	17 625363 4871209 W	2012/08 7147						7188915 (C16654) A044838 P	
AURORA TOWN (WHITCHU CON 02 015	17 625315 4871403 W	1970/04 5459	34	FR 0028	18///:	DO		6909963 ()	BLCK LOAM 0002 BRWN CLAY 0018 BLUE CLAY STNS 0028 BLUE CLAY 0040 BLUE CLAY STNS 0048
AURORA TOWN (WHITCHU CON 02 016	17 625455 4871923 W	1981/06 3108	6	UK 0170	51/170/60/0:30	DO	0177 3	6915911 ()	BRWN CLAY 0012 BLUE CLAY 0028 BLUE CLAY GRVL STNS 0116 BLUE CLAY SNDY 0165 BLUE GRVL CLAY STNS 0172 BLUE SAND 0180
AURORA TOWN (WHITCHU CON 02 016	17 625128 4871984 W	1950/07 1622	2	FR 0125	55/55//3:0	ST DO	0120 5	6907499 ()	PRDG 0092 MSND 0125
AURORA TOWN (WHITCHU CON 02 016	17 625215 4871923 W	1979/07 1663	5	FR 0088	44/80/8/1:30	DO	0088 3	6915408 ()	BLCK LOAM 0001 BRWN SAND GRVL 0010 BRWN CLAY 0015 BLUE CLAY SOFT 0078 BLUE CLAY SAND 0087 GREY MSND 0091 BLUE CLAY 0096 BLUE CLAY SAND SILT 0140 GREY MSND 0147 BLUE CLAY 0170
AURORA TOWN (WHITCHU CON 02 016	17 625071 4871975 W	2013/10 7147	1.97	FR 0011			0015 10	7211278 (Z180484) A	
AURORA TOWN (WHITCHU CON 02 017	17 625036 4872258 W	2012/01 6946						7196018 (C19561) A130271 P	
AURORA TOWN (WHITCHU CON 02 017	17 625020 4872185 W	1985/12 3108	6	FR 0113	32/115/50/1:0	DO ST		6917812 ()	YLLW CLAY 0025 BLUE CLAY 0103 BLUE CLAY GVLY 0107 BRWN SAND 0118
AURORA TOWN (WHITCHU CON 02 018	17 625045 4872261 W	2013/10 3108						7214355 (Z162178) A	
AURORA TOWN (WHITCHU YS E 01 075	17 624540 4871273 W	1965/07 2407	4	FR 0083	40/83/4/2:0	DO	0083 4	6907428 ()	LOAM 0001 BRWN MSND CLAY 0040 BRWN FSND 0083 BRWN MSND 0087
AURORA TOWN (WHITCHU YS E 01 075	17 624955 4871483 W	1978/10 1663	5	FR 0105	29/125/15/1:0	DO	0129 3	6914962 ()	BLCK LOAM 0001 YLLW CLAY 0019 BLUE CLAY 0077 BRWN SAND CLAY 0142
AURORA TOWN (WHITCHU YS E 01 075	17 624495 4871158 W	1965/08 2407	4	FR 0070	46/62/6/2:0	DO	0078 4	6907429 ()	LOAM 0001 BRWN MSND CLAY 0036 BLUE CLAY 0070 BRWN MSND 0082
AURORA TOWN (WHITCHU YS E 01 076	17 624412 4871485 W	2019/02 7147	1.25	0000	///:	MO	0014 5	7330669 (UAQL5H2V) A247200	GREY CONG 0001 BRWN SILT CLAY 0019
AURORA TOWN (WHITCHU YS E 01 076	17 625046 4871874 W	1950/06 1439	2	FR 0122	27/80/5/16:0	ST DO	0121 5	6907432 ()	CLAY 0050 CLAY GRVL 0100 GRVL SHLE 0122 GRVL 0127

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
AURORA TOWN (WHITCHU YS E 01 076	17 624613 4871457 W	1955/06 2801	6					6907435 ()	CLAY GRVL 0089 GRVL CLAY 0105 CLAY GRVL 0166 CLAY 0334 LMSN 0335
AURORA TOWN (WHITCHU YS E 01 077	17 624914 4872060 W	2013/10 7147						7210631 (C22695) A132600 P	
AURORA TOWN (WHITCHU YS E 01 077	17 624952 4872348 W	2013/08 7147						7206174 (C22664) P	
AURORA TOWN (WHITCHU YS E 01 077	17 624995 4872103 W	1981/11 3108	6	UK 0116	/116/30/1:0	DO	0122 3	6916033 ()	LOAM 0002 YLLW CLAY SAND 0018 BLUE CLAY 0102 BLUE CSND CLAY 0116 BRWN SAND 0125
AURORA TOWN (WHITCHU YS E 01 077	17 624935 4872303 W	2013/08 7147	0.98	GS 0026				7206318 (Z171562) A	
AURORA TOWN (WHITCHU YS E 01 077	17 624975 4872123 W	1979/08 3108	6	UK 0101	18/107/30/2:0	DO	0111 3	6915212 ()	LOAM 0002 YLLW CLAY 0014 BLUE CLAY 0101 BLUE SAND 0114
AURORA TOWN (WHITCHU YS E 01 077	17 624805 4872301 W	2013/12 7147	1.97	FR 0007		MO	0020 10	7213925 (Z180511) A149681	BRWN CLAY SILT 0030
AURORA TOWN (WHITCHU YS E 01 077	17 624944 4872104 W	2014/10 7147	1.97	FR 0010			0010 10	7229961 (Z192029) A	
WHITCHURCH-STOUFFVIL CON 02 015	17 625324 4871434 W	1974/03 5459	6	FR 0074	30/60/10/1:0	DO	0075 4	6912371 ()	BRWN LOAM 0002 BRWN CLAY SAND 0018 BLUE CLAY 0074 BLUE FSND 0079

TOWNSHIP CON LOT UTM DATE CNTR CASING DIA WATER PUMP TEST WELL USE SCREEN WELL FORMATION

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
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

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		

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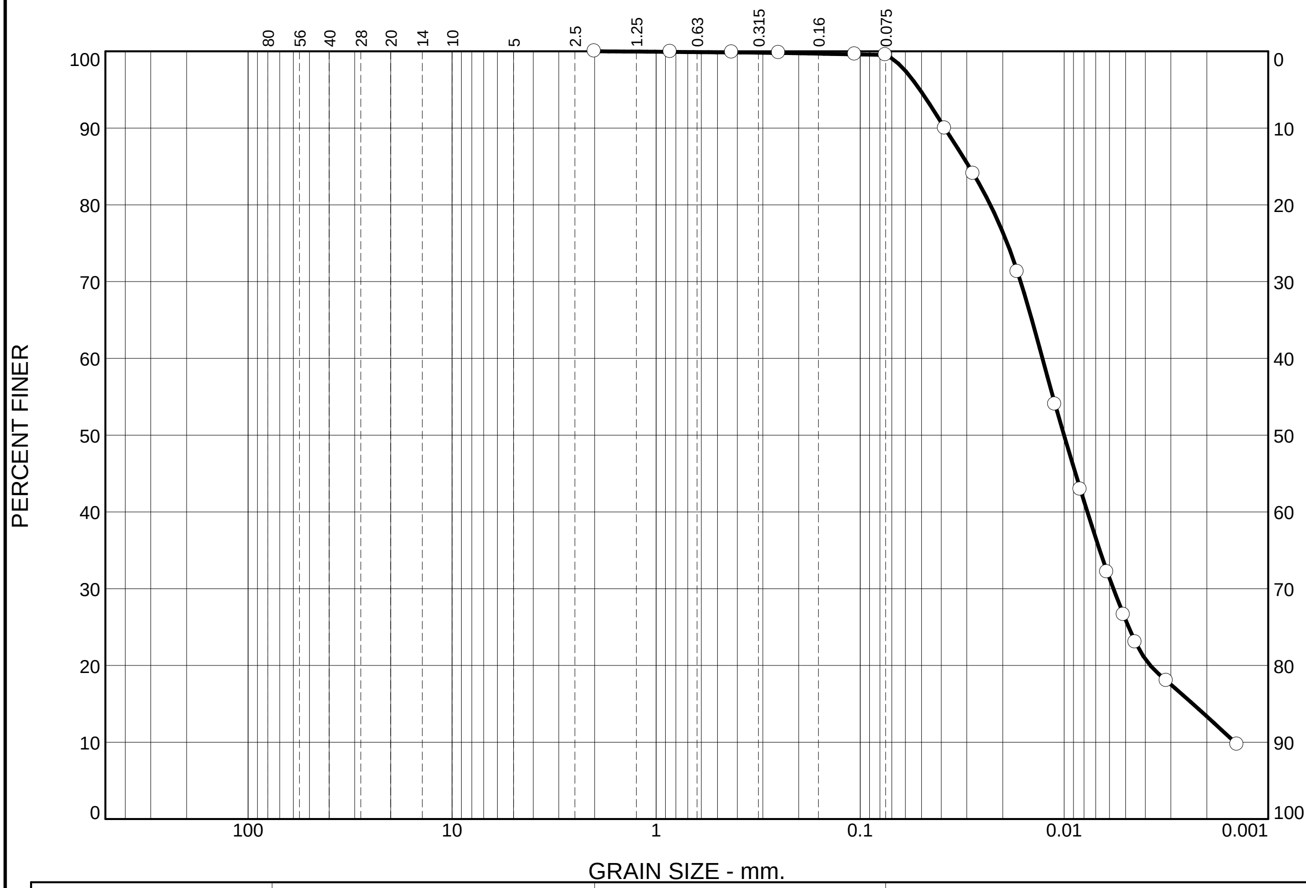
Appendix C

Hydraulic Conductivity

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	0.0	0.1	0.4	86.1	13.4

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0293	0.0128	0.0100	0.0057	0.0023	0.0015	1.77	8.77

Material Description	USCS	AASHTO
○ SILT some clay trace sand		

Project No. CA20069 **Client:** R. J. Burnside & Associates Ltd

Project: Laboratory Testing RJB # 300052893

○ **Sample Number:** MW1, SS6

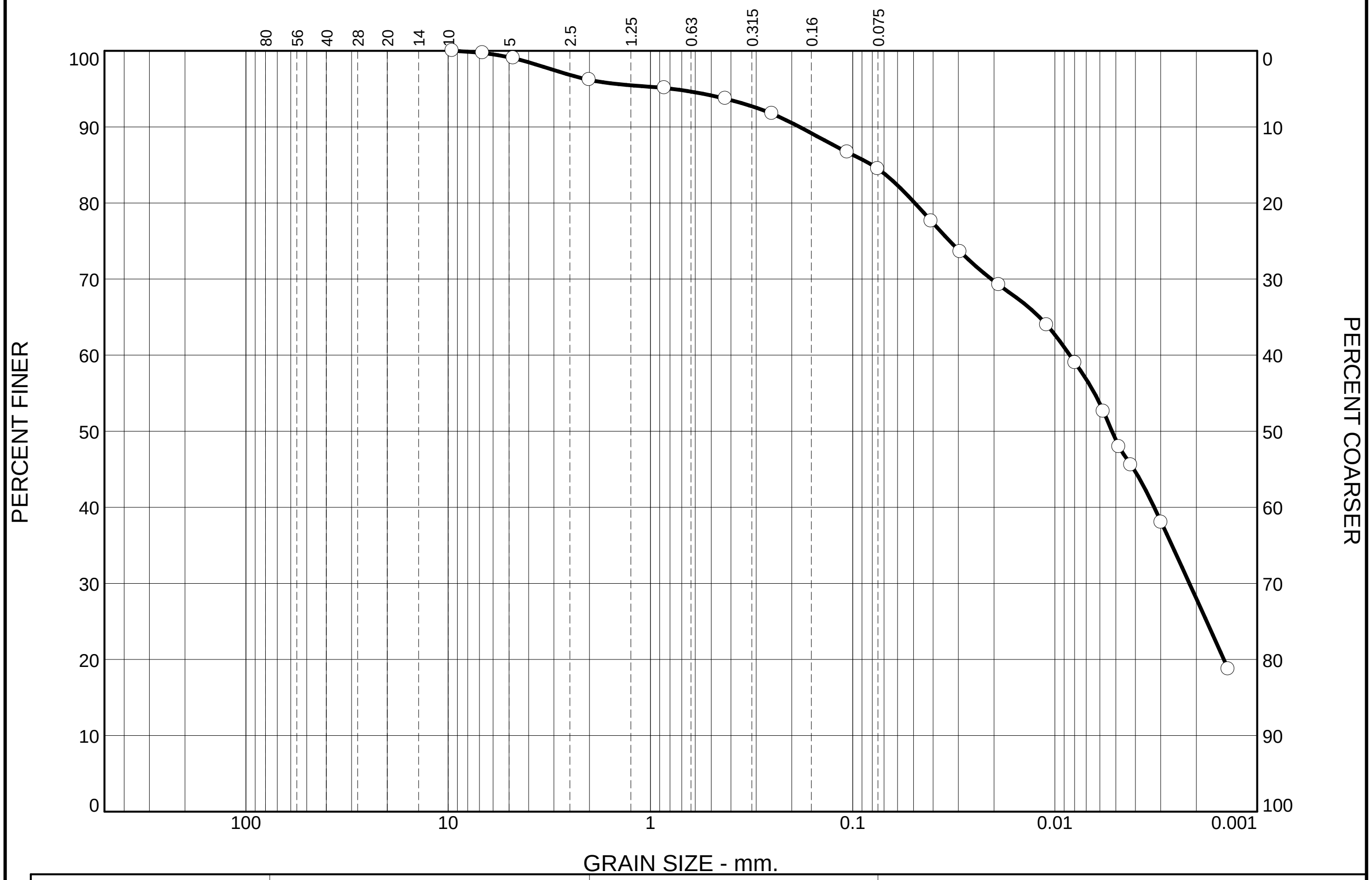
Remarks:

Terrapex

Figure 1

Tested By: AM **Checked By:** DM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	3.8	2.5	9.2	56.5	28.0

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0803	0.0084	0.0052	0.0022				

Material Description	USCS	AASHTO
○ CLAYEY SILT some sand trace gravel		

Project No. CA20069 **Client:** R. J. Burnside & Associates Ltd

Project: Laboratory Testing RJB # 300052893

○ **Sample Number:** BH2d, SS3

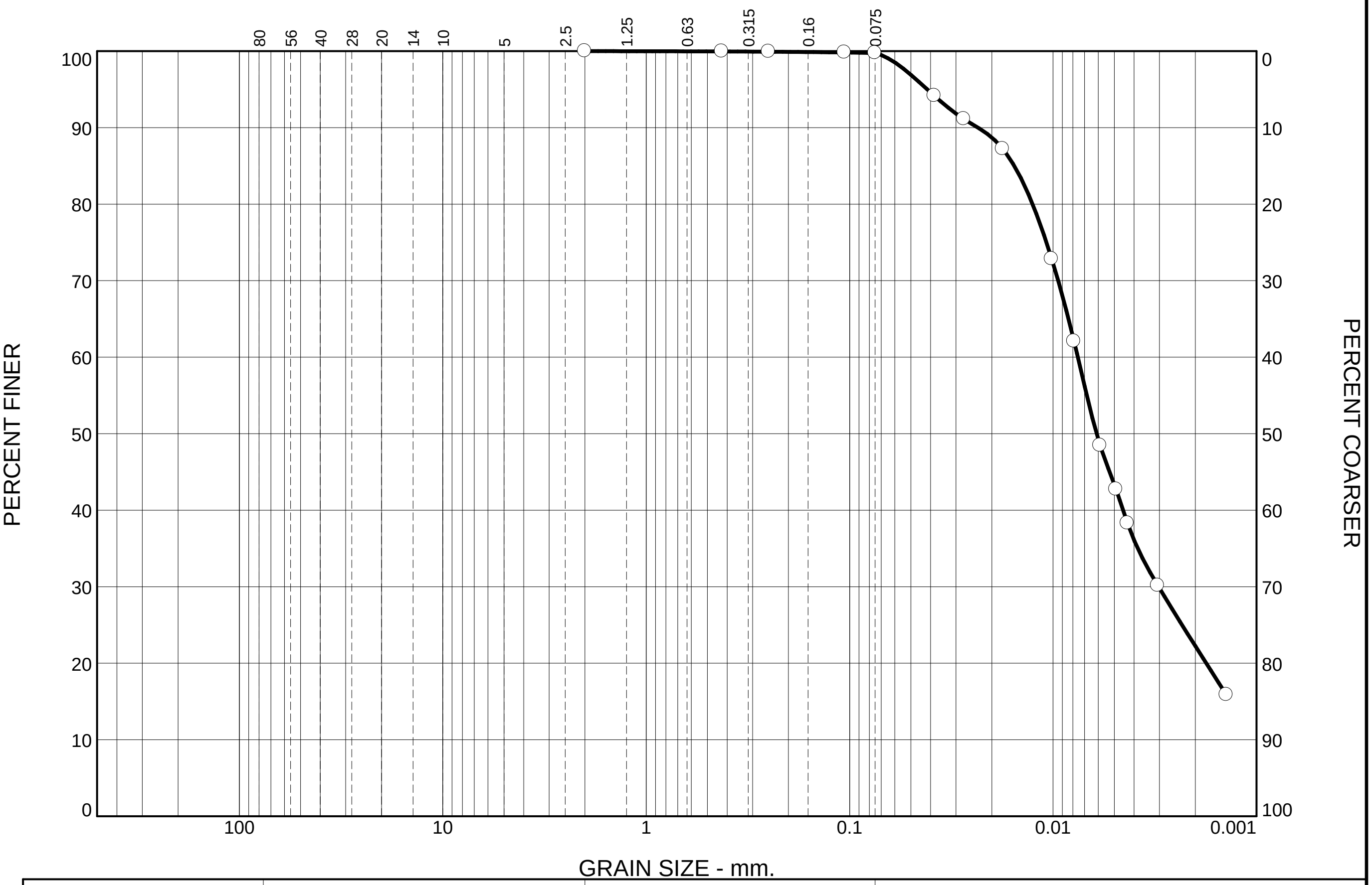
Remarks:

Terrapex

Figure 2

Tested By: AM **Checked By:** DM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	77.5	22.3

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0155	0.0076	0.0061	0.0030				

Material Description	USCS	AASHTO
○ CLAYEY SILT trace sand		

Project No. CA20069 **Client:** R. J. Burnside & Associates Ltd

Project: Laboratory Testing RJB # 300052893

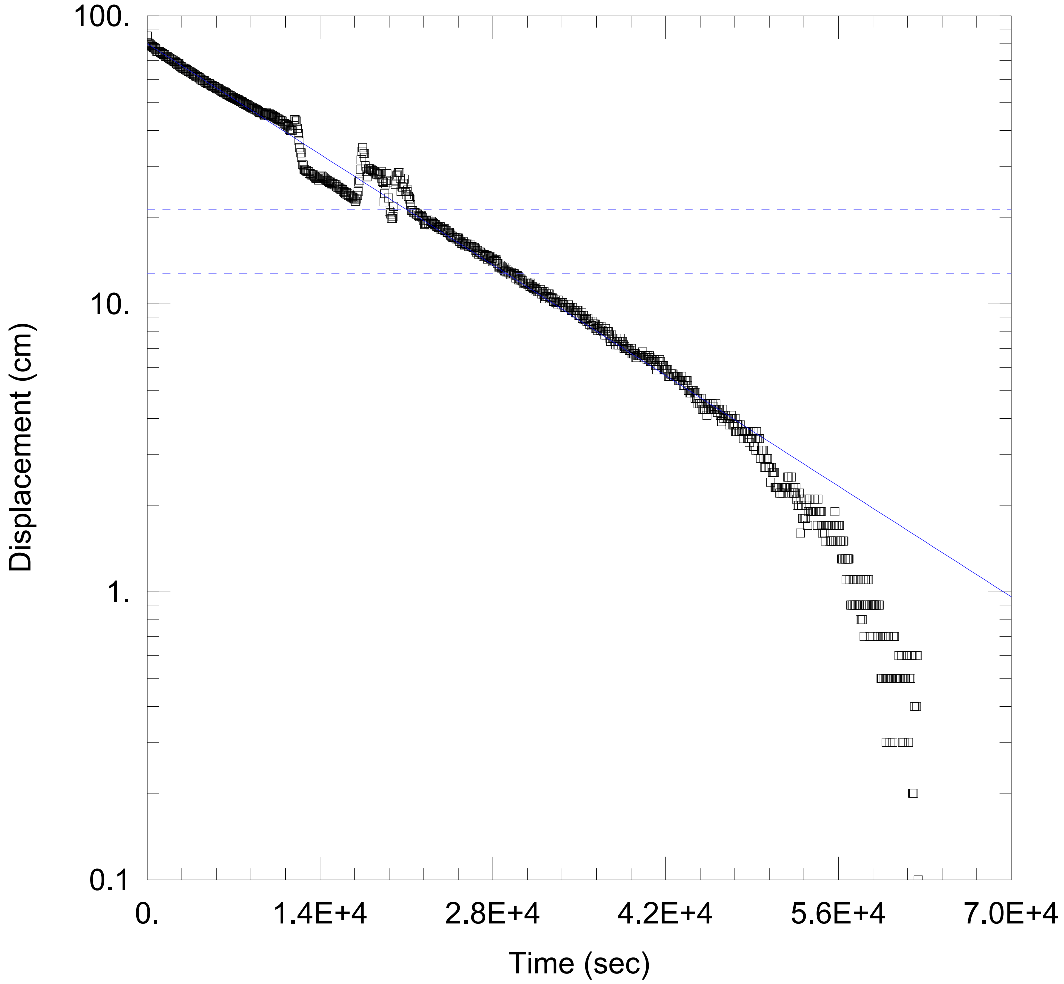
○ **Sample Number:** BH2d, SS10

Remarks:

Terrapex

Figure 3

Tested By: AM **Checked By:** DM



HYDRAULIC CONDUCTIVITY TEST AT BH2S- SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J Burnside & Associates Ltd.
Project: 300052893
Location: Archerhill Court, Aurora
Test Well: BH2s
Test Date: April 27, 2021

AQUIFER DATA

Saturated Thickness: 594. cm
Anisotropy Ratio (Kz/Kr): 1.

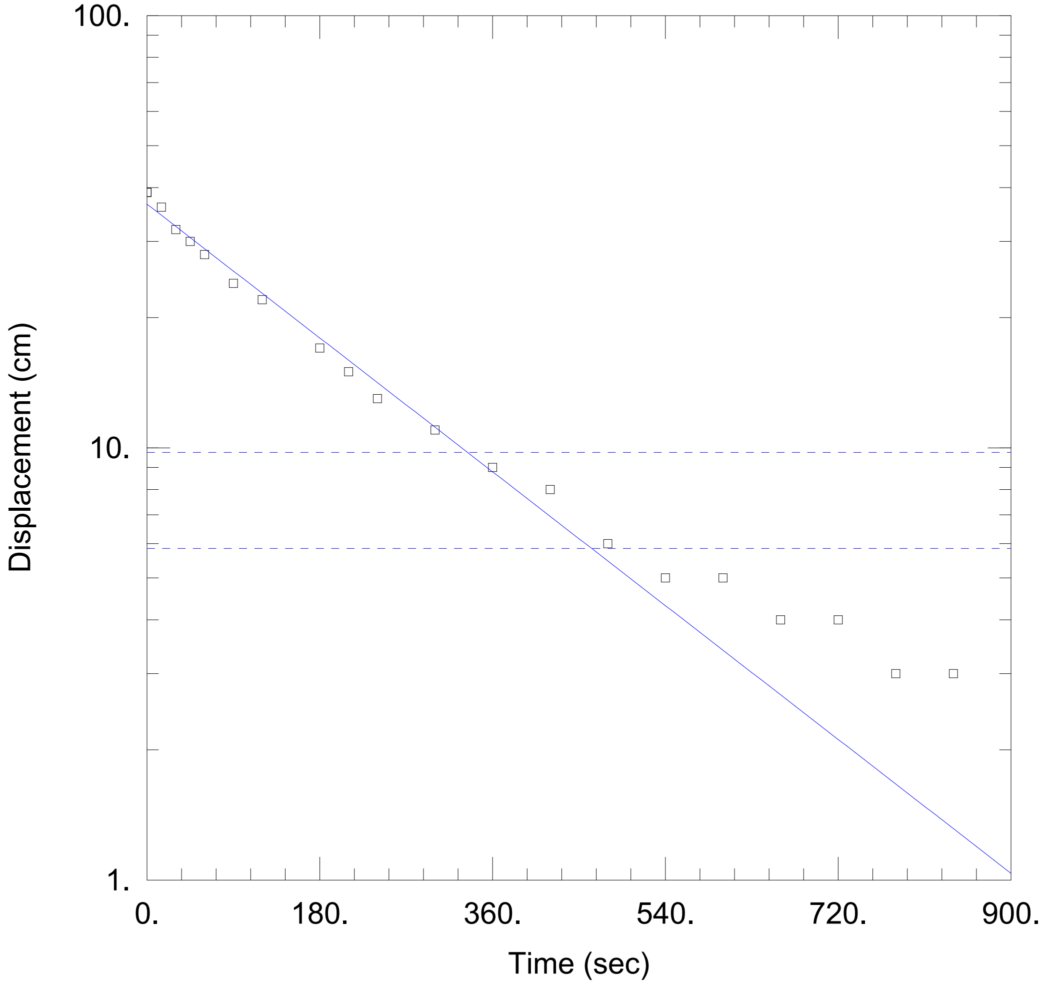
WELL DATA (BH2)

Initial Displacement: 85.1 cm
Total Well Penetration Depth: 594. cm
Casing Radius: 2.54 cm
Static Water Column Height: 594. cm
Screen Length: 304. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 2.936E-6 cm/sec
y0 = 80.04 cm



HYDRAULIC CONDUCTIVITY TEST AT BH5- SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J Burnside & Associates Ltd.
Project: 300052893
Location: Archerhill Court, Aurora
Test Well: BH5
Test Date: April 27, 2021

AQUIFER DATA

Saturated Thickness: 697. cm
Anisotropy Ratio (Kz/Kr): 1.

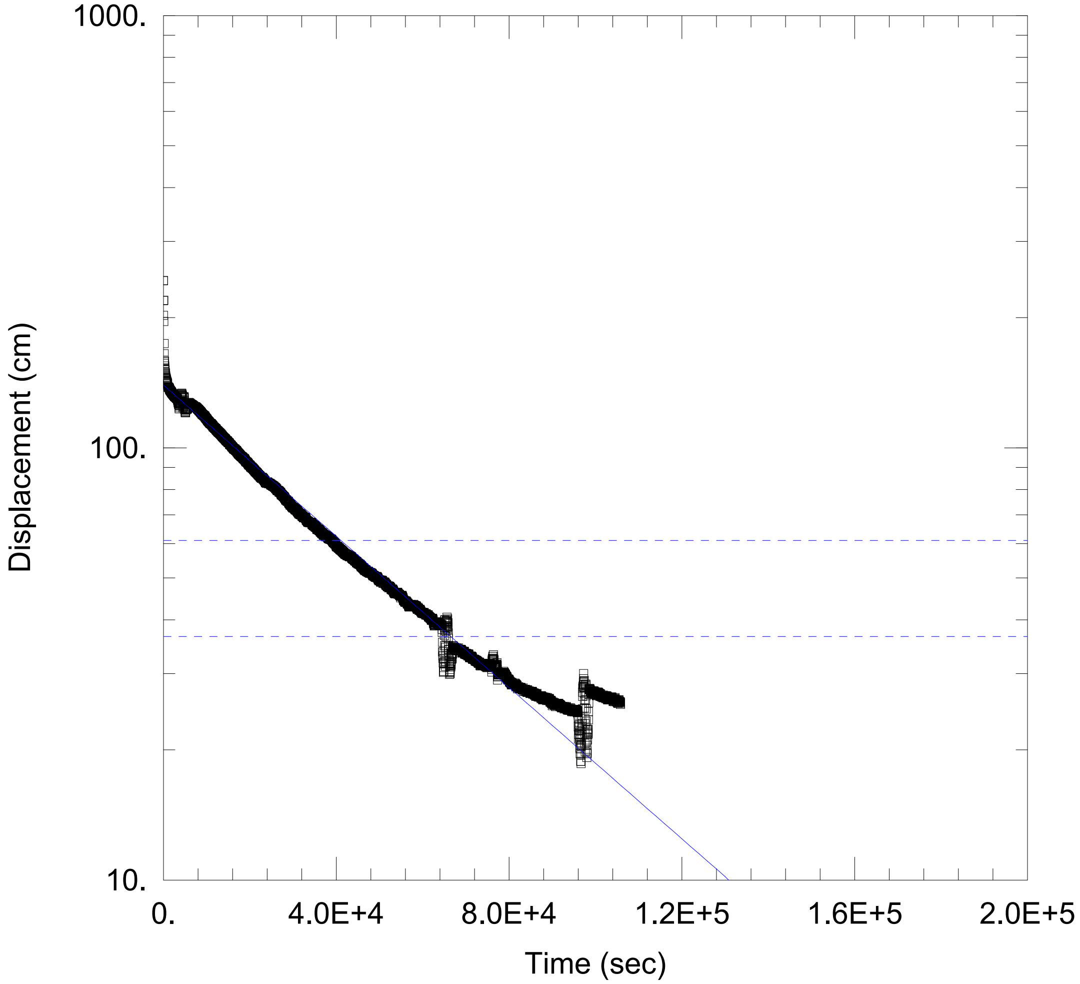
WELL DATA (BH5)

Initial Displacement: 39. cm
Total Well Penetration Depth: 697. cm
Casing Radius: 2.54 cm
Static Water Column Height: 697. cm
Screen Length: 304. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001841 cm/sec
y0 = 36.62 cm



HYDRAULIC CONDUCTIVITY TEST AT BH6- SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J Burnside & Associates Ltd.
Project: 300052893
Location: Archerhill Court, Aurora
Test Well: BH6
Test Date: April 27, 2021

AQUIFER DATA

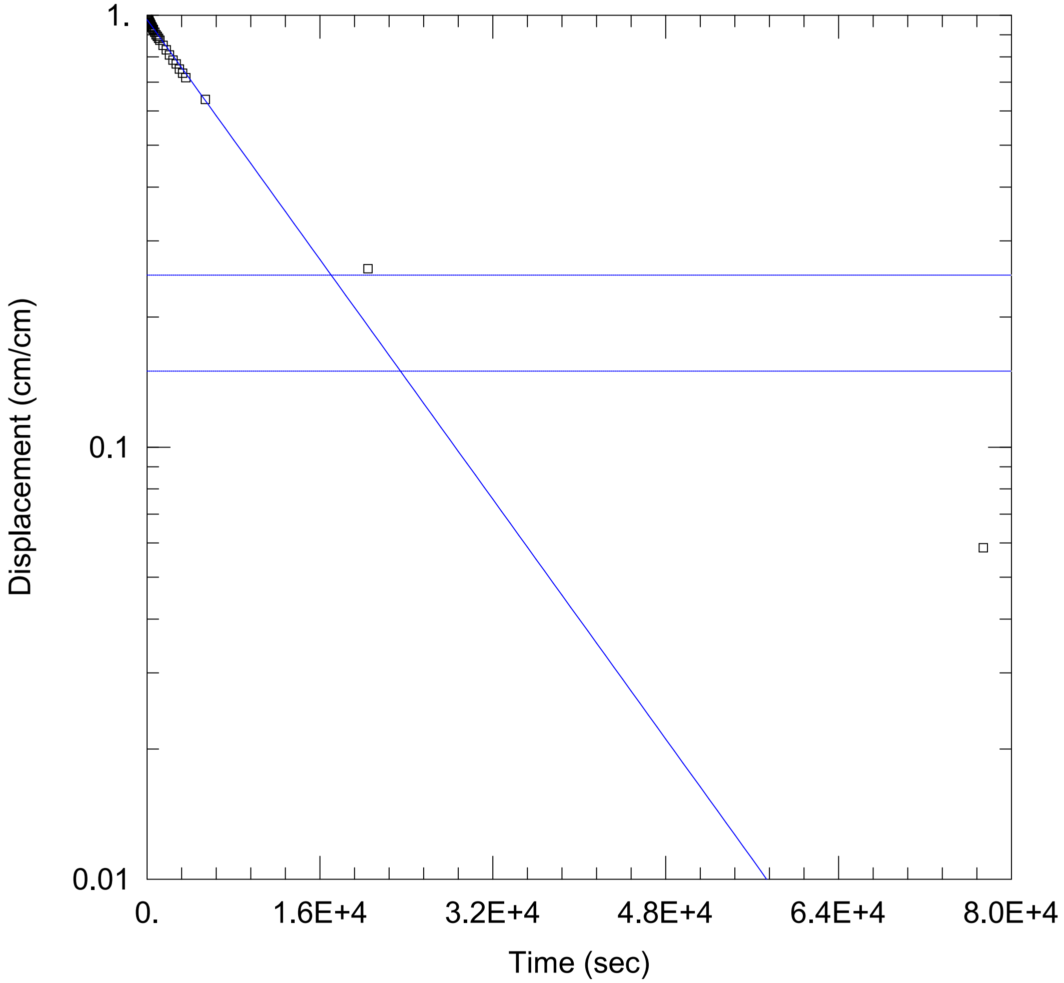
Saturated Thickness: 427. cm
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH6)

Initial Displacement: 244. cm
Total Well Penetration Depth: 427. cm
Casing Radius: 2.54 cm
Static Water Column Height: 427. cm
Screen Length: 304. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 9.362E-7 cm/sec
y0 = 139.7 cm



HYDRAULIC CONDUCTIVITY TEST AT BH2D - SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J. Burnside & Associates
Client: Archerhill
Project: 300052893
Location: Aurora, ON
Test Well: BH2d
Test Date: June 2, 2021

AQUIFER DATA

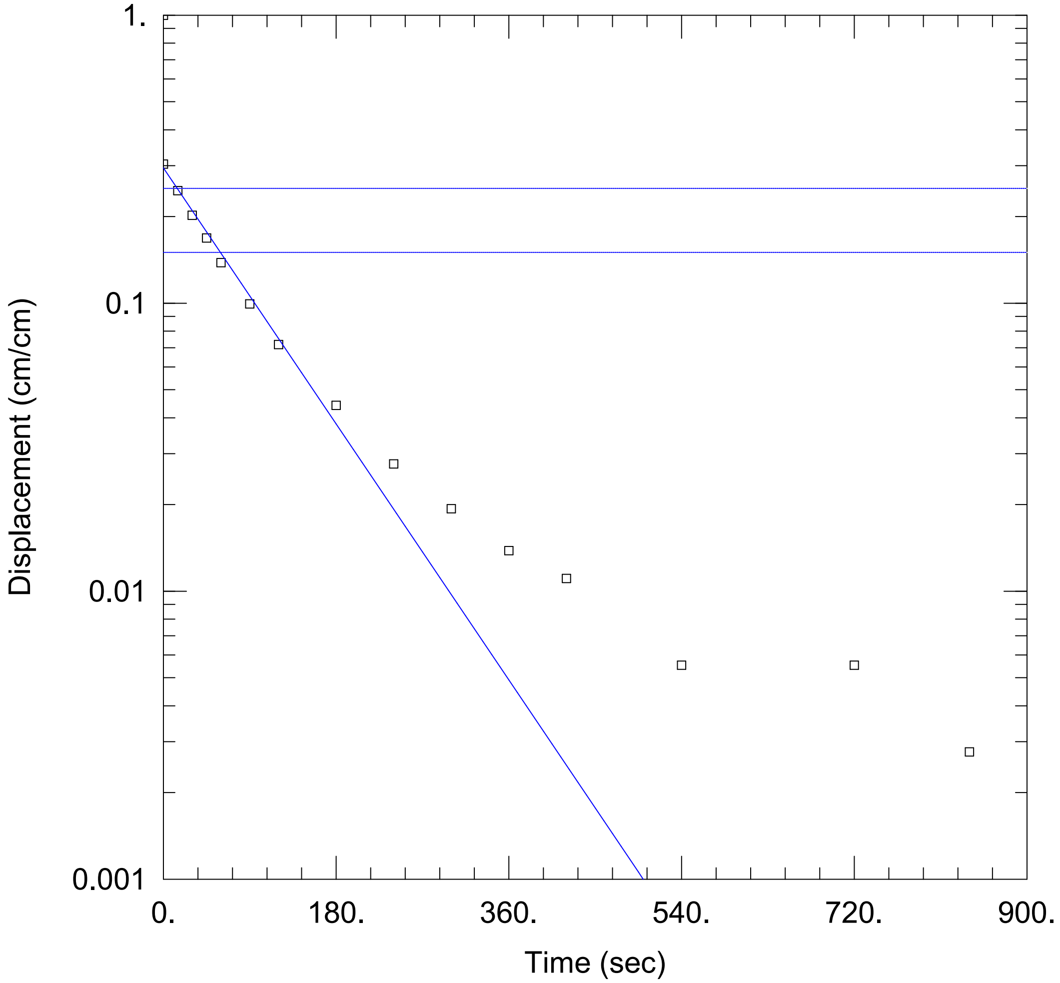
Saturated Thickness: 851. cm
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH2d)

Initial Displacement: 564. cm
Total Well Penetration Depth: 851. cm
Casing Radius: 2.54 cm
Static Water Column Height: 851. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.2E-6 cm/sec
y0 = 550.3 cm



HYDAULIC CONDUCTIVITY TEST AT MW1 - SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J. Burnside & Associates
Client: Archerhill
Project: 300052893
Location: Aurora, ON
Test Well: MW1
Test Date: June 2, 2021

AQUIFER DATA

Saturated Thickness: 906. cm
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW1)

Initial Displacement: 362. cm
Total Well Penetration Depth: 759. cm
Casing Radius: 2.54 cm
Static Water Column Height: 907. cm
Screen Length: 152. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.001 cm/sec
y0 = 106.7 cm

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Appendix D

Groundwater Levels

Appendix D

Table D-1:
Groundwater Elevations

Monitoring Well/ Piezometer	Well Depth (mbgl)	Ground Elevation (masl)	20-Jan-21		15-Mar-21		15-Apr-21		12-May-21		02-Jun-21		16-Jul-21	
			Water Level Depth (mbgl)	Water Elevation (masl)	Water Level Depth (mbgl)	Water Elevation (masl)	Water Level Depth (mbgl)	Water Elevation (masl)	Water Level Depth (mbgl)	Water Elevation (masl)	Water Level Depth (mbgl)	Water Elevation (masl)	Water Level Depth (mbgl)	Water Elevation (masl)
MW1	6.01	271.98	-	-	-	-	-	-	2.07	269.91	2.53	269.45	2.50	269.48
BH2s	7.55	275.69	2.24	273.45	2.49	273.20	1.62	274.07	1.80	273.89	2.80	272.89	4.32	271.37
BH2d	11.94	275.61	-	-	-	-	-	-	2.65	272.96	3.24	272.37	4.37	271.24
BH5	7.19	277.96	0.67	277.29	0.44	277.52	0.56	277.40	0.88	277.08	1.91	276.05	5.25	272.71
BH6	7.54	276.34	3.55	272.79	1.59	274.75	3.17	273.17	3.39	272.95	3.79	272.55	5.35	270.99
BH101	16.93	277.99	-	-	-	-	-	-	-	-	-0.40	278.39	5.76	272.23
PZ1s	1.17	269.91	-	-	-	-	0.85	269.06	0.20	269.71	0.05	269.86	-0.07	269.98
PZ1d	1.76	269.91	-	-	-	-	1.15	268.76	-0.03	269.94	-0.02	269.93	-0.12	270.03
PZ2s	1.06	261.35	-	-	-	-	1.06	260.29	0.15	261.20	0.22	261.13	0.30	261.05
PZ2d	1.24	261.31	-	-	-	-	1.24	260.07	0.15	261.16	0.15	261.16	0.08	261.23

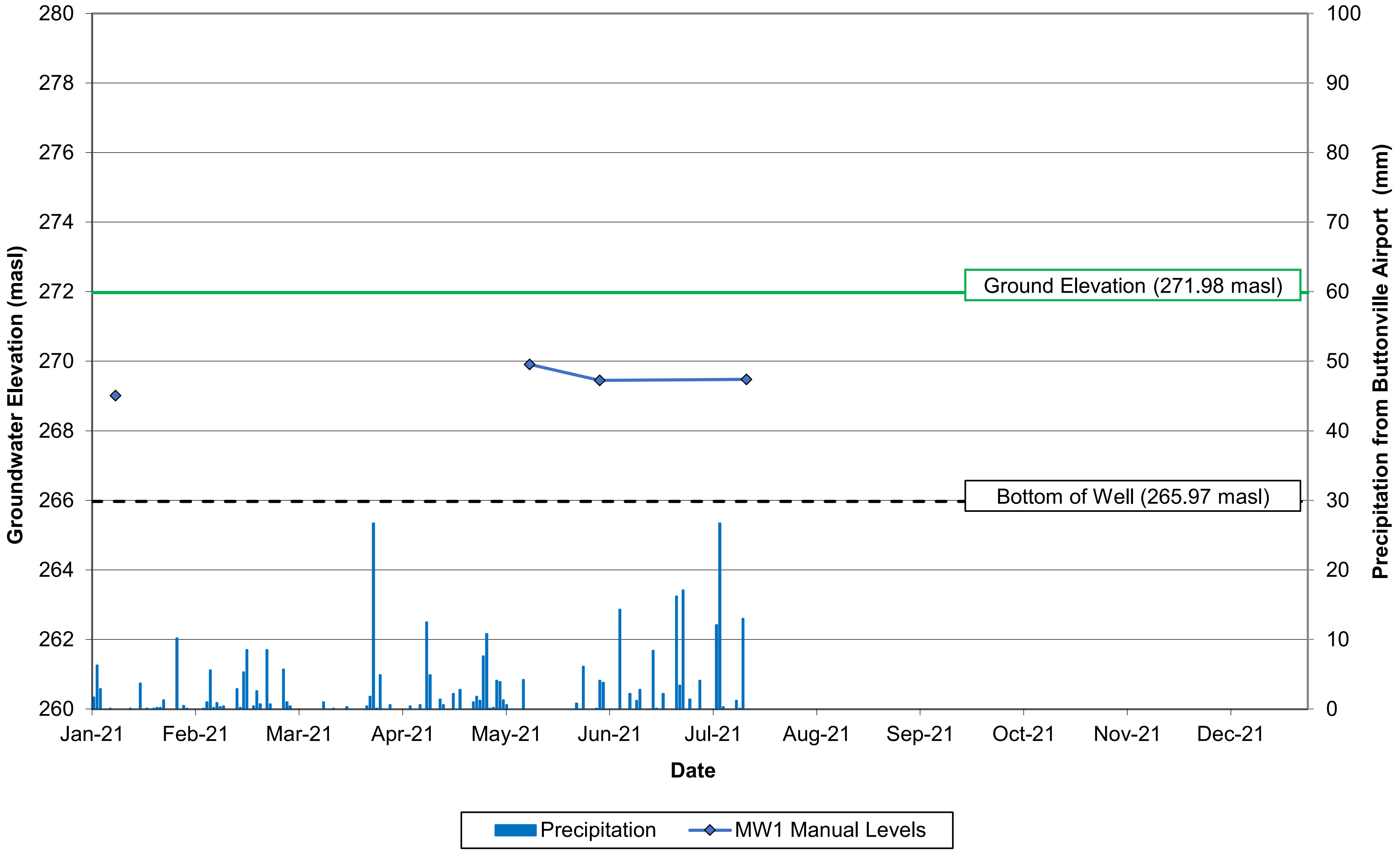
Notes:

mbgl - metres below ground level

masl - metres above sea level

"-" data unavailable

Underlined - elevations from Exp. borehole logs



Groundwater Elevations
MW1 (Well Depth: 6.0 m, Screened in Silty Clay)

Figure D-1

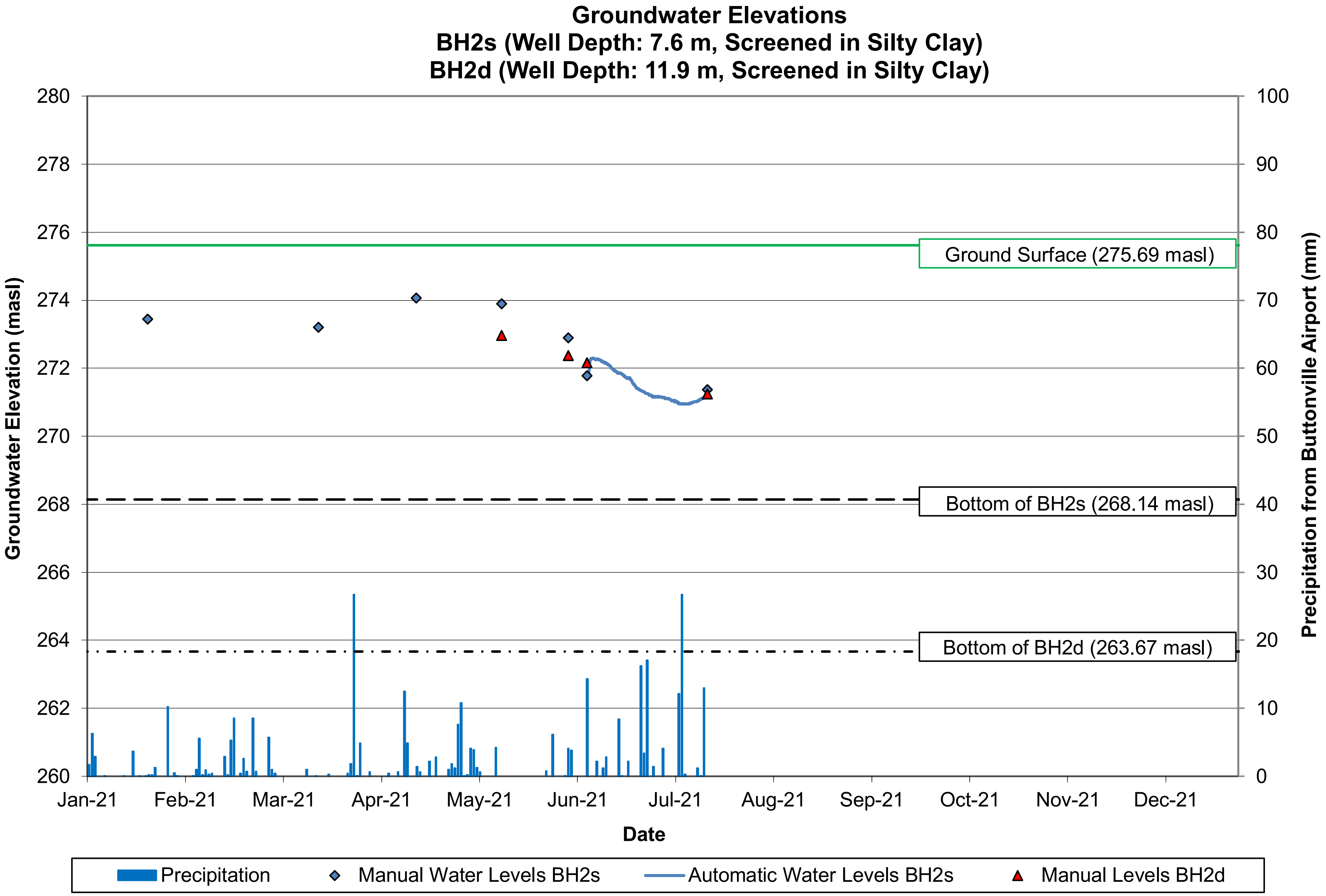


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Figure D-2

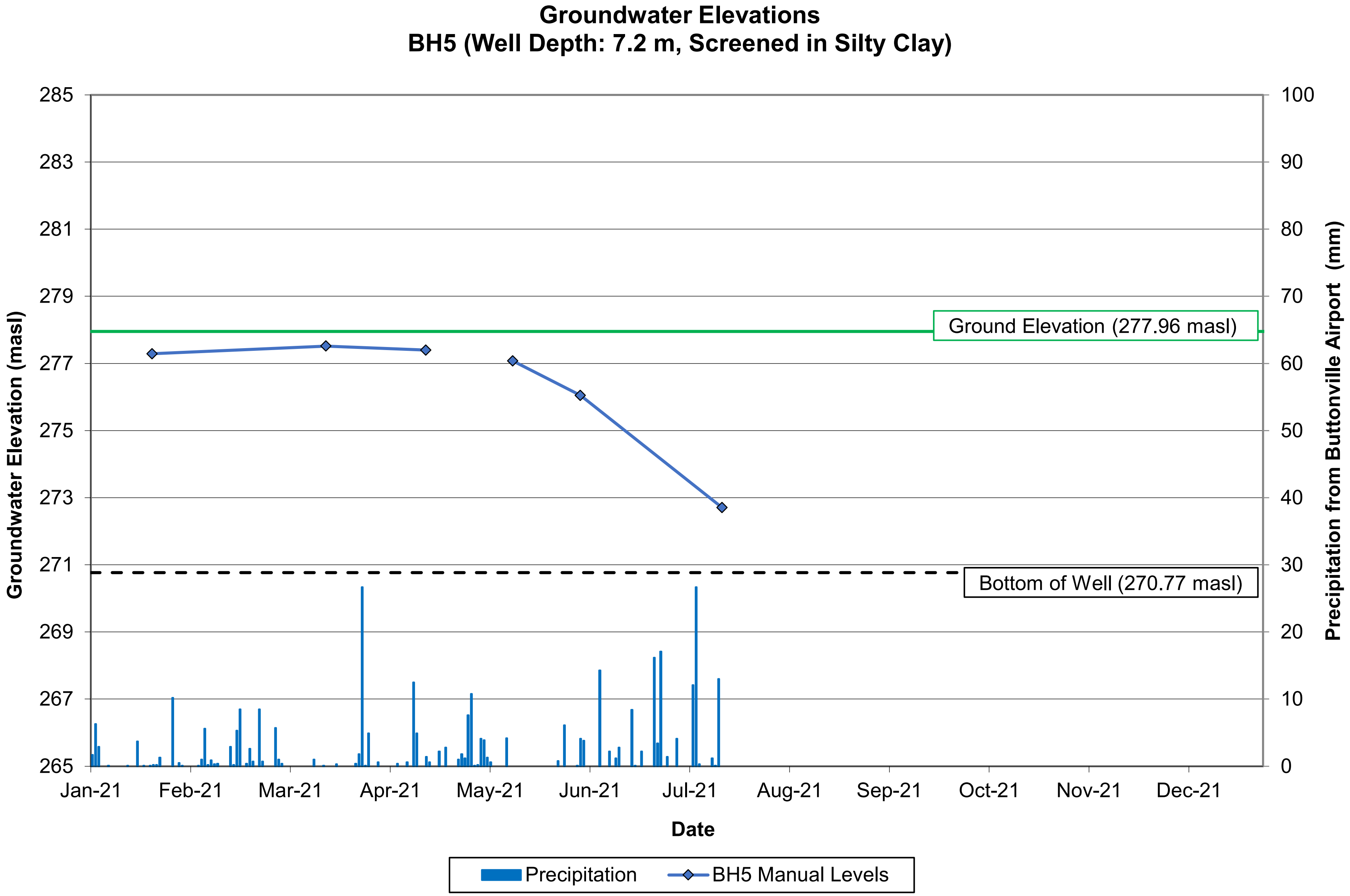

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Figure D-3

Groundwater Elevations
BH6 (Well Depth: 7.5 m, Screened in Silty Clay)

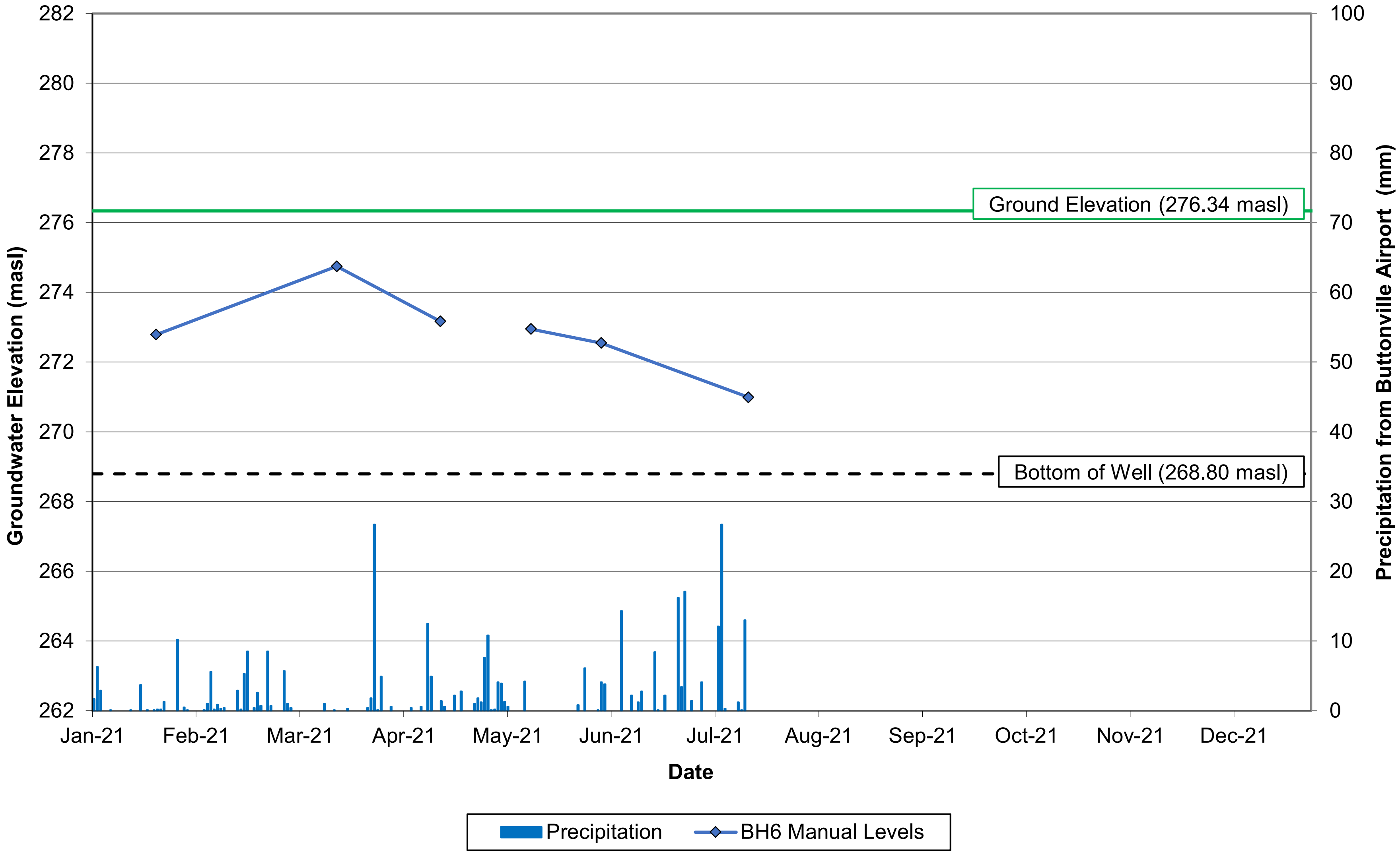

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Figure D-4

Groundwater Elevations
BH101 (Well Depth: 16.9 m, Screened in Silty Clay)

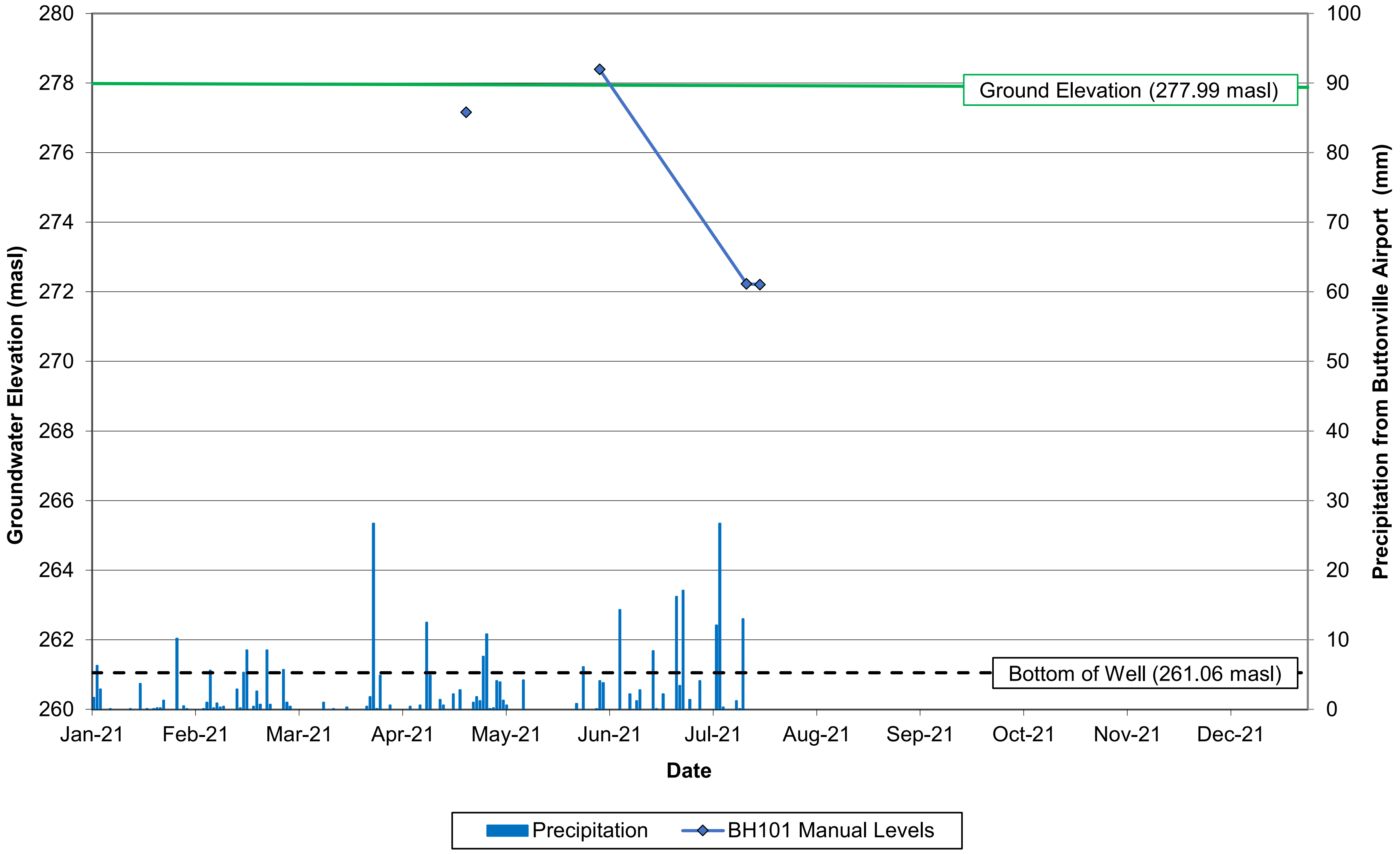

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Figure D-5

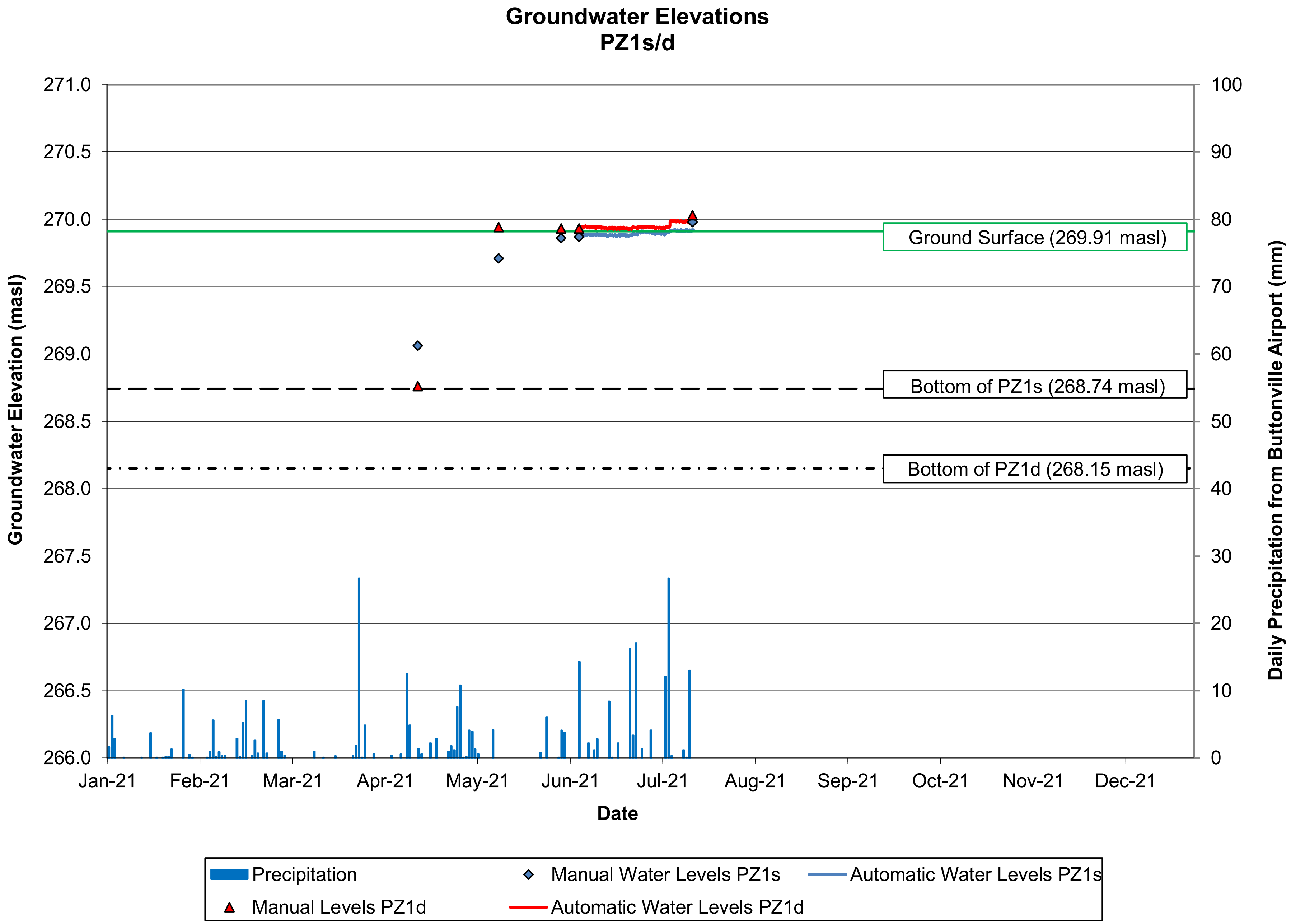

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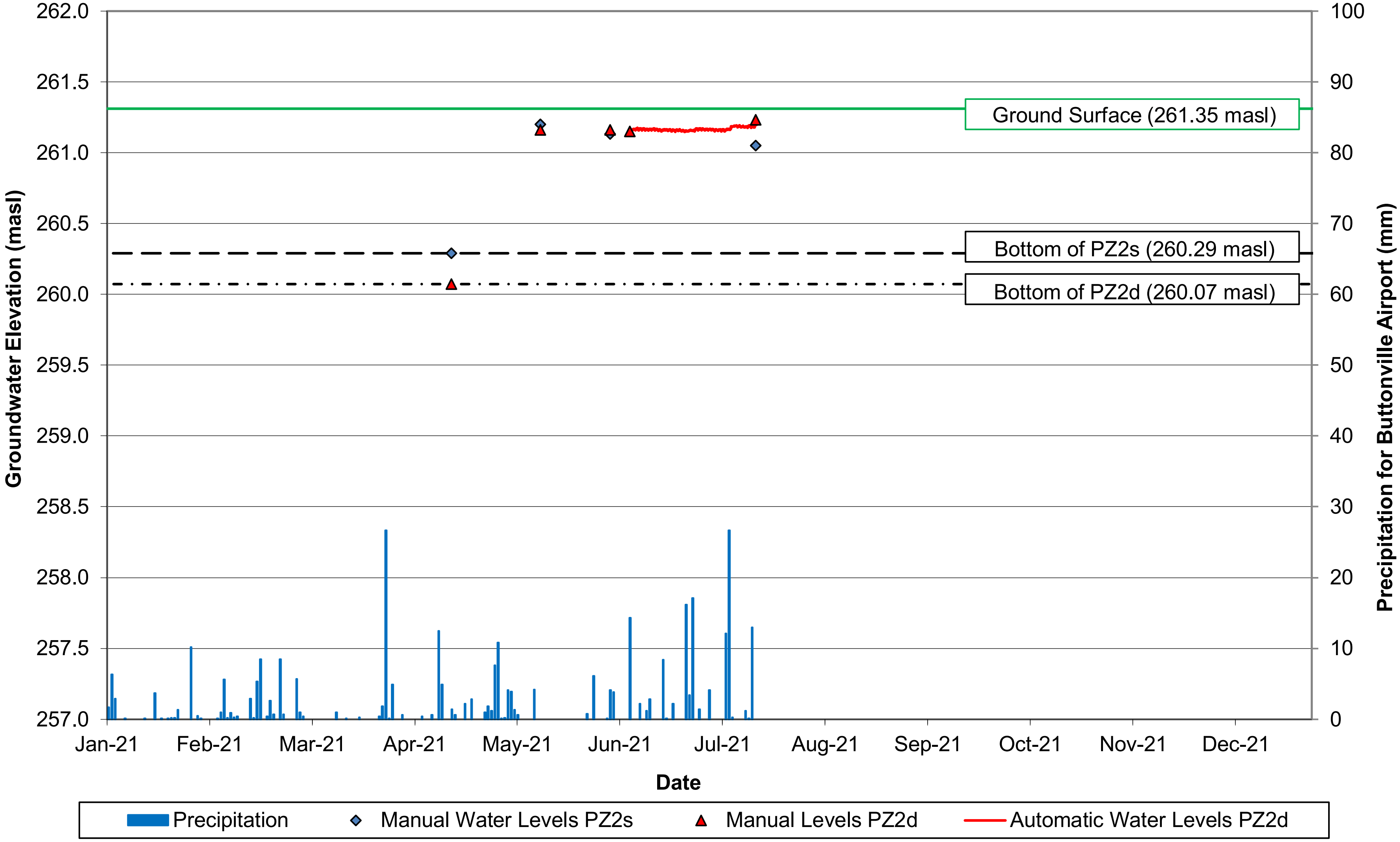
Figure D-6

Groundwater Elevations
PZ2s/d



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Appendix E

Surface Water Monitoring

Table E-1
Surface Water Flow

Date	**Days since precipitation event**	**Flow Rate (L/s)**		
		SS1	**SS2**	**SS3**
15-Mar-21	4	<0.5	-	-
15-Apr-21	0	2	34.1	-
12-May-21	2	Standing water	31.4	0.7
2-Jun-21	~6	Standing water	70.5	<0.5
16-Jul-21	0	<0.5	76.1	12.3

Notes:

<0.5" - minimal flow not measurable with equipment (estimated)

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Appendix F

Water Quality

Appendix F

Table F-1
Groundwater Quality

Monitoring Well					**BH2s**	**BH2d**
Date Sampled					**3-Jun-21**	**3-Jun-21**
Parameter	**Unit**	**RDL**	**ODWQS**	**PWQO**		
Electrical Conductivity	µS/cm	2			745	522
pH	pH Units	NA	(6.5-8.5)	(6.5-8.5)	8	8.09
Saturation pH (Calculated)					6.85	7.01
Langelier Index (Calculated)					1.15	1.08
Total Hardness (as CaCO3) (Calculated)	mg/L	0.5	(80-100)		**356**	**252**
Total Dissolved Solids	mg/L	10	500		424	256
Alkalinity (as CaCO3)	mg/L	5	(30-500)		285	265
Bicarbonate (as CaCO3)	mg/L	5			285	265
Carbonate (as CaCO3)	mg/L	5			<5	<5
Hydroxide (as CaCO3)	mg/L	5			<5	<5
Fluoride	mg/L	0.05	1.5		<0.05	0.07
Chloride	mg/L	0.10	250		33.1	2.74
Nitrate as N	mg/L	0.05	10.0		<0.05	<0.05
Nitrite as N	mg/L	0.05	1.0		<0.05	<0.05
Bromide	mg/L	0.05			<0.05	<0.05
Sulphate	mg/L	0.10	500		60.1	14.9
Ortho Phosphate as P	mg/L	0.10			<0.10	<0.10
Ammonia as N	mg/L	0.02			<0.02	0.18
Total Phosphorus	mg/L	0.02		0.03	0.07	<0.02
Total Organic Carbon	mg/L	0.5			1.7	281
Colour	TCU	5	5		<5	<5
Turbidity	NTU	0.5	5		**197**	**224000**
Calcium	mg/L	0.05			85	43
Magnesium	mg/L	0.05			35	35
Sodium	mg/L	0.50	20 (200)		2.51	3.2
Potassium	mg/L	0.05			15.9	11
Aluminum	mg/L	0.004	0.1	0.075	**0.445**	0.031
Antimony	mg/L	0.001	0.006		<0.001	<0.001
Arsenic	mg/L	0.001	0.025	1	0.002	0.002
Barium	mg/L	0.002	1		0.101	2.45
Beryllium	mg/L	0.0005			<0.0005	<0.0005
Boron	mg/L	0.010	5	2	0.016	0.044
Cadmium	mg/L	0.0001	0.005	0.0002	<0.0001	<0.0001
Chromium	mg/L	0.002	0.05	0.009	<0.002	<0.02
Cobalt	mg/L	0.0005			0.0008	0.0026
Copper	mg/L	0.001	1	0.005	0.001	<0.001
Iron	mg/L	0.010	0.3	0.3	**1.02**	**1.49**
Lead	mg/L	0.0005	0.01	0.001	0.0011	<0.0005
Manganese	mg/L	0.002	0.05		0.121	1.57
Mercury	mg/L	0.0001	0.001	0.0002	<0.0001	<0.0001
Molybdenum	mg/L	0.002		0.04	0.003	<0.002
Nickel	mg/L	0.003		0.025	<0.003	0.007
Selenium	mg/L	0.001	0.01	0.01	0.003	0.004
Silver	mg/L	0.0001		<0.002	<0.0001	<0.0001
Strontium	mg/L	0.005			0.378	4.72
Thallium	mg/L	0.0003		0.0003	<0.0003	<0.0003
Tin	mg/L	0.002			<0.002	<0.002
Titanium	mg/L	0.002			0.017	<0.002
Tungsten	mg/L	0.010			<0.010	<0.010
Uranium	mg/L	0.0005	0.02	0.005	0.0008	0.0019
Vanadium	mg/L	0.002	3		<0.002	<0.002
Zinc	mg/L	0.005	5	0.03	0.017	<0.005
Zirconium	mg/L	0.004			<0.004	<0.004

ODWQS - Ontario Drinking Water Quality Standards

RDL - Reported Detection Limit

PWQO - Provincial Water Quality Objectives

Bold indicates an exceedence of the ODWQS

Underlined indicates an exceedence of the PWQO

Table F-2
Surface Water Quality

Sample Location				**SS3**
Date Sampled				**2-Jun-21**
Parameter	**Unit**	**RDL**	**PWQO**	
Electrical Conductivity	µS/cm	2		566
pH	pH Units	NA	(6.5-8.5)	7.96
Saturation pH (Calculated)				6.67
Langelier Index (Calculated)				1.29
Total Hardness (as CaCO3) (Calculated)	mg/L	0.5		566
Total Dissolved Solids	mg/L	20		1390
Alkalinity (as CaCO3)	mg/L	5		297
Bicarbonate (as CaCO3)	mg/L	5		297
Carbonate (as CaCO3)	mg/L	5		<5
Hydroxide (as CaCO3)	mg/L	5		<5
Fluoride	mg/L	0.05		<0.05
Chloride	mg/L	0.10		558
Nitrate as N	mg/L	0.05		<0.14
Nitrite as N	mg/L	0.05		<0.11
Bromide	mg/L	0.05		<0.11
Sulphate	mg/L	0.10		32.8
Ortho Phosphate as P	mg/L	0.10		<0.26
Ammonia as N	mg/L	0.02		<0.02
Ammonia-Un-ionized (Calculated)	mg/L	0.000002	0.02	<0.000002
Total Phosphorus	mg/L	0.02	0.03	<0.02
Total Organic Carbon	mg/L	0.5		4.7
Colour	TCU	5		13
Turbidity	NTU	25		36.5
Calcium	mg/L	0.05		194
Magnesium	mg/L	0.05		19.8
Sodium	mg/L	0.05		2.46
Potassium	mg/L	0.05		294
Aluminum	mg/L	0.004	0.075	<0.004
Antimony	mg/L	0.003		<0.001
Arsenic	mg/L	0.003	1	<0.003
Barium	mg/L	0.002		0.037
Beryllium	mg/L	0.001		<0.0005
Boron	mg/L	0.010	2	0.031
Cadmium	mg/L	0.001	0.0002	<0.0001
Chromium	mg/L	0.003	0.009	<0.003
Cobalt	mg/L	0.001		<0.0005
Copper	mg/L	0.003	0.005	<0.001
Iron	mg/L	0.010	0.3	0.193
Lead	mg/L	0.001	0.001	<0.001
Manganese	mg/L	0.002		0.851
Mercury	mg/L	0.0001	0.0002	<0.0001
Molybdenum	mg/L	0.002	0.04	<0.002
Nickel	mg/L	0.003	0.025	<0.003
Selenium	mg/L	0.004	0.01	<0.002
Silver	mg/L	0.002	<0.002	<0.0001
Strontium	mg/L	0.005		0.631
Thallium	mg/L	0.006	0.0003	<0.0003
Tin	mg/L	0.002		<0.002
Titanium	mg/L	0.002		<0.002
Tungsten	mg/L	0.010		<0.010
Uranium	mg/L	0.002	0.005	<0.002
Vanadium	mg/L	0.002		<0.002
Zinc	mg/L	0.005	0.03	0.005
Zirconium	mg/L	0.004		<0.004

RDL - Reported Detection Limit
PWQO - Provincial Water Quality Objectives

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[THE DIFFERENCE IS OUR PEOPLE]

Appendix G

Water Balance

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-1

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 125 mm (urban lawn in silt loam soils)

Climate data from King Smoke Tree Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.4	-6.1	-1.5	6	12.5	17.7	20.5	19.6	15.3	8.6	2.2	-3.7	**7.0**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.32	4.00	6.78	8.47	7.91	5.44	2.27	0.29	0.00	**36.5**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.29	59.98	87.11	101.97	97.18	74.50	40.15	9.30	0.00	**497**
Adjusting Factor for U (Latitude 44° 01' 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	31	76	112	133	117	77	38	7	0	**592**

COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	52	46	51	65	87	85	86	88	84	73	85	56	**858**
Potential Evapotranspiration (PET)	0	0	0	31	76	112	133	117	77	38	7	0	**592**
P - PET	52	46	51	34	11	-28	-46	-28	7	35	77	56	**266**
Change in Soil Moisture Storage	0	0	0	0	0	-28	-46	-28	7	35	60	0	**0**
Soil Moisture Storage max 125 mm	125	125	125	125	125	97	51	23	30	65	125	125	
Actual Evapotranspiration (AET)	0	0	0	31	76	112	133	117	77	38	7	0	**592**
Soil Moisture Deficit max 125 mm	0	0	0	0	0	28	74	102	95	60	0	0	
Water Surplus - available for infiltration or runoff	52	46	51	34	11	0	0	0	0	0	17	56	**266**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	21	18	20	14	4	0	0	0	0	0	7	22	**106**
Potential Direct Surface Water Runoff (independent of temperature)	31	28	31	20	7	0	0	0	0	0	10	33	**160**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	858	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	129	mm/year											
P-PE (surplus available for runoff from impervious areas)	729	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 125 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - hilly land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt loam soils	0.2	<-- 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	**0.4**	

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

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

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TABLE G-2

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 400 mm (woodland in silt loam soils)

Climate data from King Smoke Tree Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.4	-6.1	-1.5	6	12.5	17.7	20.5	19.6	15.3	8.6	2.2	-3.7	**7.0**
Heat index: i = $(t/5)^{1.514}$	0.00	0.00	0.00	1.32	4.00	6.78	8.47	7.91	5.44	2.27	0.29	0.00	**36.5**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.29	59.98	87.11	101.97	97.18	74.50	40.15	9.30	0.00	**497**
Adjusting Factor for U (Latitude 44° 01' 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	31	76	112	133	117	77	38	7	0	**592**
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	52	46	51	65	87	85	86	88	84	73	85	56	**858**
Potential Evapotranspiration (PET)	0	0	0	31	76	112	133	117	77	38	7	0	**592**
P - PET	52	46	51	34	11	-28	-46	-28	7	35	77	56	**266**
Change in Soil Moisture Storage	0	0	0	0	0	-28	-46	-28	7	35	60	0	**0**
Soil Moisture Storage max 400 mm	400	400	400	400	400	372	326	298	305	340	400	400	
Actual Evapotranspiration (AET)	0	0	0	31	76	112	133	117	77	38	7	0	**592**
Soil Moisture Deficit max 400 mm	0	0	0	0	0	28	74	102	95	60	0	0	
Water Surplus - available for infiltration or runoff	52	46	51	34	11	0	0	0	0	0	17	56	**266**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	26	23	26	17	5	0	0	0	0	0	8	28	**133**
Potential Direct Surface Water Runoff (independent of temperature)	26	23	26	17	5	0	0	0	0	0	8	28	**133**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	858	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	129	mm/year											
P-PE (surplus available for runoff from impervious areas)	729	mm/year											

Assume January storage is 100% of Soil Moisture Storage		
Soil Moisture Storage	400 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003
*MOE SWM infiltration calculations		
topography - hilly land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt loam soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - woodland	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.5**	
Latitude of site (or climate station)	44 ° N.	

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
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TABLE G-3

Water Balance - Existing Conditions and Post-Development (with no SWM/LID measures in place)
West Tributary (Catchment 101)

	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 Infiltration Volume (m^3/a)
Existing Land Use											
Residential	7,690	0.04	300	0.729	219	7,390	0.160	1,180	0.106	787	787
NHS	16,100	0.00	0	0.729	0	16,100	0.133	2,142	0.133	2,142	2,142
TOTAL PRE-DEVELOPMENT	**23,790**		**300**		**219**	**23,490**		**3,322**		**2,928**	**2,928**
Post-Development Land Use											
Residential	11,590	0.48	5,600	0.729	4,083	5,990	0.160	956	0.106	638	638
NHS	12,200	0.00	0	0.729	0	12,200	0.133	1,623	0.133	1,623	1,623
TOTAL POST-DEVELOPMENT	**23,790**		**5,600**		**4,083**	**18,190**		**2,579**		**2,261**	**2,261**
% Change from Pre to Post											23
Effect of development (with no mitigation)											23% reduction in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

To balance pre- to post-,
the infiltration target (m^3/a)= **668** **m^3/a**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-4

Water Balance - Existing Conditions and Post-Development (with no SWM/LID measures in place)
North Tributary (Catchment 102)

	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 Infiltration Volume (m^3/a)
Existing Land Use											
Residential	76,300	0.20	15,630	0.729	11,395	60,670	0.160	9,686	0.106	6,457	6,457
NHS	5,300	0.00	0	0.729	0	5,300	0.133	705	0.133	705	705
TOTAL PRE-DEVELOPMENT	**81,600**		**15,630**		**11,395**	**65,970**		**10,391**		**7,162**	**7,162**
Post-Development Land Use											
Residential	72,950	0.68	49,710	0.729	36,241	23,240	0.160	3,710	0.106	2,473	2,473
NHS	8,650	0.00	0	0.729	0	8,650	0.133	1,151	0.133	1,151	1,151
TOTAL POST-DEVELOPMENT	**81,600**		**49,710**		**36,241**	**31,890**		**4,861**		**3,624**	**3,624**
										% Change from Pre to Post	49
										Effect of development (with no mitigation)	49% reduction in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

To balance pre- to post-,
the infiltration target (m^3/a)= **3,538** **m^3/a**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
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TABLE G-5

Water Balance - Existing Conditions and Post-Development (with no SWM/LID measures in place)
North East Wetland (Catchment 103)

	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 Infiltration Volume (m^3/a)
Existing Land Use											
Residential	6,000	0.00	0	0.729	0	6,000	0.160	958	0.106	639	639
NHS	11,500	0.00	0	0.729	0	11,500	0.133	1,530	0.133	1,530	1,530
TOTAL PRE-DEVELOPMENT	**17,500**		**0**		**0**	**17,500**		**2,488**		**2,169**	**2,169**
Post-Development Land Use											
Residential	6,100	0.03	200	0.729	146	5,900	0.160	942	0.106	628	628
NHS	11,400	0.00	0	0.729	0	11,400	0.133	1,517	0.133	1,517	1,517
TOTAL POST-DEVELOPMENT	**17,500**		**200**		**146**	**17,300**		**2,459**		**2,145**	**2,145**
										% Change from Pre to Post	1.1
										Effect of development (with no mitigation)	1% reduction in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

To balance pre- to post-,
the infiltration target (m^3/a)= **24** **m^3/a**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
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TABLE G-6

Water Balance - Existing Conditions and Post-Development with Mitigation
West Tributary (Surface Water Catchments 101 and 202)

	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)
Existing Land Use - Catchment 101											
Residential	7,690	0.04	300	0.729	219	7,390	0.160	1,180	0.106	787	1,399
NHS	16,100	0.00	0	0.729	0	16,100	0.133	2,142	0.133	2,142	2,142
TOTAL PRE-DEVELOPMENT	**23,790**		**300**		**219**	**23,490**		**3,322**		**2,928**	**3,540**
Post-Development Land Use - Catchment 202											
Residential	5,100	0.36	1,830	0.729	1,334	3,270	0.160	522	0.106	348	1,856
NHS	12,200	0.00	0	0.729	0	12,200	0.133	1,623	0.133	1,623	1,623
TOTAL POST-DEVELOPMENT	**17,300**		**1,830**		**1,334**	**15,470**		**2,145**		**1,971**	**3,479**
% Change from Pre to Post											2
Effect of development (with no mitigation)											2% reduction in runoff

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Change in runoff (m^3/a)= **-61**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-7

Water Balance - Existing Conditions and Post-Development (with no SWM/LID measures in place)
North Tributary (Surface Water Catchments 102 and 203)

	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)
Existing Land Use - Catchment 102											
Residential	76,300	0.20	15,630	0.729	11,395	60,670	0.160	9,686	0.106	6,457	21,081
NHS	31,800	0.00	0	0.729	0	31,800	0.133	4,231	0.133	4,231	4,231
Residential - North Development	5,400	0.41	2,220	0.729	1,618	3,180	0.160	508	0.106	338	2,126
TOTAL PRE-DEVELOPMENT	**113,500**		**17,850**		**13,013**	**95,650**		**14,424**		**11,026**	**27,438**
Post-Development Land Use - Catchment 203											
Residential	86,050	0.65	55,540	0.729	40,491	30,510	0.160	4,871	0.106	3,247	45,362
NHS	35,050	0.00	0	0.729	0	35,050	0.133	4,663	0.133	4,663	4,663
Residential - North Development	5,400	0.41	2,220	0.729	1,618	3,180	0.160	508	0.106	338	2,126
TOTAL POST-DEVELOPMENT	**126,500**		**57,760**		**42,110**	**68,740**		**10,042**		**8,249**	**52,151**
% Change from Pre to Post											190
Effect of development (with no mitigation)											1.9 times increase in runoff

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Change in runoff (m^3/a)= **24,714**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-8

Water Balance - Existing Conditions and Post-Development (with no SWM/LID measures in place)
North East Wetland (Surface Water Catchments 103)

	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)
Existing Land Use - Pre-Catchment 103											
Residential	6,000	0.00	0	0.729	0	6,000	0.160	958	0.106	639	958
NHS	21,130	0.00	0	0.729	0	21,130	0.133	2,811	0.133	2,811	2,811
Residential - North Development	2,100	0.30	620	0.729	452	1,480	0.160	236	0.106	158	688
Bayview Road	3,470	1.00	3,470	0.729	2,530	0	0.160	0	0.106	0	2,530
TOTAL PRE-DEVELOPMENT	**32,700**		**4,090**		**2,982**	**28,610**		**4,005**		**3,607**	**6,987**
Post-Development Land Use - Post-Catchment 103											
Residential	0	0.00	0	0.729	0	0	0.160	0	0.106	0	0
NHS	20,530	0.00	0	0.729	0	20,530	0.133	2,731	0.133	2,731	2,731
Bayview Road	3,470	1.00	3,470	0.729	2,530	0	0.160	0	0.106	0	2,530
Residential - North Development	2,100	0.30	620	0.729	452	1,480	0.160	236	0.106	158	688
TOTAL POST-DEVELOPMENT	**26,100**		**4,090**		**2,982**	**22,010**		**2,968**		**2,889**	**5,949**
% Change from Pre to Post											15
Effect of development (with no mitigation)											15% reduction in runoff

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Change in runoff (m^3/a)= **-1,038**

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-9

Water Balance - Existing Conditions and Post-Development with Mitigation
West Tributary (Catchment 101)

		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 Infiltration Volume (m^3/a)
Existing Land Use												
Residential		7,690	0.04	300	0.729	219	7,390	0.160	1,180	0.106	787	787
NHS		16,100	0.00	0	0.729	0	16,100	0.133	2,142	0.133	2,142	2,142
TOTAL PRE-DEVELOPMENT		**23,790**		**300**		**219**	**23,490**		**3,322**		**2,928**	**2,928**
Post-Development Land Use												
Residential	Directly Connected Impervious	2,000	1.00	2,000	0.729	1,458	0	0.160	0	0.106	0	0
	Roofs (directed to pervious areas) - silt and clay/till soils (assume 25% of runoff volume infiltrates[a]; excess runoff to storm)	550	1.00	550	0.729	401	0	0.160	0	0.106	0	100
	Impervious to Bioswale	500	1.00	500	0.729	365	0	0.160	0	0.106	0	0
	Pervious to Bioswale	180	0.00	0	0.729	0	180	0.160	29	0.106	19	19
	Bioswale - assume designed to accommodate 17.2 mm storm; 17.2 mm storms account for approximately 85% of total rainfall[b] (73% of total precipitation); so assume 73% of runoff total from areas directed to bioswale will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	287	287
	Impervious to Rear Yard Infiltration Trench	2,400	1.00	2,400	0.729	1,750	0	0.160	0	0.106	0	0
	Pervious to Rear Yard Infiltration Trench	4,100	0.00	0	0.729	0	4,100	0.160	655	0.106	436	436
	Rear Yard Infiltration Trench - assume designed to accommodate 25 mm storm ; 25 mm storms account for approximately 95% of total rainfall[b] (81% of total precipitation); so assume 81% of runoff total from areas directed to infiltration trench will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,947	1,947
	Remaining Pervious	1,860	0.00	0	0.729	0	1,860	0.160	297	0.106	198	198
NHS		12,200	0.00	0	0.729	0	12,200	0.133	1,623	0.133	1,623	1,623
TOTAL POST-DEVELOPMENT		**23,790**		**5,450**		**3,973**	**18,340**		**2,603**		**4,511**	**4,611**
											% Change from Pre to Post	-57
											Effect of development (with no mitigation)	57% increase in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Increase in infiltration with LIDs (m^3/a)= **1,683**

[a] based on estimation in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D

[b] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-10

Water Balance - Existing Conditions and Post-Development with Mitigation
North Tributary (Catchments 102)

		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 Infiltration Volume (m^3/a)
Existing Land Use												
Residential		76,300	0.20	15,630	0.729	11,395	60,670	0.160	9,686	0.106	6,457	6,457
NHS		5,300	0.00	0	0.729	0	5,300	0.133	705	0.133	705	705
TOTAL PRE-DEVELOPMENT		**81,600**		**15,630**		**11,395**	**65,970**		**10,391**		**7,162**	**7,162**
Post-Development Land Use												
Residential	Directly Connected Impervious	19,090	1.00	19,090	0.729	13,917	0	0.160	0	0.106	0	0
	Roofs (directed to pervious areas) - silt and clay/till soils (assume 25% of runoff volume infiltrates[a]; excess runoff to storm)	20,570	1.00	20,570	0.729	14,996	0	0.160	0	0.106	0	3,749
	Impervious to Bioswale	2,500	1.00	2,500	0.729	1,823	0	0.160	0	0.106	0	0
	Pervious to Bioswale	2,900	0.00	0	0.729	0	2,900	0.160	463	0.106	309	309
	Bioswale - assume designed to accommodate 17.2 mm storm; 17.2 mm storms account for approximately 85% of total rainfall[b] (73% of total precipitation); so assume 73% of runoff total from areas directed to bioswale will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,668	1,668
	Impervious to Rear Yard Infiltration Trench	7,980	1.00	7,980	0.729	5,818	0	0.160	0	0.106	0	0
	Pervious to Rear Yard Infiltration Trench	4,480	0.00	0	0.729	0	4,480	0.160	715	0.106	477	477
	Rear Yard Infiltration Trench - assume designed to accommodate 25 mm storm ; 25 mm storms account for approximately 95% of total rainfall[b] (81% of total precipitation); so assume 81% of runoff total from areas directed to infiltration trench will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,292	5,292
	Remaining Pervious	15,430	0.00	0	0.729	0	15,430	0.160	2,463	0.106	1,642	1,642
NHS		8,650	0.00	0	0.729	0	8,650	0.133	1,151	0.133	1,151	1,151
TOTAL POST-DEVELOPMENT		**81,600**		**50,140**		**36,554**	**31,460**		**4,792**		**10,539**	**14,288**
% Change from Pre to Post												-99
Effect of development (with no mitigation)												99% increase in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Increase in infiltration with LIDs (m^3/a)= **7,126**

[a] based on estimation in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D

[b] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

BURNSIDE

TABLE G-11

Water Balance - Existing Conditions and Post-Development with Mitigation
North East Wetland (Catchment 103)

		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 Infiltration Volume (m^3/a)
Existing Land Use												
Residential		6,000	0.00	0	0.729	0	6,000	0.160	958	0.106	639	639
NHS		11,500	0.00	0	0.729	0	11,500	0.133	1,530	0.133	1,530	1,530
TOTAL PRE-DEVELOPMENT		**17,500**		**0**		**0**	**17,500**		**2,488**		**2,169**	**2,169**
Post-Development Land Use												
Residential	Directly Connected Impervious	190	1.00	190	0.729	139	0	0.160	0	0.106	0	0
	Roofs (directed to pervious areas) - silt and clay/till soils (assume 25% of runoff volume infiltrates[a]; excess runoff to storm)	0	1.00	0	0.729	0	0	0.160	0	0.106	0	0
	Impervious to Bioswale	0	1.00	0	0.729	0	0	0.160	0	0.106	0	0
	Pervious to Bioswale	0	0.00	0	0.729	0	0	0.160	0	0.106	0	0
	Bioswale - assume designed to accommodate 17.2 mm storm; 17.2 mm storms account for approximately 85% of total rainfall[b] (73% of total precipitation); so assume 73% of runoff total from areas directed to bioswale will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0
	Impervious to Rear Yard Infiltration Trench	10	1.00	10	0.729	7	0	0.160	0	0.106	0	0
	Pervious to Rear Yard Infiltration Trench	3,000	0.00	0	0.729	0	3,000	0.160	479	0.106	319	319
	Rear Yard Infiltration Trench - assume designed to accommodate 25 mm storm ; 25 mm storms account for approximately 95% of total rainfall[b] (81% of total precipitation); so assume 81% of runoff total from areas directed to infiltration trench will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	394	394
	Remaining Pervious	2,900	0.00	0	0.729	0	2,900	0.160	463	0.106	309	309
NHS		11,400	0.00	0	0.729	0	11,400	0.133	1,517	0.133	1,517	1,517
TOTAL POST-DEVELOPMENT		**17,500**		**200**		**146**	**17,300**		**2,459**		**2,538**	**2,538**
											% Change from Pre to Post	-17
											Effect of development (with no mitigation)	17% increase in infiltration

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Increase in infiltration with LIDs (m^3/a)= **370**

[a] based on estimation in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D

[b] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)

WATER BALANCE CALCULATIONS
Highfair Investments Inc.
Archerhill Court
Aurora, Ontario
Project #: 300052893

TABLE G-12

Water Balance - Existing Conditions and Post-Development with Mitigation
West Tributary (Surface Water Catchments 101 and 202)

		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)
Existing Land Use - Catchment 101												
Residential		7,690	0.04	300	0.729	219	7,390	0.160	1,180	0.106	787	1,399
NHS		16,100	0.00	0	0.729	0	16,100	0.133	2,142	0.133	2,142	2,142
TOTAL PRE-DEVELOPMENT		**23,790**		**300**		**219**	**23,490**		**3,322**		**2,928**	**3,540**
Post-Development Land Use - Catchment 202												
Residential	Impervious to Rear Yard Infiltration Trench	1,830	1.00	1,830	0.729	1,334	0	0.160	0	0.106	0	253
	Pervious to Rear Yard Infiltration Trench	2,140	0.00	0	0.729	0	2,140	0.160	342	0.106	228	65
	Remaining Pervious	0	0.00	0	0.729	0	0	0.160	0	0.106	0	0
	Rear Yard Infiltration Trench - assume designed to accommodate 25 mm storm; 25 mm storms account for approximately 95% of total rainfall[a] (81% of total precipitation); so assume 81% of runoff total from areas directed to infiltration trench will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,065	N/A
NHS		12,200	0.00	0	0.729	0	12,200	0.133	1,623	0.133	1,623	1,623
TOTAL POST-DEVELOPMENT		**16,170**		**1,830**		**1,334**	**14,340**		**1,965**		**2,915**	**1,941**
											% Change from Pre to Post	45
											Effect of development (with no mitigation)	45% reduction in runoff

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Change in runoff (m^3/a)= **-1,599**

[a] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)

TABLE G-13

Water Balance - Existing Conditions and Post-Development with Mitigation
North Tributary (Surface Water Catchments 102 and 203)

		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)
Existing Land Use - Catchment 102												
Residential		76,300	0.20	15,630	0.729	11,395	60,670	0.160	9,686	0.106	6,457	21,081
NHS		31,800	0.00	0	0.729	0	31,800	0.133	4,231	0.133	4,231	4,231
Residential - North Development		5,400	0.41	2,220	0.729	1,618	3,180	0.160	508	0.106	338	2,126
TOTAL PRE-DEVELOPMENT		**113,500**		**17,850**		**13,013**	**95,650**		**14,424**		**11,026**	**27,438**
Post-Development Land Use - Catchment 203												
Residential	Directly Connected Impervious	21,280	1.00	21,280	0.729	15,514	0	0.160	0	0.106	0	15,514
	Roofs (directed to pervious areas) - silt and clay/till soils (assume 25% of runoff volume infiltrates[a]; excess runoff to storm)	21,120	1.00	21,120	0.729	15,397	0	0.160	0	0.106	0	11,548
	Impervious to Bioswale	4,560	1.00	4,560	0.729	3,324	0	0.160	0	0.106	0	898
	Pervious to Bioswale	1,520	0.00	0	0.729	0	1,520	0.160	243	0.106	162	66
	Bioswale - assume designed to accommodate 17.2 mm storm; 17.2 mm storms account for approximately 85% of total rainfall[b] (73% of total precipitation); so assume 73% of runoff total from areas directed to bioswale will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,604	N/A
	Impervious to Rear Yard Infiltration Trench	8,560	1.00	8,560	0.729	6,241	0	0.160	0	0.106	0	1,186
	Pervious to Rear Yard Infiltration Trench	10,050	0.00	0	0.729	0	10,050	0.160	1,604	0.106	1,070	305
	Rear Yard Infiltration Trench - assume designed to accommodate 25 mm storm ; 25 mm storms account for approximately 95% of total rainfall[b] (81% of total precipitation); so assume 81% of runoff total from areas directed to infiltration trench will infiltrate)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,355	N/A
	Remaining Pervious	20,160	0.00	0	0.729	0	20,160	0.160	3,218	0.106	2,146	3,218
NHS		35,050	0.00	0	0.729	0	35,050	0.133	4,663	0.133	4,663	4,663
Residential - North Development		5,400	0.41	2,220	0.729	1,618	3,180	0.160	508	0.106	338	2,126
TOTAL POST-DEVELOPMENT		**127,700**		**57,740**		**42,095**	**69,960**		**10,236**		**17,337**	**39,524**
											% Change from Pre to Post	144
											Effect of development (with no mitigation)	1.4 times increase in runoff

* data provided by SCS Consulting

** figures from Tables G-1 and G-2

Change in runoff (m^3/a)= **12,086**

[a] based on estimation in the LID SWM Planning and Design Guide (CVC & TRCA, 2010) for hydrologic groups C & D

[b] based on the Toronto Wet Weather Flow Management Guidelines (City of Toronto, 2006)

R.J. Burnside & Associates Limited