REPORT

Hydrogeological Investigation - Revised

Shining Hill (Phase 3), 162, 306, 370, 434 & 488 St. John's Sideroad West, Aurora, Ontario

Submitted to:

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Distribution List

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Shining Hill Estates Collection Inc. c/o SCS Consulting Group Ltd. (SCS) to conduct a hydrogeological investigation in support of the draft plan submission process for the proposed development located at 162, 306, 370, 434 & 488 St. John’s Sideroad West in Aurora, Ontario, at the location shown on the Key Plan (Figure 1). This revised report incorporates updates to the development design and Low Impact Development (LID) scheme in November 2021.

The purposes of this hydrogeological investigation are to characterize the existing hydrogeological conditions, to prepare pre- and post-development water balance assessments based on current designs, to assess potential LID options and to assess the potential hydrogeological impacts of development. Further to a request by the Lake Simcoe Region Conservation Authority (LSRCA), six water balances have been prepared on a site-wide basis (one water balance) and for portions of the development contributing to certain adjacent watercourses (three water balances) and wetlands (two water balances). In addition, a preliminary assessment of the need for construction dewatering permitting is included.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report" which are included in Appendix A. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 BACKGROUND

2.1 Site and Project Description

The 31.8 ha development property is located at 162, 306, 370, 434 & 488 St. John’s Sideroad West in Aurora, to the northwest of the intersection of St. John’s Sideroad West and Yonge Street (see Figure 1). The Draft Plan of Subdivision prepared by Malone Given Parsons Ltd. (MGP) is provided in Appendix B (MGP, 2021). It is generally comprised of a 17.8 ha undeveloped natural heritage system / open space block (i.e., Block 95) to the west, and a residential subdivision and private school to the east that total 14.1 ha in area. The 14.1 ha development area is known as the Phase 3 (Aurora) lands. Undeveloped Block 95 is not discussed further in this report. The focus of this report is the proposed 14.1 ha residential subdivision and private school areas, referred to hereafter as the site or the Phase 3 lands.

As shown on Figure 2A, Site Plan, the site is currently occupied by a three-storey residence in the northwest portion of the site, a swimming pool, an indoor horse arena with stables, several outdoor horse arenas, a one-storey residence in the southeast corner of the site, and private roadways. A former ice rink was located in the southeast portion of the site. The majority of the site is grass-covered with paved areas adjacent to the three-storey residence, indoor horse arena and former ice rink.

The site is bordered by the Town of Newmarket municipal boundary, an outdoor horse arena and agricultural land to the north, by St. John’s Sideroad West and residential homes to the south, by undeveloped lands with light to dense vegetation to the east, and by undeveloped lands with light to dense vegetation (i.e., Block 95) and agricultural land to the west.

Based on the Draft Plan of Subdivision, it is understood that the overall Phase 3 development is to be comprised of 87 single-detached homes, 21 townhouses, Saint Anne's School (Block 93) and associated access (Block 101), a neighbourhood park block (Block 94), a stormwater management facility / trail head block (Blocks 96 and 97), servicing blocks (Block 98 and 111), overland flow blocks (Blocks 99 and 100), vista / open space blocks (Blocks 102 to 109), road widening blocks and internal roads.

Based on the Proposed Servicing Plan prepared by SCS (SCS, 2021; see Appendix B), the proposed depths of underground service trenches (e.g., sewers, watermain) typically range from approximately 2 m to 6.5 m below existing grade. A figure showing the Proposed Development Plan is provided as Figure 2B.

2.2 Topography, Drainage and Natural Heritage Features

The site is located within the Tannery Creek sub-watershed of the East Holland River sub-watershed which ultimately reports to Lake Simcoe. As shown on Figure 2A, Tannery Creek is located at distances ranging from approximately 50 m to 200 m east of the site and has a local elevation of approximately 246 metres above sea level (masl). Its associated valley lands are generally located adjacent to the eastern limit of the site. A tributary of Tannery Creek (Tannery Creek West Tributary) is located adjacent to the southwest of the site and has an elevation ranging from approximately 258 masl at St. John's Sideroad West to 270 masl near the western limit of the site. An on-line constructed pond is located approximately 20 m southwest of the site, which discharges to Tannery Creek West Tributary via a riser pipe outlet structure. A second tributary of Tannery Creek (Tannery Creek North Tributary) is located at distances ranging from approximately 25 m north to 100 m northeast of the site and has an elevation ranging from approximately 250 masl to 268 masl in the vicinity of the site.

Based on the Natural Heritage Evaluation prepared by Beacon Environmental (Beacon, 2021), it is our understanding that the Tannery Creek North Tributary is a coldwater and intermittent stream. Tannery Creek and the Tannery Creek West Tributary are understood to be coldwater and permanently flowing streams. Downstream of the confluence of the Tannery Creek North Tributary and Tannery Creek, the thermal regime of Tannery Creek is understood to transition to warmwater.

Water balance assessments for the portions of the site contributing to Tannery Creek, and to the Tannery Creek North and West Tributaries are provided in Section 5 of this report.

Based on ecological land classification information (Beacon, 2021; see Appendix B), the site is primarily comprised of anthropogenic land use, mineral cultural meadow, mixed forest, hedgerow and mineral cultural thicket. A mineral meadow marsh (MAM2) is located in a localized low-lying area in the southeast portion of the site. This feature will not be retained as part of the development and is therefore not assessed further.

Southwest of the site, the land surrounding the on-line pond and the Tannery Creek West Tributary is generally comprised of forested areas. Around the perimeter of the on-line pond, Beacon has identified a relatively small mineral meadow marsh (MAM2), approximately 0.02 ha in size, and a cattail mineral shallow marsh (MAS2-1), approximately 0.03 ha in size. Another mineral meadow marsh (MAM2), approximately 0.1 ha in size, is located approximately 15 m east of the pond. These features are understood to be primarily riverine in nature. A willow mineral thicket swamp (SWT2-2) (herein referred to as the Southern Wetland), approximately 0.4 ha in size, is also located southwest of the site further downstream of the on-line pond, as shown on Figure 2A. The Southern Wetland is understood to include a riverine portion in proximity to the Tannery Creek West Tributary, and a palustrine portion at its north end (i.e., north of the Tannery Creek West Tributary) on the sloped portion of the valley lands. With respect to the features described above as being primarily riverine in nature, the potential for hydrogeological impacts to these features as a result of the proposed development is considered to be low based on the field data presented in Section 3 and as summarized in Section 3.7. Given this distinction, a water balance for the portion of the site contributing to the palustrine section of the Southern Wetland is provided in Section 5.

A reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1) (herein referred to as the Northern Wetland) is located approximately 65 m northeast of the site and is situated primarily on the northern adjoining property on the north side of the Newmarket boundary, as shown on Figure 2A. The Northern Wetland is located at the downstream end of the Tannery Creek North Tributary. A water balance for the portion of the site contributing to the Northern Wetland (i.e., to the south of the Tannery Creek North Tributary) is provided in Section 5.

The site is generally located on tableland areas between Tannery Creek and the North and West Tributaries of Tannery Creek, situated at elevations ranging from approximately 266 masl to 272 masl. As indicated on the Existing Storm Drainage Plan prepared by SCS (SCS, 2021; see Appendix B), the site is divided into a total of five catchments, defined as Catchments 101 to 105. Catchments 101 (4.07 ha) and 105 (2.68 ha) drain in a south to southwest direction to the Tannery Creek West Tributary. Catchments 102 (3.63 ha) and 104 (1.06 ha) drain in a northeast direction to the Tannery Creek North Tributary. Catchment 103 (2.38 ha) drains in an east direction to Tannery Creek. Catchments 101 to 105 total 13.8 ha. The St. John's Sideroad West road widening allowance (0.21 ha; Block 110) located at the south end of the site is excluded from the areas considered in the water balances in this report.

Available on-line LSRCA mapping (https://maps.lsrca.on.ca) indicates that portions of the site are located within LSRCA regulated areas (see Figure 3). Also, based on MNRF mapping, the western portion of the site is located within the Oak Ridges Moraine Conservation Plan Area (Ontario Regulation 140/02) and is part of the Greenbelt, as shown on Figure 3, Regulated Areas.

2.2.1 Water Balance Area Definitions

For the purposes of the six water balances prepared in this report, the following sub-watershed and catchment areas are defined:

- Tannery Creek West Tributary: The entire Tannery Creek West Tributary sub-watershed is defined as the watershed upstream of a point approximately 85 m south of St. John's Sideroad West (see Figure 3). Based on information obtained on-line using the Ontario Flow Assessment Tool (OFAT), pre-development Catchments 101 and 105 (6.75 ha, see Figure 9) represent 5% of the entire Tannery Creek West Tributary sub-watershed (135.3 ha; OFAT, 2021).
- Southern Wetland: Within the entire Tannery Creek West Tributary sub-watershed (135.3 ha), the catchment area draining to the palustrine portion of the Southern Wetland (1.3 ha) is shown on Figure 9. The Southern Wetland catchment represents 1% of the entire Tannery Creek West Tributary sub-watershed (135.3 ha; OFAT, 2021).
- Tannery Creek North Tributary: The entire Tannery Creek North Tributary sub-watershed is defined as the watershed upstream of a point located at the downstream end of the Northern Wetland (see Figure 3). Pre-development Catchments 102 and 104 (4.69 ha, see Figure 9) represent 10% of the entire Tannery Creek North Tributary sub-watershed (45.5 ha; OFAT, 2021).
- Northern Wetland: Within the entire Tannery Creek North Tributary sub-watershed (45.5 ha), the catchment area draining to the Northern Wetland (2.4 ha) (i.e., south of the Tannery Creek North Tributary) is shown

on Figure 9. The Northern Wetland catchment represents 5% of the entire Tannery Creek West Tributary sub-watershed (45.5 ha; OFAT, 2021).

- Tannery Creek Upstream of Yonge Street: The portion of Tannery Creek to which the site contributes run-off is considered to be upstream of a point located approximately 305 m north of St. John's Sideroad West and 320 m west of Yonge Street (see Figure 3). Hereafter, this will be referred to as the Tannery Creek sub-watershed upstream of Yonge Street. Pre-development Catchment 103 (2.38 ha, see Figure 9) represents 0.06% of the Tannery Creek sub-watershed upstream of Yonge Street (3,827.9 ha; OFAT, 2021).
- Site: Overall, pre-development Catchments 101 to 105 (i.e., the 13.8 ha site, see Figure 9) represent 0.4% of the Tannery Creek sub-watershed upstream of Yonge Street.

2.3 Physiography and Geology

The site is mapped within the physiographic region of southern Ontario known as the Schomberg Clay Plains. The physiographic region known as the Oak Ridges Moraine is mapped approximately 700 m west of the site (Chapman and Putnam, 2007). However, as mentioned in Section 2.2, available Region mapping indicates that the western portion of the site is located within the Oak Ridges Moraine Conservation Plan Area (Ontario Regulation 140/02), as shown on Figure 3.

According to published mapping and as presented on Figure 5, Quaternary Soils Map, the surficial soil conditions are composed of fine-textured glaciolacustrine deposits of silt and clay. Off-site to the east and west, the fine-textured glaciolacustrine deposits are overlain by modern alluvial deposits that are mapped parallel to Tannery Creek within its valley lands, and portions of the Tannery Creek North and West Tributary valley lands. A flow terrace is mapped to the east of the site, on the west side of the Tannery Creek valley lands.

The geologic mapping is generally consistent with the conditions encountered during the site-specific subsurface investigation conducted by Soil Engineering Ltd. (see Section 3.2), which indicates relatively thin non-cohesive silt and sand deposits underlain by thick silty clay deposits are predominant.

2.4 Wellhead Protection Areas (WHPA)

Available on-line Region of York (Region) mapping (https://ww6.yorkmaps.ca) indicates that the site is located within an area designated by the Region as Wellhead Protection Areas WHPA-Q1 and -Q2, where WHPA-Q1 is an area designated as being within the cone of influence of a municipal well and WHPA-Q2 is an area where future reduction in recharge would significantly impact that area. Further with respect to the WPHA-Q1 area, the site is located within areas designated as WHPA-B/C/D areas, or the 2-, 5- and 25-year travel time zones, respectively, as shown on Figure 4, Wellhead Protection Areas.

Two municipal wells (nos. 6918411 and 7285109) are located approximately 600 m east of the site and one municipal well (no. 6916976) is located approximately 1.3 km northeast of the site. It is noted that the site is not located within a Significant Groundwater Recharge Area (SGRA), which is defined by the Region as areas with porous soils such as sand or gravel that have higher than average infiltration rates and that are hydraulically connected to a groundwater supply well. Refer to Section 2.5, Water Well Records, for further discussion on the two municipal supply wells.

2.5 Water Well Records

Water well records were obtained from the Ministry of the Environment, Conservation and Parks (MECP). Approximately 20 water well records were reported within 500 m of the site, three of which are reported to be located on the site (nos. 6901581, 6915585 and 6923894). The locations of the reported water well records are shown on Figure 6, Recorded Wells. A table summarizing the water well record data is provided in Appendix C, MECP Recorded Wells. It is noted that historically there was not a requirement to register dug wells with the MECP, and they can be under-represented in the water well record database.

Little information was provided on one of the records (no. 7326065), which is not discussed further. The remaining 19 wells were constructed between 1949 and 2017 and include 6 test holes/observation wells and 13 water supply wells. The water supply wells are comprised of:

- Two public use wells (i.e., nos. 6901581 and 6915585) and one domestic well (i.e., no. 6923894) located on the east side of the site, all of which are drilled wells with well depths ranging from 49.7 metres below ground surface (mbgs) to 81.4 mbgs. The three wells were constructed between 1961 and 1997. The status of these wells is not known to Golder, and it is recommended that, if present, they be decommissioned in accordance with applicable legislation as part of site development activities;
- One public use well (i.e., no. 6913488) located approximately 100 m east of the site. This drilled well is situated on the west side of Tannery Creek in the valley lands, with a ground surface elevation of approximately 251.8 masl, and with a reported well depth of 50.3 m. This well is not one of the active municipal wells discussed in Section 2.4, all of which are located more than 500 m from the site; and
- Seven domestic wells, all of which are drilled wells with well depths ranging from about 29.2 mbgs to 116.4 mbgs and two livestock wells, both of which are bored wells with well depths ranging from about 10.1 mbgs to 13.7 mbgs.

Cross sections summarizing the reported soil stratigraphy on the well records are provided on Figures 6A and 6B, MECP Section A – A’ and B – B’, respectively. In general, the wells were reported to encounter thick clay or till soil units at surface, which contained confined sand or gravel layers/units or were underlain by confined sand or gravel units at various depths. These various confined sand or gravel layers/units are inferred to be the primary aquifers utilized by the private wells. At the three wells present on the site, the reported thickness of the clay/till is on the order of 50 m or more.

Based on the MECP water well record search and our experience in the area, active private well use may be expected generally to the northwest of the intersection of St. John’s Sideroad West and Yonge Street. The relatively recent subdivision developments located south of St. John’s Sideroad West and northeast of the intersection of Bathurst Street and St. John’s Sideroad West in the Town of Aurora, and about 700 m northeast of the site in the Town of Newmarket are municipally serviced by groundwater-based supplies, although remnant private wells may be present on properties that pre-date the recent developments.

As mentioned in Section 2.4, available on-line Region mapping indicates that two municipal wells (nos. 6918411 and 7285109) are located approximately 600 m east of the site and one municipal well (no. 6916976) is located approximately 1.3 km northeast of the site, as shown on Figures 4 and 6. These municipal wells are screened in a deep confined sand and gravel unit at depths ranging from approximately 97.6 mbgs to 106.7 mbgs and overlain by thick clay/till units.

2.6 Previous Reports

The following geotechnical reports have been prepared for the site by Soil Engineering Ltd. (Soil Eng.) and were provided to Golder:

- Soil Engineering Ltd. (January 2021). *A Geotechnical Investigation And Slope Stability Assessment For Proposed Residential Development, Shining Hill Phase 3, 162 St. John's Sideroad, Town of Aurora*. (Soil Eng., 2021A); and
- Soil Engineering Ltd. (January 2021). *A Geotechnical Investigation For Proposed School Block, Shining Hill Phase 3, 306 St. John's Sideroad, Town of Aurora*. (Soil Eng., 2021B).

The factual subsurface data and information obtained in these geotechnical investigation reports were reviewed and pertinent data was used in preparation of this report. The existing borehole and monitoring well locations from the geotechnical investigation are shown on Figure 2A, and the accompanying Record of Borehole sheets are attached in Appendix D.

3.0 SITE CHARACTERIZATION

3.1 Drilling and Monitoring Well Installation

As reported in the geotechnical investigation reports prepared by Soil Eng. (Soil Eng., 2021A/B), the geotechnical field investigation was carried out in September 2020, during which time fourteen boreholes (designated as BH101 to BH108 and BH201 to BH206) were advanced to depths ranging from approximately 6.6 mbgs to 35.3 mbgs. The borehole locations are shown on Figure 2A. The reader is referred to the geotechnical reports for additional details.

Twelve groundwater monitoring wells were installed by Soil Eng. in selected boreholes to monitor groundwater levels and to facilitate Golder's hydrogeological field program. Single groundwater monitoring wells were installed in BH101 to BH108, BH202 and BH205, and a nested groundwater monitoring well was installed at BH206 located near the on-line pond and the Tannery Creek West Tributary (i.e., BH206-D [deep] and BH206-S [shallow]). The wells consist of nominal 50 mm diameter PVC pipe screens surrounded with filter sand pack, above which the annular space adjacent the riser pipe was sealed with bentonite and completed with a flush-mount or stick-up monument casings.

The subsurface soil and groundwater conditions encountered in the boreholes, and details of the monitoring well installations are provided on the Record of Borehole sheets (Appendix D).

3.2 Piezometer and Staff Gauge Installation

One shallow piezometer (P) and staff gauge (SG) pair, P1/SG1, was manually installed by Golder on November 16, 2020 within the Southern Wetland, as shown on Figure 2A. A second shallow piezometer and staff gauge pair, P2/SG2, was manually installed by Golder in the Southern Wetland on June 2, 2021. The shallow piezometers (19 mm inside diameter stainless steel drive point model) were installed to an approximate depth of 1.5 mbgs. The pairs were installed to assess the vertical hydraulic gradient at the Tannery Creek West Tributary and the Southern Wetland in the riverine (i.e., P1/SG1) and palustrine (i.e., P2/SG2) portions of the wetland.

Two shallow piezometer and staff gauge pairs, P3/SG3 and P4/SG4, were manually installed by Golder in the Northern Wetland on June 2, 2021, as shown on Figure 2A. The shallow piezometers (19 mm inside diameter stainless steel drive point model) were installed to an approximate depth of 1.2 mbgs. The pairs were installed to assess the vertical hydraulic gradient at the Tannery Creek North Tributary and the Northern Wetland.

The as-installed piezometer and staff gauge locations and the ground surface and top-of-pipe/gauge elevations were surveyed by Golder using a Trimble Geo 7X GPS capable of 0.1 m accuracy. The ground surface elevations are referenced to geodetic datum.

3.3 Subsurface Soil Conditions

A detailed summary of subsurface soil conditions encountered at the borehole locations is provided in Soil Eng.'s geotechnical investigation reports (Soil Eng., 2021A/B), to which the reader is referred. The Record of Borehole sheets, grain size distribution curves and Atterberg limits testing results for selected soil samples are provided in Appendix D.

The surficial materials encountered at the borehole locations generally consist of topsoil, pavement structure, fill materials and surficial deposits of native silt and sand.

The fill or topsoil fill was encountered in all boreholes except for BH102, BH104, BH106 and BH206. The fill consisted predominantly of topsoil and silty sand, with silty clay, sandy silt or silt encountered at some locations. Where encountered, the fill extended to depths ranging between 0.8 mbgs and 3.3 mbgs, with an average thickness of approximately 1.7 m.

The topsoil and fill were generally underlain by a non-cohesive native deposit ranging in gradation from silt to sand, with an average thickness of approximately 3.2 m. The non-cohesive unit was encountered in all boreholes except for BH101 and BH107.

A deposit of silty clay was generally encountered below the non-cohesive unit or below the fill (e.g., in BH101 and BH107), and was encountered in all boreholes except for BH201 and BH202. Where encountered, the silty clay unit extended to the depth of exploration, which ranged from approximately 6.6 mbgs to 35.3 mbgs.

Cross sections summarizing the encountered soil stratigraphy are provided on Figures 7A to 7C, Site Sections A - A', B - B' and C - C', respectively.

3.4 Water Level Monitoring

3.4.1 Monitoring Wells

Groundwater levels were manually measured at the monitoring wells by Soil Eng. on September 29, 2020, and by Golder on eleven events between November 2020 and November 2021. Water level depths and elevations are provided in Table E-1, Water Level Depths and Elevations (Appendix E). It should be noted that these observations reflect the groundwater conditions encountered at the time of the field investigation and some seasonal and annual fluctuations should be anticipated. Further, stabilized groundwater conditions may not have been present at BH106 on September 29, November 16, November 24, and December 1, 2020.

The depth to groundwater at the monitoring wells ranged from 1.33 mbgs (BH104 on January 19, 2021) to 4.77 mbgs (BH202 on September 9, 2021) and from elevations of 258.30 masl (BH107 on September 29, 2020) to 271.68 masl (BH206-D [deep] on January 19, 2021) on the dates monitored. The groundwater elevation data on September 29, 2020 are shown on the Record of Borehole Sheets (Appendix D), and the groundwater elevation data on December 1, 2020 and January 19, 2021 are shown on Figures 7A to 7C, Site Sections A - A', B - B' and C - C', respectively. The groundwater elevation data from January 19, 2021 are presented in plan view on Figure 8, Water Table (January 2021). In general, shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek

North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary, depending on location (refer to Figure 8).

The groundwater elevations at BH206-D (deep) ranged from about 1.7 m to 2.2 m higher than at BH206-S (shallow) during the monitoring events, indicating an upward vertical gradient at that location. It is noted that the monitoring well in BH105 was installed by Soil Eng. for geotechnical purposes and was screened in the silty clay unit at a lower elevation (i.e., 250.0 masl to 253.1 masl) relative to the other monitoring wells. Therefore, the groundwater levels measured in BH206-D and BH105 are not considered representative of water table conditions.

Automatic data loggers (i.e., pressure transducers) were installed at BH102, BH107, BH206-D (deep) and BH206-S (shallow) on December 1, 2020, set to record every four hours and downloaded on November 12, 2021. Daily precipitation data were obtained from Environment and Climate Change Canada (ECCC) for the Uxbridge West Meteorological Station (ID 6159123), which was the nearest station to the site with daily precipitation data for this period. Hydrographs of the logger data with daily precipitation data are provided as Figures E-2 to E-5, Appendix E. As shown, the data indicate typical seasonal groundwater level fluctuations, with a flat water level trend in the winter months, followed by an increasing trend from March through to seasonally high groundwater levels in mid-April through late-May, a decreasing trend in the warmer and drier summer months through to seasonally low groundwater levels in late-September, followed by increasing trends in the cooler, wetter fall months. The data also indicate that the groundwater elevation in BH102 and BH107 often sharply increases in delayed response to larger rain events. A similar but muted groundwater elevation trend is observed at BH206-D (deep), while the same trends in groundwater elevations were observed at BH206-S (shallow) during this period but without the sharp increases in response to larger rain events.

3.4.2 Piezometers and Staff Gauges

Automatic data loggers were installed at P1/SG1 and P2/SG2 on September 29, 2021, set to record every four hours and downloaded on November 12, 2021. Hydrographs of the logger data is provided as Figure E-6, Appendix E.

At staff gauge SG1, located in the riverine portion of the Southern Wetland, a water depth ranging from 0.23 m to 0.29 m was recorded on the eleven monitoring events between November 2020 and November 2021. Similarly, the logger data confirm that surface water was recorded at SG1 on September 29, 2021 through November 12, 2021, with water depth increases in response to some rain events during this period. These data indicate the consistent presence of surface water at this location in proximity to the Tannery Creek West Tributary. Below grade water levels were recorded at piezometer P1 on the eleven monitoring events between November 2020 and November 2021. A downward hydraulic gradient was observed at P1/SG1 on November 16, November 24 and December 1, 2020, and September 3, September 9 and September 29, 2021. An upward hydraulic gradient was observed at P1/SG1 on January 19, April 8, June 2, June 9, and November 12, 2021. These data suggest seasonal groundwater discharge to the riverine portion of the Southern Wetland at times of seasonally higher groundwater levels. A change from recharging to discharging conditions in late October 2021 is illustrated on the hydrograph presented on Figure E-6. These observations are generally consistent with the classification of the Tannery Creek West Tributary as a permanent coldwater stream, but suggest that permanently discharging conditions are present upstream in the sub-catchment while groundwater contributions in the area of the site may be more seasonal in nature.

Staff gauge SG2, located in the palustrine portion of the Southern Wetland, was dry and groundwater levels below the base of the piezometer (June) or below grade (September and November) were recorded at piezometer P2 on four monitoring events in June, September and November 2021. Shallow groundwater depths with an increasing trend from early-October through mid-November 2021 at P2 are illustrated on the hydrograph presented on Figure E-6. These observations are consistent with the location of P2/SG2 in the palustrine portion of the wetland and suggest this portion of the wetland is supported by at least seasonally high groundwater levels.

Staff gauge SG3 and SG4, located in the Northern Wetland, were dry on all five monitoring events in June and September 2021. Below-grade heads were recorded at piezometers P3 and P4, with fluctuating groundwater levels ranging in depth from 1.23 mbgs (P3 on June 2, 2021) to 0.05 mbgs (P4 on September 29, 2021). These observations are consistent with the classification of the Tannery Creek North Tributary as intermittent, and suggest that the Northern Wetland is supported in part by groundwater levels that fluctuate at times close to grade.

3.5 Hydraulic Testing

Single well response testing (i.e., rising head tests) was carried out at BH103, BH108 and BH202 on November 16, 2020, and at BH101 and BH206-S (shallow) on December 1, 2020. The rising head tests were carried out by rapidly lowering the water levels by purging with a dedicated Waterra footvalve and tubing. The resulting water level recoveries were monitored with an electronic water level tape and automatic data logger. The recovery data were analyzed using the AQTESOLV for Windows (1996 – 2007) Version 4.5 software. The Bouwer and Rice (1976) method for unconfined conditions was applied to the rising head test data. Estimates of hydraulic conductivity (K) obtained from the rising head tests are summarized below in Table 1. Summary printouts of the rising head test data and results from AQTESOLV are included in Appendix F.

Table 1: Summary of Estimated Hydraulic Conductivity

Borehole	Unit Screened	Depth of Monitoring Well (mbgs)	Method	K (cm/s)
BH101	SILTY CLAY	7.6	Bouwer and Rice (1976), unconfined	$2x10^{-6}$
BH103	SANDY SILT	4.6	Bouwer and Rice (1976), unconfined	$1x10^{-3}$
BH108	SANDY SILT	4.6	Bouwer and Rice (1976), unconfined	$5x10^{-4}$
BH202	SILTY FINE SAND	6.1	Bouwer and Rice (1976), unconfined	$4x10^{-4}$
BH206-S (shallow)	SILTY CLAY	7.6	Bouwer and Rice (1976), unconfined	$3x10^{-6}$

Notes:
mbgs – metres below ground surface. cm/s – centimetres per second

The hydraulic conductivity estimates for the non-cohesive sandy silt and silty fine sand soils ranged from $4x10^{-4}$ cm/s to $1x10^{-3}$ cm/s, with a geometric mean of $6x10^{-4}$ cm/s (n=3). The hydraulic conductivity estimates for the silty clay unit ranged from $2x10^{-6}$ cm/s to $3x10^{-6}$ cm/s, with a geometric mean of $3x10^{-6}$ cm/s (n=2). The estimated hydraulic conductivity values are considered reasonable for the units tested.

3.6 Guelph Permeameter Testing

Soil infiltration rate testing was carried out on November 24, 2020 in the unsaturated zone using a Guelph Permeameter (Soilmoisture Equipment Corp., Model 2800K1). The Guelph Permeameter was operated in general accordance with the procedures outlined by the manufacturer (Soilmoisture Equipment Corp., 2012) using a single head method. The apparatus was installed at the base of hand-augered test holes.

Once the outflow of water at the depth of installation reached a steady-state flow rate, the field-saturated hydraulic conductivity, K_{fs}, of the soil was estimated using the following equation (Elrick et. al., 1989):

$$K_{fs} = \frac{C_1 Q_1}{2\,\pi\, H_1^2 + \pi\, a^2\, C_1 + 2\,\pi \frac{H_1}{\alpha^*}}$$

Where:
C_1 = shape factor
Q_1 = flow rate (cm^3/s)
H_1 = water column height (cm)
a = well radius (cm)
α^* = alpha factor (0.12 cm^{-1} for Type 3 soils)

The field data and analysis of the infiltration rate tests are presented as Figures F-1 to F-5, Appendix F. Based on the resulting K_{fs} (cm/s), the corresponding infiltration rates (mm/hr) were estimated using the approximate relationship presented in the *Low Impact Development Stormwater Management Planning and Design Guide* (or "*Design Guide*") (TRCA and CVCA, 2010). A summary of the infiltration rate test results is presented in Table 2, below.

Table 2: Summary of Estimated Infiltration Rates

Test	Soil Description	Test Depth Relative to Grade (mbgs)	Approximate Test Elevation [6] (masl)	Est. Field-Saturated Hydraulic Conductivity K_{fs} (cm/s)	Estimated Infiltration Rate [1] (mm/hr)	Correction Factor	Corrected Estimated Infiltration Rate [2] (mm/hr)
GP-101 (near BH101)	Inferred SILTY SAND (FILL)[3]	1.0	264.0	$9x10^{-5}$	49	3.5	14
GP-102 (near BH102)	SILT	0.7	264.2	$1x10^{-5}$	30	2.5[5]	12
GP-105 (near BH105)	SAND	0.8	266.0	$1x10^{-4}$	50	3.5	14
GP-106 (near BH106)	Inferred SILTY FINE SAND[4]	1.1	264.2	$3x10^{-4}$	62	3.5	18
GP-206 (near BH206)	SAND	0.7	272.6	$1x10^{-3}$	75	2.5[5]	30

Notes:
mbgs – metres below ground surface. cm/s - centimetres per second. mm/hr – millimetres per hour

[1] – based on Table C1 from TRCA and CVCA (2010).

[2] – correction factor in accordance with Table C2 from TRCA and CVCA (2010).

[3] – the base of the test hole was near the contact point between silty sand fill and the underlying silty clay unit. In Golder’s opinion, this result is more representative of silty sand fill.

[4] – the base of the test hole was near the contact point between silty fine sand and the underlying silty clay unit. In Golder’s opinion, this result is more representative of silty fine sand.

[5] – should the clearance between the invert of the LID feature(s) and the underlying silty clay unit be less than 1.5 m, the correction factor should be increased to 3.5.

[6] – approximate elevation of infiltration rate test based on nearby borehole as indicated.

The field-saturated hydraulic conductivity values of the silty sand fill, silt, silty fine sand, and sand ranged from approximately $1x10^{-5}$ cm/s to $1x10^{-3}$ cm/s, with corresponding infiltration rates ranging from 30 mm/hr to 75 mm/hr.

The infiltration rate estimates from this investigation are based on the test methods discussed above and are for the corresponding fill/soil types encountered. They represent the fill/soil conditions at the tested locations and depths only; conditions may vary between and beyond the tested locations. Care should be taken during construction of any proposed infiltration measures to preserve the existing soil structure and avoid compaction and re-working which could reduce its infiltrative properties.

For preliminary design purposes, a correction factor was applied to estimate the design infiltration rate in accordance with guidance provided in TRCA and CVCA (2010), to account for potential reductions in soil permeability due to compaction, smearing during the construction of a given infiltration feature and the gradual accumulation of fine sediments over the lifespan of the infiltration feature. Based on the guidance, a correction factor of 2.5 to 3.5 was applied to the estimated infiltration rates. The corrected infiltration rate estimate ranges from approximately 12 mm/hr to 30 mm/hr, with a geometric mean of 17 mm/hr (n=5). As noted above in Table 2, should the clearance between the invert of the LID feature(s) and the underlying silty clay unit be less than 1.5 m, the correction factor should be increased to 3.5 where applicable.

3.7 Summary

The Phase 3 development site is currently occupied by a three-storey residence in the northwest portion of the site, a swimming pool, an indoor horse arena with stables, several outdoor horse arenas, a one-storey residence in the southeast corner of the site, and private roadways. The majority of the site is grass-covered with paved areas adjacent to the three-storey residence, indoor horse arena and a former ice rink. The site is generally located on tableland areas between Tannery Creek and the North and West Tributaries of Tannery Creek. Portions of the site are mapped within LSRCA regulated areas, and the western portion of the site is mapped within the Oak Ridges Moraine Conservation Plan Area and Greenbelt.

A non-cohesive deposit of silt to sand is the predominant surficial native soil type at the site. The non-cohesive deposit had an average thickness of about 3.2 m but was locally absent at two of 14 borehole locations. It was generally overlain by about 0.8 m to 3.3 m of fill, typically comprised of topsoil fill and silty sand fill, except at boreholes BH102, BH104, BH106 and BH206 where the fill was absent. The estimated geometric mean hydraulic conductivity (below the water table) of the surficial non-cohesive silt and sand soils was $6x10^{-4}$ cm/s (n=3). The estimated geometric mean design infiltration rate (above the water table) of the silt, silty fine sand, and sand was 17 mm/hr (n=4). A relatively thick deposit of silty clay was encountered below the non-cohesive unit or below the fill (e.g., in BH101 and BH107) in all boreholes except for BH201 and BH202. Where encountered, the silty clay unit extended to the depth of exploration, and on-site water well records indicate the silty clay unit is on the order of 50 m thick. The estimated geometric mean hydraulic conductivity (below the water table) of the silty clay unit was $3x10^{-6}$ cm/s (n=2).

The depth to groundwater at the monitoring wells ranged from 1.33 mbgs to 4.77 mbgs and from elevations of 258.30 masl to 271.68 masl on eleven monitoring events between November 2020 and November 2021, although seasonal and annual fluctuations should be expected. Shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary, depending on location.

Off-site to the southwest in proximity to the Tannery Creek West Tributary, Beacon has identified several small wetlands that are riverine in nature. Further downstream, the Southern Wetland includes a riverine portion in proximity to the Tannery Creek West Tributary, and a palustrine portion at its north end (i.e., north of the Tannery Creek West Tributary) on the sloped portion of the valley lands.

Beacon indicates that the Tannery Creek West Tributary and Tannery Creek are classified as permanently flowing coldwater streams. An upward hydraulic gradient was identified at a bi-level monitoring well installation in the southwest portion of the site which is consistent with the presence of coldwater streams in the area. Twelve months of data from the P1/SG1 pair in the riverine portion of the Southern Wetland confirm that the Tannery Creek West Tributary is permanently flowing, although continuous groundwater discharge is inferred to occur upstream of the site while groundwater contributions from the site appear to be seasonal in nature. The potential for hydrogeological impacts to the riverine wetland features as a result of the proposed development is considered low given their location in the lowest parts of the valley lands and the inferred continuous upstream groundwater discharge. The catchment for the palustrine portion of the Southern Wetland is located mainly within the site limits, indicating it is supported by surface and groundwater contributions from the site. Data from the P2/SG2 pair in the palustrine portion of the Southern Wetland indicate the absence of surface water and seasonal high groundwater levels on four monitoring events between June and November 2021.

Beacon indicates that the Tannery Creek North Tributary adjacent to the marsh areas is a coldwater and intermittent stream. Data from the P3/SG3 and P4/SG4 pairs in the Northern Wetland indicate the absence of surface water in June and September 2021, with groundwater levels that fluctuate close to grade at times. These data confirm the intermittent nature of the Tannery Creek North Tributary. The location of the Northern Wetland at the downstream end of the Tannery Creek North Tributary sub-watershed suggests that it is in the location the least susceptible to hydrogeological changes within the catchment.

Most of the infiltration at the site is inferred to discharge locally in the Tannery Creek Sub-watershed. It contributes to seasonal groundwater discharge to the Tannery Creek West Tributary and the adjacent riverine wetlands, and to seasonally high groundwater levels in the palustrine portion of the Southern Wetland and the Northern Wetland. A smaller fraction will likely recharge deeper aquifers and result in groundwater base flow further downstream in the East Holland River sub-watershed. The portions of site currently draining to: the Tannery Creek West Tributary represents 5% of that sub-watershed; to the Tannery Creek North Tributary represents 10% of that sub-watershed; and to Tannery Creek upstream of Yonge Street represents 0.06% of that sub-watershed. Therefore, changes in the water balances to these watercourses will be tempered by their relatively small percentage of the overall inputs within these sub-watersheds.

Groundwater use in the area is expected primarily from municipal wells at distances beyond 500 m from the site utilizing a deep confined aquifer (well depths of 97.6 mbgs to 106.7 mbgs). The site is mapped within a Wellhead

Protection Area (i.e., within the WHPA-Q1/-Q2 areas, and with respect to the WHPA-Q1, the site is located within the WHPA-B/C/D or the 2-, 5- and 25-year zones, respectively, depending on location). Active private well use within 500 m of the site is generally expected to the northwest of the intersection of St. John's Sideroad West and Yonge Street. Thirteen private water supply wells are recorded within 500 m of the site, comprised of two bored wells (depths of 10.1 mbgs and 13.7 mbgs) and 11 deep drilled wells (depths ranging from 29.2 mbgs to 116.4 mbgs), which are inferred to utilize various confined aquifers. Three of the drilled private wells are indicated to be present on the site, although their current status is not known to Golder.

4.0 GROUNDWATER CONTROL

At the time of writing, site designs are at a conceptual or preliminary stage. This section provides a preliminary assessment of short-term (construction) dewatering needs and potential permitting requirements. The assessment should be confirmed once additional details concerning site designs are known. A detailed assessment of construction dewatering needs and potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the MECP.

4.1 Temporary Construction Dewatering Permitting

Based on the Proposed Servicing Plan prepared by SCS (SCS, 2021; see Appendix B), the proposed depths of underground service trenches (e.g., sewers, watermain) typically range from approximately 2 m to 6.5 m below existing grade. As shown on Table E-1 (Appendix E), groundwater levels across the site were observed to range from approximately 1.3 mbgs to 4.8 mbgs on the dates monitored. Therefore, the need for temporary groundwater control during construction is anticipated.

The method of construction dewatering should be solely determined by the Contractor based on their own assessment of the site-specific conditions, and likely by their specialist dewatering contractor. In any case, the groundwater level should be lowered to a minimum of 1 m below the inverts in advance of the excavation reaching the invert levels. Surface water runoff must be directed away from any open excavation.

It is recommended that a licensed, specialist dewatering subcontractor supervise the installation, operation and decommissioning of any dewatering systems for this project, in accordance with applicable legislation. It is understood that a dewatering plan from a specialist subcontractor has not yet been prepared.

Water takings in excess of 50 m^3/day are regulated by the MECP. Certain takings of groundwater for construction site dewatering purposes of less than 400 m^3/day qualify for self-registration on the MECP's Environmental Activity and Sector Registry (EASR). A Category 3 Permit to Take Water (PTTW) is required where the proposed groundwater taking is greater than 400 m^3/day.

The rate of groundwater inflow to excavations will vary during construction. Initially, higher inflow rates will occur as groundwater is removed from storage within the zone of influence. With time, rates will decrease toward a steady-state condition.

Groundwater input from the silty clay unit to servicing trenches is expected to be negligible, with more significant seepage anticipated from the overlying saturated non-cohesive soils (i.e., silt to sand).

Based on the hydrogeological conditions encountered at the borehole locations, the sum of the steady state groundwater inflow rate and the initial removal of groundwater from storage for typical linear servicing activities is estimated to result in construction dewatering rates that exceed 50 m^3/day but are less than 400 m^3/day. Accordingly, the need to register a water taking for construction dewatering purposes on the MECP's EASR should be anticipated at this time. The preparation of a Water Taking Report and Discharge Plan by a qualified professional is also required under the EASR process. This finding should be reviewed upon the completion of detailed design and the development of construction methods and plans.

5.0 HYDROLOGIC WATER BALANCE

Six water balance assessments related to the 13.8 ha Phase 3 development (excluding the 0.21 ha of road widening) were carried out to assess the potential hydrogeological impacts of the proposed site development with respect to post-development infiltration rates, including potential impacts to groundwater-dependent resources. The rationale and areas considered in the water balances are detailed in Sections 2.1 and 2.2. The assessment included the pre- and post-development conditions within the site boundary, and considered all development proposed for the entirety of the site.

5.1 Methods

The water balance assessments were based on meteorological data obtained from ECCC for the Toronto Buttonville A Meteorological Station (ID 6158409), which was the nearest station to the site with a substantial period of historical data (1986 to 2017), information on current and proposed land uses, and native soil types as identified through the subsurface investigation activities at the site.

Water balance calculations are based on the following equation, which is described in more detail below:

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

Where: P = precipitation;

S = change in soil water storage;

ET = evapotranspiration;

R = surface runoff; and

I = infiltration (groundwater recharge).

Precipitation data obtained from ECCC for the Toronto Buttonville A station indicate a mean annual precipitation (P) of 864 mm/yr.

Short-term or seasonal changes in soil water storage (S) are anticipated to occur on an annual basis as demonstrated by the typically dry conditions in the summer months and the wet conditions in the winter and spring. Long-term changes (e.g., year to year) in soil water storage are considered to be negligible in this assessment.

Evapotranspiration (ET) refers to water lost to the atmosphere from vegetated surfaces. The term combines evaporation (i.e., water lost from soil or water surfaces) and transpiration (i.e., water lost from plants and trees). Potential ET refers to the loss of water from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of ET is typically less than the potential rate under dry conditions (e.g., during the summer months when there is a moisture deficit). The mean annual potential ET for the areas considered in the water balances is approximately 635 mm/yr based on data provided by ECCC.

The mean annual water surplus is the difference between P and the actual ET. The water surplus represents the total amount of water available for either surface runoff (R) or groundwater infiltration (I) on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snowmelt, and maximum soil or snow pack storage is exceeded. Maximum soil storage is quantified using a water holding capacity (WHC) specific to the soil type and land use. The WHC data obtained from ECCC are shown in Table G-1, Appendix G.

Infiltration rates were estimated using the method presented in the Ontario Ministry of the Environment (MOE) (now the MECP) *Stormwater Management Planning and Design (SWM) Manual* (MOE, 2003). There are three main factors that determine the percent infiltration of the water surplus: topography, soil type and ground cover. The sum of the fractions representing these three factors establishes the approximate annual percentage of surplus which can be infiltrated in an area with a sufficient downward groundwater gradient. Wetlands (e.g., the on-site mineral meadow marsh [MAM2], see Section 2.2) were assumed to have an upward or negligible downward gradient (i.e., the latter in this instance), resulting in all surpluses being contained in these areas, which were assumed to provide increased evaporation and no infiltration. Pertinent assumptions for pre-development and post-development conditions are described in the following subsections.

5.1.1 Pre-Development Condition

Land use at the site under existing (pre-development) conditions was inferred from details shown on the Topographic Survey (Llyod & Purcell, 2020; see Appendix B) and the ecological land use classification (Beacon, 2021; see Appendix B). The site was considered to be comprised of two sections: the private residential property located west of the hedgerow (Block 93), and the remainder of the private recreational/lawn areas to the east of the hedgerow. The private residence section includes a three-storey stone residence, a garage, and a courtyard. The private residential property also includes a section of mineral cultural meadow and hedgerow along the north boundary. The south border of the private residential property is situated adjacent to the Tannery Creek West Tributary valley lands.

The eastern private recreational area includes an ice rink and dwelling in the southeast and an arena / horse stables in the north. The section also includes scattered sections of mineral cultural meadow, mineral cultural thicket, hedgerows, and mixed forest throughout the property, as well as a section of mineral meadow marsh and coniferous plantations towards the south boundary. The surface treatments within both the private residential property and recreational area include gravel, asphalt, and grassed lawns.

5.1.2 Post-Development Condition

Land use at the site under post-development conditions was based on the Draft Plan of Subdivision and the Site Grading Plan (see Appendix B). On the west side of the site, the three-storey stone residence, garage, and adjoining grounds (i.e., Block 90) are proposed to be redeveloped as Saint Anne’s School (SAS), with changes to the existing land uses including the addition of small roadways connecting the school grounds to the east development, sidewalks, a portable school building, parking lots, detached washroom facilities, and an extension to the existing building. The subdivision development on the east side of the site will include single detached houses, townhouses (Block 88-92), an underground SWM facility / trailhead (Block 97), and a neighbourhood park (Block 94) as described in Section 2.1. The imperviousness of each land use type was estimated as follows, in accordance with the Proposed Storm Drainage Plan (SCS, 2021; see Appendix B) and information provided to Golder:

- Park: 85% impervious;
- Single detached houses: 59% impervious, of which 7% is paved;
- Townhouses: 64% impervious, of which 13% is paved;
- Underground SWM Facility / Trail Head: 85% impervious;
- 15 m road right of way (ROW): 69% impervious;
- 16.5 m road right of way (ROW): 77% impervious;
- 18 m road right of way (ROW): 78% impervious; and
- 23 m road right of way (ROW): 80% impervious.

5.2 Water Balance Parameters

Based on the results of subsurface investigation activities at the site (see Section 3), the existing surficial soil types (predominantly silt to sand) was considered for the purposes of this report to be silt loam based on the U.S. Bureau of Soils classification system and the relative percentages of sand, silt and clay obtained from selected soil samples. For the purpose of this report, the post-development surficial soil type was also considered to be silt loam, noting that this assumption will need to be confirmed during detailed design on the basis of grading plans and any soil importation requirements. Water holding capacities were assigned to this soil type using the values listed in Table 3.1: Hydrologic Cycle Component Values, from the MOE *SWM Manual* (MOE, 2003), as summarized in Table G-2, Appendix G.

The surplus data obtained from ECCC for the respective water holding capacities were split into infiltration and runoff components by applying an infiltration factor based on Table 3.1 from the MOE *SWM Manual* (MOE, 2003). The infiltration factors were based on a sum of site-specific topography, surficial soil type and vegetative cover factors as presented in Table G-2 of Appendix G. Based on the Topographic Survey (Lloyd and & Purcell, 2020; see Appendix B), Preliminary Grading Plan (SCS, 2021, see Appendix B), and the Site Grading Plan (see Appendix B), topography factors of 0.1, representing hilly land (with an average slope of 28 m/km to 47 m/km) and 0.15, representing land with an average slope between the factors of 0.1 and 0.2 (representing rolling land with an average slope 2.8 m/km to 3.8 m/km), were applied to the pre-development and post-development conditions at the site, as applicable. The silt loam soil was considered to have infiltration properties in between open sandy loam and medium combinations of clay and loam. Therefore, the soil was assigned a soils factor of 0.3. Grass-covered areas, meadows and shrubs were assigned a cover factor of 0.1, representing cultivated land. Forested areas (i.e., thicket, mixed forest, and hedgerow) were assigned a cover factor of 0.2, representing woodland. For impervious surfaces (buildings, gravel, and paved areas), no infiltration factor was applied.

The water balance analysis was developed under the following assumptions:

- WHCs were chosen based on Table 3.1 in the MOE *SWM Manual* (2003) corresponding to the silt loam soil type, existing land uses and proposed post-development conditions.
  - Mineral Cultural Thicket / Mixed Forest / Hedgerow / Plantation (Mature Forest): 400 mm WHC and 0.65 infiltration factor (pre- and post-development conditions).
  - Mineral Cultural Meadow (Pasture and Shrubs): 250 mm WHC and 0.55 infiltration factor (pre- and post-development conditions).

  - Lawn / Vistas & Open Space / Overland Flow Area (Urban Lawn): 125 mm WHC and 0.50 or 0.55 infiltration factor, depending on topography (pre- and post-development conditions).
  - Mineral Meadow Marsh (MAM2): Surplus assumed to equal precipitation minus potential evapotranspiration, with a null (i.e., 0%) infiltration factor.
  - Neighborhood Park (Urban Lawn): 125 mm WHC and 0.60 infiltration factor (post-development).
  - Underground SWM Facility (Urban Lawn): 125 WHC, with a null (i.e., 0%) infiltration factor.
  - Impervious Areas (i.e., paved parking lots, artificial turf, roads and rooftops): Surplus assumed as 90% of precipitation and null (i.e., 0%) infiltration factor (Conservation Authorities Geoscience Group, 2013).
- Net surplus was estimated by multiplying the estimated monthly surplus (mm/month) for the assumed WHC by the associated drainage area. Annual evapotranspiration and surplus values were obtained from the meteorological data from the Toronto Buttonville A ECCC Meteorological Station based on the WHC assigned to each land use area.
- Runoff was calculated as the difference between surplus and infiltration.

5.3 Water Balance Results

Average annual water balance assessments were carried out on i) a site-wide basis; for the portions of the site contributing to ii) the entire Tannery Creek West Tributary sub-watershed, iii) the entire Tannery Creek North Tributary sub-watershed and iv) the Tannery Creek sub-watershed upstream of Yonge Street, and for portions of the site contributing to v) the palustrine section of the Southern Wetland and vi) the Northern Wetland bordered by Tannery Creek North Tributary), as described in Section 2.2. For the purposes of this report, the contributing areas of the site are referred to as catchments, which are distinct from the sub-watersheds defined in Section 2.2.1. The results for the pre-development, post-development, and mitigated post-development scenarios are presented in this section for each of the six assessments.

The names of the pre- and post-development contributing areas (catchments) referred to hereafter are summarized in the following table.

Pre-Development (see Figure 9)	Post-Development (see Figure 10)
Catchments 101 & 105 (6.75 ha)	Tannery Creek West (SAS) and Tannery Creek West, collectively the Tannery Creek West Tributary Catchment (5.36 ha)
Catchments 102 & 104 (4.69 ha)	Tannery Creek North (SAS) and Tannery Creek North, collectively the Tannery Creek North Tributary Catchment (5.37 ha)
Catchment 103 (2.38 ha)	Tannery Creek Catchment (3.08 ha)
Southern Wetland (wetland catchment south) (1.31 ha)	Southern Wetland (wetland catchment south) (1.29 ha)
Northern Wetland (wetland catchment north) (2.40 ha)	Northern Wetland (wetland catchment north) (4.01 ha)

Pre-Development (see Figure 9)	Post-Development (see Figure 10)
Site (sum of Catchments 101 to 105) (13.8 ha)	Site (sum of the Tannery Creek West and North Tributary and Tannery Creek Catchments) (13.8 ha)

Section 6.0 provides a discussion of the water balance results for the contributing areas relative to the entire sub-watershed areas for these features.

5.3.1 Pre-Development Condition

5.3.1.1 Site-Wide & Watercourse Catchments

Based on the results of the assessment, the average annual pre-development water balance was estimated on a site-wide and watercourse sub-watershed basis as summarized in Table 3, and as detailed in Tables G-3 to G-6, Appendix G.

Table 3: Pre-Development Average Annual Water Balance Results – Site Wide & Watercourse Catchments

Component	Average Annual Volume m^3/yr			
	Site-Wide (Catchments 101 to 105)	Catchments 101 & 105 (Tannery Creek West Tributary Catchment)	Catchments 102 & 104 (Tannery Creek North Tributary Catchment)	Catchment 103 (Tannery Creek Catchment)
Precipitation (P)	119,320	58,320	40,435	20,565
Evapotranspiration (ET)	71,755	36,320	24,020	11,415
Surplus (S)	47,225	21,835	16,285	9,105
Infiltration (I)	16,740	8,460	5,555	2,725
Runoff (R)	30,485	13,375	10,730	6,380

For the pre-development condition, the estimated average annual runoff from the total site is approximately 30,485 m^3 and the average annual infiltration on the site is approximately 16,740 m^3. The estimated average annual runoff from the Tannery Creek West Tributary Catchment is approximately 13,375 m^3 and the average annual infiltration within this catchment is 8,460 m^3. The estimated average annual runoff from the Tannery Creek North Tributary Catchment is approximately 10,730 m^3 and the average annual infiltration within this catchment is approximately 5,555 m^3. The estimated average annual runoff from the Tannery Creek Catchment is approximately 6,380 m^3 and the average annual infiltration within this catchment is approximately 2,725 m^3.

5.3.1.2 Wetland Catchments

Based on the results of the assessment, the average annual pre-development water balances for Southern Wetland (palustrine portion) and the Northern Wetland were estimated as summarized in Table 4, and as detailed in Tables G-7 to G-8, Appendix G.

Table 4: Pre-Development Average Annual Water Balance Results – Wetlands

Component	Average Annual Volume	
	Southern Wetland	Northern Wetland
Precipitation (P)	11,350	20,735
Evapotranspiration (ET)	6,125	12,075
Surplus (S)	5,190	8,605
Infiltration (I)	1,500	2,690
Runoff (R)	3,690	5,915

For the pre-development condition, the estimated average annual runoff contributing to the palustrine section of the Southern Wetland is approximately 3,690 m^3 and the average annual infiltration contributing to the palustrine section of the Southern Wetland is approximately 1,500 m^3. The estimated average annual runoff contributing to the Northern Wetland is approximately 5,915 m^3 and the average annual infiltration contributing to the Northern Wetland is approximately 2,690 m^3.

5.3.2 Post-Development Condition

5.3.2.1 Site Wide & Watercourse Catchments

Based on the results of the assessment, the average annual post-development water balance was estimated on a site-wide and watercourse catchment basis, as summarized in Table 5, and as detailed in Tables G-3 to G-6, Appendix G.

Table 5: Post-Development Average Annual Water Balance Results - Site Wide & Watercourse Catchments

Component	Average Annual Volume m^3/yr			
	Site-Wide	Tannery Creek West Tributary Catchment	Tannery Creek North Tributary Catchment	Tannery Creek Catchment
Precipitation (P)	119,320	46,310	46,400	26,610
Evapotranspiration (ET)	42,020	18,820	15,600	7,600
Surplus (S)	77,205	27,440	30,760	19,005
Infiltration (I)	9,185	4,415	3,125	1,645
Runoff (R)	68,020	23,025	27,635	17,360

For the post-development condition, the estimated average annual runoff from the site is approximately 68,020 m^3) and the estimated average annual infiltration within the catchment is approximately 9,185 m^3. As a result of land use changes from site development, runoff is expected to increase by 123% (i.e., 30,485 m^3 to 60,020 m^3) and infiltration is expected to decrease by 45% (i.e., 16,740 m^3 to 9,185 m^3) on an average annual basis.

The estimated average annual runoff from the Tannery Creek West Tributary Catchment is approximately 23,025 m^3 and the estimated average annual infiltration within the catchment is approximately 4,415 m^3. As a result of land use changes from site development, runoff is expected to increase by 72% (i.e., 13,375 m^3 to 23,025 m^3) and infiltration is expected to decrease by 48% (i.e., 8,460 m^3 to 4,415 m^3) on an average annual basis.

The estimated average annual runoff from the Tannery Creek North Tributary Catchment is approximately 27,635 m^3 and the estimated average annual infiltration within the catchment is approximately 3,125 m^3. As a result of land use changes from site development, runoff is expected to increase by 158% (i.e., 10,730 m^3 to 27,635 m^3) and infiltration is expected to decrease by 44% (i.e., 5,555 m^3 to 3,125 m^3) on an average annual basis.

The estimated average annual runoff from the Tannery Creek Catchment is approximately 17,360 m^3 and the estimated average annual infiltration within the catchment is approximately 1,645 m^3. As a result of land use changes from site development, runoff is expected to increase by 172% (i.e., 6,380 m^3 to 17,360 m^3) and infiltration is expected to decrease by 40% (i.e., 2,725 m^3 to 1,645 m^3) on an average annual basis.

5.3.2.2 Wetland Catchments

Based on the results of the assessment, the average annual post-development water balance for Southern Wetland (palustrine portion) and the Northern Wetland were estimated as summarized in Table 6, and as detailed in Tables G-7 to G-8, Appendix G.

Table 6: Post-Development Average Annual Water Balance Results – Wetlands

Component	Average Annual Volume	
	Southern Wetland	Northern Wetland
Precipitation (P)	11,375	34,630
Evapotranspiration (ET)	5,425	8,670
Surplus (S)	5,930	25,945
Infiltration (I)	1,310	1,440
Runoff (R)	4,620	24,505

For the post-development condition, the estimated average annual runoff contributing to the palustrine portion of the Southern Wetland is approximately 4,620 m^3 and the estimated average annual infiltration contributing to the palustrine portion of the Southern Wetland is approximately 1,310 m^3. As a result of land use changes from site development, runoff is expected to increase by 25% (i.e., 3,690 m^3 to 4,620 m^3) and infiltration is expected to decrease by 13% (i.e., 1,500 m^3 to 1,310 m^3) on an average annual basis.

The estimated average annual runoff contributing to the Northern Wetland is approximately 24,505 m^3 and the estimated average annual infiltration contributing to the Northern Wetland is approximately 1,440 m^3. As a result of land use changes from site development, runoff is expected to increase by 314% (i.e., 5,915 m^3 to 24,505 m^3) and infiltration is expected to decrease by 46% (i.e., 2,690 m^3 to 1,440 m^3) on an average annual basis.

5.3.3 Post-Development Condition Including Mitigation

Average annual infiltration volumes at the site are expected to decrease relative to pre-development conditions and runoff volumes are expected to increase as a result of development. Groundwater recharge from the site assists to support the Tannery Creek West Tributary, Tannery Creek North Tributary and the Tannery Creek valley lands, which are classified as intermittent and permanent coldwater streams, and the associated natural heritage features, as described in Section 3. In addition, the western portion of the site is within the Oak Ridges Moraine Conservation Plan area, and the site is within the WHPA-Q1 (i.e., within the WHPA-B/C/D areas of York Region municipal wells to the east) and WHPA-Q2 areas. Therefore, it is considered prudent to incorporate low impact development (LID) measures into the development design to mitigate against reductions to post-development infiltration rates to the extent practical. Further, the use of LID measures for stormwater runoff from development sites assists to support the natural hydrologic cycle by helping to maintain groundwater recharge, provide additional water quality treatment and reduce the volume of runoff from a site.

The conceptual LID measures proposed for the site as part of the Functional Servicing design by SCS are presented on the LID Plan (SCS, 2021; see Appendix B), and are comprised of rear-yard infiltration trenches, catchbasin filtration trenches, bioswale filtration/infiltration trenches, downspout disconnection, and on-site infiltration as described below. Preliminary information provided by GEI Consultants Ltd. (GEI, 2021; see Appendix B) indicates that the school block (Block 93) will utilize enhanced grassed swales and filter strips to infiltrate runoff from impervious areas. The designed retention volumes for each of the measures in the Functional Servicing design were provided by SCS (i.e., excluding the school block LID measures). The LID measures are located throughout the site so that the enhancements to post-development infiltration rates and the attenuation of storm water volumes will benefit Tannery Creek as well as the North and West Tributaries of Tannery Creek. The following provides additional description of the LID measures.

Rear-Yard Infiltration Trenches

Rear-yard infiltration trenches along selected proposed single-detached units on Street B (Blocks 14 to 17 and Block 62) and select townhouse units along Street D (Blocks 88, 89 and 92), are proposed to capture flow from rear roof runoff for these proposed dwellings via overland flow.

The infiltration trenches should be designed with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the infiltration trenches will be designed to retain up to an approximately 20 mm storm event. The preliminary rear yard infiltration trench design is shown in the Rear Yard Infiltration Trench Detail in Appendix B (SCS, 2021).

A frequency analysis of precipitation observed at the Toronto Buttonville A station (1986 to 2017) was conducted based on the available storage of the proposed infiltration trenches. A resultant runoff reduction factor of 76.5% was applied to the area draining to the infiltration trenches.

Catchbasin Filtration Trenches

The Draft Plan of Subdivision (see Appendix B) includes 32 single-detached homes along Street B (Blocks 36-67), 20 along the Street E (Blocks 68-87), 12 on Street C (Blocks 21-32), and 18 on Street A (Blocks 1-13, 18-20, and 33-34). Catchbasin filtration trenches along the right of ways of Streets A, B, and C and E are proposed to capture flow from impervious paved surfaces for these proposed dwellings and adjoining street areas via overland flow.

The catchbasin filtration trenches should be designed in accordance with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the filtration trench will be designed with an impermeable liner, which will promote attenuation and settlement of sediments but will not increase infiltration. The preliminary filtration trench design is shown in the Catchbasin Filtration Trench Detail in Appendix B (SCS, 2021).

Bioswales

The following locations have been identified for the use of bioswales to collect and retain runoff (refer to the Draft Plan of Subdivision; Appendix B):

- The north half of Street B adjacent to the neighborhood park, the north half of Street E, and half of the single detached houses along the north side of Street E are proposed to incorporate a bioswale filtration trench which will be designed to capture flow from the impervious surfaces of these proposed dwellings and road via overland flow.
- Street D as well as the adjacent townhouse units are proposed to incorporate a bioswale infiltration trench which will be designed to capture flow from the front roof runoff and other impervious surfaces for these proposed dwellings and road via overland flow.

The bioswales should be designed with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the bioswales will be designed to retain up to an approximately 10 mm storm event. The preliminary bioswale infiltration trench design is shown in the Bioswale/Infiltration Detail in Appendix B (SCS, 2021) and the preliminary bioswale sizing calculations are also provided in Appendix B (SCS, 2021).

A frequency analysis of precipitation observed at the Toronto Buttonville A station (1986 to 2017) was conducted based on the available storage of the proposed bioswale infiltration trench. A resultant runoff reduction factor of 69% was applied to the areas draining towards Street D. No runoff reduction was applied to the areas draining toward the proposed bioswale filtration trench, noting that the proposed design does not include an infiltration component.

On-site Infiltration – Saint Anne's School

The school block will utilize proposed LID measures as shown on the Site Grading Plan prepared by GEI Consultants Ltd. (GEI, 2021; see Appendix B). Enhanced grassed swales are proposed to capture flow from sections of paved road and other impervious surfaces directly in front of the existing residence within Block 93. The school block will also utilize a proposed vegetated filter strip in the southwest corner of Block 93 to infiltrate runoff from the roof of the portable school building near the west side of the property and the adjacent paved road, parking lot, and sidewalk area. In the absence of detailed design information, preliminary runoff reduction rates of 10% and 25% were adopted for this assessment for the enhanced grass swales and vegetated filter strip, respectively, based on the silt loam surficial soil type. Dry Swales are proposed along the north edge of the SAS block, but were not included in this assessment, due to the potential for less than 1 m of separation between the invert of the feature and the seasonally high groundwater table. Designs for these LID features are not available at this time but will be developed at the site plan control stage.

Downspout Disconnection

The Draft Plan of Subdivision (see Appendix B) includes 87 single-detached homes throughout the site. As an LID measure, it is proposed that all single-detached houses that are not serviced by rear-yard infiltration trenches or bioswales would incorporate downspout disconnection to direct flow from front and full roof downspouts to a pervious lawn area that drains away from the building. Downspouts should discharge to a gradual sloped pervious area 3 m away from the foundation that conveys runoff away from the building along a minimum flow path length of 5 m. A runoff reduction rate of 25% was adopted for this assessment, based on the silt loam surficial soil type (TRCA & CVC, 2010).

Groundwater Elevations

The types and locations of the conceptual LIDs consider the available groundwater elevation data and were selected for areas where it was deemed that the use of subsurface LIDs was feasible. The mitigated post-development scenario presented below assumes that a 1 m separation between the subsurface LID inverts and the inferred seasonally high groundwater elevations will be maintained. It is recommended that additional groundwater level monitoring continue through the detailed design stage.

Details such as final grades and the inverts of LID measures will be available as designs progress. The depth to groundwater could present challenges to the implementation of subsurface infiltration features used as LID measures in some areas of the site. In the event that a 1 m separation distance cannot be maintained, a subsurface LID would still enhance post-development infiltration rates, especially at times of seasonally low groundwater conditions, provided that the outlet or overflow of the LID remains above the seasonally high groundwater level. If the separation distance is less than 1 m, less average annual infiltration and more average annual runoff would be achieved than presented below. In any event, the infiltration features also function to capture and attenuate precipitation events at the site and provide a benefit to the storm water management scheme. The findings presented below should be re-assessed at the time of detailed design and on the basis of any additional groundwater elevation data and final grades.

5.3.3.1 Results – Site-Wide & Watercourse Catchments

Based on the above, the average annual mitigated post-development water balance for was estimated on a site-wide and watercourse catchment basis, as summarized in Table 7, and as detailed in Tables G-3 to G-6, Appendix G.

Table 7: Mitigated Post-Development Average Annual Water Balance Results – Site-Wide & Watercourse Catchments

Component	Average Annual Volume m³/yr			
	Site-Wide	Tannery Creek West Tributary Catchment	Tannery Creek North Tributary Catchment	Tannery Creek Catchment
Precipitation (P)	119,320	46,310	46,400	26,610
Evapotranspiration (ET)	42,020	18,820	15,600	7,600
Surplus (S)	77,205	27,440	30,760	19,005
Infiltration (I)	17,205	7,225	5,900	4,080
Runoff (R)	60,000	20,215	24,860	14,925

The proposed LID mitigation scheme is estimated to increase average annual infiltration by approximately 8,020 m^3 and reduce average annual runoff, similarly, compared to the un-mitigated post-development condition. On a site-wide basis, average annual infiltration is estimated to increase by 3% (i.e., 16,740 m^3 to 17,205 m^3) and average annual runoff is expected to increase by 97% (i.e., 30,485 m^3 to 60,000 m^3) as a result of development compared to pre-development conditions.

Considering the proposed LID mitigation, the estimated average annual runoff contributing to the Tannery Creek West Tributary Catchment is approximately 20,215 m^3 and the estimated average annual infiltration within the catchment is approximately 7,225 m^3. As a result of catchment boundary and land use changes from site development, runoff is expected to increase by 51% (i.e., 13,375 m^3 to 20,215 m^3) and infiltration is expected to decrease by 15% (i.e., 8,460 m^3 to 7,225 m^3) on an average annual basis.

Considering the proposed LID mitigation, the estimated average annual runoff contributing to the Tannery Creek North Tributary Catchment is approximately 24,860 m^3 and the estimated average annual infiltration within the catchment is approximately 5,900 m^3. As a result of catchment area and land use changes from site development, runoff is expected to increase by 132% (i.e., 10,730 m^3 to 24,860 m^3) and infiltration is expected to increase by 6% (i.e., 5,555 m^3 to 5,900 m^3) on an average annual basis.

Considering the proposed LID mitigation, the estimated average annual runoff contributing to the Tannery Creek Catchment is approximately 14,925 m^3 and the estimated average annual infiltration within the catchment is approximately 4,080 m^3. As a result of catchment boundary and land use changes from site development, runoff is expected to increase by 134% (i.e., 6,380 m^3 to 14,925 m^3) and infiltration is expected to increase by 50% (i.e., 2,725 m^3 to 4,080 m^3) on an average annual basis.

5.3.3.2 Results – Wetland Catchments

Based on the results of the assessment, the average annual mitigated post-development water balance for the Southern Wetland (palustrine portion) and the Northern Wetland were estimated as summarized in Table 8, and as detailed in Tables G-7 to G-8, Appendix G.

Table 8: Mitigated Post-Development Average Annual Water Balance Results – Wetlands

Component	Average Annual Volume	
	Southern Wetland	Northern Wetland
Precipitation (P)	11,375	34,630
Evapotranspiration (ET)	5,425	8,670
Surplus (S)	5,930	25,945
Infiltration (I)	1,765	4,215
Runoff (R)	4,165	21,730

Considering the proposed LID mitigation scheme and the relatively small changes in the catchment area, average annual infiltration contributing to the palustrine section of the Southern Wetland is estimated to increase by 18% (i.e., 1,500 m^3 to 1,765 m^3) and average annual runoff is expected to increase by 13% (i.e., 3,690 m^3 to 4,165 m^3) as a result of development compared to pre-development conditions.

Considering the proposed LID mitigation scheme and increase in the catchment area, average annual infiltration contributing to the Northern Wetland is estimated to increase by 57% (i.e., 2,690 m^3 to 4,215 m^3) and average annual runoff is expected to increase by 267% (i.e., 5,915 m^3 to 21,730 m^3) as a result of development compared to pre-development conditions.

6.0 DISCUSSION

The site is generally located on tableland areas between the Tannery Creek West Tributary, Tannery Creek North Tributary and Tannery Creek. Portions of the site are mapped within LSRCA regulated areas, and the western portion of the site is mapped within the Oak Ridges Moraine Conservation Plan Area and Greenbelt.

The findings of the subsurface investigation indicate that shallow native soils at the site are predominantly comprised of a non-cohesive silt to sand deposit with an average thickness of about 3.2 m and with moderate hydraulic conductivity. A thick underlying deposit of silty clay has moderate to low hydraulic conductivity. Based on MECP water well records, the thickness of the clay/till aquitard at the site is on the order of 50 m or more. Shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary, depending on location.

Off-site to the southwest in proximity to the Tannery Creek West Tributary, Beacon has identified several small wetlands that are riverine in nature. Further downstream, the Southern Wetland includes a riverine portion in proximity to the Tannery Creek West Tributary, and a palustrine portion at its north end (i.e., north of the Tannery Creek West Tributary) on the sloped portion of the valley lands.

Beacon indicates that the Tannery Creek West Tributary and Tannery Creek are classified as permanently flowing coldwater streams. An upward hydraulic gradient was identified at a bi-level monitoring well installation in the southwest portion of the site which is consistent with the presence of coldwater streams in the area. Twelve months of data from the P1/SG1 pair in the riverine portion of the Southern Wetland confirm that the Tannery Creek West Tributary is permanently flowing, although continuous groundwater discharge is inferred to occur upstream of the site while groundwater contributions from the site appear to be seasonal in nature. The potential for hydrogeological impacts to the riverine wetland features as a result of the proposed development is considered low given their location in the lowest parts of the valley lands and the inferred continuous upstream groundwater discharge. The catchment for the palustrine portion of the Southern Wetland is located mainly within the site limits, indicating it is supported by surface and groundwater contributions from the site. Data from the P2/SG2 pair in the palustrine portion of the Southern Wetland indicate the absence of surface water and seasonal high groundwater levels on four monitoring events between June and November 2021.

Beacon indicates that the Tannery Creek North Tributary adjacent to the marsh areas is a coldwater and intermittent stream. Data from the P3/SG3 and P4/SG4 pairs in the Northern Wetland indicate the absence of surface water in June and September 2021, with groundwater levels that fluctuate close to grade at times. These data confirm the intermittent nature of the Tannery Creek North Tributary. The location of the Northern Wetland at the downstream end of the Tannery Creek North Tributary sub-watershed suggests that it is in the location the least susceptible to hydrogeological changes within the catchment.

The proposed site development is understood to be comprised of 87 single-detached homes, 21 townhouses (Blocks 88-92), an underground SWM facility (Block 97), a park block (Block 94), a school block for Saint Anne's School (Block 93), servicing blocks (Blocks 98 and 111), road widening, internal roads, and trail heads.

Site designs are at a conceptual or preliminary stage, and therefore a preliminary assessment of short-term (construction) dewatering needs and permitting requirements is provided at this time. The need for temporary construction dewatering during the construction of linear underground site services is expected. The need to register a water taking for construction dewatering purposes on the MECP's EASR should be anticipated at this time. The preparation of a Water Taking Report and Discharge Plan by a qualified professional is also required under the EASR process. This finding should be reviewed upon the completion of detailed design and the development of construction methods and plans. A detailed assessment of potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the MECP.

Six water balance estimates were carried out to assess the potential hydrogeological impacts of the proposed development with respect to average annual post-development infiltration rates. The development of the 13.8 ha site, without the implementation of mitigation measures, is expected to result in a 45% reduction in average annual infiltration.

The proposed LID strategy includes the following measures to enhance post-development infiltration rates: rear-yard infiltration trenches, bioswale infiltration trenches, downspout disconnection, enhanced grassed swales, and a vegetated filter strip. Catchbasin filtration trenches and bioswale filtration trenches with an impermeable liner are also proposed that will promote storm water attenuation and settlement of sediments but will not increase infiltration.

6.1 Site-Wide

In the mitigated post-development scenario, average annual infiltration on a site-wide basis is estimated to increase by approximately 3% (i.e., 16,740 m^3 to 17,205 m^3) and average annual runoff is estimated to increase by approximately 97% (i.e., 30,485 m^3 to 60,000 m^3), relative to pre-development rates. The site-wide mitigated-post-development infiltration rate is therefore considered to approximate (i.e., is within +/- 10% of) pre-development conditions, and therefore no impacts to groundwater features (e.g., in the Tannery Creek Sub-Watershed upstream of Yonge Street) including groundwater recharge as it relates to potable groundwater quantity are expected as a result of site development.

Two municipal groundwater supply wells are located approximately 600 m east of the site and one municipal well is located approximately 1.3 km northeast of the site. The site is located within the WHPA-Q1 (i.e., within the WHPA B/C/D or the 2-, 5- and 25-year travel time zones, respectively) and the WHPA-Q2 areas. Given that pre-development infiltration rates will be approximated, no water quantity reduction to the municipal wells is anticipated. Further, these three municipal wells are screened in a deep confined sand and gravel unit at depths ranging from approximately 97.6 mbgs to 106.7 mbgs, and therefore recharge to this aquifer is expected to occur from a broad lateral extent outside of the WHPA-Q1 area.

Active private well use may occur within 500 m of the site, generally to the northwest of the intersection of St. John's Sideroad West and Yonge Street. Three private wells are reported to be present on the site that, if present, are recommended to be decommissioned as part of site development activities. Given that no reduction in post-development infiltration rates is estimated at this time, no water quantity reduction to any remaining off-site private wells is anticipated.

6.2 Tannery Creek West Tributary

Within the Tannery Creek West Tributary Catchment, the average annual infiltration is estimated to decrease by approximately 15% (i.e., 8,460 m^3 to 7,225 m^3) and average annual runoff is estimated to increase by approximately 51% (i.e., 13,375 m^3 to 20,215 m^3), relative to pre-development rates. The 5.36 ha Tannery Creek West Tributary Catchment represents 4% of the 135.5 ha Tannery Creek West Tributary Sub-watershed. Given that the riverine wetland features in proximity to the tributary are located in the topographically low portions of the valley lands and the presence of continuous groundwater discharge upstream of the site, a 0.8% reduction in groundwater contribution to the Tannery Creek West Tributary Sub-watershed are not likely to be significant for groundwater-dependent features. A separate discussion for the palustrine portion of the Southern Wetland is provided below.

As site designs for the school block progress, it is recommended that additional LID measures be considered to target a mitigated post-development infiltration rate within the Catchment that is 10% of pre-development rates.

6.3 Tannery Creek North Tributary

Within the Tannery Creek North Tributary Catchment, the average annual infiltration is estimated to increase by approximately 6% (i.e., 5,555 m^3 to 5,900 m^3) and average annual runoff is estimated to increase by approximately 132% (i.e., 10,730 m^3 to 24,860 m^3), relative to pre-development rates. The Tannery Creek North Tributary Catchment mitigated-post-development infiltration rate is therefore considered to approximate (i.e., is within +/- 10% of) pre-development conditions, and therefore no impacts to groundwater features are expected. A separate discussion for the Northern Wetland is provided below.

6.4 Tannery Creek Upstream of Yonge Street

Within the Tannery Creek Catchment, the average annual infiltration is estimated to increase by approximately 50% (i.e., 2,725 m^3 to 4,080 m^3) and average annual runoff is estimated to increase by approximately 134% (i.e., 6,380 m^3 to 14,925 m^3), relative to pre-development rates. While more infiltration is expected as a result of development compared to pre-development conditions, the Tannery Creek Catchment (3.08 ha) represents 0.08% of the 3,827.9 ha Tannery Creek Sub-watershed upstream of Yonge Street. On this basis, no significant impact to groundwater-dependent features in the Tannery Creek Sub-watershed upstream of Yonge Street is expected.

6.5 Southern Wetland

Most of the palustrine portion of the Southern Wetland receives water contributions from the site. Within the catchment of the palustrine portion of the Southern Wetland, the average annual infiltration is estimated to increase by approximately 18% (i.e., 1,500 m^3 to 1,765 m^3) and average annual runoff is estimated to increase by approximately 13% (i.e., 3,690 m^3 to 4,165 m^3), relative to pre-development rates. While post-development infiltration is expected to slightly increase over pre-development conditions, the increase is not likely to result in measurable changes to groundwater elevations in the palustrine portion of the wetland given the annual variation in precipitation rates.

6.6 Northern Wetland

Within the Northern Wetland Catchment (i.e., south of the Tannery Creek North Tributary), the average annual infiltration is estimated to increase by approximately 57% (i.e., 2,690 m^3 to 4,215 m^3) and average annual runoff is estimated to increase by approximately 267% (i.e., 5,915 m^3 to 21,730 m^3), relative to pre-development rates. The increase in infiltration rates is largely attributed to grading of the proposed park block such that it increases the post-development catchment area of the Northern Wetland.

The Tannery Creek North Tributary is classified as an intermittent coldwater stream, and field data confirms that the North Wetland at least seasonally has no standing surface water and groundwater levels that fluctuate at times close to grade. The Northern Wetland is located at the downstream end (and the topographically lowest portion) of the Tannery Creek North Tributary Sub-watershed; this part of the sub-watershed receives groundwater input from most of the sub-watershed area and is therefore the least susceptible area to groundwater level changes. Further, the Tannery Creek North Tributary Catchment (5.37 ha) represents 12% of the 45.5 ha Tannery Creek North Tributary Sub-watershed. Therefore, while additional groundwater input to the North Wetland Catchment area may occur, the increase is tempered by overall balanced mitigated post-development infiltration rates within the Tannery Creek North Tributary Sub-watershed which contributes to the groundwater regime in the vicinity of the North Wetland.

6.7 Water Quality

Given the proposed LID strategy described above, precipitation falling on certain roof and paved areas will be directed to rear-yard infiltration trenches and bioswales for infiltration. Other areas will infiltrate to grassed areas, including enhanced grass swales and a vegetated filter strip. The infiltration of runoff from residential roof areas is considered have a low potential to degrade groundwater quality. Runoff from paved areas such as low traffic roads, parking areas and sidewalks typically has increased concentrations of one or more of metals, oil and grease, and road salt and should be pre-treated to remove large and fine particulate from runoff using devices such as oil and grit separators, or sedimentation chambers or sumps. With properly designed pre-treatment (e.g., oil grit separator or equivalent) for paved areas, this infiltration is expected to be moderately clean and is expected to have a low potential to degrade groundwater quality at the site, noting that, with the exception of road salt, these materials quickly become immobile in the shallow subsurface. Given the presence of a shallow groundwater flow regime, where most infiltration at the site is expected to report to Tannery Creek Sub-watershed, the potential for water quality impacts to off-site private and municipal water wells using primarily deep confined aquifers is considered to be low.

7.0 RECOMMENDATIONS

Based on the findings of this hydrogeological investigation, the following are recommended:

- The monitoring well network should be maintained and used for further monitoring of groundwater levels. It is recommended that the data loggers installed at P1/SG1, P2/SG2, BH102, BH107, BH206-D (deep) and BH206-S (shallow) remain to continue monitoring seasonal groundwater levels at the site. Once the monitoring wells are no longer required, decommissioning should occur in accordance with applicable legislation.
- A detailed assessment of construction dewatering needs and potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the

MECP. In this regard, a door-to-door private well survey can be carried out to identify any groundwater users within the zone of influence, if required.

- It is recommended that additional LID measures be designed to target a mitigated post-development infiltration rate within 10% of pre-development rates in the Tannery Creek West Tributary Catchment.
- These water balance findings be re-assessed at the time of detailed design and on the basis of seasonal high groundwater elevation data, LID invert design elevations and final grading plans.
- It is recommended that additional soil infiltration rate testing be conducted once LID locations and grading plans are finalized.
- The presence of any private water wells on the site should be investigated. All existing private water wells should be decommissioned in accordance with applicable legislation as part of site development activities.

8.0 CLOSURE

We trust that this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned.

Signature Page

Yours truly,

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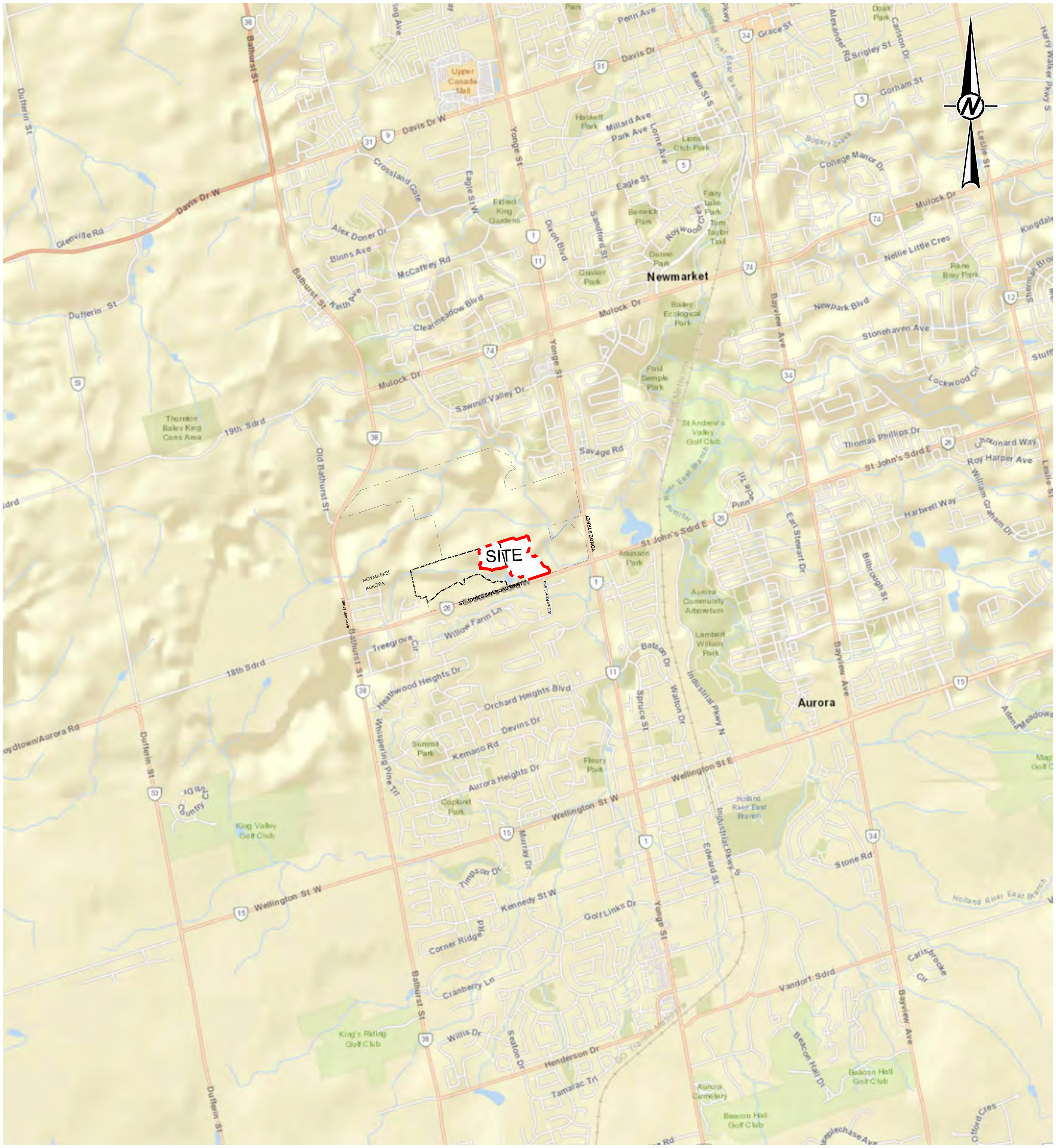
FIGURES



LEGEND

— · — PHASE 3 (AURORA) SITE BOUNDARY

REFERENCES AND NOTES

1. Worldwide Street Maps; Compilation of ESRI & Geographic Partners
2. Malone Given Parson, Draft Plan of Subdivision 16th February 2021

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CLIENT

SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT

HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

TITLE

KEY PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
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Last Edited By: jregier Date: 2021-03-09 Time:3:06:32 PM | Printed By: JRegier Date: 2021-12-16 Time:1:48:39 PM
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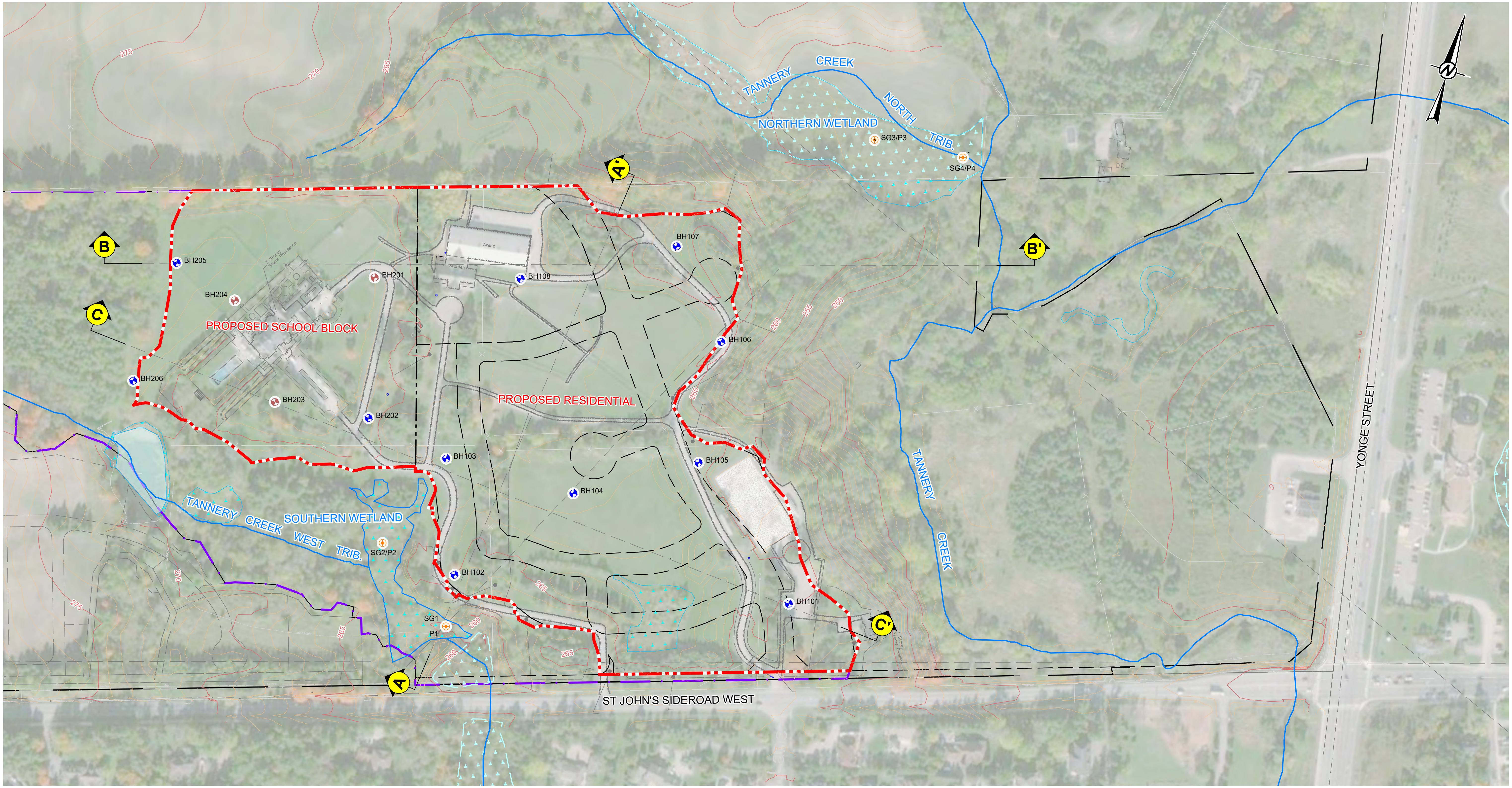

0 50 100 150 m

1:2500

LEGEND

🟥	PHASE 3 (AURORA) SITE BOUNDARY
●	SOIL ENG MONITORING WELL
●	SOIL ENG BOREHOLE
●	GOLDER PIEZOMETER / STAFF GAUGE
Ⓐ	LINE OF SECTION
▨	UNEVALUATED WETLAND (MNRF)
▨	MAPPED WETLAND (BEACON)
—	SITE CONTOURS (1 masl INTERVAL)

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	2A

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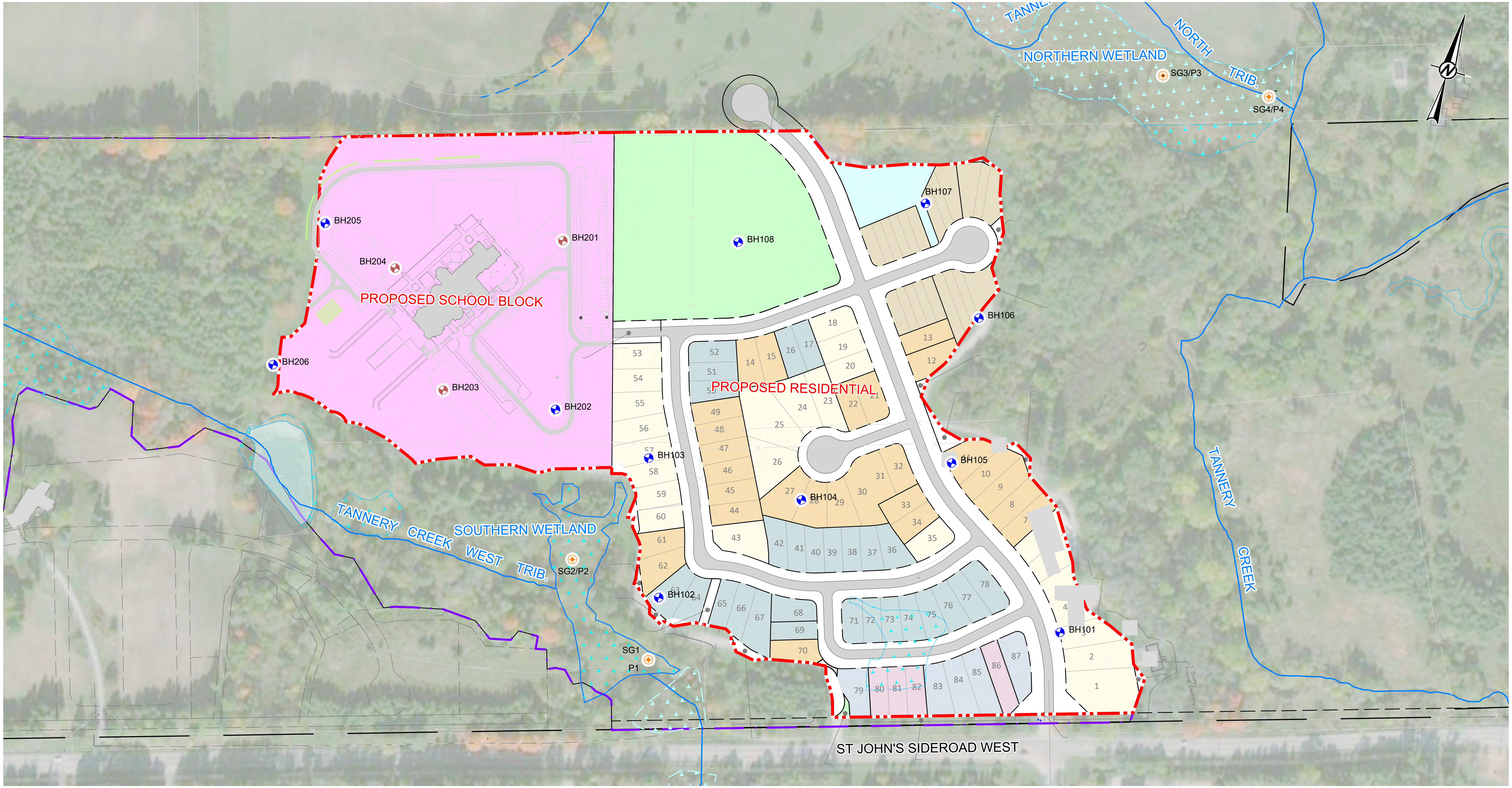

LEGEND

🟥	PHASE 3 (AURORA) SITE BOUNDARY	🟪	SCHOOL BLOCK (EXISTING)
●	SOIL ENG MONITORING WELL	🟩	PARK BLOCK 91
●	SOIL ENG BOREHOLE	🟨	MID-HIGH RESIDENTIAL
●	GOLDER PIEZOMETER / STAFF GAUGE	▨	RESIDENTIAL 15 m FRONTS
		▨	RESIDENTIAL 12 m FRONTS
		🟧	RESIDENTIAL 13 m FRONTS
		▨	RESIDENTIAL 13 m LANE
		▨	RESIDENTIAL 12 m LANE

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. DRAFT PLAN, MALONE GIVEN PARSONS; FEBRUARY 2021

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
PROPOSED DEVLOPMENT PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	2B

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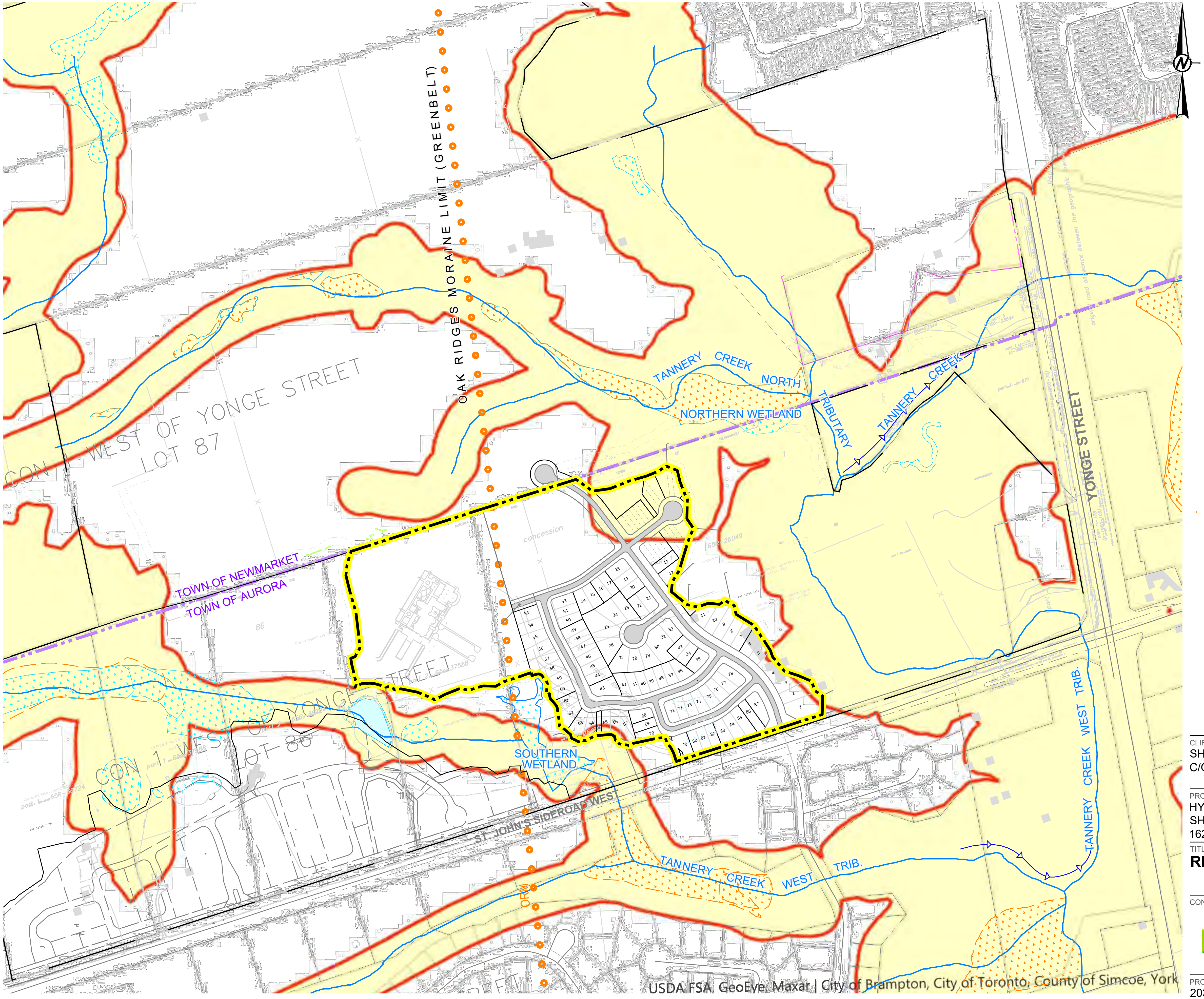

LEGEND

▬ ▪ ▪ ▬	PHASE 3 (AURORA) LIMITS
▨	MAPPED WETLANDS (BEACON)
▨	LSRCA REGULATED AREA (see note)
● ● ● ●	OAK RIDGES MORAINE LIMIT (GREENBELT)

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Regulated Areas, Lake Simcoe Region Conservation Authority
3. Concept Plan, Malone Given Parsons; November 2021
4. Mapped Features and Locations are Approximate and Not to Scale

0 100 200 300 m
1:5000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
REGULATED AREAS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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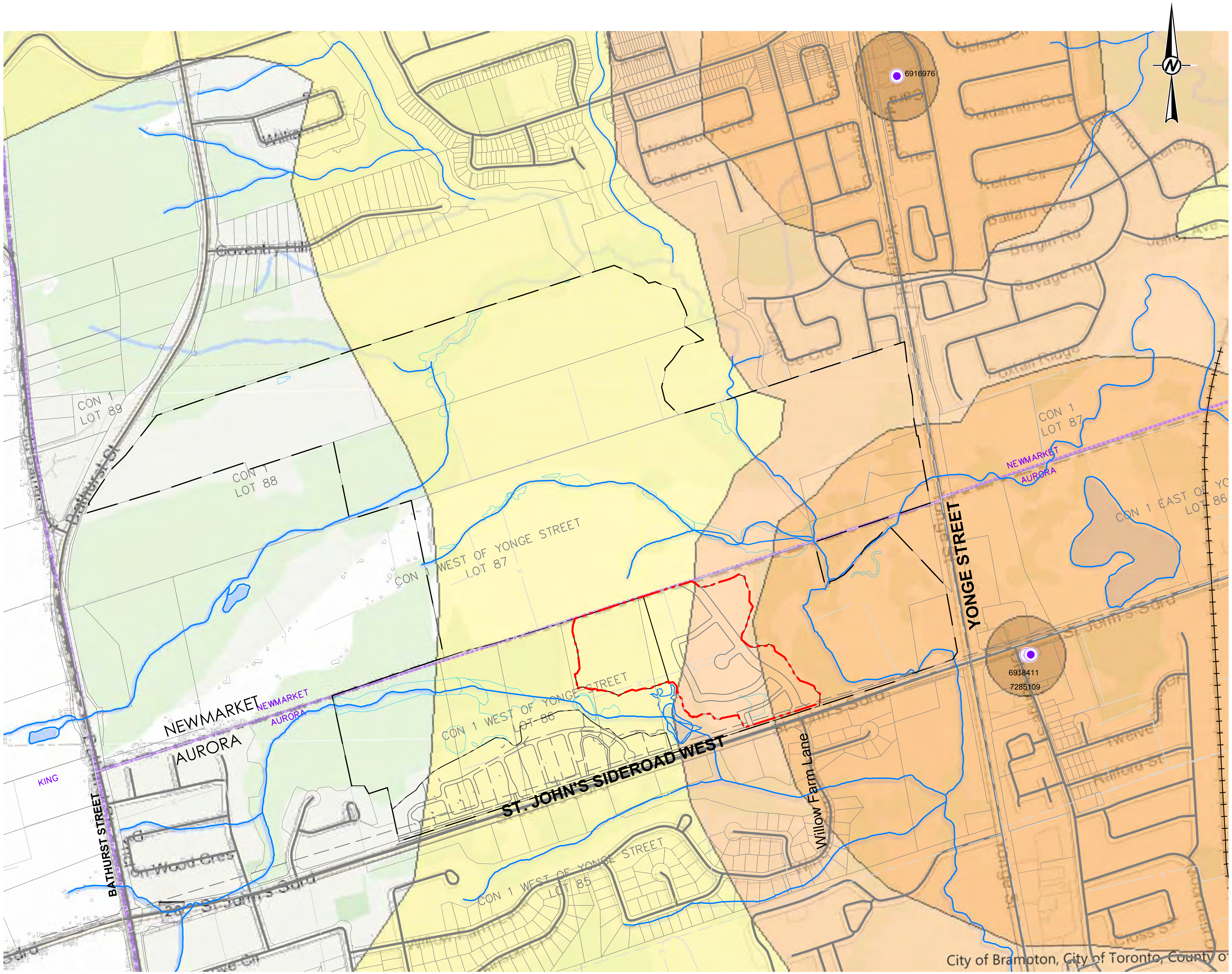

LEGEND

🟥	PHASE 3 (AURORA) SITE BOUNDARY
●	MUNICIPAL SUPPLY WELL
🟥	100 m WHPA A
🟧	2 YEAR WHPA ZONE
🟧	5 YEAR WHPA ZONE
🟨	25 YEAR WHPA ZONE

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Selected MOE Centroid Well Locations have been relocated based on Drillers Record
3. Region of York, Source Water Protection
4. Mapped Features and Locations are Approximate and Not to Scale

0 200 400 600 m

1:10000

CLIENT

SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT

HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE

WELLHEAD PROTECTION AREAS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25 mm
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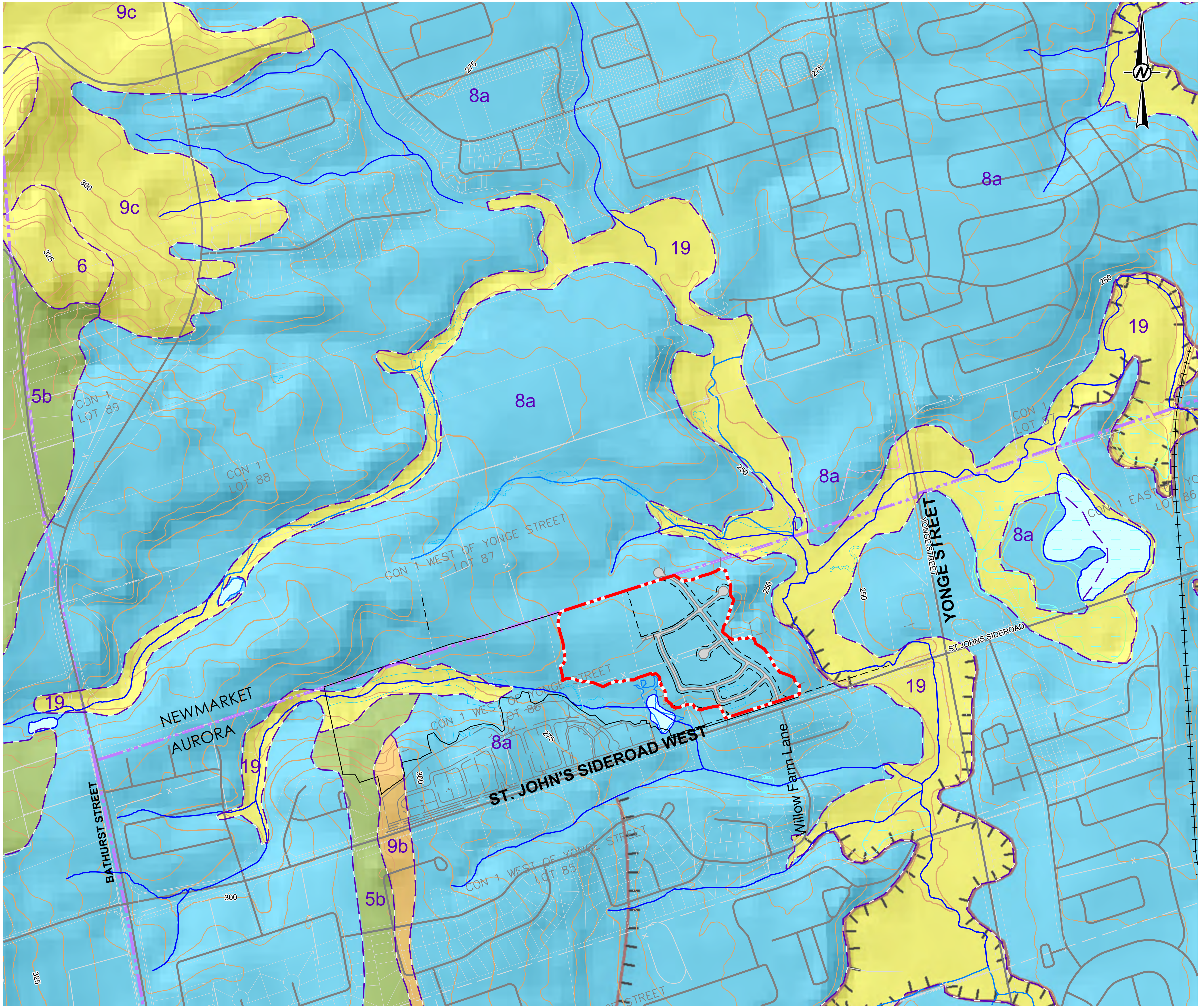

LEGEND

PHASE 3 (AURORA) BOUNDARY

🟨	19	FLUVIAL SILT, SAND, GRAVEL
🟧	9b	GLACIOLACUSTRINE SAND DEPOSITS
🟨	9c	GLACIOLACUSTRINE SILT & SAND DEPOSITS
🟦	8a	GLACIOLACUSTRINE DEEP WATER DEPOSITS
🟧	6	ICE CONTACT SEDIMENTS, ESKERS
🟩	5b	ABLATION TILL

FLOW TERRACE

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Quatenary Geology, OGS / GSC Digital Compilation, Queen's Printer

0 200 400 600 m

1:10000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
QUATERNARY SOILS MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	5

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25 mm
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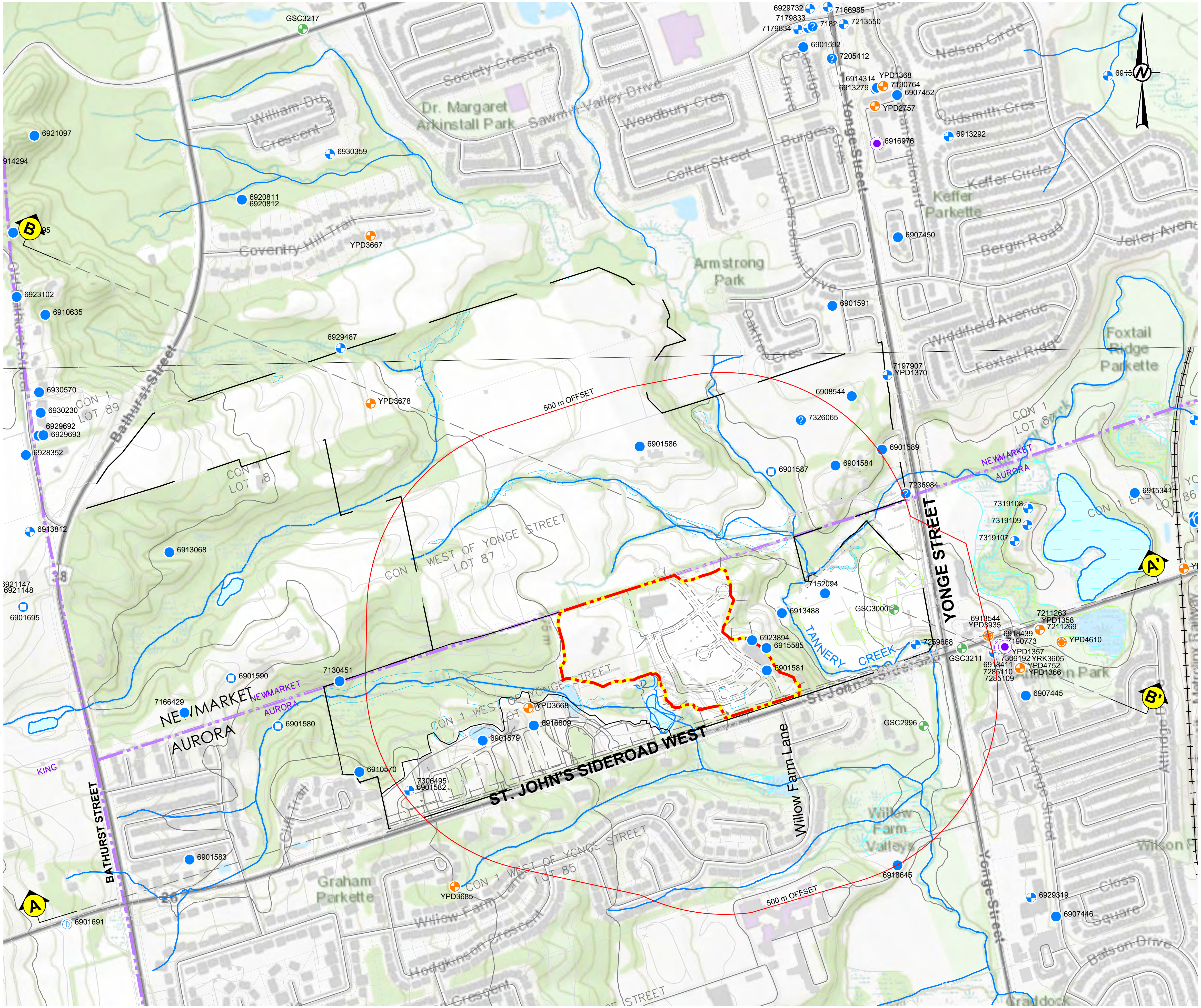

LEGEND

PHASE 3 (AURORA) SITE BOUNDARY

MOE WATER WELL RECORD		OAK RIDGES MORAINE DATABASE	
◕	TEST OR OBSERVATION WELL	◕	OGS / GSC BOREHOLE
Ⓓ	DUG WELL	◕	MONITORING WELL
▢	BORED WELL	✺	TEST HOLE TO BEDROCK
●	DRILLED WELL		
✺	DRILLED TO BEDROCK		
◉	MUNICIPAL SUPPLY WELL		
6200000	MOE NUMBER		

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Selected MOE Centroid Well Locations have been relocated based on Drillers Record
3. Abandoned wells, Centroid located wells, and Temporary Shallow Dewatering wells excluded
4. Mapped Features and Locations are Approximate and Not to Scale
5. Minsitry Water Well Records, Queen's Printer 2020
6. Conservation Authorities Oak Ridges Moraine (ORM) Coalition / TRCA Database

0 200 400 600 m

1:10000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
MINISTRY RECORDED WELLS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	6

25 mm
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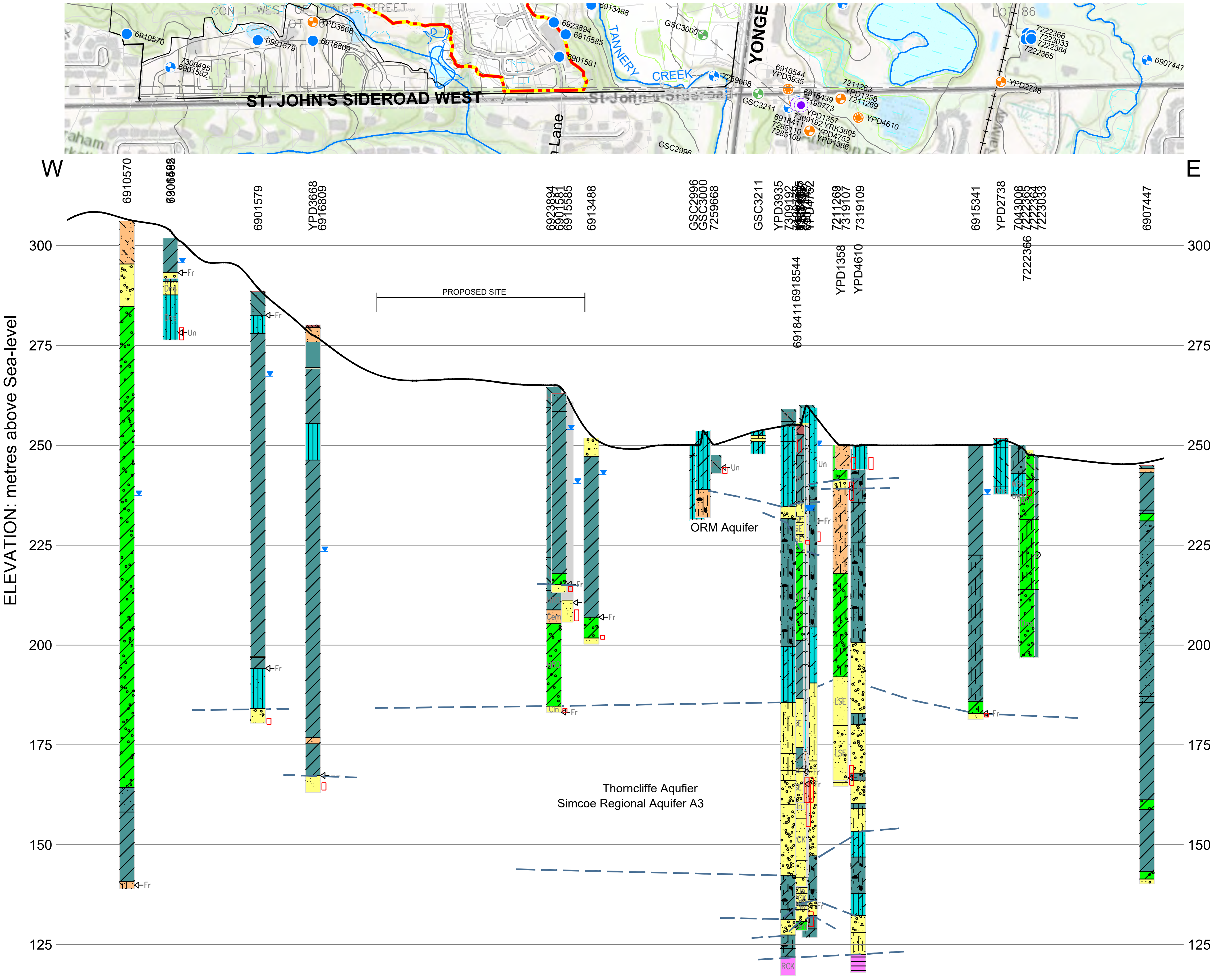

PLAN LEGEND

- ◌ SHALLOW DUG OR BORED <10 M
- ◌ DEEP BORED WELL >10 M
- ● DRILLED OVERBURDEN WELL
- ◐ TEST OR OBSERVATION WELL
- ▨ DRILLED BEDROCK WELL
- ◉ MUNICIPAL / PUBLIC SUPPLY
- ⊗ RECORD OF ABANDONMENT

OAK RIDGES MORAINE DATABASE

- ◐ OGS / GSC BOREHOLE
- ◐ MONITORING WELL
- ✱ TEST HOLE TO BEDROCK

SOIL PATTERN LEGEND AND GENERIC SHADING

▨	UNOXIDIZED CLAY BLUE, GREY WHITE, OR UNDEFINED	⬜	UNKNOWN
▧	OXIDIZED CLAY BROWN, RED, YELLOW	🟥	PEAT/LOAM
▥	SILT	🟨	SANDS & GRAVELS
∴	SAND	🟧	GRANULAR TILL
△	GRAVEL	🟦	SILT
○	STONES, PEBBLES	🟦	SILT CLAYEY
◯	BOULDER	🟦	CLAY
▪	TILL	🟩	TILL
▤	SHALE	🟪	LIMESTONES
▦	LIMESTONE	🟪	SHALES

- 23453 MOE RECORDED PRIVATE WELL
- ▼ RECORDED STATIC WATER LEVEL
- ↗ FLOWING WELL
- ◁ WATER PRODUCING ZONE
- ▯ SCREEN

NOTES

MINISTRY OF ENVIRONMENT WATER WELL INFORMATION SYSTEM, QUEEN'S PRINTER. LOCATION AND ELEVATIONS OF FIELD VERIFIED WELLS ARE SUBJECT TO REVISION.

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 200 400 600 m

1:10000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
AREA CROSS-SECTION A - A'

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	6A

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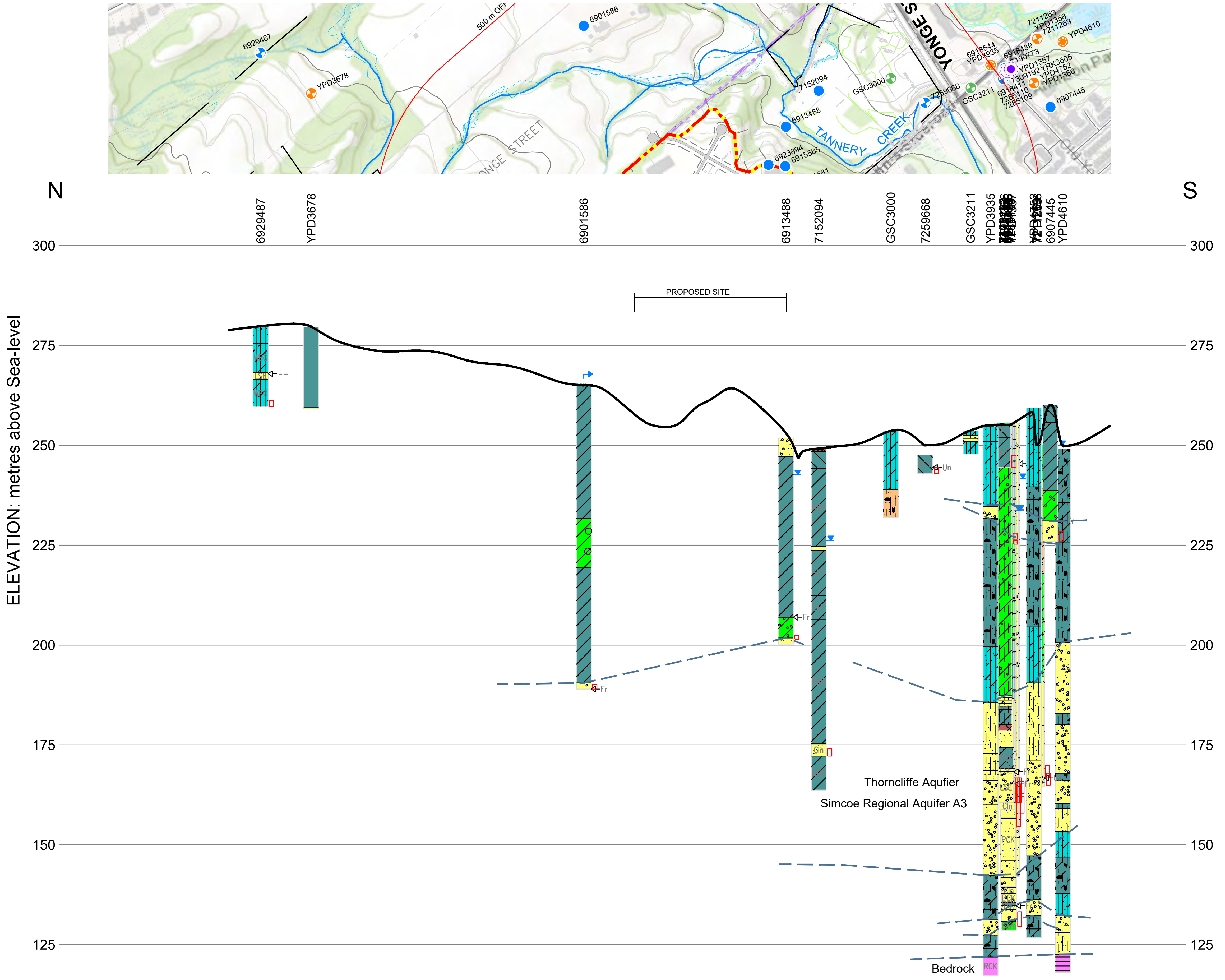

PLAN LEGEND

- Ⓓ SHALLOW DUG OR BORED <10 M
- ▢ DEEP BORED WELL >10 M
- ● DRILLED OVERBURDEN WELL
- ◕ TEST OR OBSERVATION WELL
- ⊕ DRILLED BEDROCK WELL
- ◉ MUNICIPAL / PUBLIC SUPPLY
- ⊗ RECORD OF ABANDONMENT

OAK RIDGES MORAINE DATABASE

- ◕ OGS / GSC BOREHOLE
- ◕ MONITORING WELL
- ⊕ TEST HOLE TO BEDROCK

SOIL PATTERN LEGEND AND GENERIC SHADING

- ▨ UNOXIDIZED CLAY
  BLUE, GREY WHITE, OR UNDEFINED
- ▧ OXIDIZED CLAY
  BROWN, RED, YELLOW
- ▥ SILT
- ⁘ SAND
- △ GRAVEL
- ○ STONES, PEBBLES
- ◯ BOULDER
- ⁙ TILL
- ▤ SHALE
- ▦ LIMESTONE

- ⬜ UNKNOWN
- 🟫 PEAT/LOAM
- 🟨 SANDS & GRAVELS
- 🟧 GRANULAR TILL
- 🟦 SILT
- 🟦 SILT CLAYEY
- 🟦 CLAY
- 🟩 TILL
- 🟪 LIMESTONES
- 🟪 SHALES

23453 MOE RECORDED PRIVATE WELL

▼ RECORDED STATIC WATER LEVEL

↱ FLOWING WELL

◁ WATER PRODUCING ZONE

▯ SCREEN

NOTES

MINISTRY OF ENVIRONMENT WATER WELL INFORMATION SYSTEM, QUEEN'S PRINTER. LOCATION AND ELEVATIONS OF FIELD VERIFIED WELLS ARE SUBJECT TO REVISION.

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 200 400 600 m
1:10000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN’S SIDEROAD WEST, AURORA

TITLE
AREA CROSS-SECTION B - B'

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	6B

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25 mm
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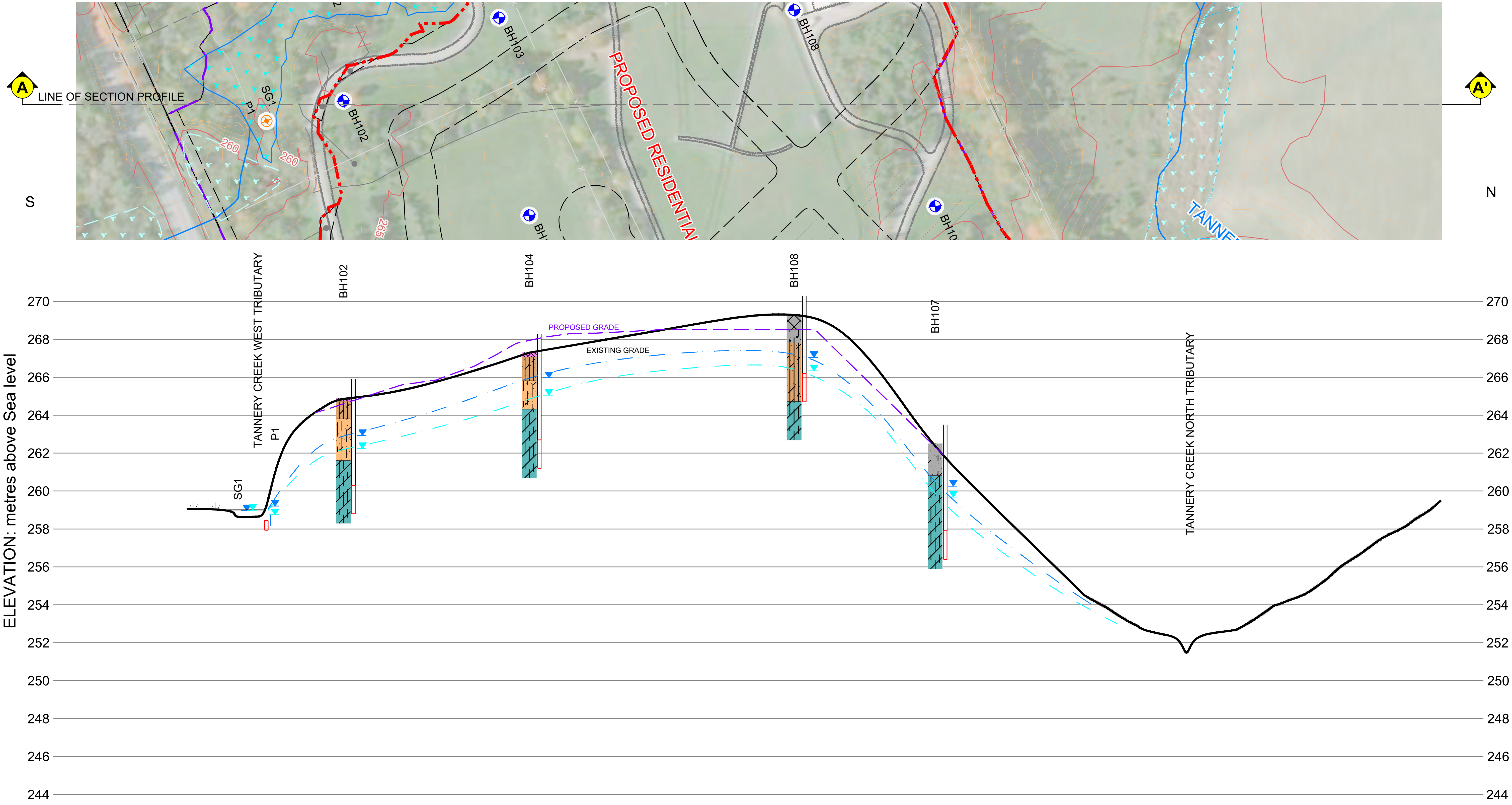

SOILS LEGEND

☒	EARTH / TOPSOIL FILL	▨	TOPSOIL
▒	GRANULAR FILL	▨	SILTY SAND TRACE CLAY
░	SAND	▨	SANDY SILT WITH TO TRACE CLAY
░	SAND TRACE SILT SILTY SAND	▨	SILTY CLAY

SECTION LEGEND

BH1	BOREHOLE ID
▼	RECORDED STATIC WATER LEVEL 1st DECEMBER 2020
▼	RECORDED STATIC WATER LEVEL JANUARY 2021
▯	SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 40 80 120 m
1:2000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION A - A'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	7A

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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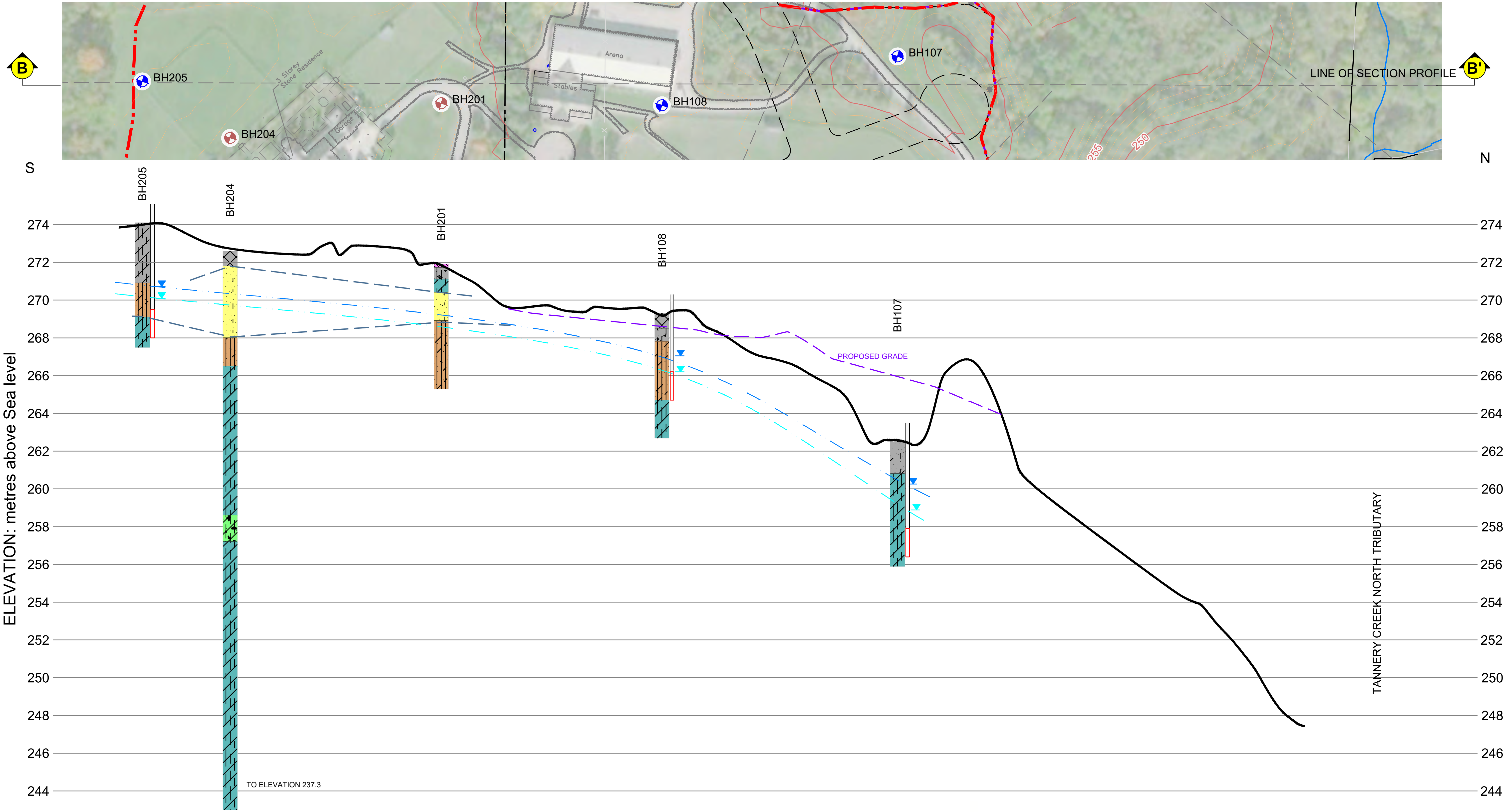


SOILS LEGEND

▨	EARTH / TOPSOIL FILL
▨	GRANULAR FILL
▨	SAND
▨	SAND TRACE SILT
▨	SILTY SAND
▨	TOPSOIL
▨	SILTY SAND TRACE CLAY
▨	SANDY SILT WITH TO TRACE CLAY
▨	SILTY CLAY
▨	SILTY SAND DIAMICT
▨	SILTY CLAY DIAMICT

SECTION LEGEND

BH1	BOREHOLE ID
▼	RECORDED STATIC WATER LEVEL 1st DECEMBER 2020
▼	RECORDED STATIC WATER LEVEL JANUARY 2021
▯	SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 40 80 120 m
1:2000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

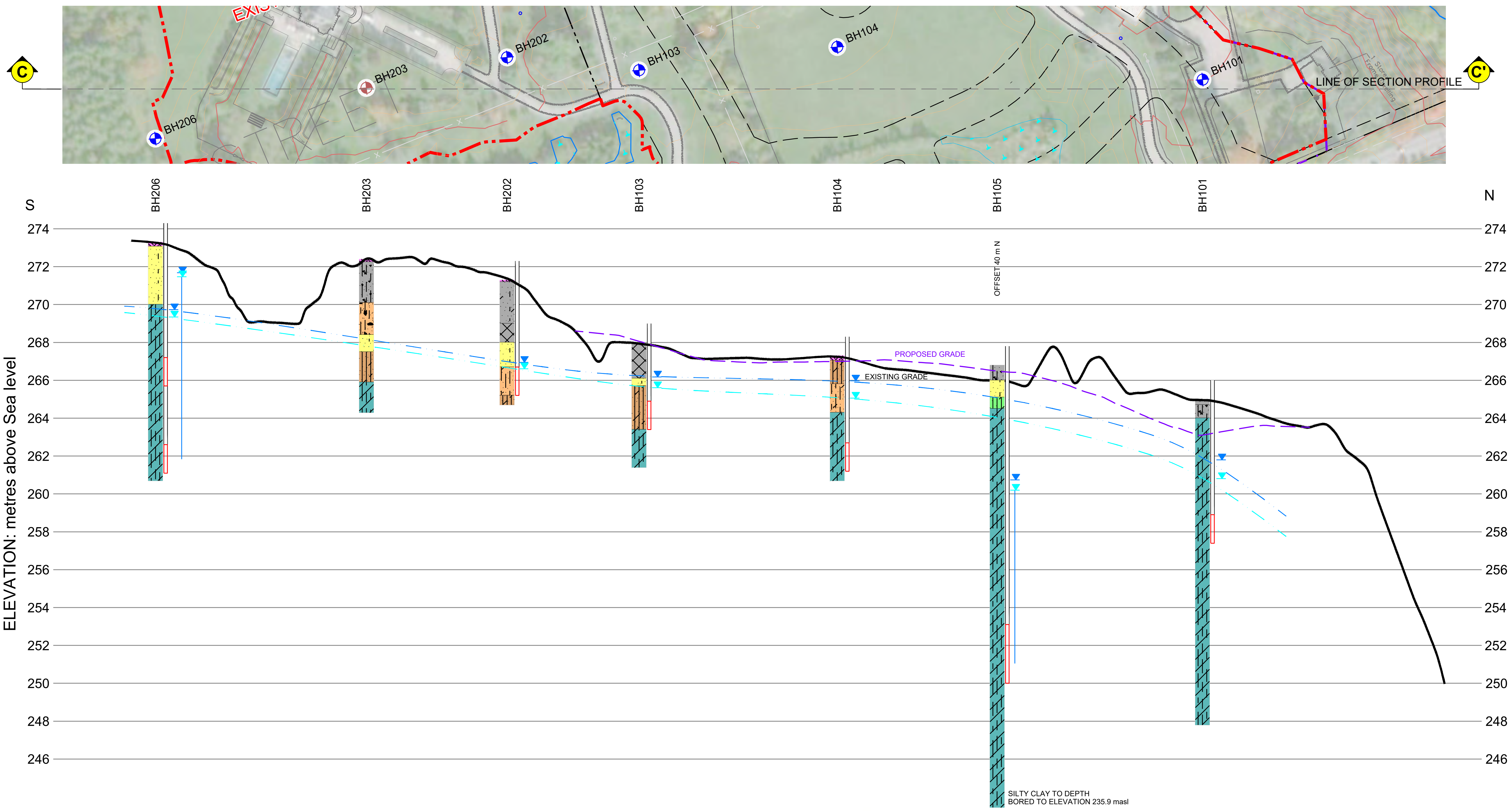
PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION B - B'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	7B

25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\gal\Barrie\ComplexData\SIM\Clients\Shining_Hill_Estates_Aurora\162_St_Johns_SideRoad\99_PROJ\20360612_SCS\40_PROD\0001-HydroG\ | File Name: 20360612-0001-CH-0002.dwg | Last Edited By: jregier Date: 2021-12-16 Time:1:06:19 PM | Printed By: JRegier Date: 2021-12-16 Time:1:35:05 PM



SILTY CLAY TO DEPTH
BORED TO ELEVATION 235.9 masl

SOILS LEGEND

- ▨ EARTH / TOPSOIL FILL
- ▨ GRANULAR FILL
- ▨ SAND
- ▨ SAND TRACE SILT
- SILTY SAND
- ▨ TOPSOIL
- ▨ SILTY SAND TRACE CLAY
- ▨ SANDY SILT WITH TO TRACE CLAY
- ▨ SILTY CLAY
- ▨ SILTY SAND DIAMICT
- ▨ SILTY CLAY DIAMICT

SECTION LEGEND

- BH1 BOREHOLE ID
- ▼ RECORDED STATIC WATER LEVEL 1st DECEMBER 2020
- ▼ RECORDED STATIC WATER LEVEL JANUARY 2021
- ▯ SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 40 80 120 m
1:2000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

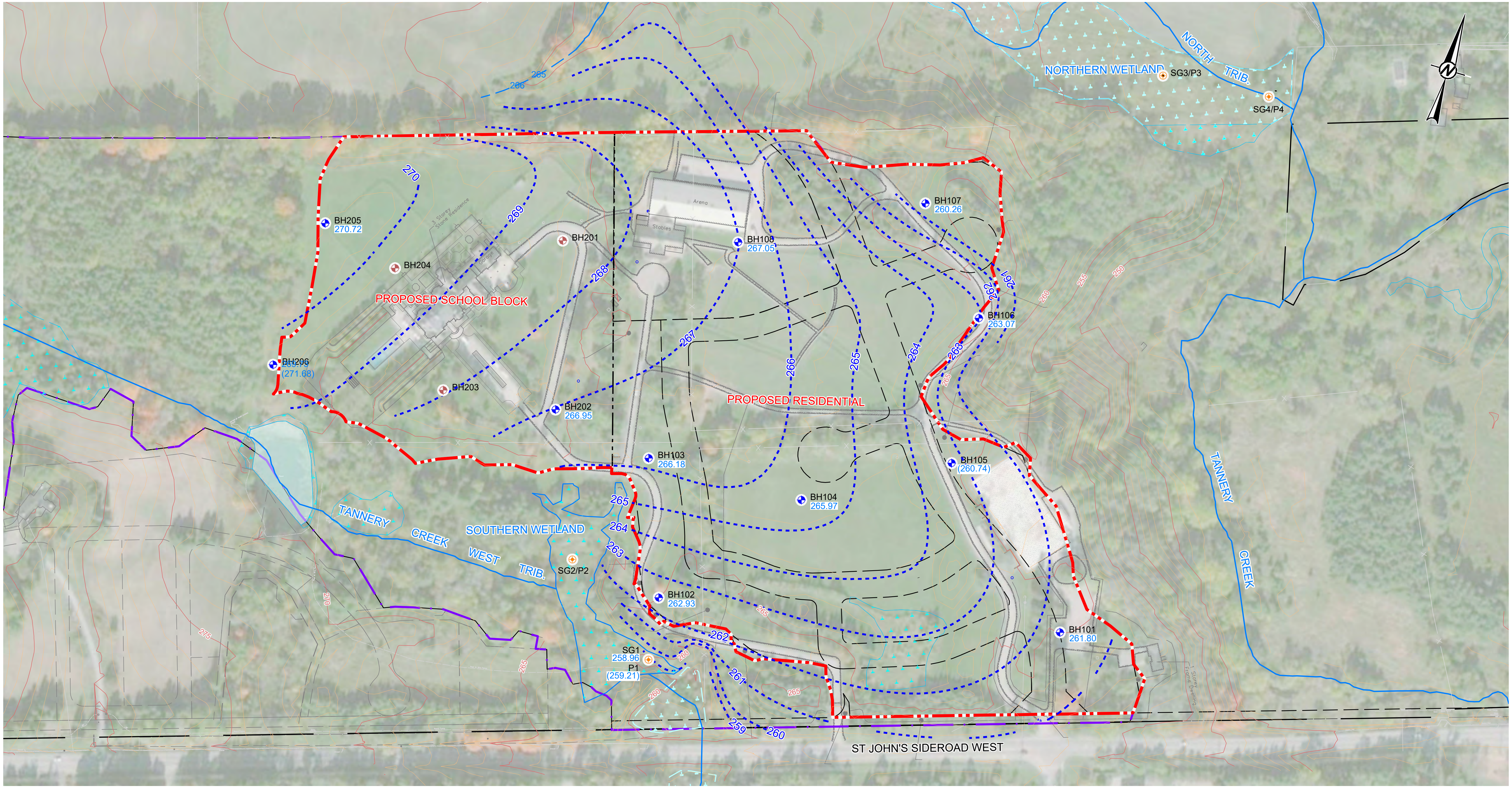
YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION C - C'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	7C

25 mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- PHASE 3 (AURORA) BOUNDARY
- SOIL ENG MONITORING WELL
- SOIL ENG BOREHOLE
- GOLDER PIEZOMETER / STAFF GAUGE
- 262.42 STATIC WATER LEVEL (JANUARY 2021)
- (258.99) LOWER SCREENED POTENTIAL (masl)
- WATER TABLE CONTOUR (masl)
- WETLAND (BEACON)
- SITE CONTOURS (1 masl INTERVAL)

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. BETWEEN THE WELLS AND TEST WELLS, CONTOURED SURFACES ARE NOT PROVEN.
5. LOWER SCREENED POTENTIALS (LEVELS IN BRACKETS) NOT USED FOR INTERPOLATION.

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
WATER TABLE JANUARY 2021

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	B	8

Path: \\golder.gds\complexdata\office\mississauga\sim\Clients\Shining_Hill_Estates_Aurora\162_St_Johns_SideRoad\99_PROJ\20360612_SCS\40_PROD\0001-HydroG\ | File Name: 20360612-0001-CH-0002.dwg | Last Edited By: jregier Date: 2021-12-16 Time:2:18:42 PM | Printed By: JRegier Date: 2021-12-16 Time:5:20:52 PM

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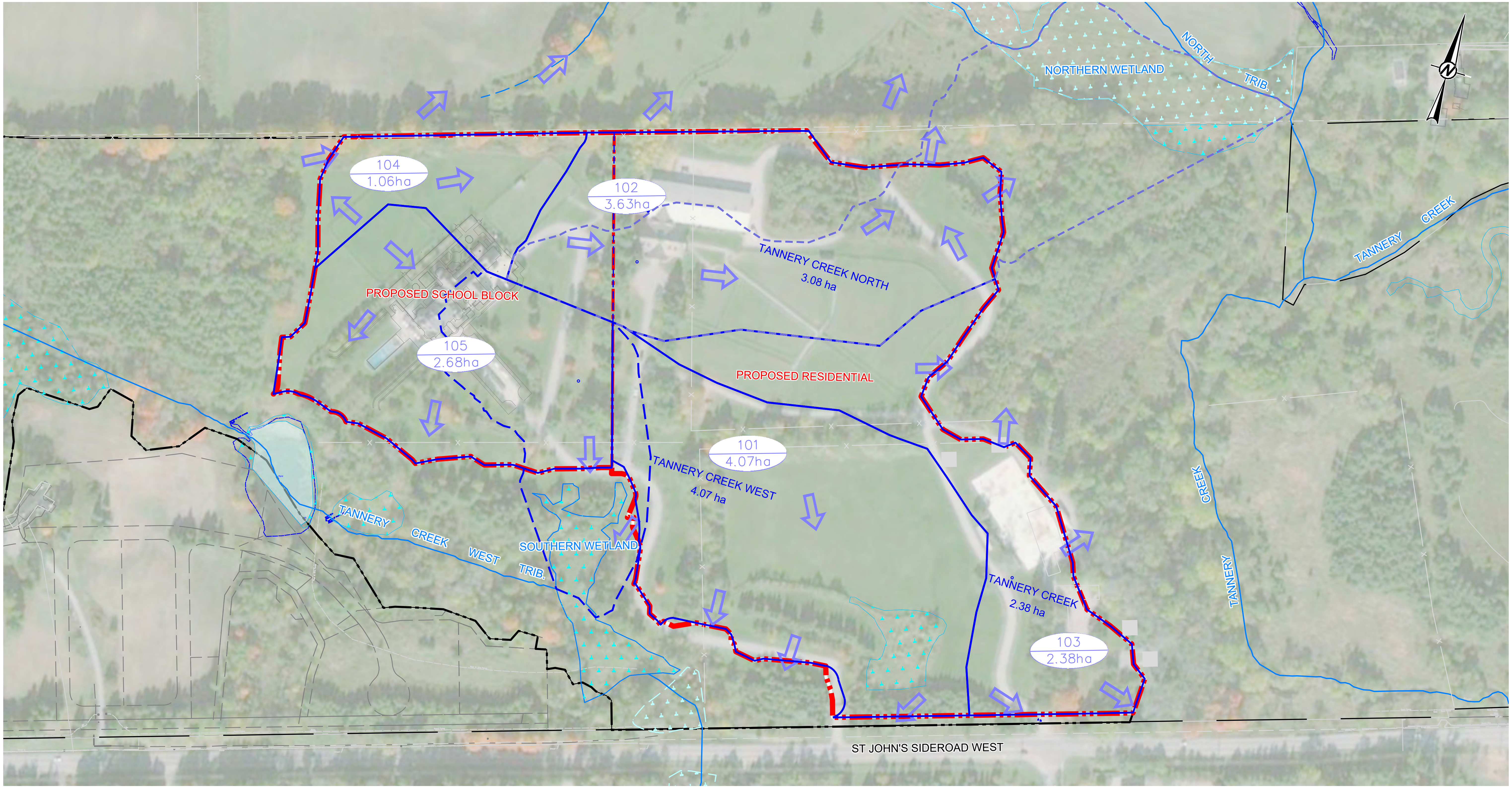

0 50 100 150 m

1:2500

LEGEND

▬ · · ▬	PHASE 3 (AURORA) SITE BOUNDARY
🟥	LIMIT OF DEVELOPMENT
▬	STORM CATCHMENT
▨	UNEVALUATED WETLAND (MNRF)
▨	MAPPED WETLAND (BEACON)
– – –	WETLAND CATCHMENT NORTH
– – –	WETLAND CATCHMENT SOUTH

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. CONCEPT PLAN MALONE GIVEN PARSONS, NOVEMBER 2021
5. WATERSHED CATCHMENT, SCS; NOVEMBER 2021

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	DH
APPROVED	MCK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
PRE-DEVELOPMENT WATERSHEEDS

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0002	B	9

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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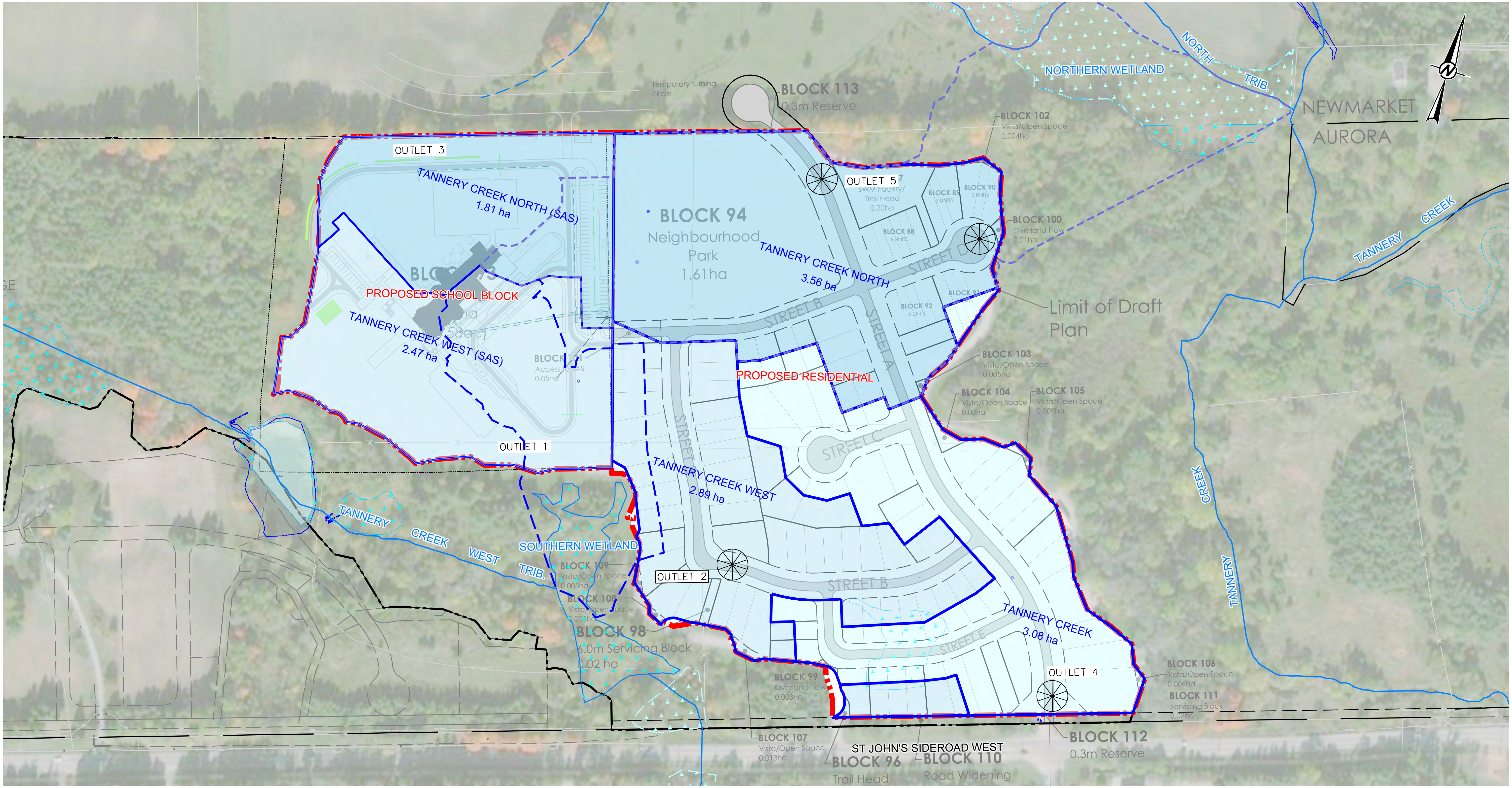


LEGEND

▬ · ▬	PHASE 3 (AURORA) SITE BOUNDARY
🟥	LIMIT OF DEVELOPMENT
▬	STORM CATCHMENT
▨	TANNERY CREEK CATCHMENT
▨	TANNERY CREEK NORTH TRIBUTARY CATCHMENT
▨	TANNERY CREEK WEST TRIBUTARY CATCHMENT
▨	WETLAND (BEACON)
- - -	WETLAND CATCHMENT NORTH
— —	WETLAND CATCHMENT SOUTH

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. CONCEPT PLAN MALONE GIVEN PARSONS, NOVEMBER 2021
5. WATERSHED CATCHMENT, SCS; NOVEMBER 2021
6. CONCEPT PLAN & DESIGN FEATURE DETAILS SUBJECT TO REVISION.

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-12-15
DESIGNED	
PREPARED	JPR
REVIEWED	DH
APPROVED	MCK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
POST DEVELOPMENT WATERSHEDS

PROJECT NO.	CONTROL	REV.	FIGURE
20360612		B	10

Path: \\golder.gds\gal\Barrie\ComplexData\SIM\Clients\Shining_Hill_Estates_Aurora\162_St_Johns_SideRoad\99_PROJ\20360612_SCS\40_PROD\0002-HydroG-2021\ | File Name: 20360612-0002-CH-000S.dwg | Last Edited By: jregier Date: 2022-01-06 Time:6:50:56 AM | Printed By: JRegier Date: 2022-01-06 Time:8:25:01 AM

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A

Important Information and Limitations of this Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder’s express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder’s report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Supporting Documentation

DRAFT PLAN OF SUBDIVISION

Part of Lot 86, Concession 1
Town of Aurora
Regional Municipality of York

KEY PLAN

■ SUBJECT PROPERTY
▨ OTHER LANDS OWNED BY APPLICANT

SCHEDULE OF LAND USE

LOT / BLOCK	LAND USE		UNITS	AREA
1-78	Single Detached Min. 15.24m	☐	23	1.46
	Single Detached Min. 13.70m	+	28	1.43
	Single Detached Min. 12.20m	O	27	1.18
79-87	Lane Access Single Detached Min. 13.70m	^	5	0.30
	Lane Access Single Detached Min. 12.20m	~	4	0.18
88-92	Townhouses Min. 6.1m	=	21	0.54
93	Saint Anne's School			4.28
94	Neighbourhood Park			1.61
95	Natural Heritage / Open Space			17.77
96-97	SWM / Trailhead			0.21
98 & 111	Servicing Blocks			0.04
99-100	Overland Flow			0.01
101	Access to Saint Anne's School			0.05
102-109	Vista's / Open Space			0.07
110	Road Widening			0.21
112-113	0.3m Reserves			0.01
Street A	23.0m Right of Way 436m			1.02
Street B-D	18.0m Right of Way 490m			0.96
Street E	16.5m Right of Way 165m			0.27
Street B	15.0m Right of Way 160m			0.19
TOTAL			**108**	**31.79**

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the Town of Aurora.

See Original
Angelo DeGasperis

See Original
Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided and their relationship to the adjacent lands are correctly shown.

See Original
Neil A. LeGrow

See Original
Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Soil is clay loam and sandy loam.
(h),(k) - Full municipal services to be provided.

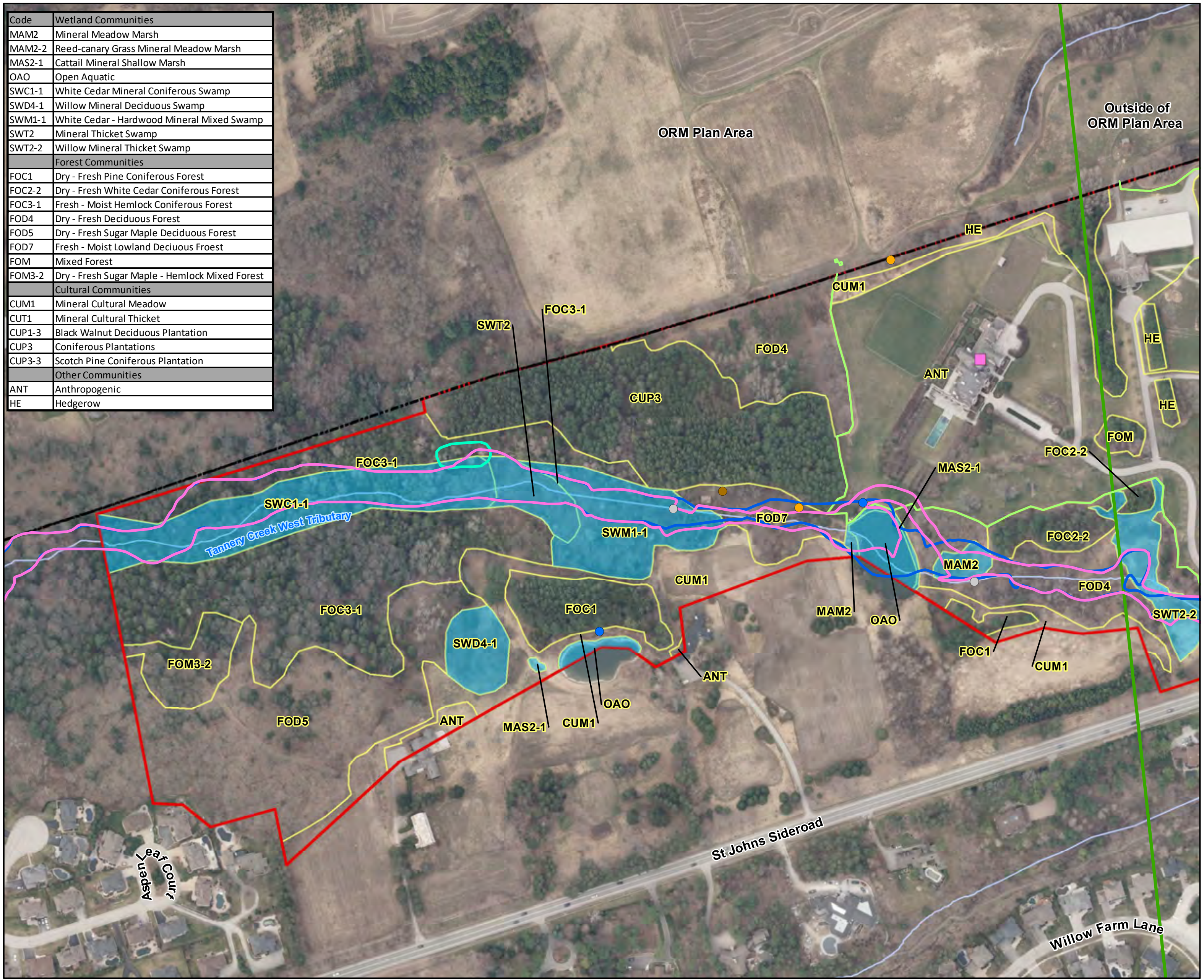
Prepared by:

140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

Prepared for:
SHINING HILL ESTATES COLLECTION INC.

Date: March 8, 2021
Project No.: 15-2374

Date	Revision	By
Oct 7/21	Revise the plan according to Town's comments	DR
Nov 1/21	Add servicing block and temporary turning circle	DR



Code	Wetland Communities
MAM2	Mineral Meadow Marsh
MAM2-2	Reed-canary Grass Mineral Meadow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
OAO	Open Aquatic
SWC1-1	White Cedar Mineral Coniferous Swamp
SWD4-1	Willow Mineral Deciduous Swamp
SWM1-1	White Cedar - Hardwood Mineral Mixed Swamp
SWT2	Mineral Thicket Swamp
SWT2-2	Willow Mineral Thicket Swamp
	Forest Communities
FOC1	Dry - Fresh Pine Coniferous Forest
FOC2-2	Dry - Fresh White Cedar Coniferous Forest
FOC3-1	Fresh - Moist Hemlock Coniferous Forest
FOD4	Dry - Fresh Deciduous Forest
FOD5	Dry - Fresh Sugar Maple Deciduous Forest
FOD7	Fresh - Moist Lowland Deciuous Froest
FOM	Mixed Forest
FOM3-2	Dry - Fresh Sugar Maple - Hemlock Mixed Forest
	Cultural Communities
CUM1	Mineral Cultural Meadow
CUT1	Mineral Cultural Thicket
CUP1-3	Black Walnut Deciduous Plantation
CUP3	Coniferous Plantations
CUP3-3	Scotch Pine Coniferous Plantation
	Other Communities
ANT	Anthropogenic
HE	Hedgerow

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2020\220166 Shining Hill Phase 2 NHE\MXD\2020-10-28_Figure02_ExistingConditionsAuroraWest_220166.mxd

Existing Conditions

Figure 2A

Shining Hill Estate Collection Inc.

Legend

🟥	Study Area
—	Staked Dripline (LSRCA, July 21, 2020)
—	Long Term Stable Top of Slope (Soil Engineers Ltd. 2020)
—	Watercourse (MNRF 2019)
—	Staked Dripline (LSRCA 24 Aug 2015)
—	Staked Top of Slope (LSRCA 24 Aug 2015)
☐	Chimney Crayfish Locations
☐	ELC Communities
☐	Municipal Boundary (MNRF 2019)
—	Regional Floodline (LSRCA)
—	Proposed Regional Floodline (Schaeffers Consulting Engineers, 2020)
■	Nesting Chimney Swift
■	Wetlands (Beacon 2020)
●	Amphibian Monitoring Locations
●	Culvert Location
☐	Oak Ridges Moraine Boundary (MNRF 2020)

Butternut Locations

●	Category 1
●	Category 2

BEACON ENVIRONMENTAL

Project: 220166
Last Revised: March, 2021

Client: Shining Hill Estate Collection Inc.

Prepared by: BD
Checked by: CS

DRAFT

N

1:3,000

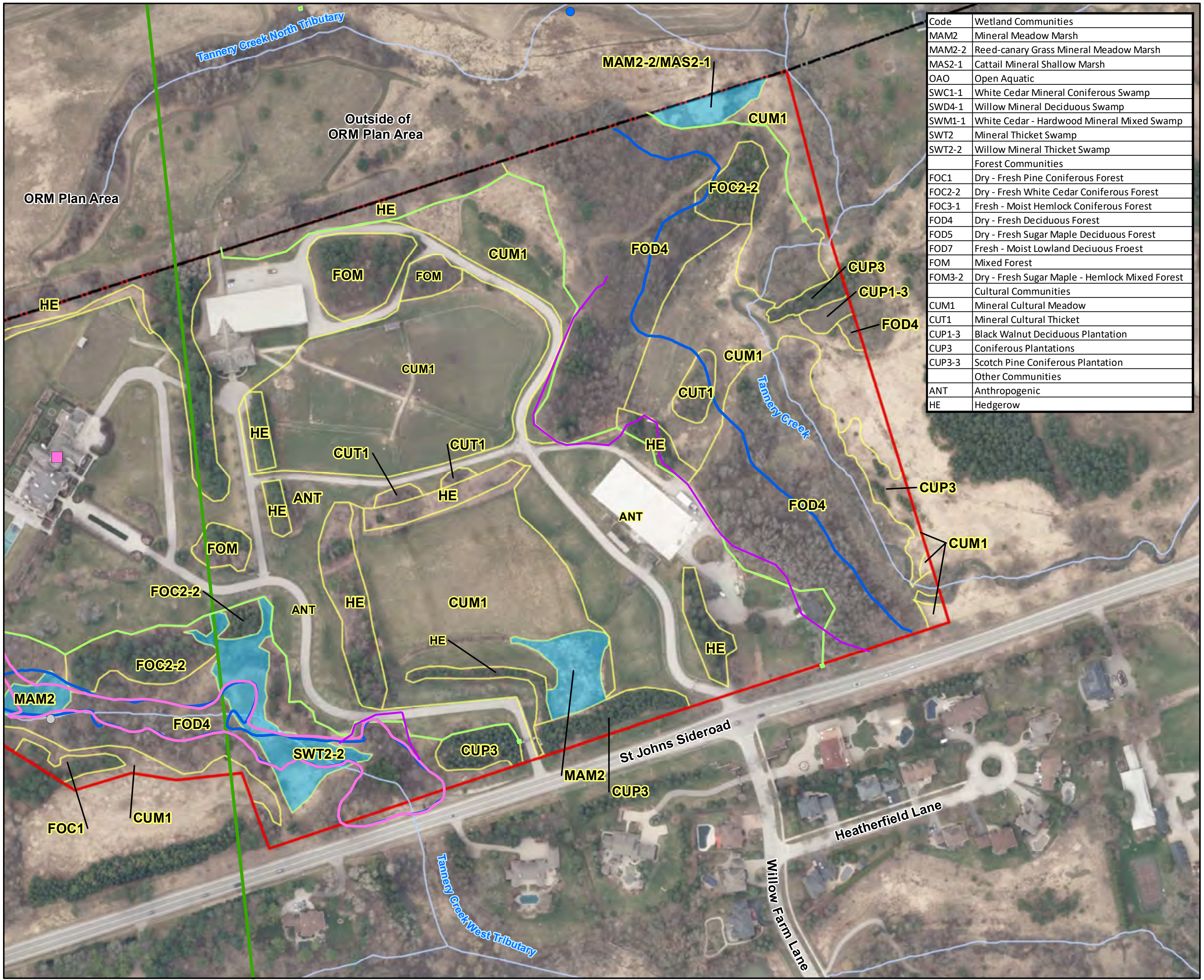
0 60 120 m

Contains information licensed under the Open Government License–Ontario
Orthoimagery Baselayer: 2019 (FBS)

Existing Conditions

Figure 2B

Shining Hill Estate Collection Inc.



Code	Wetland Communities
MAM2	Mineral Meadow Marsh
MAM2-2	Reed-canary Grass Mineral Meadow Marsh
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FOC2-2	Dry - Fresh White Cedar Coniferous Forest
FOC3-1	Fresh - Moist Hemlock Coniferous Forest
FOD4	Dry - Fresh Deciduous Forest
FOD5	Dry - Fresh Sugar Maple Deciduous Forest
FOD7	Fresh - Moist Lowland Deciuous Froest
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CUT1	Mineral Cultural Thicket
CUP1-3	Black Walnut Deciduous Plantation
CUP3	Coniferous Plantations
CUP3-3	Scotch Pine Coniferous Plantation
	Other Communities
ANT	Anthropogenic
HE	Hedgerow

Legend

- ▭ Study Area
- — Staked Dripline (LSRCA, July 21, 2020)
- — Long Term Stable Top of Slope (Soil Engineers Ltd. 2020)
- — Watercourse (MNRF 2019)
- ▭ Chimney Crayfish Locations
- ▭ ELC Communities
- ▭ Municipal Boundary (MNRF 2019)
- — Regional Floodline (LSRCA)
- — Proposed Regional Floodline (Schaeffers Consulting Engineers, 2020)
- ■ Wetlands (Beacon 2020)
- ● Amphibian Monitoring Locations
- ● Culvert Location
- ■ Nesting Chimney Swift
- ▭ Oak Ridges Moraine Boundary (MNRF 2020)

Butternut Locations

- ● Category 1
- ● Category 2

BEACON ENVIRONMENTAL

Project: 220166
Last Revised: March, 2021

Client: Shining Hill Estate Collection Inc.

Prepared by: BD
Checked by: CS

DRAFT

N

1:2,550

0 50 100 m

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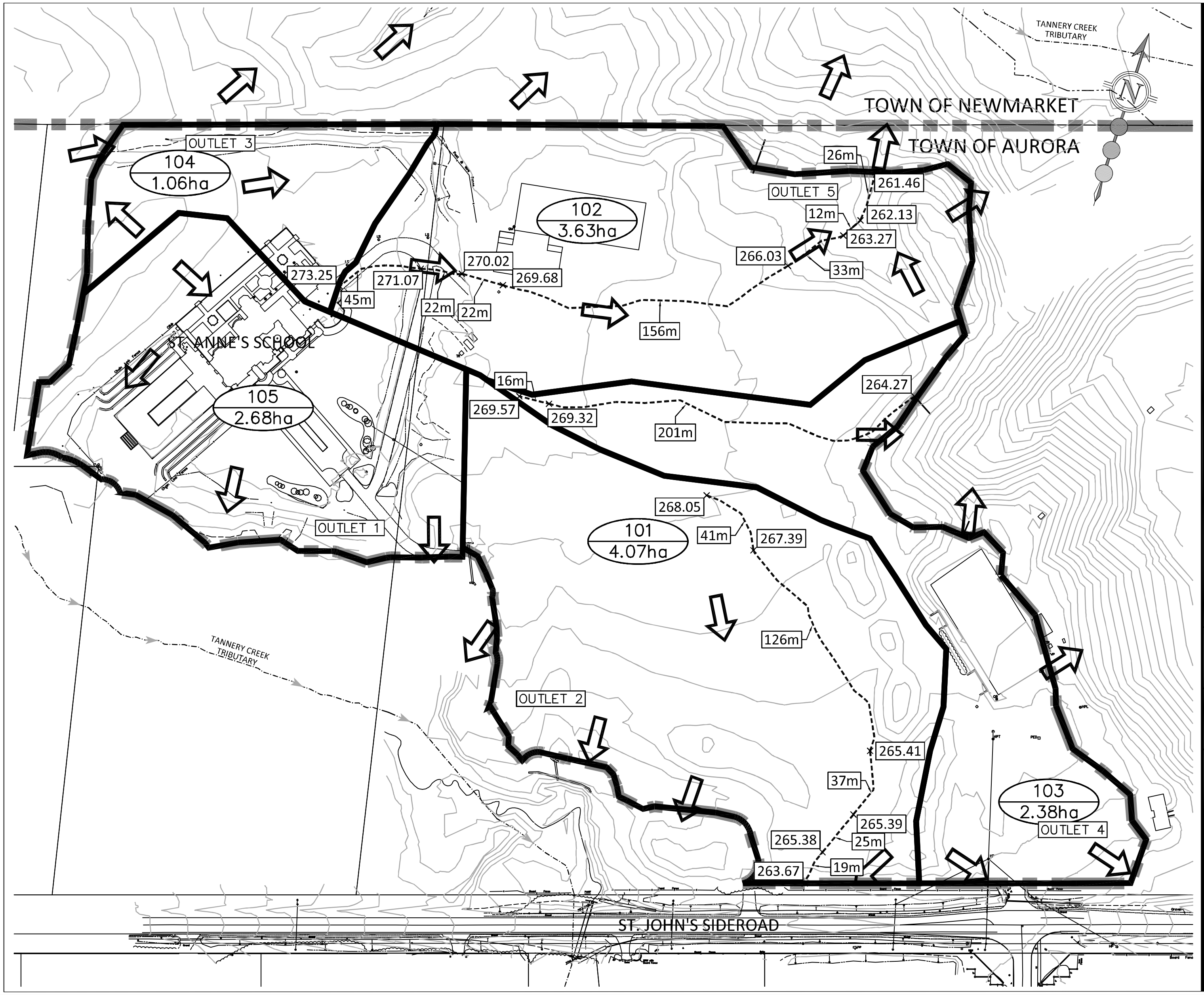
Orthoimagery Baselayer: 2019 (FBS)

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2020\220166 Shining Hill Phase 2 NHE\MXD\2020-11-02_Figure02B_ExistingConditionsAuroraEast_220166.mxd



LEGEND:

▬ ▪ ▪ ▬	MUNICIPAL BOUNDARY
▬ ▪ ▬	LIMIT OF DEVELOPMENT
255.00	EXISTING CONTOUR AND ELEVATION
— · — · —	WETLAND BOUNDARY
▬▬▬	STORM DRAINAGE BOUNDARY
- - - - -	TIME TO PEAK LENGTH
×273.25	TIME TO PEAK ELEVATION
⇨	OVERLAND FLOW DIRECTION
0.50	CATCHMENT ID
0.20ha	DRAINAGE AREA (HECTARES)

SCS consulting group ltd

30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

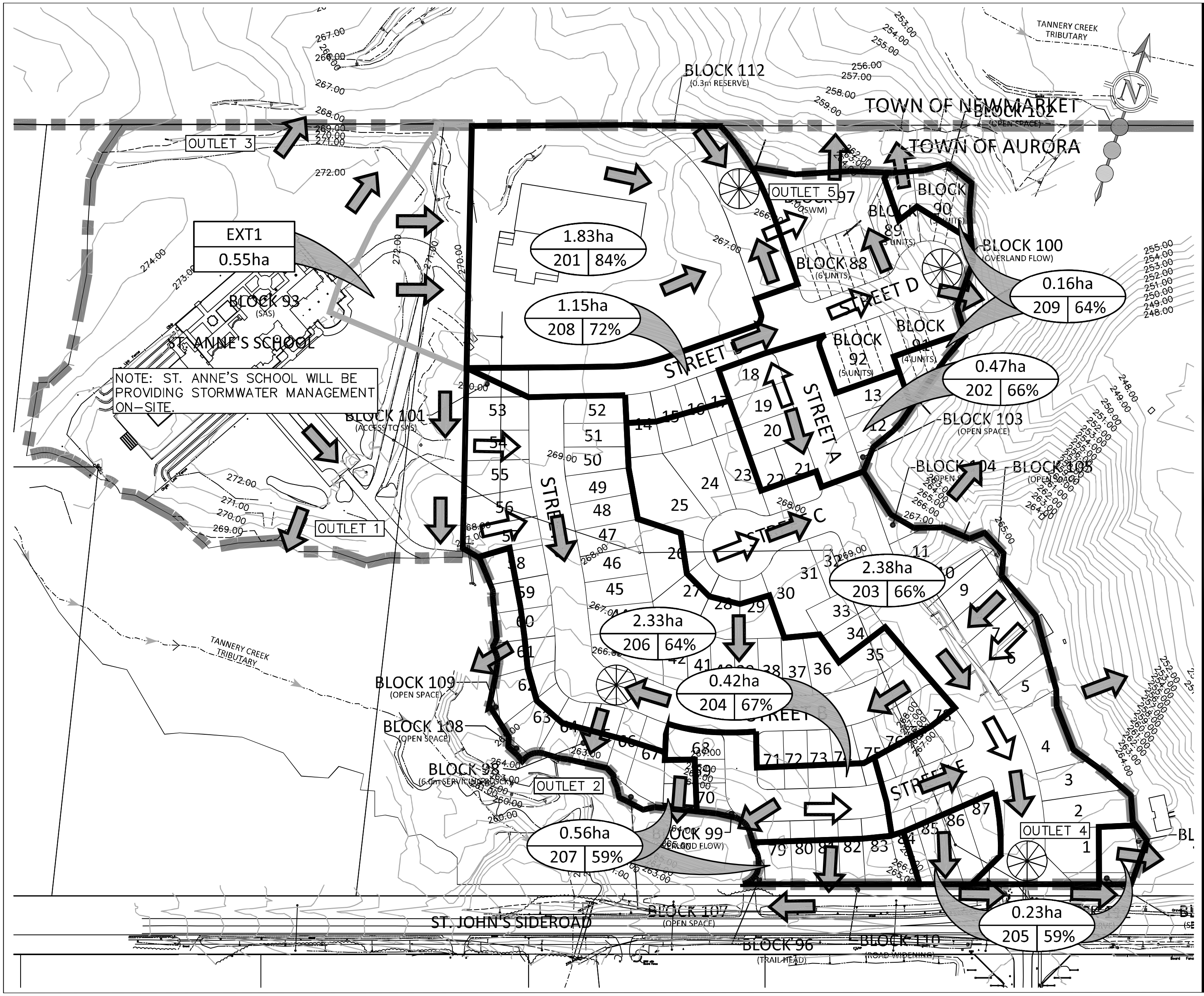
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

EXISTING STORM DRAINAGE

DESIGNED BY: E.T.C.K.
CHECKED BY: S.E.K.
SCALE: 1:2000
DATE: NOVEMBER 2021
PROJECT No: 2183
FIGURE No: 2.1

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-STRM-EXST-2.1.dwg - Revised by <YKASPIN> : Mon, Nov 01 2021 - 10:15am



LEGEND:

- MUNICIPAL BOUNDARY
- LIMIT OF DEVELOPMENT
- 255.00 EXISTING CONTOUR AND ELEVATION
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- WETLAND BOUNDARY
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 100 YEAR CAPTURE LOCATION

2.39ha	DRAINAGE AREA (HECTARES)
64%	IMPERVIOUSNESS
206	CATCHMENT ID
EXT1	EXTERNAL CATCHMENT ID
0.55ha	DRAINAGE AREA

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SCS consulting group ltd

30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

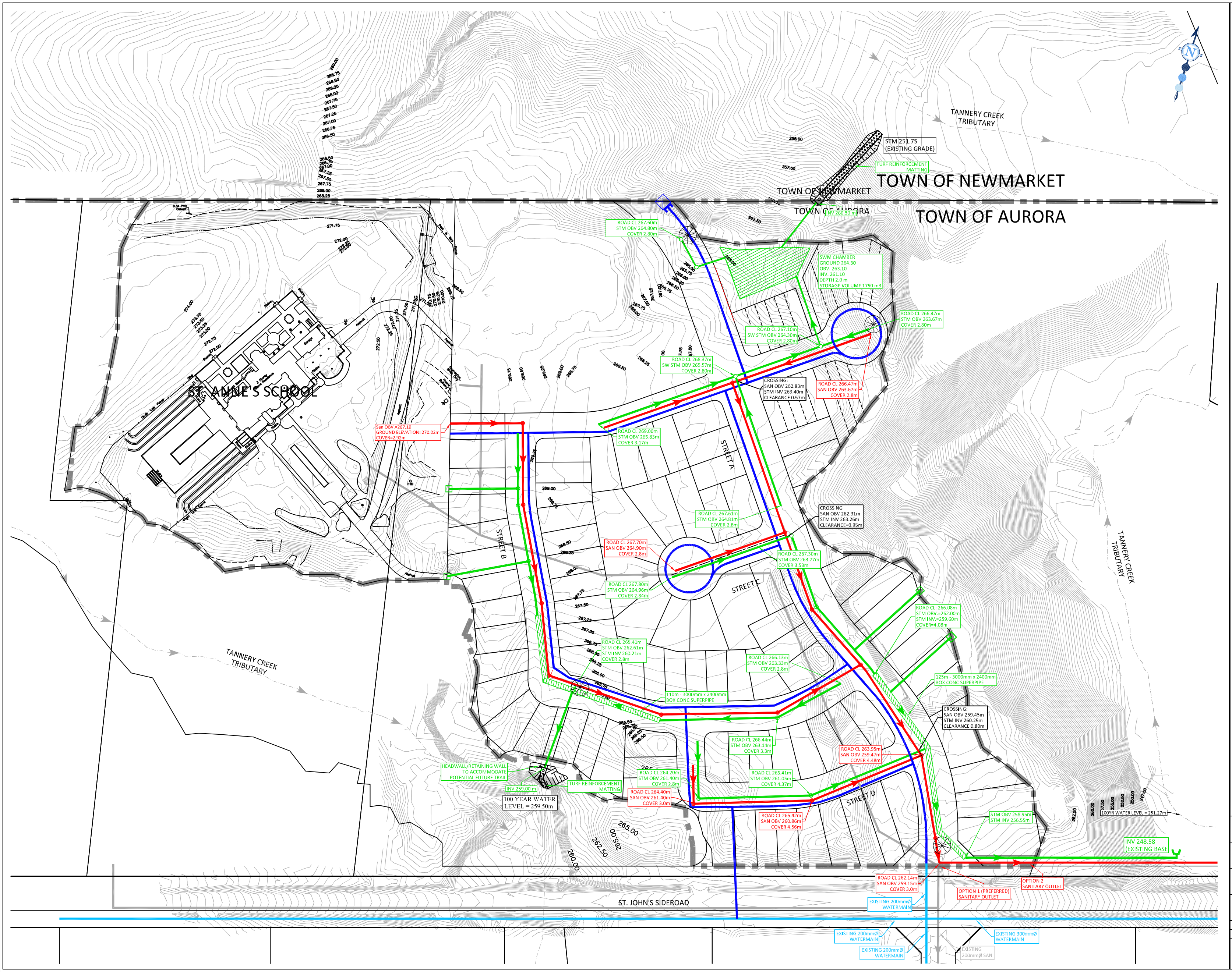
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

PROPOSED STORM DRAINAGE

DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	1:2000	DATE:	NOVEMBER 2021
PROJECT No:	2183	FIGURE No:	2.2

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-STRM-PROP-2.2.dwg - Revised by <YKASPIN> : Mon, Nov 01 2021 - 10:06am



LEGEND:

▬ ▪ ▬	LIMIT OF DEVELOPMENT
▬ ▪ ▪ ▬	MUNICIPAL BOUNDARY
→	STORM SEWER
▨	SUPERPIPE STORM SEWER
→	SANITARY SEWER
▬	EXISTING SANITARY SEWER
▬	WATERMAIN
▬	EXISTING WATERMAIN
□	REAR YARD CATCHBASIN
▨	PROPOSED UNDERGROUND STORAGE
☒	METER CHAMBER AND PRESSURE REDUCING VALVE
⊛	100 YEAR CAPTURE LOCATION

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

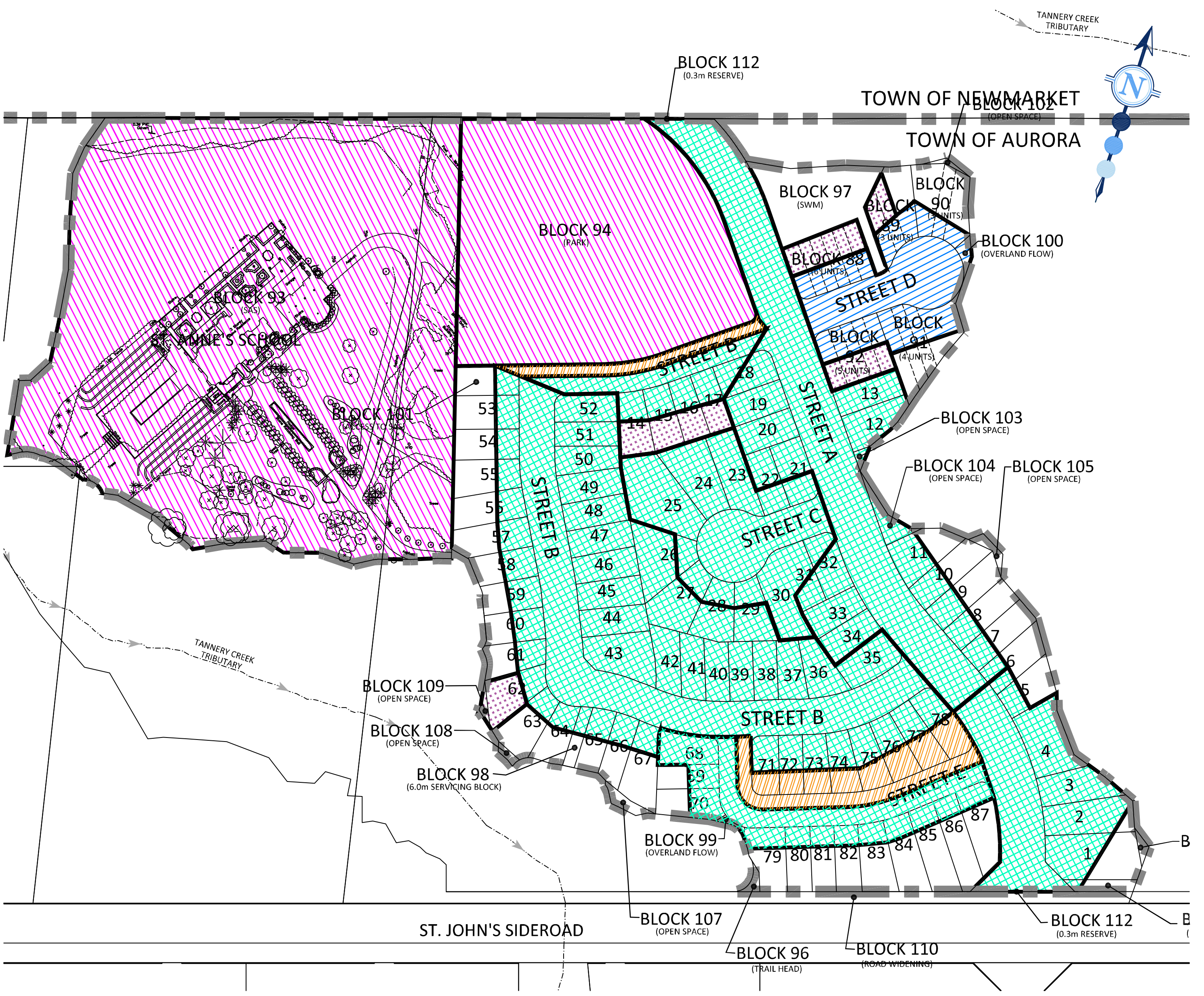
SHINING HILL ESTATES
COLLECTION INC.

SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

PROPOSED SERVICING PLAN

DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	1:1000	DATE:	NOVEMBER 2021
PROJECT No:	2183	FIGURE No:	2.3

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-SERV-2.3.dwg - Revised by <TMCNEIL> : Wed, Nov 03 2021 - 3:30pm



LEGEND:

▬ ▪ ▪ ▬	MUNICIPAL BOUNDARY
▬ ▪ ▬	LIMIT OF DEVELOPMENT
━	STORM DRAINAGE BOUNDARY
▨	REAR YARD INFILTRATION TRENCH (25 mm/imp-ha)
▦	CATCHBASIN FILTRATION SYSTEM
▨	ON-SITE INFILTRATION (25 mm/imp-ha)
▨	BIOSWALE INFILTRATION (25 mm/imp-ha)
▥	BIOSWALE FILTRATION (25 mm/imp-ha)

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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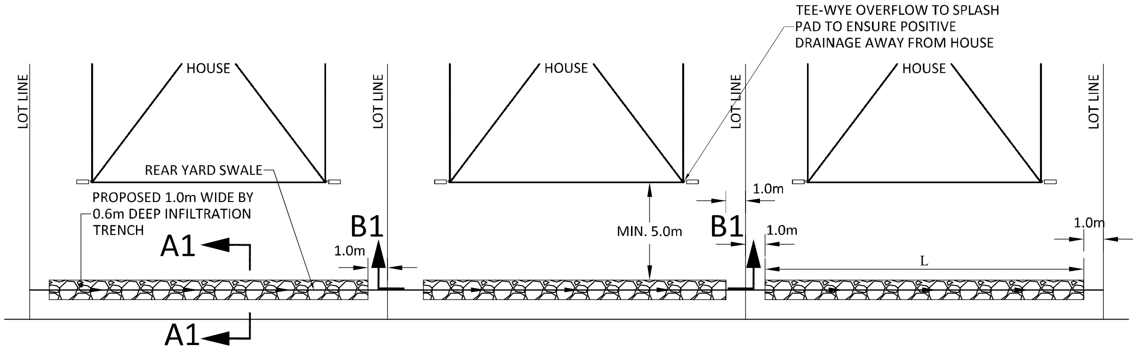
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

LID PLAN

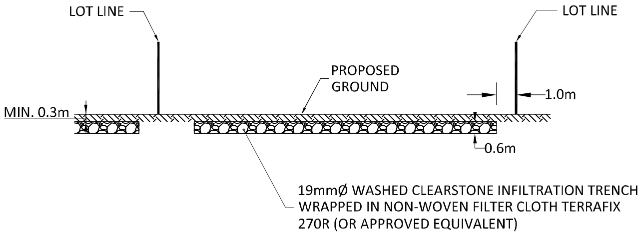
DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	1:2000	DATE:	NOVEMBER 2021
PROJECT No:	2183	FIGURE No:	2.6

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-LIDS-2.5.dwg - Revised by <LYULE> : Mon, Mar 01 2021 - 1:22pm



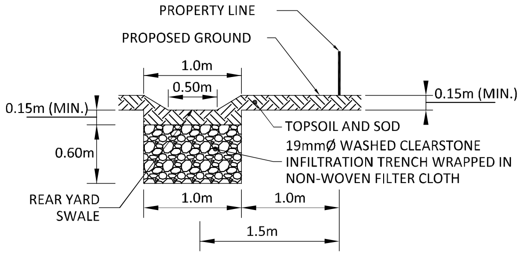
SPLIT DRAINING LOTS PLAN

SCALE 1:250



SECTION B1-B1

SCALE 1:250



SECTION A1-A1
INFILTRATION TRENCH ASSEMBLY

SCALE 1:50

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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LEGEND:

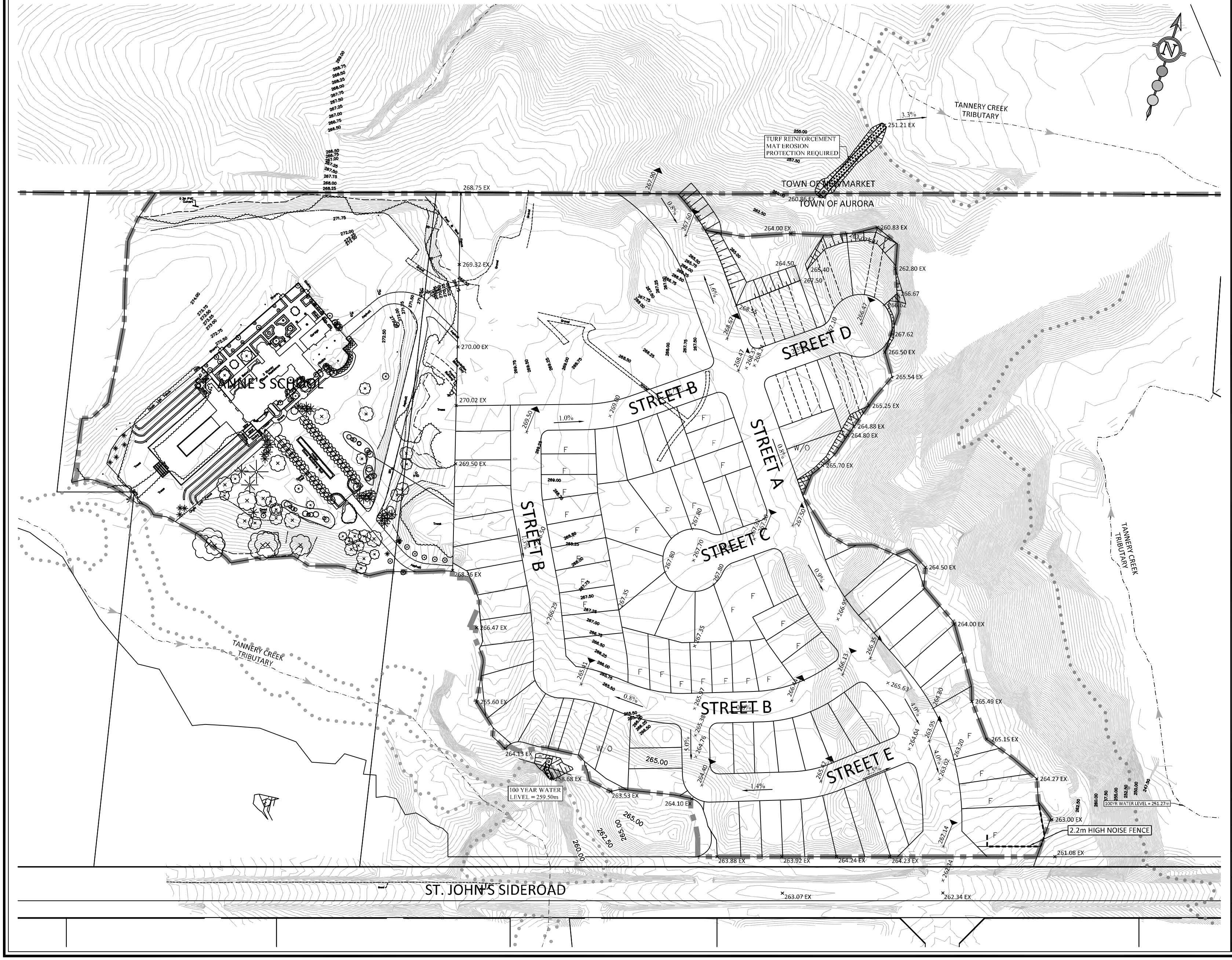
SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	AS SHOWN	DATE:	NOVEMBER 2021

REAR YARD INFILTRATION
TRENCH DETAIL

PROJECT No:	FIGURE No:
2183	2.9

File: P:\2183 Shining Hill Estates\Drawings\FSSR–Phase 3\Fig\Report Figures\2183P–FIGS–DETL–REAR–YARD–INFL–2.8.dwg – Revised by <DDILAY> : Tue, Mar 02 2021 – 2:28pm



LEGEND:

▬ ▪ ▪ ▬	MUNICIPAL BOUNDARY
▬ ▪ ▬	LIMIT OF DEVELOPMENT
255.25	EXISTING CONTOUR AND ELEVATION
255.25	PROPOSED CONTOUR
×262.80 EX	EXISTING ELEVATION
×255.09	PROPOSED ELEVATION
┬┬┬┬	PROPOSED 3:1 MAX SLOPE
1.0% →	PROPOSED ROAD GRADE
↗ ↗	PROPOSED ROAD HIGH / LOW POINT
● ● ● ● ●	EXISTING REGULATORY FLOODLINE
F	FRONT DRAINING LOT
W/O	WALKOUT LOT

NOTE: ALL SINGLE RESIDENTIAL LOTS ARE SPLIT DRAINING UNLESS OTHERWISE NOTED.
*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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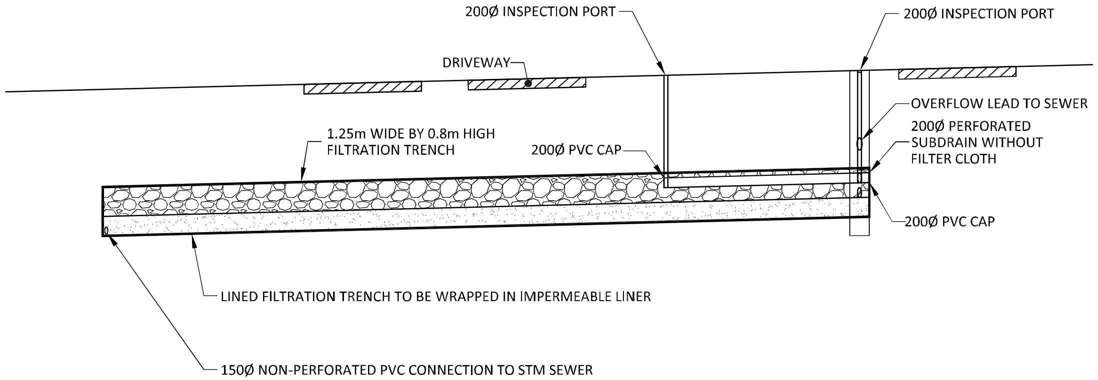
SHINING HILL ESTATES
COLLECTION INC.

SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

PRELIMINARY GRADING PLAN

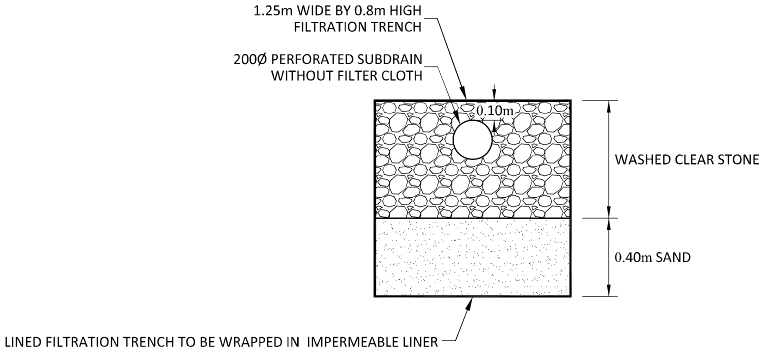
DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	1:1000	DATE:	NOVEMBER 2021
PROJECT No:	2183	FIGURE No:	5.1

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-GRAD-5.1.dwg – Revised by <YKASPIN> : Mon, Nov 01 2021 – 9:48am



PRELIMINARY FILTRATION TRENCH - PROFILE VIEW

SCALE: N.T.S.



PRELIMINARY FILTRATION TRENCH CROSS-SECTION

SCALE: N.T.S.

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SHINING HILL ESTATES
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LEGEND:

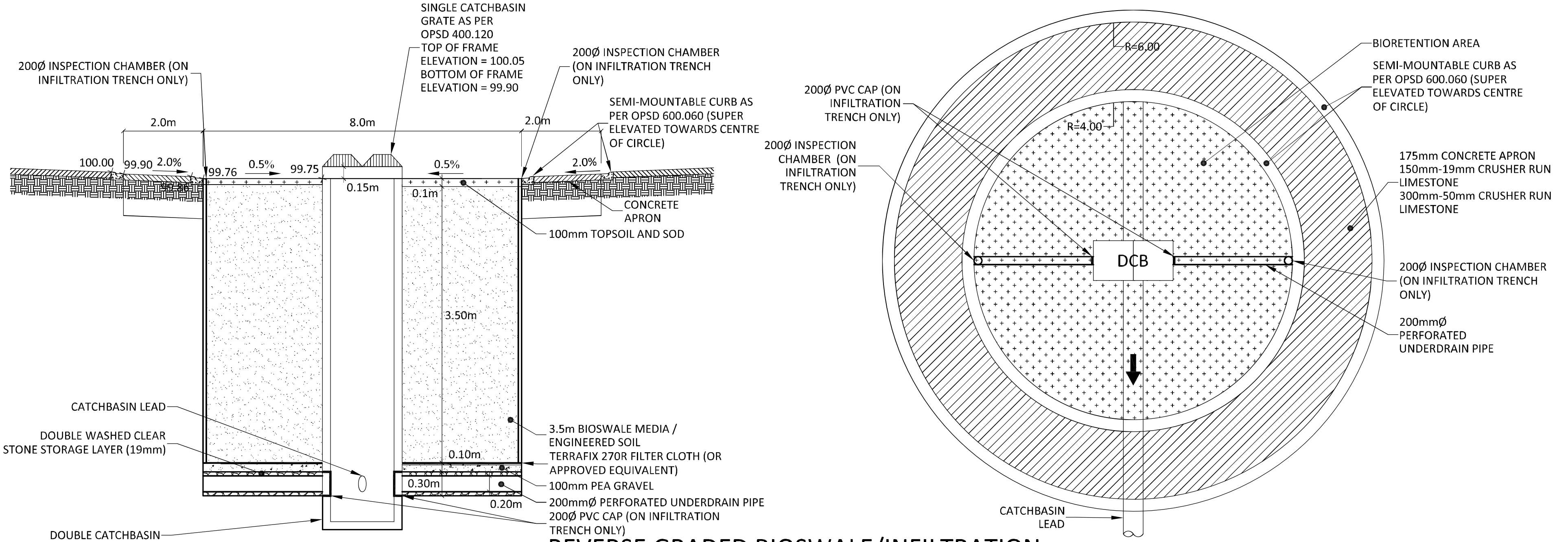
SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

DESIGNED BY:	E.T.C.K.	CHECKED BY:	S.E.K.
SCALE:	AS SHOWN	DATE:	NOVEMBER 2021

CATCHBASIN FILTRATION
TRENCH DETAIL

PROJECT No:	FIGURE No:
2183	6.6

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-DETL-CSBN-FILT-6.7.dwg - Revised by <LYULE> : Mon, Mar 01 2021 - 12:45pm



REVERSE GRADED BIOSWALE/INFILTRATION CUL-DE-SAC DETAIL

SCALE: H 1:100 V 1:50

* ELEVATIONS SHOWN ARE FOR REFERENCE PURPOSES ONLY

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SHINING HILL ESTATES
COLLECTION INC.

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LEGEND:

SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

DESIGNED BY: E.T.C.K.
CHECKED BY: S.E.K.
SCALE: AS SHOWN
DATE: NOVEMBER 2021

BIOSWALE/INFILTRATION
DETAIL

PROJECT No: 2183
FIGURE No: 6.7

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-DETL-CSBN-INFL-6.8.dwg – Revised by <LYULE> : Mon, Mar 01 2021 – 12:46pm

REAR YARD INFILTRATION TRENCH SIZING

Estimate imperviousness of drainage area from back half of roof draining to rear yard infiltration trenches, using a sample 13.7 m wide lot.

Total Area (1/2 of Lot Depth x Lot Frontage Width)	13.7 x 15 =	205.50	m^2
Imp Area (back 1/2 Roof)	(11.9 x 18 x 0.5)	107.10	m^2
Total Imp. Area		107.10	m^2
Imperviousness		**52.1%**	
Sample Drainage Area	205.5	0.02055	ha/m

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	29.0	m^3/ha
Required Water Quality Infiltration Volume	**0.597**	m^3/Lot

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	130.3	m^3/ha
Required 25 mm Storm Event Volume	**2.678**	m^3/Lot

Required Bioswale Volume	**2.678**	**m^3/Lot**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS (FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Bioswale Design - Provided

	Units	Total to Bioswale
D - Depth	m	0.60
W - Width	m	1.0
L - Length	m	11.70
A - Bottom Area	m^2	11.7
Total Volume of the Bioswale (i.e. media volume)	m^3	7.0
n - Media Porosity		0.40
Total Runoff Storage Volume of the Bioswale	m^3	2.81
Total Runoff Storage Volume of the Bioswale	mm	26.2

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: Nov 2021
Designer: ETCK

Half of 15m ROW BIOSWALE SIZING

Estimate imperviousness of drainage area from road area draining to bioswale

Total Area (assume 1 m sample section, crown of road to ROW limit)	5.75 x 1 =	5.75 m^2
Imp Area (Roof)		0 m^2
Imp Area (Driveway)		0 m^2
Imp Area (Sidewalk/Trail)		0 m^2
Imp Area (Pavement+Curb)	3.75 + 0.5	4.25 m^2
Total Imp. Area		4.25 m^2
Imperviousness		**73.9%**
Sample Drainage Area	5.75 m2/m-road	0.000575 ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	36.3 m^3/ha
Required Water Quality Infiltration Volume	**0.021** m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	184.8 m^3/ha
Required 25 mm Storm Event Volume	**0.106** m^3/m-road

Required Trench Volume	**0.106 m^3/m-road**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Bioswale Design - Provided

	Units	Total to Bioswale
D - Depth	m	0.60
W - Width	m	0.5
L - Length	m	1.00
A - Bottom Area	m^2	0.5
Total Volume of the Bioswale (i.e. media volume)	m^3	0.3
n - Media Porosity		0.40
Total Runoff Storage Volume of the Bioswale	m^3	0.12
Total Runoff Storage Volume of the Bioswale	mm	28.2

15m HALF ROW BOULEVARD FILTRATION TRENCH SIZING

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: Nov 2021
Designer: MECM

Estimate imperviousness of drainage area from roofs, driveway, and road areas draining to filtration trench. Assume a section of road with a 12.2 m frontage lot with a split draining lot

Total Area	12.2 x 24 =	292.80 m^2
Imp Area (Roof)	(187 x 1/2) =	93.50 m^2
Imp Area (Driveway, including boulevard driveway)	(6 x 6) + (5.5 x 6) =	69 m^2
Imp Area (Sidewalk, less driveway overlap)	(1.5 x 12.2) - (6 x 1.5)=	9.3 m^2
Imp Area (Pavement+Curb)	(3.75 + 0.5) x 12.2=	51.85 m^2
Total Imp. Area		223.65 m^2
Imperviousness		**76.4%**
Sample Drainage Area	24 m2/m-road	0.0024 ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	37.1	m^3/ha
Required Water Quality Infiltration Volume	**0.089**	m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	191.0	m^3/ha
Required 25 mm Storm Event Volume	**0.458**	m^3/m-road

Required Trench Volume	**0.458**	**m^3/m-road**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Filtration Trench Design - Provided

	Units	Total to Filtration Trench
D - Depth	m	0.80
W - Width	m	1.25
L - Length	m	1.00
A - Bottom Area	m^2	1.3
Total Volume of the Filtration Trench (i.e. stone volume)	m^3	1.0
n - Media Porosity		0.40
Total Runoff Storage Volume of the Filtration Trench	m^3	0.40
Total Runoff Storage Volume of the Filtration Trench	mm	21.8

Based on the maximum dimensions of the filtration trench to avoid conflicts with service laterals and utilities in the boulevard, the filtration trench provides 21.8 mm/impervious area of storage.

SCS consulting group ltd

Half of 16.5m ROW BIOSWALE SIZING

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: Nov 2021
Designer: ETCK

Estimate imperviousness of drainage area from half of the road area and half of the adjacent 13.7m lot draining to bioswale

Total Area (assume 1 m sample section, crown of road to lot split point)	13.5 + 7.25 x 1 =	20.75 m^2
Imp Area (Roof)	11.9 / 13.7 x 1 x 9 =	7.82 m^2
Imp Area (Driveway)	6 / 13.7 x 1 x 4.5 =	1.97 m^2
Imp Area (Sidewalk/Trail/Multi-Use Pathway)		0 m^2
Imp Area (Pavement+Curb)	3.75 + 0.5 =	4.25 m^2
Total Imp. Area		14.04 m^2
Imperviousness		**67.7%**
Sample Drainage Area	20.75 m2/m-road	0.002075 ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	34.2 m^3/ha
Required Water Quality Infiltration Volume	**0.071** m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	169.1 m^3/ha
Required 25 mm Storm Event Volume	**0.351** m^3/m-road

Required Trench Volume	**0.351 m^3/m-road**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Bioswale Design - Provided

	Units	Total to Bioswale
D - Depth	m	0.73
W - Width	m	1.20
L - Length	m	1.00
A - Bottom Area	m^2	1.20
Total Volume of the Bioswale (i.e. media volume)	m^3	0.9
n - Media Porosity		0.40
Total Runoff Storage Volume of the Bioswale	m^3	0.35
Total Runoff Storage Volume of the Bioswale	mm	25.0

Based on the maximum dimensions of the bioswale to avoid conflicts with service laterals and utilities in the boulevard, the bioswale provides 25 mm/impervious area of storage.

16.5m ROW BOULEVARD FILTRATION TRENCH SIZING

Estimate imperviousness of drainage area from roofs, driveway, and road areas draining to filtration trench. Assume a section of road with a 13.7 m frontage lot with a split draining lot on one side.

Total Area	13.7 x 24.25 =	332.23 m^2
Imp Area (Roof)	214 x 1/2 =	107.00 m^2
Imp Area (Driveway, including boulevard driveway)	(6 x 6) + (5.5 x 6) =	69 m^2
Imp Area (Sidewalk, less driveway overlap)	(1.5 x 13.7) - (6 x 1.5)=	11.55 m^2
Imp Area (Pavement+Curb)	(3.7 + 0.5) x 13.7 =	57.54 m^2
Total Imp. Area		245.09 m^2
Imperviousness		**73.8%**
Sample Drainage Area	13.7 m2/m-road	0.00137 ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	36.3 m^3/ha
Required Water Quality Infiltration Volume	**0.050** m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	184.4 m^3/ha
Required 25 mm Storm Event Volume	**0.253** m^3/m-road

Required Trench Volume	**0.253 m^3/m-road**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Filtration Trench Design - Provided

	Units	Total to Filtration Trench
D - Depth	m	0.80
W - Width	m	1.25
L - Length	m	1.00
A - Bottom Area	m^2	1.3
Total Volume of the Filtration Trench (i.e. stone volume)	m^3	1.0
n - Media Porosity		0.40
Total Runoff Storage Volume of the Filtration Trench	m^3	0.40
Total Runoff Storage Volume of the Filtration Trench	mm	39.6

Based on the maximum dimensions of the filtration trench to avoid conflicts with service laterals and utilities in the boulevard, the filtration trench provides 39.6 mm/impervious area of storage.

SCS consulting group ltd

18m ROW BIOSWALE INFILTRATION SIZING
STREET D CUL-DE-SAC

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: Nov 2021
Designer: ETCK

Estimate imperviousness of drainage area from road area and half of the adjacent Townhouse lots draining to bioswale

Total Area (assume 1 m sample section, whole ROW plus 2 half lots)	(18 + 15 + 15) x 1 =	48.00 m^2
Imp Area (Roof)	2 x 31.05 / 34 x 1 x 7.5 =	13.70 m^2
Imp Area (Driveway)	2 x 3.5 x 5 / 34 x 1 x 7.5 =	7.72 m^2
Imp Area (Sidewalk/Trail)	1.5 x 1 =	1.5 m^2
Imp Area (Pavement+Curb)	2 x (4 + 0.5) =	9 m^2
Total Imp. Area		31.92 m^2
Imperviousness		**66.5%**
Total Drainage Area to Biofiltration Infiltration System	4500 m2	0.45 ha

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	33.8 m^3/ha
Required Water Quality Infiltration Volume	**15.225** m^3

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	166.2 m^3/ha
Required 25 mm Storm Event Volume	**74.810** m^3

Required Trench Volume	**74.810 m^3**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Bioswale Design - Provided

	Units	Total to Bioswale
D - Depth	m	3.50
A - Bottom Area	m^2	48.93
Total Volume of the Bioswale (i.e. media volume)	m^3	171.3
n - Media Porosity		0.40
Total Runoff Storage Volume of the Bioswale	m^3	68.50
Total Runoff Storage Volume of the Bioswale	mm	22.9

(Total area of Cul-de-sac Bioswale Infiltration Trench, less area of catchbasins. See **Figure 6.7**.)

SCS consulting group ltd

18m ROW BOULEVARD FILTRATION TRENCH SIZING

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: Nov 2021
Designer: MECM

Estimate imperviousness of drainage area from roofs, driveway, and road areas draining to filtration trench. Assume a section of road with a 13.7 m frontage lot with a split draining lot on one side and front draining lot on the other.

Total Area	13.7 x 68 =	931.60	m^2
Imp Area (Roof)	(185 x 1/2) + (185) =	277.50	m^2
Imp Area (Driveway, including boulevard driveway)	(6 x 6 x 2) + (5 x 6 x 2) =	132	m^2
Imp Area (Sidewalk, less driveway overlap)	(1.5 x 13.7) - (6 x 1.5)=	11.55	m^2
Imp Area (Pavement+Curb)	(8 + 0.5 + 0.5) x 13.7=	123.3	m^2
Total Imp. Area		544.35	m^2

Imperviousness **58.4%**

Sample Drainage Area 68 m2/m-road 0.0068 ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	31.1	m^3/ha
Required Water Quality Infiltration Volume	**0.212**	m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	146.1	m^3/ha
Required 25 mm Storm Event Volume	**0.993**	m^3/m-road

Required Trench Volume	**0.993**	**m^3/m-road**

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Filtration Trench Design - Provided

	Units	Total to Filtration Trench
D - Depth	m	0.80
W - Width	m	1.25
L - Length	m	1.00
A - Bottom Area	m^2	1.3
Total Volume of the Filtration Trench (i.e. stone volume)	m^3	1.0
n - Media Porosity		0.40
Total Runoff Storage Volume of the Filtration Trench	m^3	0.40
Total Runoff Storage Volume of the Filtration Trench	mm	10.1

Based on the maximum dimensions of the filtration trench to avoid conflicts with service laterals and utilities in the boulevard, the filtration trench provides 10.1 mm/impervious area of storage.

Shining Hill Estates Ph3 (Aurora)
Project Number: 2183
Date: November 2021
Designer: MECM

23m ROW BOULEVARD FILTRATION TRENCH SIZING

Estimate imperviousness of drainage area from roofs, driveway, and road areas draining to filtration trench. Assume a section of road with a 15.2 m frontage lot with a split draining lot on one side and front draining lot on the other.

Total Area	15.2 x 68 =	1033.60	m^2
Imp Area (Roof)	(208 x 1/2) + (208) =	312.00	m^2
Imp Area (Driveway, including boulevard driveway)	(6 x 6 x 2) + (5.5 x 6) + (7 x 6) =	147	m^2
Imp Area (Sidewalk, MUP, less driveway overlap)	(3 x 15.2) + (1.5 x 15.2) - (6 x 1.5) - (6 x 3) =	41.4	m^2
Imp Area (Pavement and curbs)	(10.5+0.5+0.5) x 15.2=	174.8	m^2
Total Imp. Area		675.20	m^2
Imperviousness		**65.3%**	
Sample Drainage Area	68 m2/m-road	0.0068	ha/m-road

Required Volume per Hectare (Water Quality Requirements)

(as per Table 3.2, MOE, 2003)	33.4	m^3/ha
Required Water Quality Infiltration Volume	**0.227**	m^3/m-road

Required Volume per Hectare (25 mm Storm Requirements)

as per 25 mm Storm Event	163.3	m^3/ha
Required 25 mm Storm Event Volume	**1.111**	m^3/m-road

Required Trench Volume	**1.111**	**m^3/m-road**

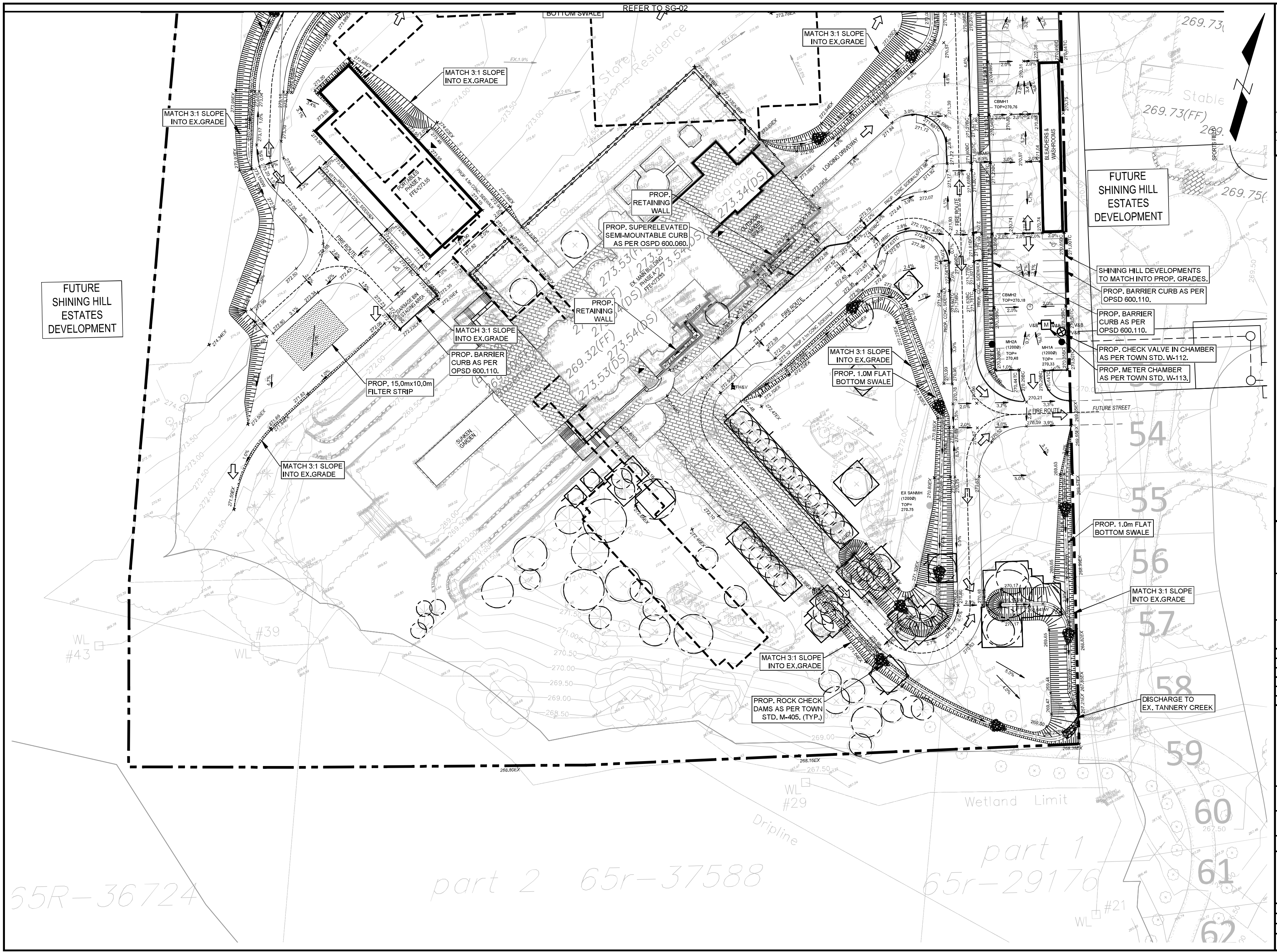
TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

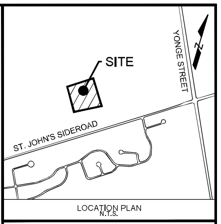
Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Filtration Trench Design - Provided

	Units	Total to Filtration Trench
D - Depth	m	0.80
W - Width	m	1.25
L - Length	m	1.00
A - Bottom Area	m^2	1.3
Total Volume of the Filtration Trench (i.e. stone volume)	m^3	1.0
n - Media Porosity		0.40
Total Runoff Storage Volume of the Infiltration/Filtration Trench	m^3	0.40
Total Runoff Storage Volume of the Infiltration/Filtration Trench	mm	9.0

Based on the maximum dimensions of the filtration trench to avoid conflicts with service laterals and utilities in the boulevard, the filtration trench provides 9 mm/impervious area of storage.





LOCATION PLAN
N.T.S.

LEGEND

PROPERTY LINE	▬ ▪ ▪ ▬
OUTLINE OF BUILDING AT GROUND LEVEL	▬▬
OUTLINE OF FUTURE BUILDING PHASES	▬ ▬ ▬
PROP. SEMI-MOUNTABLE CURB	═
PROP. FULL CURB	═
PROP. DOOR / OVERHEAD DOOR	▼/▽
EX. ELEVATION	×165.50EX
PROP. ELEVATION	×149.50
PROP. TOP OF CURB ELEVATION	×137.52TC
PROP. BOTTOM OF CURB ELEVATION	×137.52BC
PROP. SWALE ELEVATION	×137.52SW
PROP. TOP OF WALL ELEVATION	×137.29TW
PROP. BOTTOM OF WALL ELEVATION	×135.85BW
PROP. SWALE	═►═
PROP. OVERLAND FLOW ROUTE	⇦
EX. OVERLAND FLOW ROUTE	⇦
PROP. RETAINING WALL	▨
PROP. STORM MAINTENANCE HOLE	○
PROP. STORM CATCHBASIN MAINTENANCE HOLE	⊡
PROP. OIL-GRIT SEPARATOR	◎
PROP. SANITARY MAINTENANCE HOLE	●
PROP. CATCHBASIN / DOUBLE CATCHBASIN	□/□□
EX. STORM MANHOLE	○
EX. SANITARY MANHOLE	●
EX. CATCHBASIN / DOUBLE CATCHBASIN	□/□□
PROP. VALVE AND BOX	⋈ V&B
PROP. FIRE HYDRANT AND VALVE	⌖ FH&V
PROP. WATER METER	M
PROP. CHECK VALVE AND CHAMBER	⊗

LIST OF DRAWINGS

SG-01 - SITE GRADING PLAN
SG-02 - SITE GRADING PLAN
SS-01 - SITE SERVICING PLAN
SS-02 - SITE SERVICING PLAN
EC-01 - EROSION AND SEDIMENT CONTROL PLAN
XS-01 - CROSS SECTIONS
DD-01 - DETAIL DRAWING

SITE PLAN INFORMATION

MONTGOMERY SISAM
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WEBSITE: montgomerysisam.com

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BENCHMARK INFORMATION:
ELEVATIONS SHOWN HEREON ARE GEODETIC (CGVD-1928:1978) AND ARE REFERRED TO THE REGIONAL MUNICIPALITY OF YORK BENCHMARK N° 62-300 HAVING A PUBLISHED ELEVATION OF 251.610 METRES.

No.	DATE	ISSUE/REVISION	INTIAL
2	11/18/2021	ISSUED FOR COORDINATION	TVL
1.	9/10/2021	ISSUED FOR 1st SPA SUBMISSION	TVL

TOWN OF AURORA
YORK REGION

ST. ANNE'S SCHOOL
MONTGOMERY SISAM ARCHITECTS
AURORA, ONTARIO

SITE GRADING PLAN

GEI Consultants

DESIGNED BY: PS	DATE: MAY, 2021	CHECKED BY: TVL
DRAWN BY: PS	PROJECT No. 2100423	DRAWING No. SG-01
SCALE: 1:400		

5.0 0 5.0m 10.0m 15.0m 20.0m 25.0m

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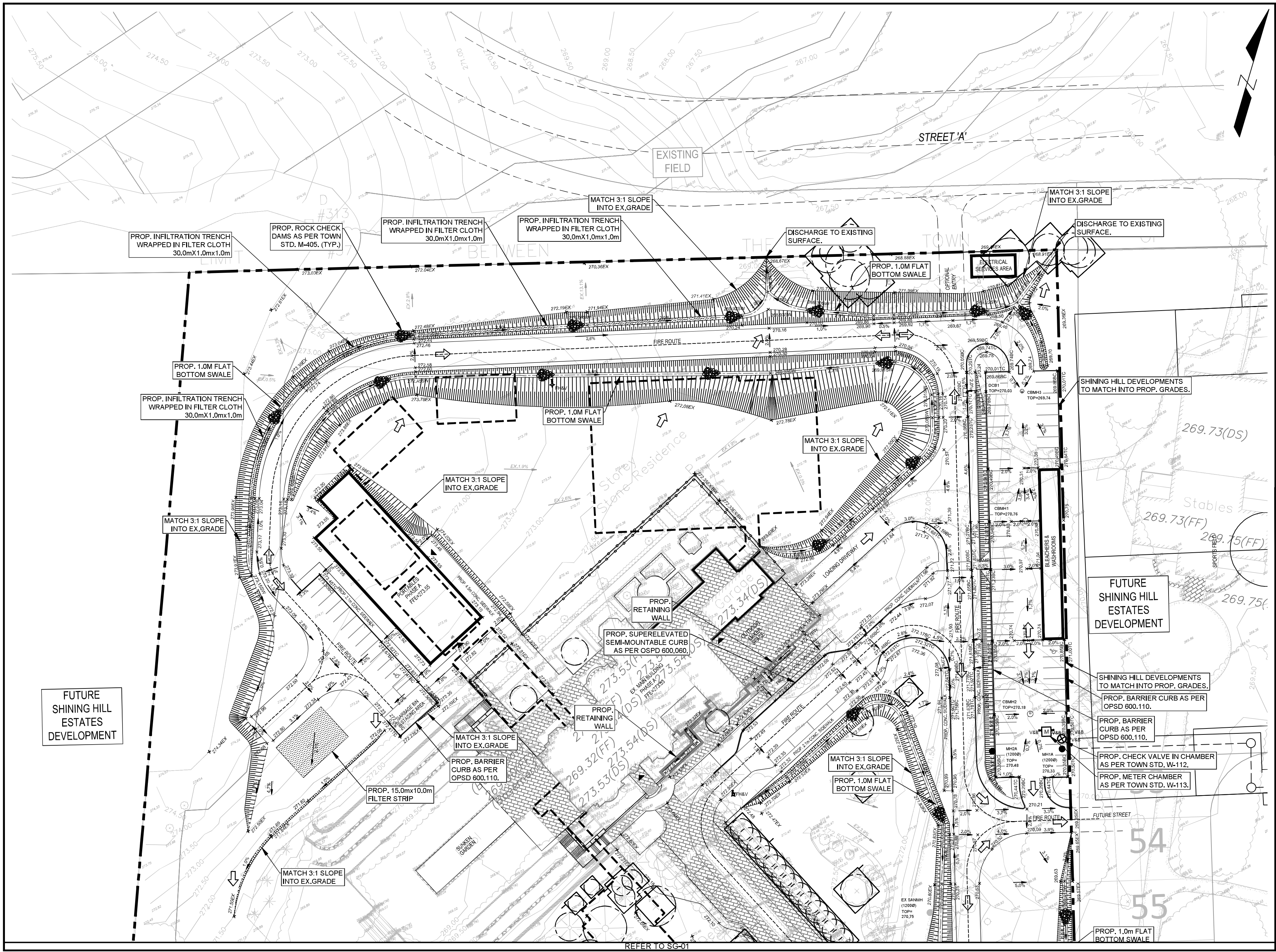
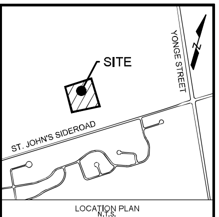


REFER TO SG-01



LOCATION PLAN
N.T.S.

LEGEND

PROPERTY LINE	▬ ▪ ▪ ▬
OUTLINE OF BUILDING AT GROUND LEVEL	▬▬
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PROP. FULL CURB	─
PROP. DOOR / OVERHEAD DOOR	▼/▽
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PROP. SWALE	═→
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PROP. CATCHBASIN / DOUBLE CATCHBASIN	□/□□
EX. STORM MANHOLE	○
EX. SANITARY MANHOLE	●
EX. CATCHBASIN / DOUBLE CATCHBASIN	□/□□
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PROP. CHECK VALVE AND CHAMBER	⊗

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No.	DATE	ISSUE/REVISION	INTIAL
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1.	9/10/2021	ISSUED FOR 1st SPA SUBMISSION	TVL

TOWN OF AURORA
YORK REGION

ST. ANNE'S SCHOOL
MONTGOMERY SISAM ARCHITECTS
AURORA, ONTARIO

SITE GRADING PLAN

GEI Consultants

DESIGNED BY: PS	DATE: MAY, 2021	CHECKED BY: TVL
DRAWN BY: PS	PROJECT No. 2100423	DRAWING No. SG-02
SCALE: 1:400		

5.0 0 5.0m 10.0m 15.0m 20.0m 25.0m

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APPENDIX C

MECP Water Well Records

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl	 Qu	CR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6901579	1 86	Aug-57	621280 4874782	288.6	94.5 6.1	Fr Fr	107.0	-1.5	21.3	14	2160	29.0	4823 CT	WS DO	**MOE# 6901579** 0.0 TPSL 0.3 YLLW CLAY MSND 6.1 SILT MSND 10.7 GREY CLAY 91.4 GRVL 91.7 BLUE CLAY 94.5 SILT MSND 104.5 MSND GRVL 108.2
6901581	1 86	Nov-61	622013 4874963	263.0	47.9	Fr	48.5	-1.2	9.1	23	480	21.3	2310 CT	WS PU	**MOE# 6901581** 0.0 TPSL 0.3 CLAY MSND 4.6 BLUE CLAY 45.1 CLAY GRVL 47.9 MSND 50.0
6901582	1 86	Jan-62	621090 4874655	301.8	8.5	Fr			6.1	9			4102 CT	WS ST	**MOE# 6901582** 0.0 BLUE CLAY 8.5 GRVL 10.1
6901584	1 87	Apr-59	622190 4875492	254.8	75.6	Fr	76.2	-1.2	1.2	55	300	2.7	2310 CT	WS DO	**MOE# 6901584** 0.0 YLLW CLAY 25.9 STNS 48.8 GREY CLAY 73.2 CLAY 75.6 MSND 77.4
6901586	1 87	Jul-49	621685 4875541	265.2	76.2	Fr	75.0	-1.2	FLW	27			2310 CT	WS DO	**MOE# 6901586** 0.0 CLAY 33.5 CLAY BLDR 45.7 CLAY 74.7 GRVL 76.2
6901587	1 87	Jul-62	622024 4875476	249.0	9.1	Fr			3.0	9			4102 BR	WS ST	**MOE# 6901587** 0.0 BLUE CLAY 9.1 GREY CLAY MSND 13.7
6901589	1 87	Oct-63	622310 4875533	250.5	69.2	Fr	70.1	-1.2	4.6	36	60	24.4	2310 CT	WS DO	**MOE# 6901589** 0.0 TPSL 0.6 GREY CLAY 6.7 BLUE CLAY 35.1 MSND GRVL CLAY 40.2 CLAY MSND 53.3 BLUE CLAY 67.1 CLAY GRVL 69.2 CSND 71.6
6907445	1 85	Aug-62	622681 4874898	260.0	29.0	Fr	31.7	-2.4	10.1	68	120	15.2	2310 CT	WS DO	**MOE# 6907445** 0.0 RED CLAY 4.3 GREY CLAY 21.3 CLAY STNS 29.0 GRVL 34.1
6908544	1 87	Apr-68	622232 4875671	256.3	74.7	Fr	73.8	-2.1	8.5	45	120	15.2	2310 CT	WS DO	**MOE# 6908544** 0.0 GREY CLAY 4.3 BLUE CLAY 32.3 BLUE CLAY GRVL STNS 61.9 BLUE CLAY 74.7 MSND 75.9
6910570	1 86	Apr-71	620962 4874701	306.0	166.1	Fr			68.6	23	540	82.3	1663 CT	WS DO	**MOE# 6910570** 0.0 BRWN MSND CLAY 10.7 BRWN GRVL MSND 21.3 BLUE CLAY STNS 141.7 BLUE CLAY MSND 147.8 BLUE CLAY 165.2 BLCK MSND SILT CLAY 167.0
6913488	1 86	Sep-76	622052 4875111	251.8	44.8	Fr	49.4	-0.9	9.1	23	4800	48.2	2341 CT	WS PU	**MOE# 6913488** 0.0 BRWN SAND STNS 4.6 BLUE CLAY 44.8 CLAY GRVL 50.0 SAND 51.5
6915585	1 86	Sep-80	622012 4875021	260.9	50.3	-	52.1	-2.7	20.4	45	300	25.0	3108 RC	WS PU	**MOE# 6915585** 0.0 PRDR 49.7 SAND 55.2
6916809	1 86	Nov-83	621412 4874821	280.1	112.8	-	114.6	-1.8	56.7	23	240	85.3	3108 RC	WS DO	**MOE# 6916809** 0.0 TPSL 0.6 BRWN SAND CLAY 7.9 BLUE CLAY 24.7 BLUE SILT 33.8 BLUE CLAY 103.3 BLUE SAND CLAY 104.9 BLUE CLAY 112.8 BLUE FSND VERY 117.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6918411	1 85	Dec-86	622617 4875023	255.1	89.9 Fr	89.9 -10.7	21.3	909	480	22.9	1413 RC	WS MU	**MOE# 6918411** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.9 GREY SAND MGRD CLN 81.7 GREY SAND PCKD 86.0 GREY SAND LOOS 88.4 GREY GRVL STNS HARD 89.9 GREY GRVL CLN LOOS 94.5 GREY GRVL SAND CLN 96.3
6918439	1 85	Jan-87	622623 4875028	255.1	120.4 Fr	88.4 -6.1 121.9 -3.7	21.3	227	480	45.7	1413 RC	TH NU	**MOE# 6918439** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.6 BRWN SAND CLN LOOS 80.8 GREY CLAY SAND PCKD 86.0 GREY SAND CLN LOOS 86.9 GREY GRVL SAND CLN 95.1 GREY GRVL PCKD 109.1 GREY GRVL CLN LOOS 111.3 GREY GRVL 113.4 GREY CLAY DNSE 114.3 GREY GRVL SAND PCKD 115.8 GREY GRVL SAND CLN 117.3 GREY GRVL SAND PCKD 119.5 GREY CLAY SAND PCKD 120.4 GREY SAND CLN 121.3 GREY GRVL SAND CGRD 124.4 GREY CLAY STNS CMTD 126.5
6918544	1 85	Feb-87	622614 4875023	255.1	86.9 Fr	88.4 -6.1	21.3	2728	240	48.8	1413 RC	TH NU	**MOE# 6918544** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.6 BRWN SAND CLN LOOS 80.8 GREY CLAY SAND PCKD 86.0 GREY SAND CLN LOOS 86.9 GREY GRVL SAND LOOS 94.5
6918645	1 85	Sep-86	622350 4874460	253.0	29.3 Fr	27.4 -1.8	6.1	27	130	29.0	5459 CT	WS DO	**MOE# 6918645** 0.0 BRWN CLAY 5.2 BLUE CLAY SOFT 29.3 BRWN SAND MGRD 31.1
6923894	1 86	May-97	621975 4875041	264.6	81.4 Fr	80.5 -0.9	NR	114	150	76.2	1413 RA	WS DO	**MOE# 6923894** 0.0 BRWN CLAY HARD 5.2 GREY CLAY SOFT 42.7 BRWN CLAY SAND LYRD 50.9 GREY CLAY HARD 55.8 BRWN SAND GRVL CMTD 59.1 GREY CLAY STNS HARD 79.9 BRWN FSND CLN 81.4
7130451	1 87	Jun-08	620911 4874935	285.6	102.7 Un	107.6 -1.5	77.4	50	60	91.1	1663 RC	WS DO	**MOE# 7130451 TAG#A075076** 0.0 BRWN SAND 4.9 BRWN CLAY SILT 7.0 GREY CLAY GRVL 23.8 BRWN SAND CLAY 29.6 GREY SILT CLAY 82.9 BRWN SAND STNS CLAY 86.3 GREY CLAY GRVL 102.7 GREY FSND SILT LYRD 109.1
7152094	1 86	Sep-10	622163 4875162	249.0		75.0 -1.8	22.9		2880	22.9	6300 RC	WS -	**MOE# 7152094 TAG#A081679** 0.0 TPSL 0.6 BRWN CLAY 4.9 BLUE CLAY HARD 24.4 GRVL 25.3 BLUE CLAY SOFT 36.6 BLUE CLAY SOFT 42.7 BLUE CLAY HARD 73.8 SAND CLN 76.8 BLUE CLAY HARD 85.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
7190773	1 85	Oct-12	622613 4875032	255.1		29.0 0.0	NR				5459 RA	OW MO	**MOE# 7190773 TAG#A124709** 0.0 GREY FILL SOFT 2.4 GREY CLAY SOFT 7.6 GREY CLAY SILT LYRD 19.2 RED BLDR DNSE 19.5 GREY MSND GRVL SILT 22.9 GREY MSND STNS LOOS 24.4 BRWN MSND LOOS 27.4 GREY CSND GRVL LOOS 29.6
7236984		Dec-14	622371 4875420	249.3			NR				6032 -	- -	**MOE# 7236984 TAG#A102044** 0.0
7259668	1 86	Feb-16	622397 4875030	247.5	3.0 Un	3.0 -1.5	NR				7147 BR	OW MO	**MOE# 7259668 TAG#A198730** 0.0 BRWN CLAY SOFT 4.6
7285109		Sep-16	622627 4875024	255.4	10.1 Un	93.3 -4.3 89.6 -3.0	13.7	3300	4320	18.6	7564 RC	WS MU	**MOE# 7285109 TAG#A172641** 0.0 TPSL 0.6 BRWN CLAY 6.4 GREY CLAY SOFT 19.8 GREY GRVL SAND 33.5 GREY CLAY GRVL 49.1 GREY CLAY DNSE 67.4 GREY SILT 73.2 GREY FSND 87.8 GREY GRVL SAND 99.7
7285110		Sep-16	622627 4875024	255.4			NR				7564 -	- -	**MOE# 7285110 TAG#A172641** 0.0 MSND GRVL 102.7
7306495		Aug-17	621091 4874653	NR	13.4 Un	12.2 -3.0	NR				7247 RC	OW TH	**MOE# 7306495 TAG#A201420** 0.0 BRWN SILT SAND WTHD 0.6 BRWN SAND SILT DNSE 4.0 BRWN SILT SAND DNSE 15.2
7309192	1 85	Dec-16	622599 4875009	NR		7.6 -3.0	NR				6032 BR	OW MO	**MOE# 7309192 TAG#A194356** 0.0 BRWN CLAY SOFT 3.0 GREY CLAY SOFT 10.7
7326065	1 87	Nov-18	622101 4875609	NR			NR				7230 -	- -	**MOE# 7326065 TAG#A253727** 0.0
GSC2996		Jan-01	622417 4874820	249.9			NR				 -	- -	**MOE# GSC2996** 0.0 SILT CLAY CLYY 2.4 SILT CLAY CLYY 18.6
GSC3000		Jan-01	622341 4875120	253.6			NR				 -	- -	**MOE# GSC3000** 0.0 SILT CLAY CLYY 14.6 SAND SLTY TILL 21.6
GSC3211		Jan-01	622516 4875020	253.6			NR				 -	- -	**MOE# GSC3211** 0.0 SILT CLAY CLYY 1.2 SAND SLTY 1.8 GRVL SAND GRVL 2.7 SILT CLAY CLYY 5.8
YPD1357		Jan-13	622629 4875020	255.4			NR				 -	- -	**MOE# YPD1357** 0.0 BRWN SILT CLAY 6.1 GREY CLAY 15.2 GREY CLAY 18.3 GREY SILT SAND GRVL 24.4 BRWN SAND 29.0 BRWN SAND GRVL 33.5 GREY CLAY HARD 68.0 GREY SAND FGRD 76.2 GREY SAND 79.2 GREY SAND FGRD 86.9 GREY SAND GRVL 99.1 GREY SAND 103.6 GREY SAND 112.8 GREY CLAY 113.4
YPD1366		Oct-12	622609 4875025	255.4		27.4 -1.5	NR				 -	- -	**MOE# YPD1366** 0.0 GREY CLAY SILT GRVL 68.0 GREY SAND GRVL 68.6 GREY SAND SILT FGRD 69.2 SAND GRVL 70.1 GRVL SAND SILT 70.7 CLAY SILT LYRD 71.6 CLAY SILT 75.3 BRWN FILL 76.8
YPD3668		Jan-01	621398 4874866	275.8			NR				 -	- -	**MOE# YPD3668** 0.0 6.4 SAND 6.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
YPD3935		Jan-01	622584 4875053	254.5					NR				 -	- -	**MOE# YPD3935** 0.0 SILT SAND CLAY 3.7 SILT SAND CLAY 19.8 GRVL SAND 22.9 TILL SILT SAND 54.9 SILT SAND CLAY 68.9 SAND SILT 81.7 SAND SILT 86.0 SAND SILT 88.4 GRVL SAND 94.5 GRVL SAND 112.2 TILL CLAY SILT 120.7 TILL CLAY SILT 123.1 GRVL SAND 127.1 TILL CLAY SILT 130.5 CLAY SILT 132.6 ROCK 137.2
YPD4752		Jan-01	622666 4874969	259.4					NR				 -	- -	**MOE# YPD4752** 0.0 SILT SAND CLAY 19.8 TILL SAND SILT 22.9 TILL SILT SAND 54.9 SILT SAND CLAY 68.9 SAND SILT 88.4 GRVL SAND 112.2 TILL CLAY SILT 120.7 TILL SILT SAND 123.1 GRVL SAND 127.1 TILL CLAY SILT 130.5 CLAY SILT 132.6

	QUALITY:		TYPE:		USE:				METHOD :
Fr	Fresh	WS	Water Supply	CO	Comercial	NU	Not Used	CT	Cable Tool
Mn	Mineral	AQ	Abandoned Quality	DO	Domestic	IR	Irrigation	JT	Jetting
Sa	Salty	AS	Abandoned Supply	MU	Municipal	AL	Alteration	RC	Rotary Conventional
Su	Sulphur	AB	Abandonment Record	PU	Public	MO	Monitoring	RA	Rotary Air
--	Unrecorded	TH	Test Hole or Observation	ST	Stock	-	Not Recorded	BR	Boring

Easting and Northings UTM NAD 83 Zone 17, Translated from Recorded UTM NAD, subject to Field Verified Location or Improved Location Accuracy.

Records Copyright Ministry of Environment Queen's Printer. Selected information tabulated to metric with changes and corrections subject to Driller's Records.

APPENDIX D

List of Abbreviations and Description of Terms

Record of Borehole Sheets BH101 to BH108 & BH201 to BH206

Plasticity Chart and Grain Size Analysis

(Soil Eng. 2021A and 2021B)

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

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

SOIL DESCRIPTION

Cohesionless Soils:

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

Cohesive Soils:

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

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

☐ Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

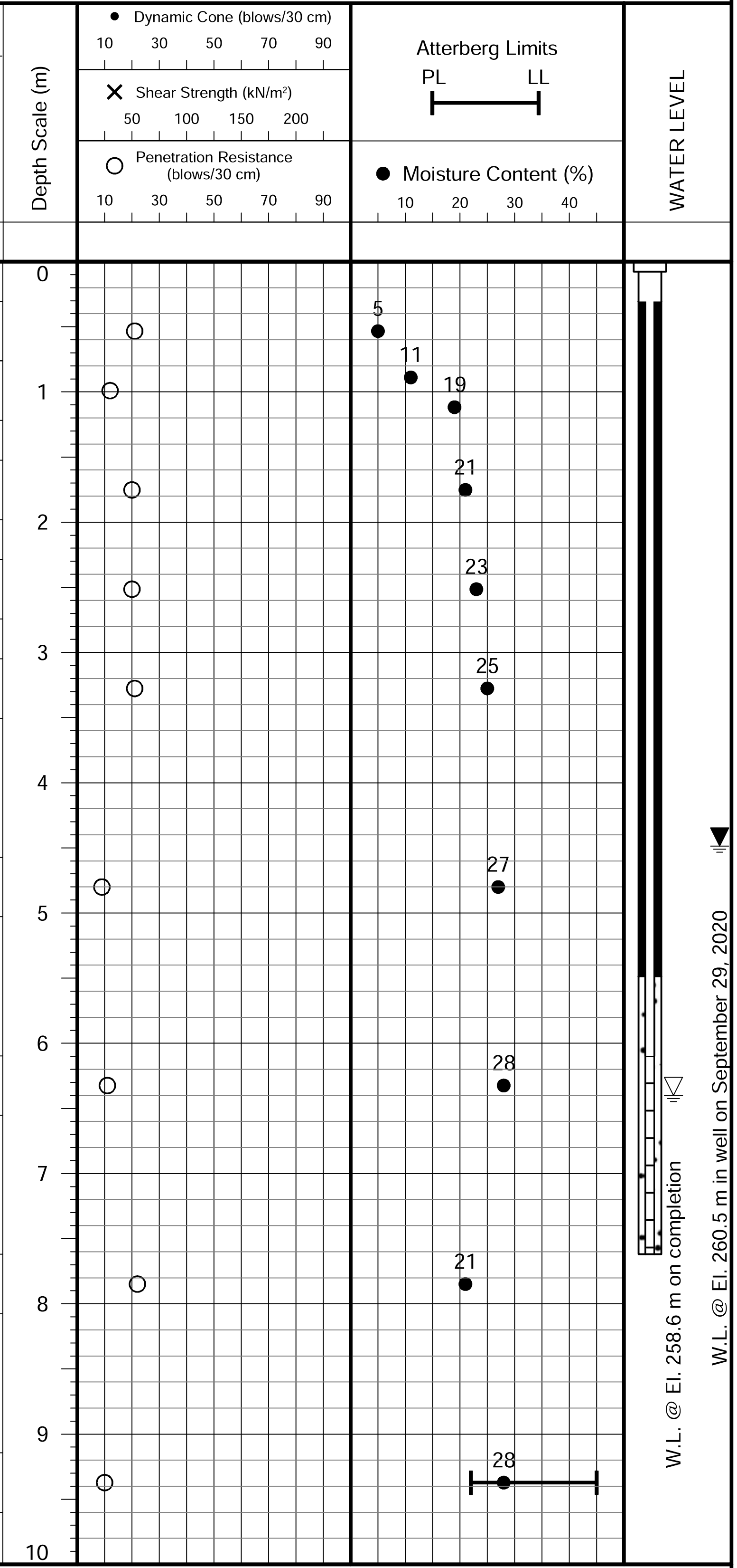
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 10 and 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
265.0	Pavement Surface			
0.0	**80 mm ASPHALT CONCRETE** **300 mm GRANULAR FILL**			
	Brown **EARTH FILL** **(Silty Sand)** a trace of gravel	1	DO	21
		2A	DO	12
264.0 1.0	Stiff to very stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	2B		
		3	DO	20
		4	DO	20
		5	DO	21
	brown grey	6	DO	9
		7	DO	11
		8	DO	22
		9	DO	10
255.0	*(Continued on next page)*			



JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

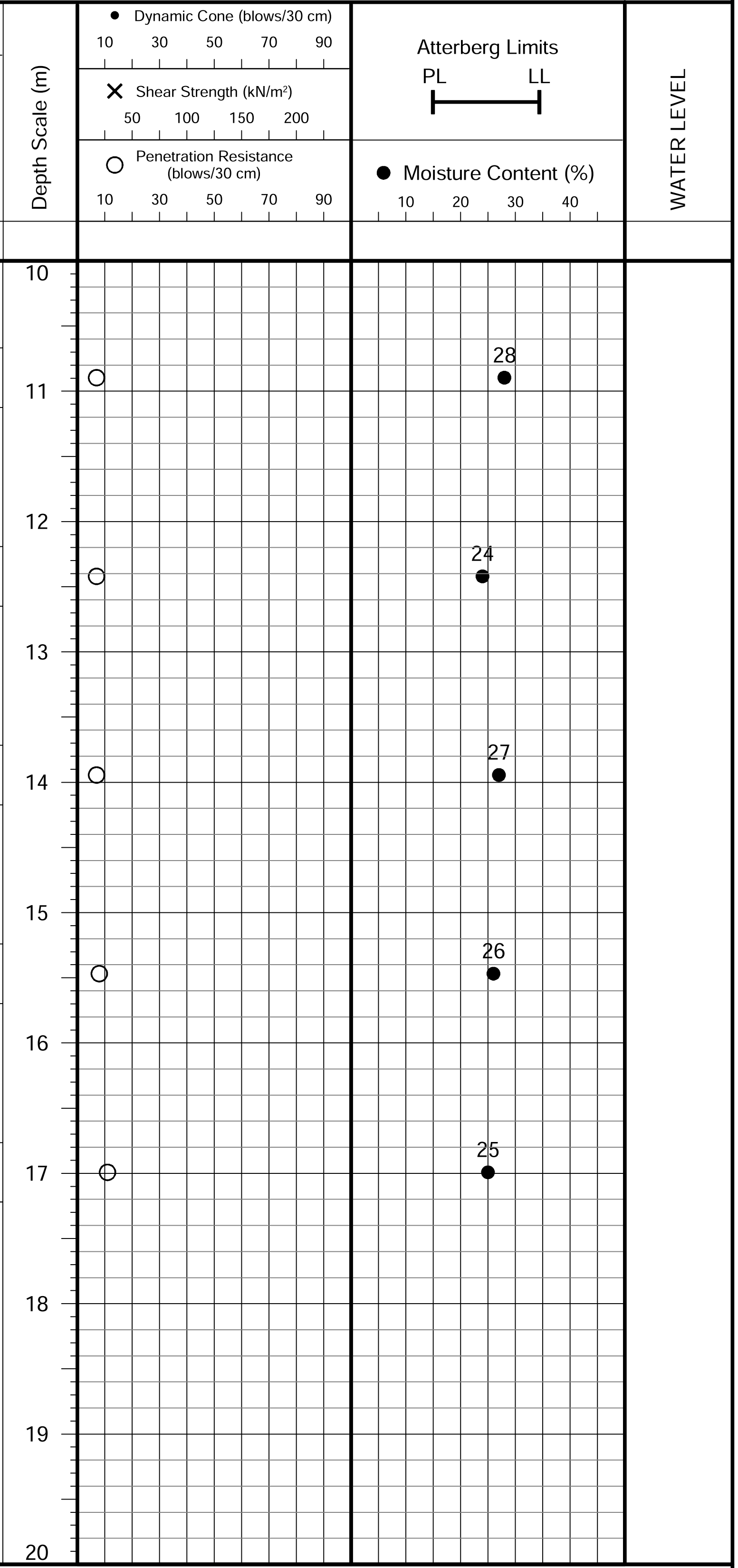
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 10 and 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt seams and layers			
		10	DO	7
		11	DO	7
		12	DO	7
		13	DO	8
		14	DO	11
247.8 17.2	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen)
Sand backfill from 5.5 m to 7.6 m
Bentonite holeplug from 0.3 m to 5.5 m
Provided with a flushmount casing
Sealed with 0.3 m concrete to surface
with top and bottom caps



Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 102

FIGURE NO.: 2

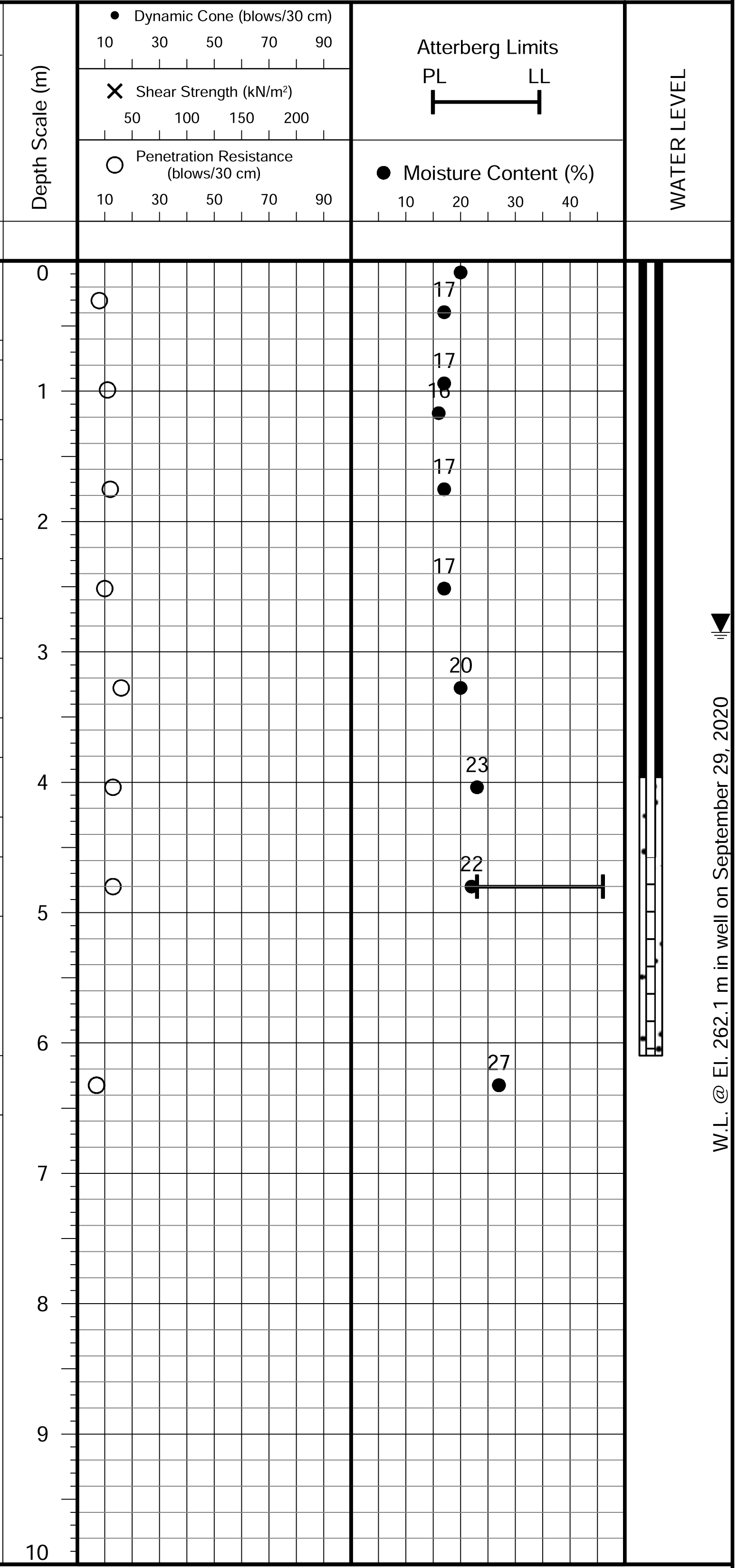
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
264.9	Ground Surface			
0.0	**18 cm TOPSOIL**	1A	DO	8
	Brown, loose to compact, weathered **SILT** a trace of clay a trace to some sand	1B		
		2A 2B	DO	11
263.8 1.1	Brown, loose to compact **SILTY FINE SAND** — — weathered a trace of clay occ. gravel	3	DO	12
		4	DO	10
261.6 3.3	Grey, firm to stiff **SILTY CLAY** a trace of sand	5	AS	16
		6	DO	13
		7	DO	13
		8	DO	7
258.3 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 103

FIGURE NO.: 3

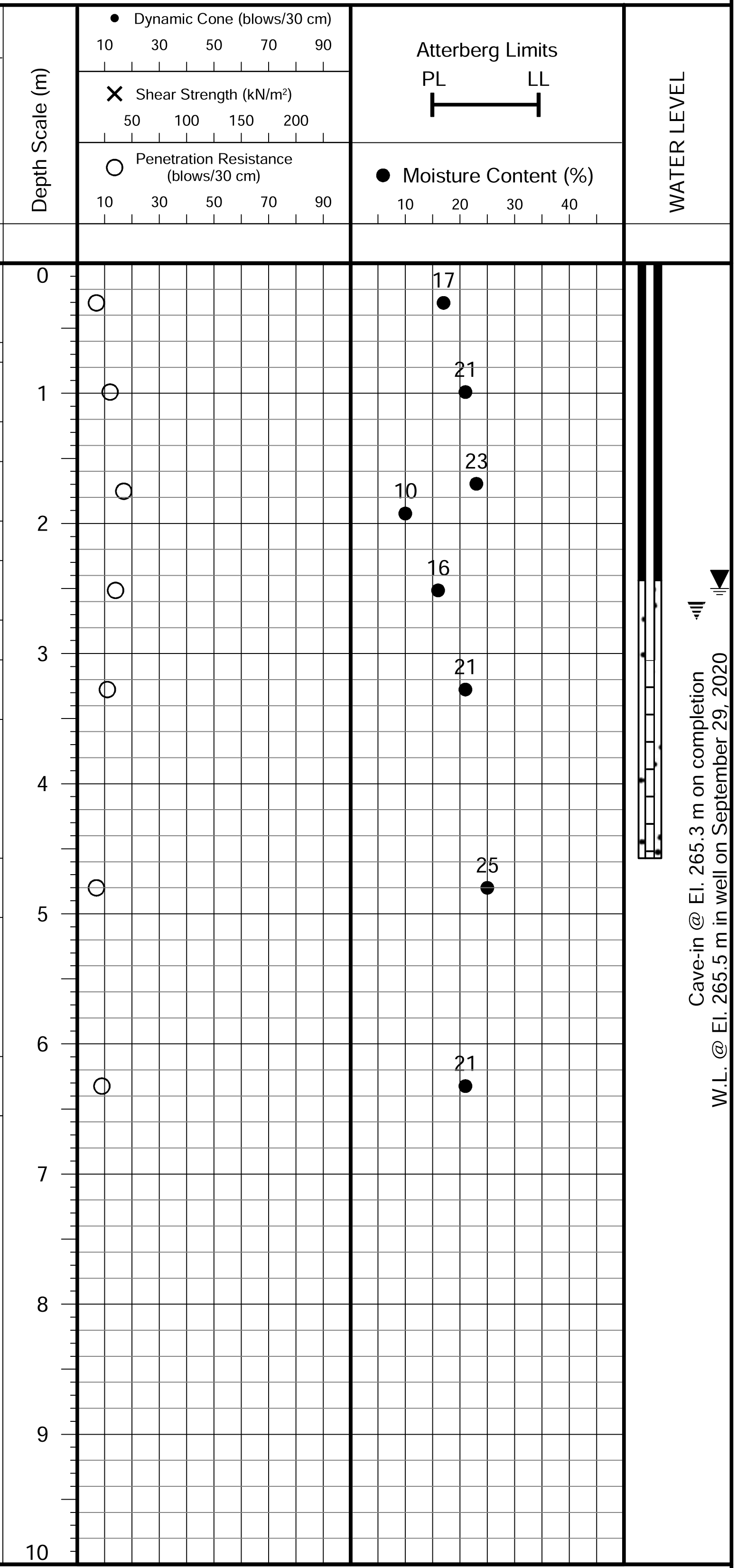
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
268.0	Ground Surface			
0.0	**TOPSOIL FILL** (mixed with clay and silt)	1	DO	7
		2	DO	12
		3A	DO	17
266.1 1.9	Brown, compact **SAND** fine to coarse grained a trace of silt	3B		
265.7 2.3	Brown, compact **SANDY SILT** a trace of clay occ. silt layers	4	DO	14
		5	DO	11
263.4 4.6	Grey, firm to stiff **SILTY CLAY** a trace of sand with sand and silt seams, and occ. gravel	6	DO	7
		7	DO	9
261.4 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 4.6 m (1.5 m screen) Sand backfill from 2.4 m to 4.6 m Bentonite holeplug from 0 m to 2.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Cave-in @ El. 265.3 m on completion

W.L. @ El. 265.5 m in well on September 29, 2020

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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 104

FIGURE NO.: 4

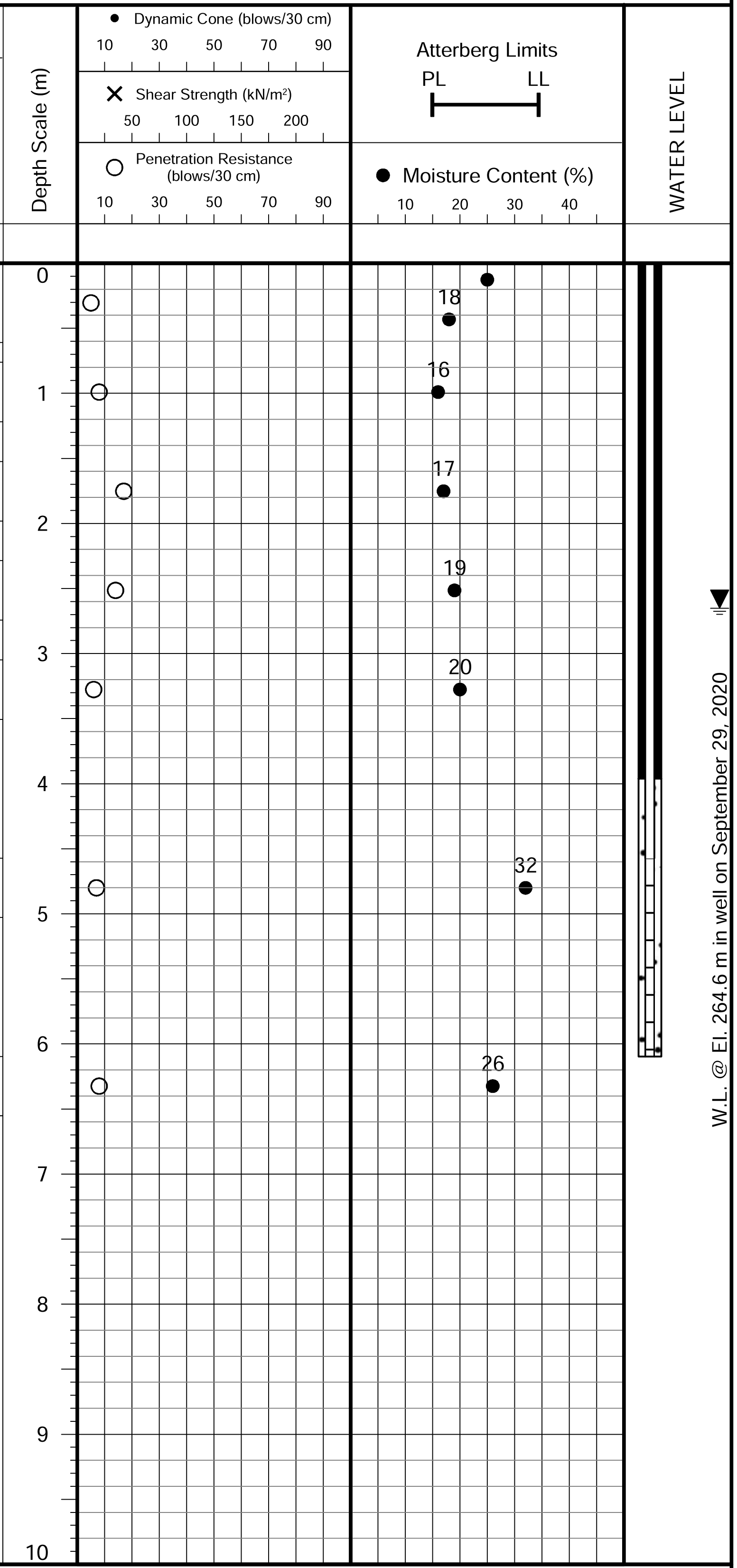
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
267.3	Ground Surface			
0.0	**25 cm TOPSOIL**	1A	DO	5
	Brown, loose, weathered **SILT** a trace of clay a trace to some sand occ. sand layers	1B		
		2	DO	8
265.8 1.5	Brown, compact **SILTY FINE SAND** a trace of clay	3	DO	17
		4	DO	14
264.3 3.0	Firm **SILTY CLAY** a trace of sand with sand and silt seams and layers silt/brown grey	5	DO	6
		6	DO	7
		7	DO	8
260.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

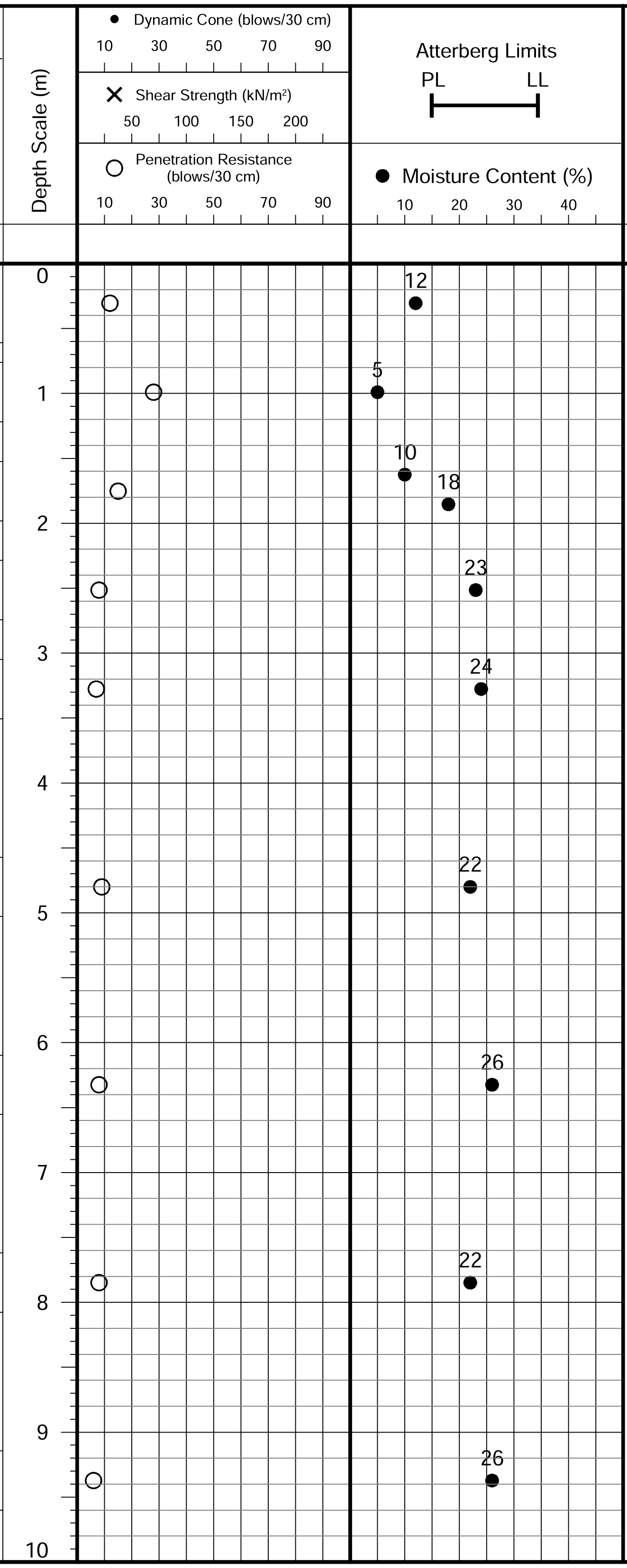
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
266.8	Ground Surface			
0.0	Brown **EARTH FILL** **(Silty Sand)** traces of clay and gravel with organic inclusions	1	DO	12
266.0 0.8	Brown, compact **SAND** fine grained a trace to some silt	2	DO	28
265.1 1.7	Brown, compact **SILT** some clay, a trace of sand	3A 3B	DO	15
264.5 2.3	Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt seams and layers	4	DO	8
		5	DO	7
		6	DO	9
		7	DO	8
		8	DO	8
		9	DO	6
256.8	*(Continued on next page)*			



WATER LEVEL

No W.L. recorded due to process of washboring to carry out deep borehole

W.L. @ El. 259.6 m in well on September 29, 2020

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

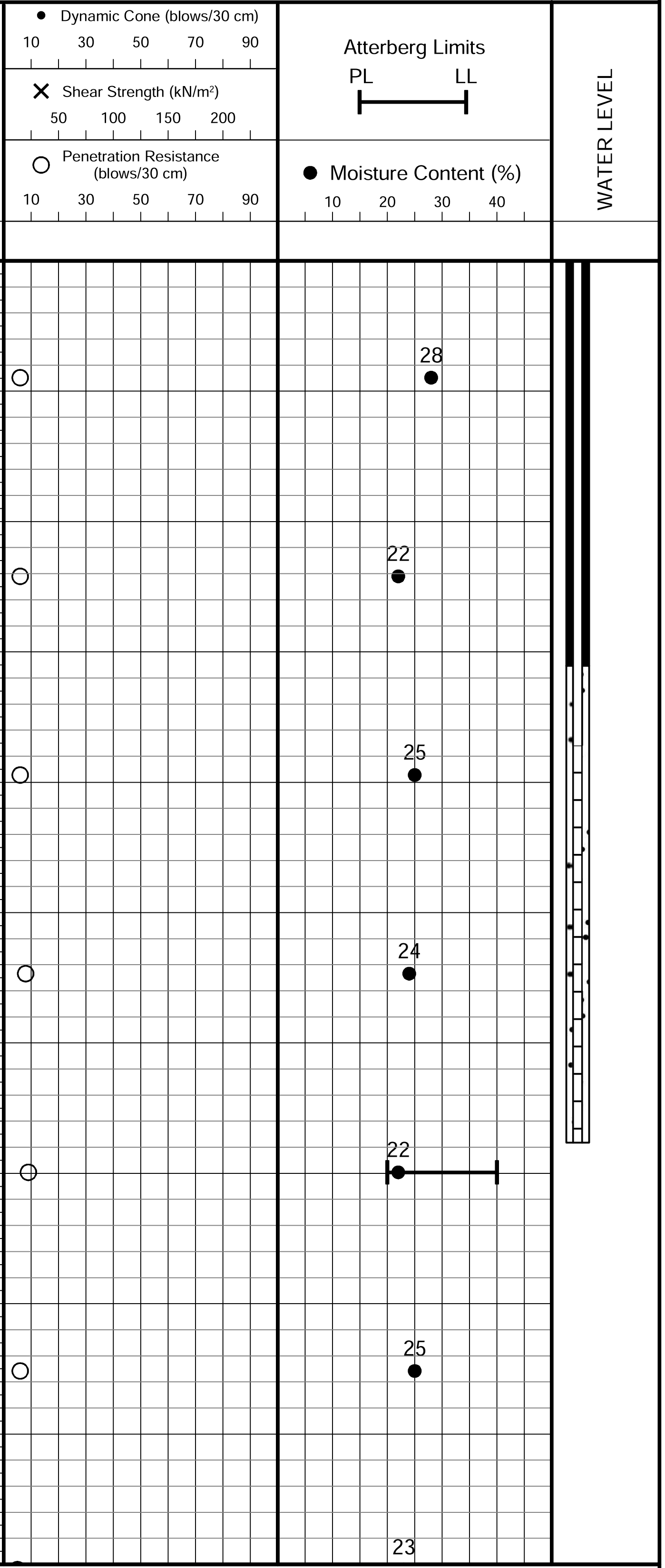
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY (varved)** a trace of sand with silt layers				10
		10	DO	6	11
					12
		11	DO	6	
					13
		12	DO	6	14
					15
		13	DO	8	
					16
		14	DO	9	17
					18
		15	DO	6	
					19
246.8	*(Continued on next page)*				20



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

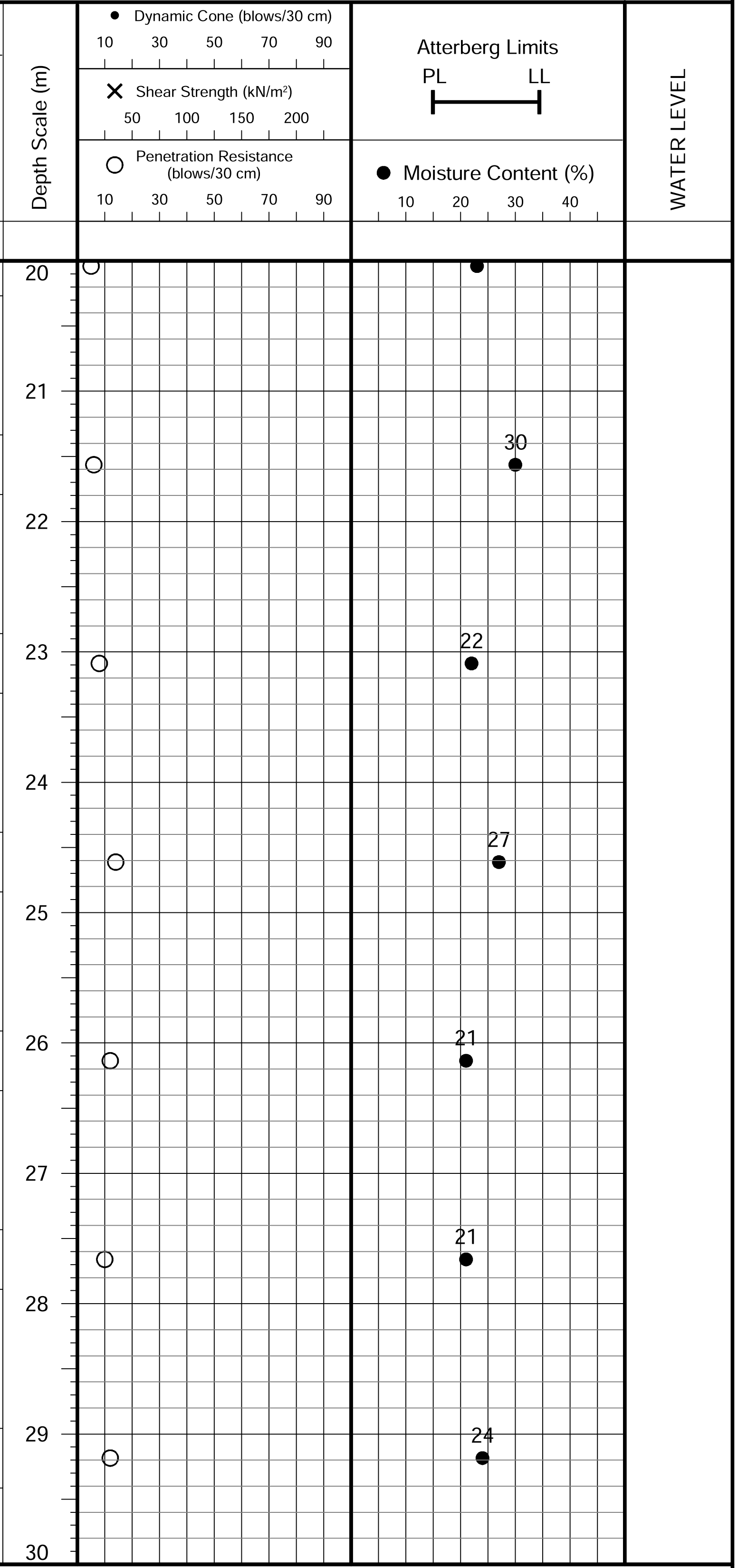
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
20.0	*(Continued)* Grey, firm to stiff **SILTY CLAY (varved)** a trace of sand with silt layers	16	DO	5
		17	DO	6
		18	DO	8
		19	DO	14
		20	DO	12
		21	DO	10
		22	DO	12
236.8	*(Continued on next page)*			



Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

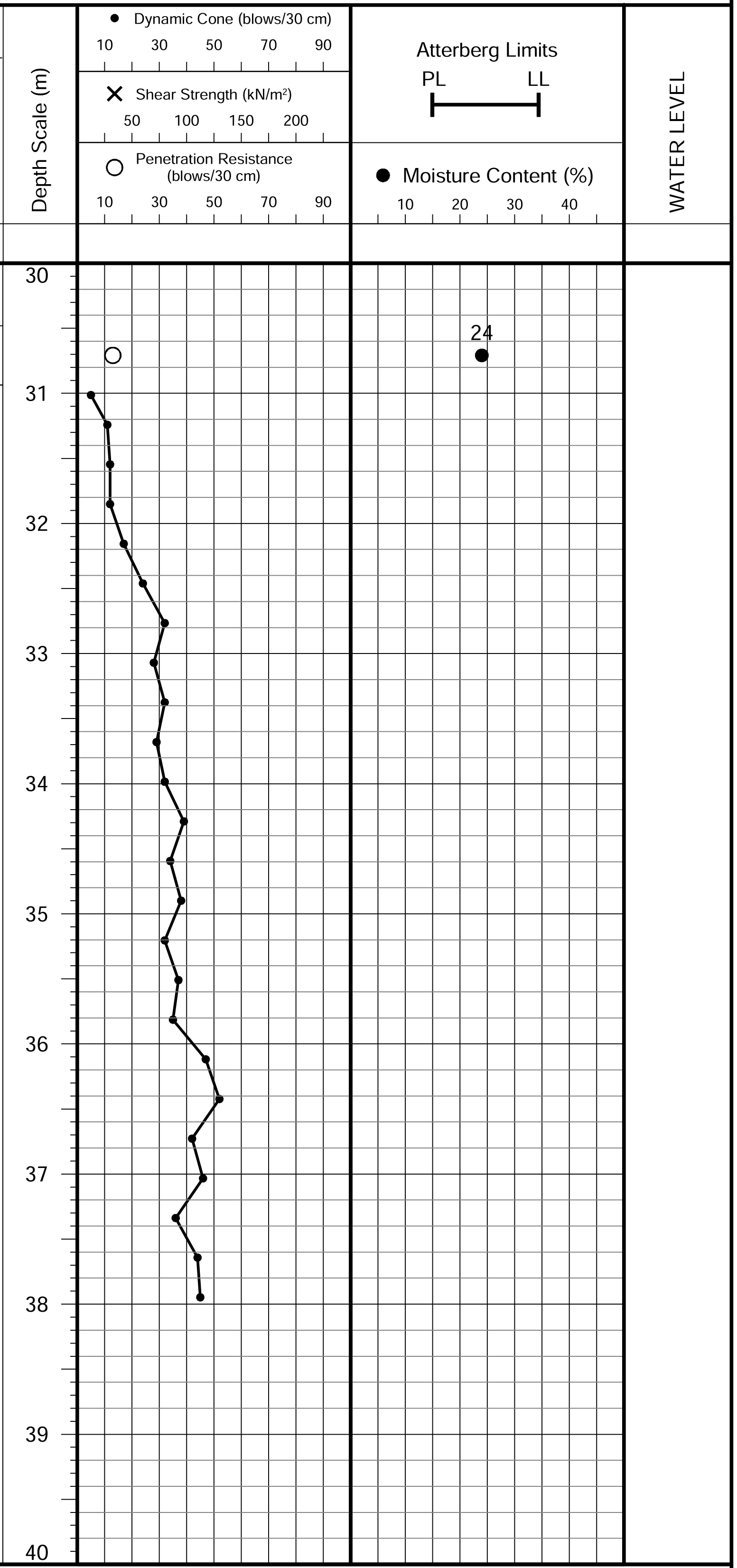
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
30.0	*(Continued)* Grey, stiff **SILTY CLAY (varved)** a trace of sand with silt layers	23	DO	13
235.9 30.9	**END OF BOREHOLE** **DYNAMIC CONE PENETRATION TEST**			
228.7 38.1	**END OF DYNAMIC CONE TEST** Installed 50 mm Ø PVC monitoring well to 16.8 m (3.0 m screen) Sand backfill from 13.1 m to 16.8 m Bentonite holeplug from 0 m to 13.1 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 106

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

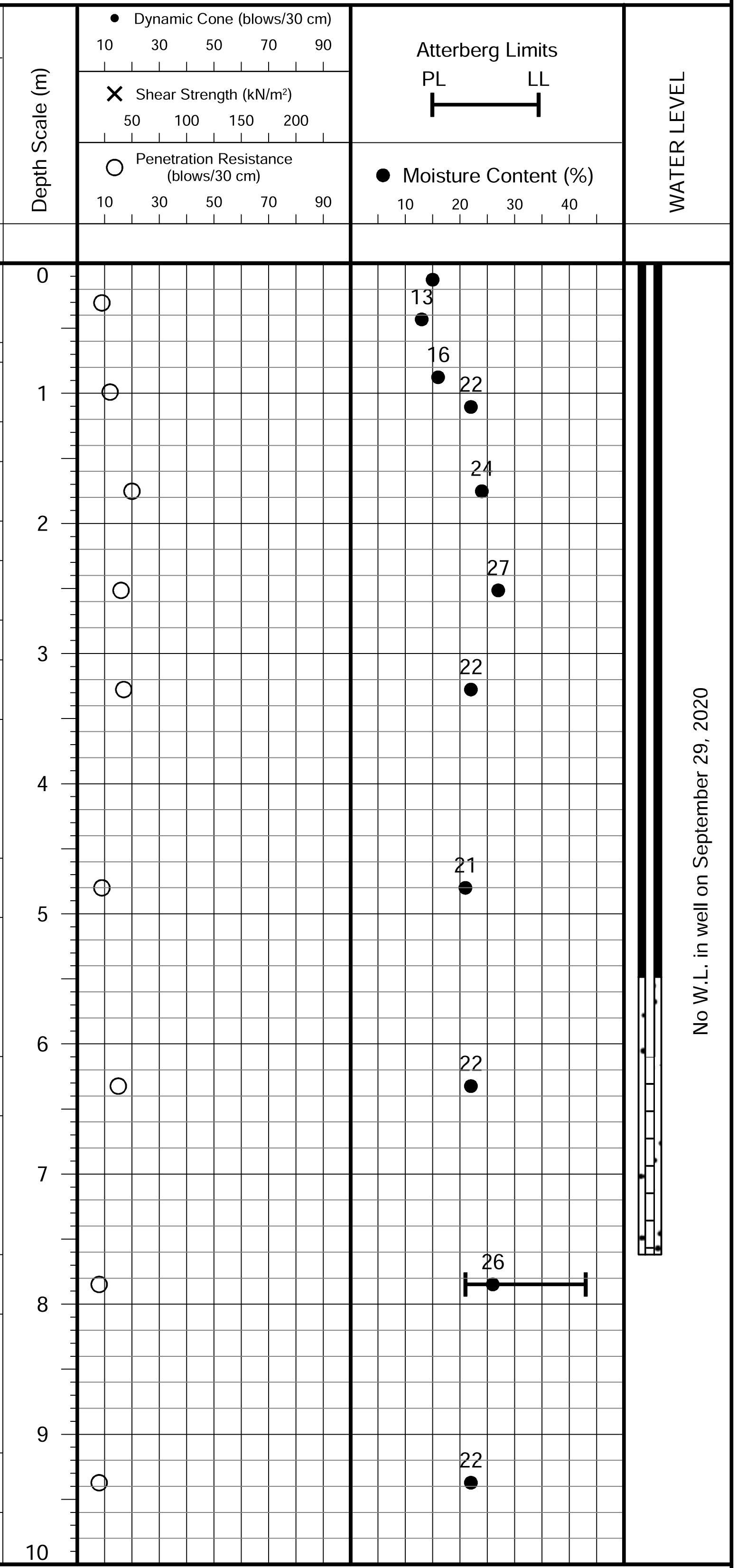
PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11 and 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION
265.3	Ground Surface
0.0	**25 cm TOPSOIL**
	Brown, loose, weathered **SILT** a trace of clay a trace to some sand
264.5 0.8	
264.3 1.0	Brown, compact, weathered **SILTY FINE SAND** a trace of clay
	Firm to very stiff **SILTY CLAY (varved)** a trace of sand with silt layers
	weathered
	brown grey
255.3	*(Continued on next page)*

SAMPLES

Number	Type	N-Value
1A 1B	DO	9
2A 2B	DO	12
3	DO	20
4	DO	16
5	DO	17
6	DO	9
7	DO	15
8	DO	8
9	DO	8



Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 106

FIGURE NO.: 6

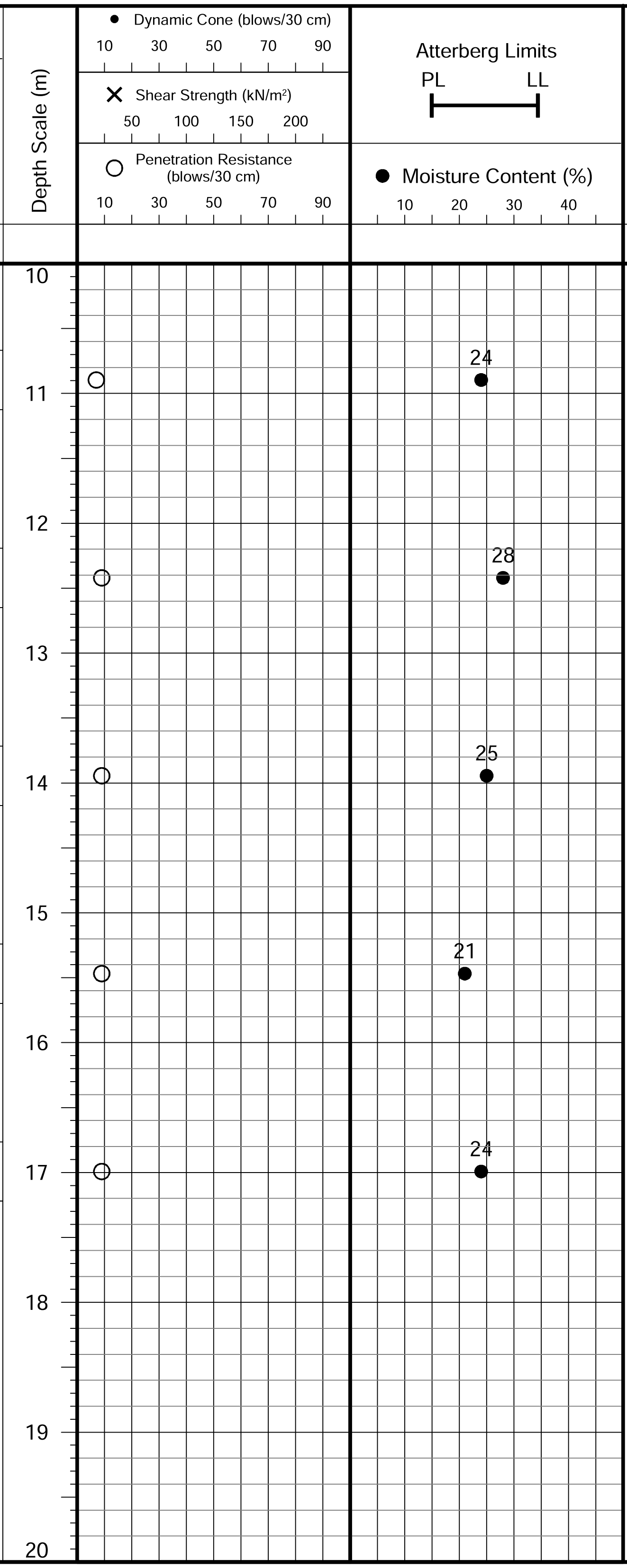
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11 and 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY (varved)** a trace of sand with silt layers			
		10	DO	7
		11	DO	9
		12	DO	9
		13	DO	9
		14	DO	9
248.1 17.2	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 m to 7.6 m Bentonite holeplug from 0 m to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



WATER LEVEL

▽ W.L. @ El. 253.7 m on completion

Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 107

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

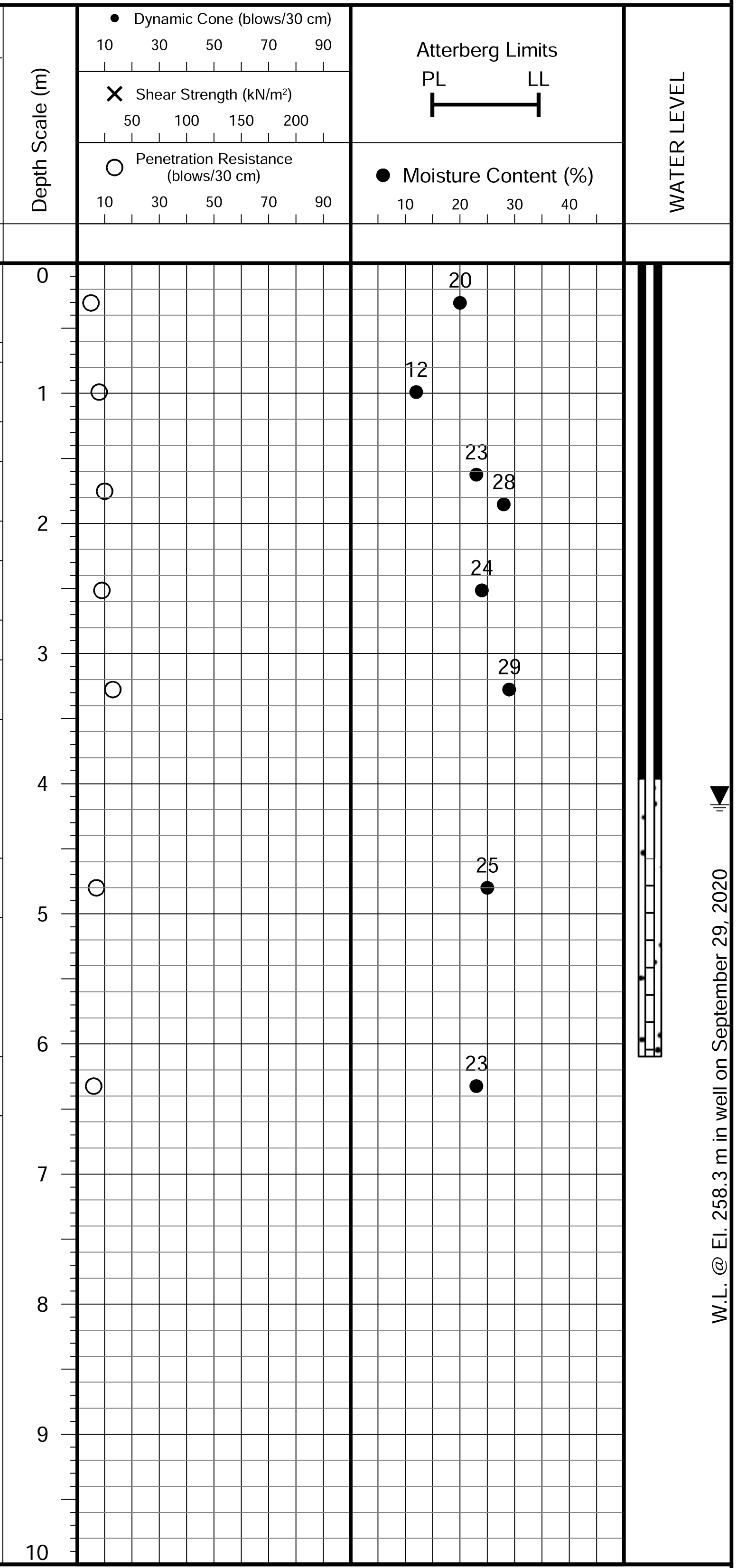
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
262.5	Ground Surface			
0.0	Brown/grey/dark brown **EARTH FILL** **(Silty Clay and Sandy Silt)** a trace of gravel with topsoil/organic inclusions	1	DO	5
		2	DO	8
260.8 1.7	Firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	3A 3B	DO	10
		4	DO	9
		5	DO	13
	— — — brown grey	6	DO	7
		7	DO	6
255.9 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen)
Sand backfill from 4.0 m to 6.1 m
Bentonite holeplug from 0 m to 4.0 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 108

FIGURE NO.: 8

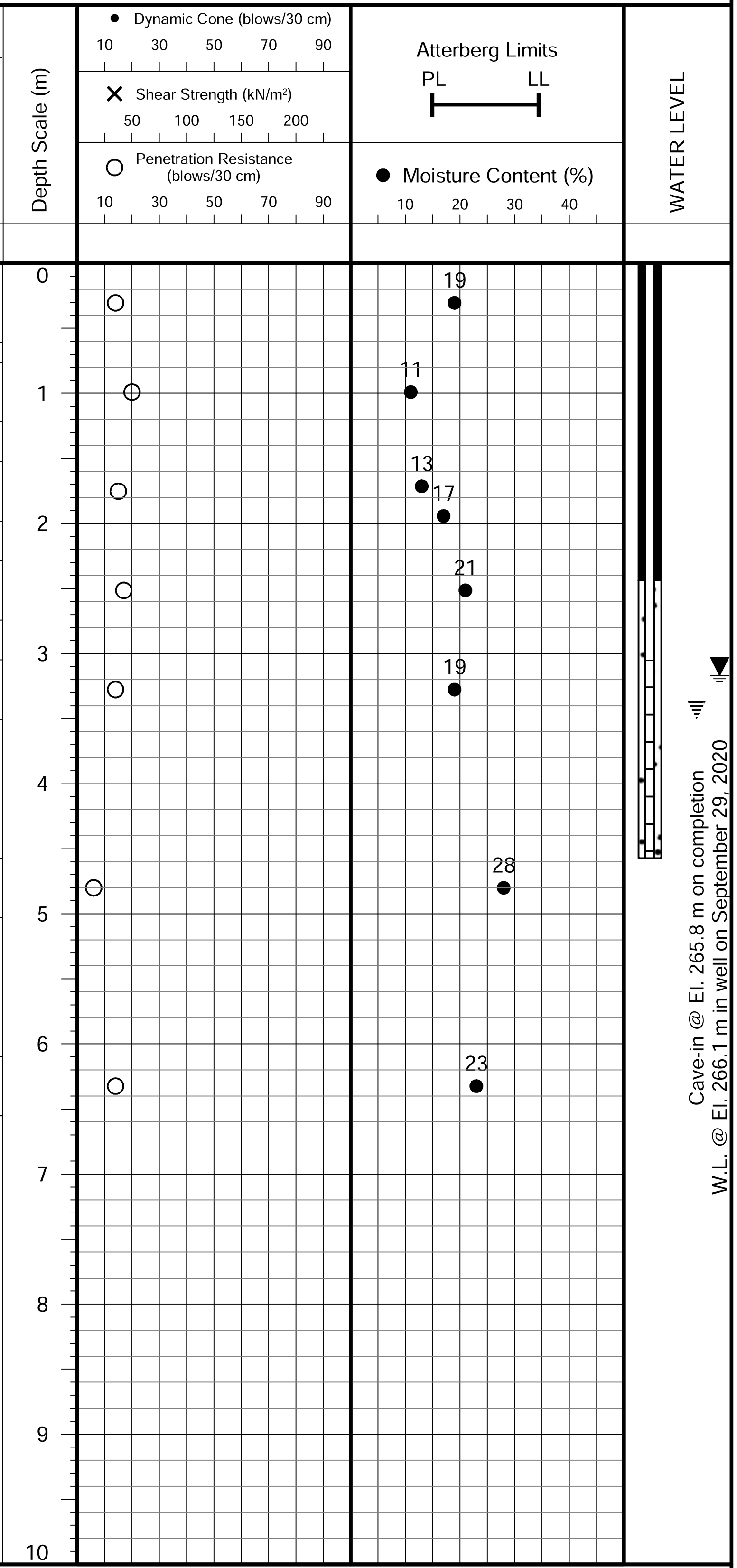
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
269.3	Ground Surface			
0.0	**TOPSOIL FILL** (mixed with silty sand)	1	DO	14
268.5 0.8	Brown **EARTH FILL** **(Silty Sand)** a trace of gravel	2	DO	20
267.8 1.5	Brown, compact **SANDY SILT** a trace of clay occ. sand and silt layers silty fine sand layer	3A 3B	DO	15
		4	DO	17
		5	DO	14
264.7 4.6	Grey, firm to stiff **SILTY CLAY** a trace of sand with silt seams	6	DO	6
		7	DO	14
262.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 4.6 m (1.5 m screen) Sand backfill from 2.4 m to 4.6 m Bentonite holeplug from 0 m to 2.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

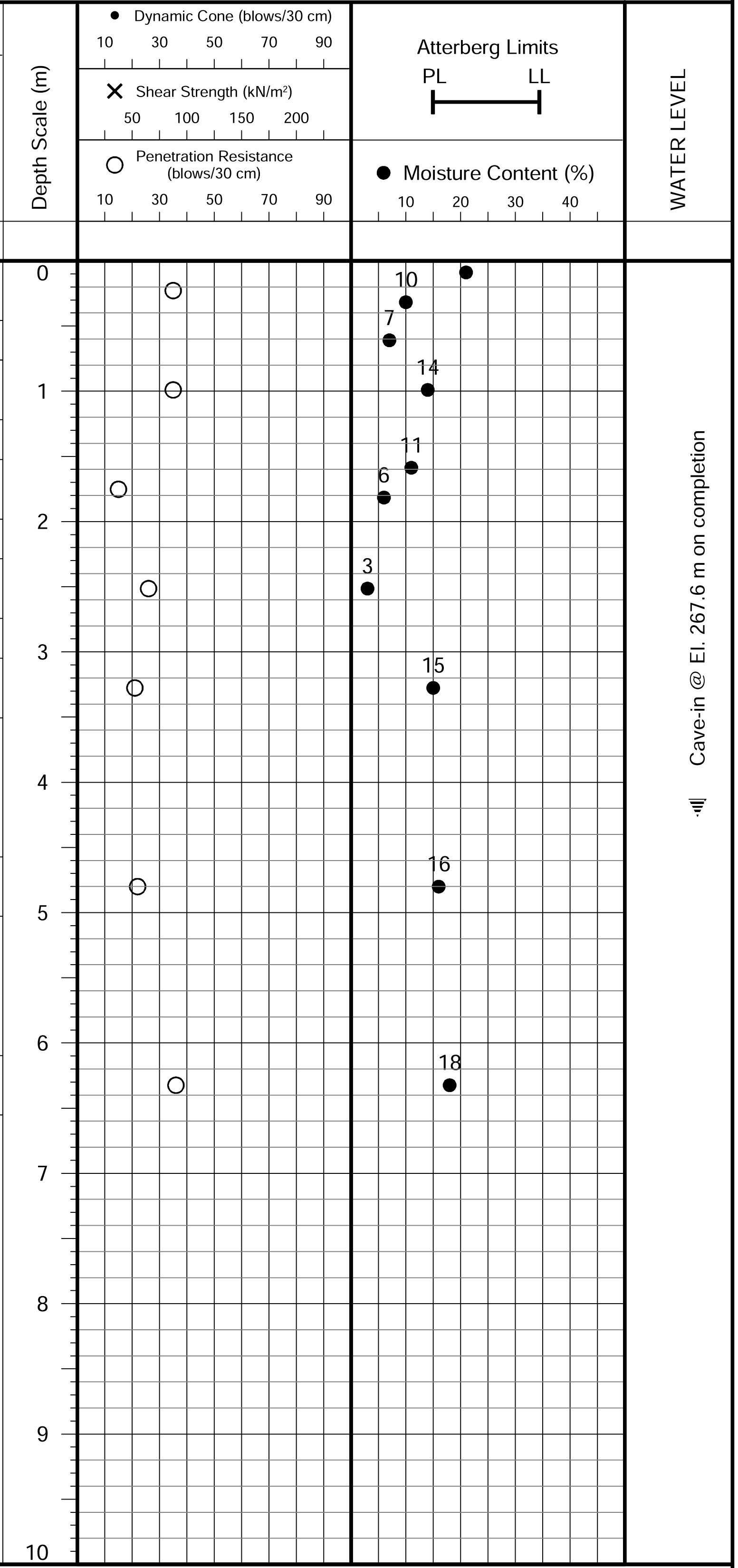
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
271.9	Ground Surface			
0.0	**18 cm TOPSOIL**	1A	DO	35
	Brown **EARTH FILL** **(Silty Sand)** a trace of clay, some gravel	1B		
		2	AS	-
271.1 0.8	Brown, hard **SILTY CLAY** a trace of sand with silt layers, and occ. gravel	3	DO	35
270.4 1.5	sandy silt layer Brown, compact **SAND** fine grained a trace to some silt	4A 4B	DO	15
		5	DO	26
268.9 3.0	Brown, compact to dense **SANDY SILT** a trace of clay	6	DO	21
		7	DO	22
		8	DO	36
265.3 6.6	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed School Block

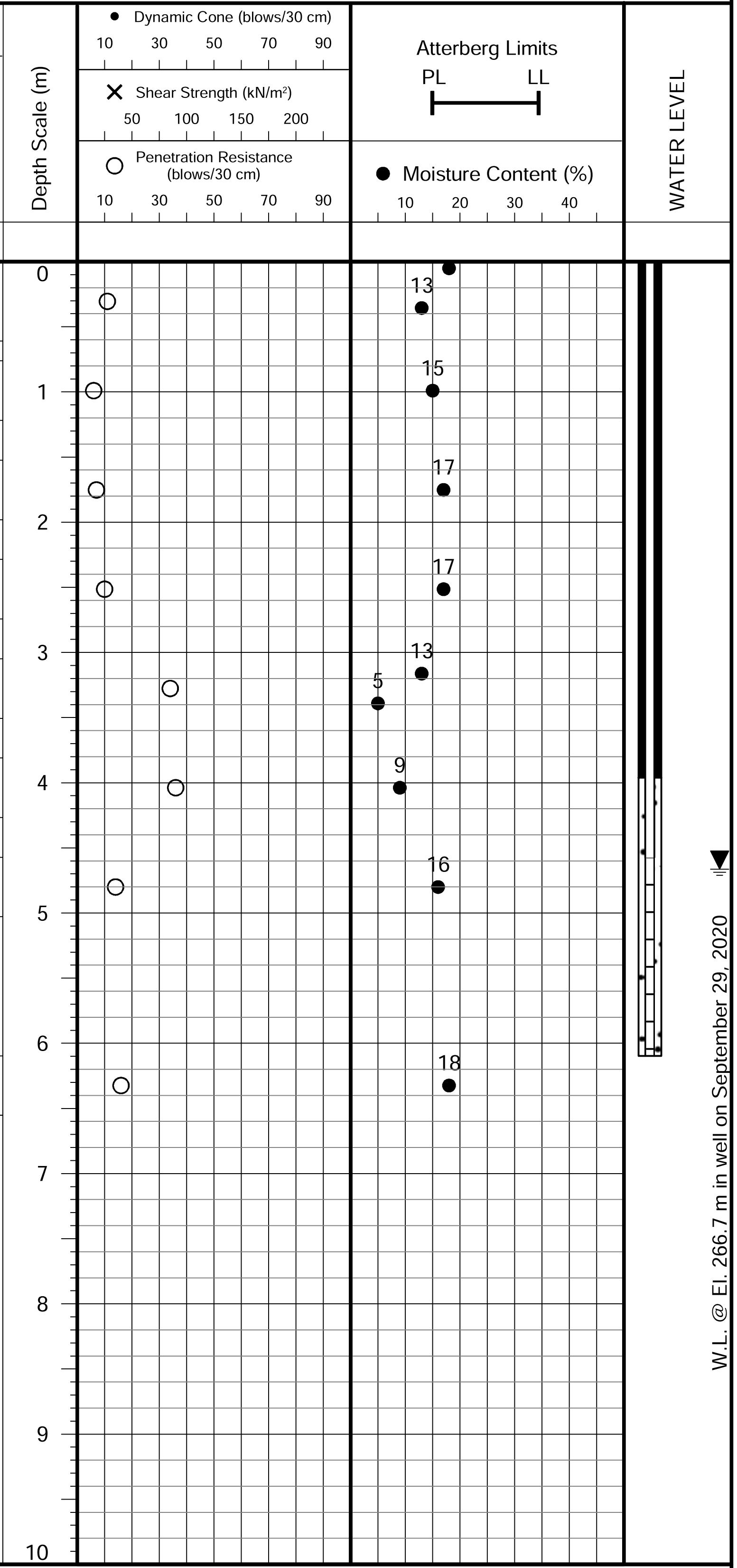
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
271.3	Ground Surface			
0.0	**10 cm TOPSOIL**	1A		
	Brown **EARTH FILL** **(Silty Clay and Sandy Silt)** a trace of gravel	1B	DO	11
	organic inclusions	2	DO	6
		3	DO	7
	silty clay sandy silt topsoil inclusions	4	DO	10
268.0 3.3	Brown, dense **SAND** fine to medium grained a trace to some silt	5A 5B	DO	34
		6	DO	36
266.7 4.6	Brown, compact **SILTY FINE SAND** a trace of clay	7	DO	14
265.2 6.1	Brown, compact **SILT** traces of clay and sand	8	DO	16
264.7 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen)
Sand backfill from 4.0 m to 6.1 m
Bentonite holeplug from 0 m to 4.0 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

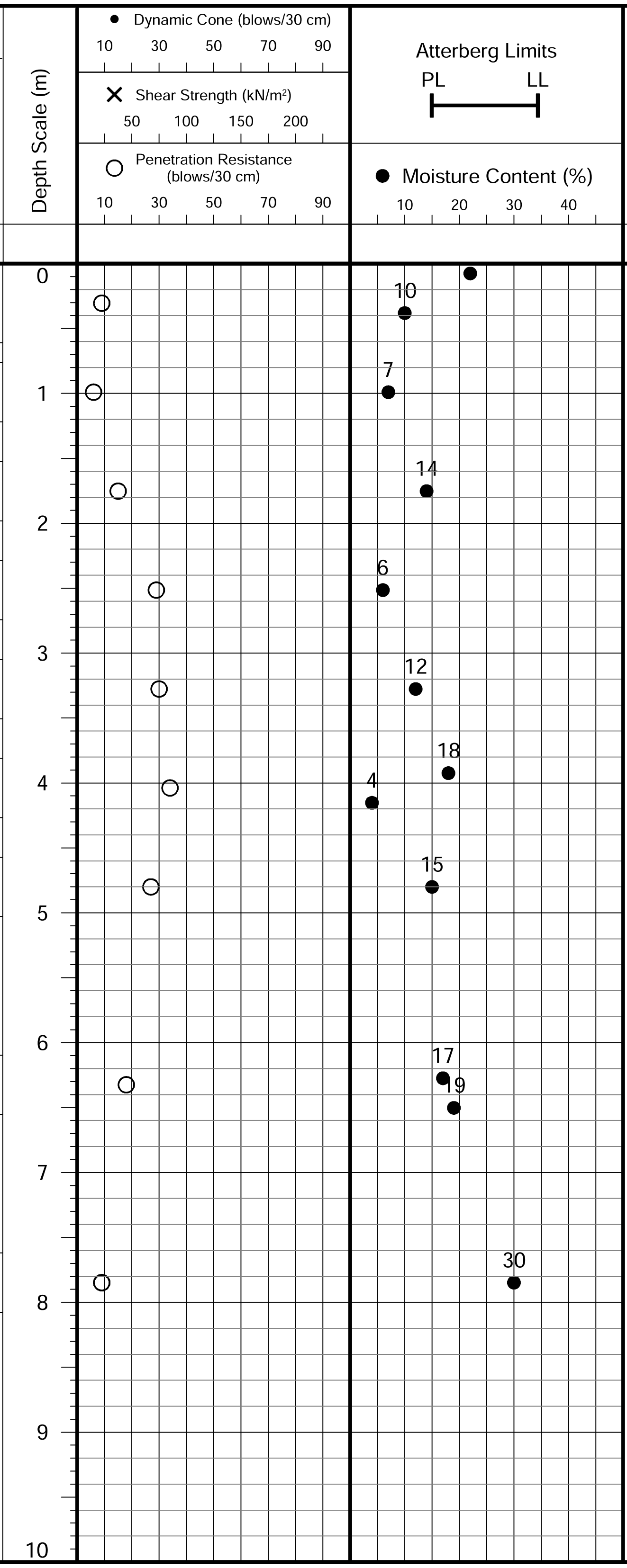
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
272.4	Ground Surface			
0.0	**15 cm TOPSOIL**	1A		
	Brown **EARTH FILL** **(Silty Sand)** a trace of clay	1B	DO	9
		2	DO	6
	organic inclusions	3	DO	15
270.1 2.3	Brown, compact **SILTY SAND TILL** a trace of clay a trace to some gravel occ. sand seams and layers, cobbles and boulders	4	DO	29
		5	DO	30
268.4 4.0	Brown, compact to dense **SAND** fine to coarse grained a trace of silt	6A 6B	DO	34
		7	DO	27
267.5 4.9	Brown, compact **SANDY SILT** a trace of clay	8A 8B	DO	18
265.9 6.5	Stiff **SILTY CLAY** a trace of sand brown grey	9	DO	9
264.3 8.1	**END OF BOREHOLE**			



WATER LEVEL

Cave-in @ El. 267.2 m on completion

Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

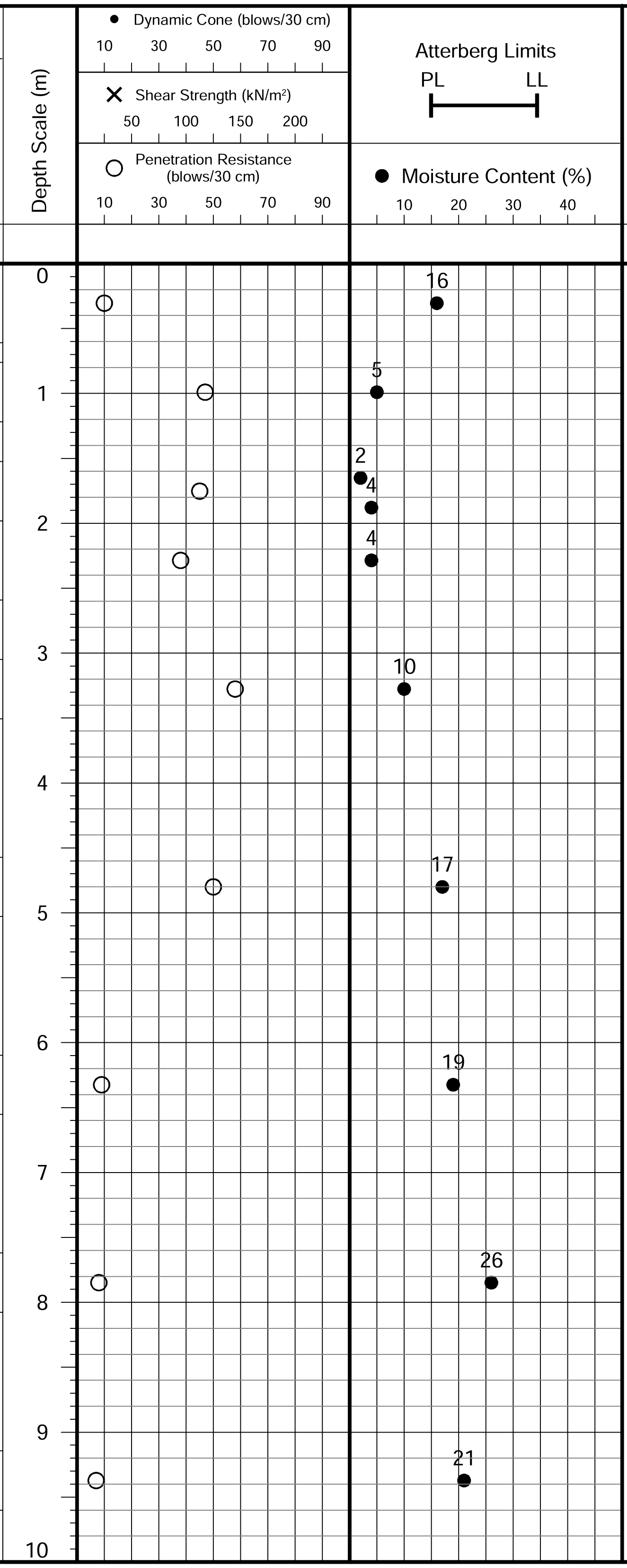
PROJECT DESCRIPTION: Proposed School Block

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
272.6	Ground Surface			
0.0	**TOPSOIL FILL**	1	DO	10
271.8 0.8	Brown, dense to very dense **SAND** fine and fine to medium grained a trace of silt	2	DO	47
	— — — gravelly	3A 3B	DO	45
		4	DO	38
	— — silt layers	5	DO	58
268.0 4.6	Brown, dense **SANDY SILT** a trace of clay	6	DO	50
266.5 6.1	Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers occ. gravel	7	DO	9
		8	DO	8
		9	DO	7
262.6	*(Continued on next page)*			



WATER LEVEL

No W.L. recorded due to process of washboring to carry out deep borehole

Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

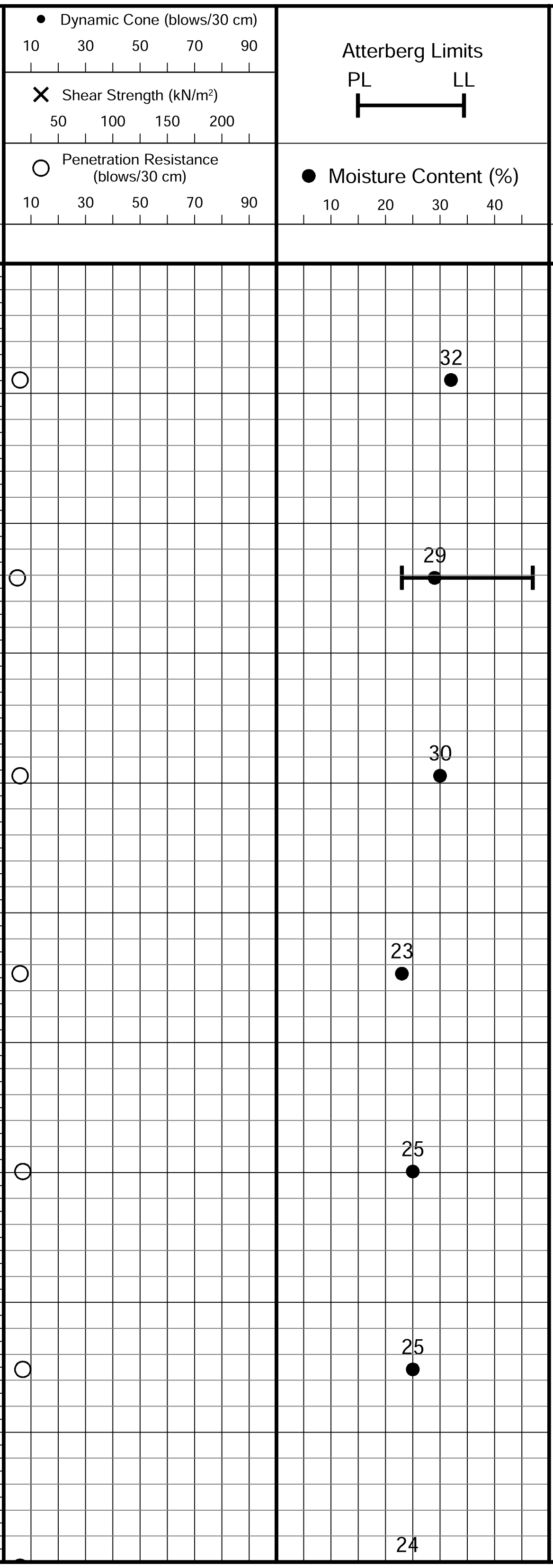
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

PROJECT LOCATION:
Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
10.0	*(Continued)* Grey, firm **SILTY CLAY (varved)** a trace of sand with silt layers occ. gravel				10
		10	DO	6	11
		11	DO	5	12
		12	DO	6	13 14
	silty clay till layer				15
		13	DO	6	16
		14	DO	7	17 18
		15	DO	7	19
252.6	*(Continued on next page)*				20



WATER LEVEL

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

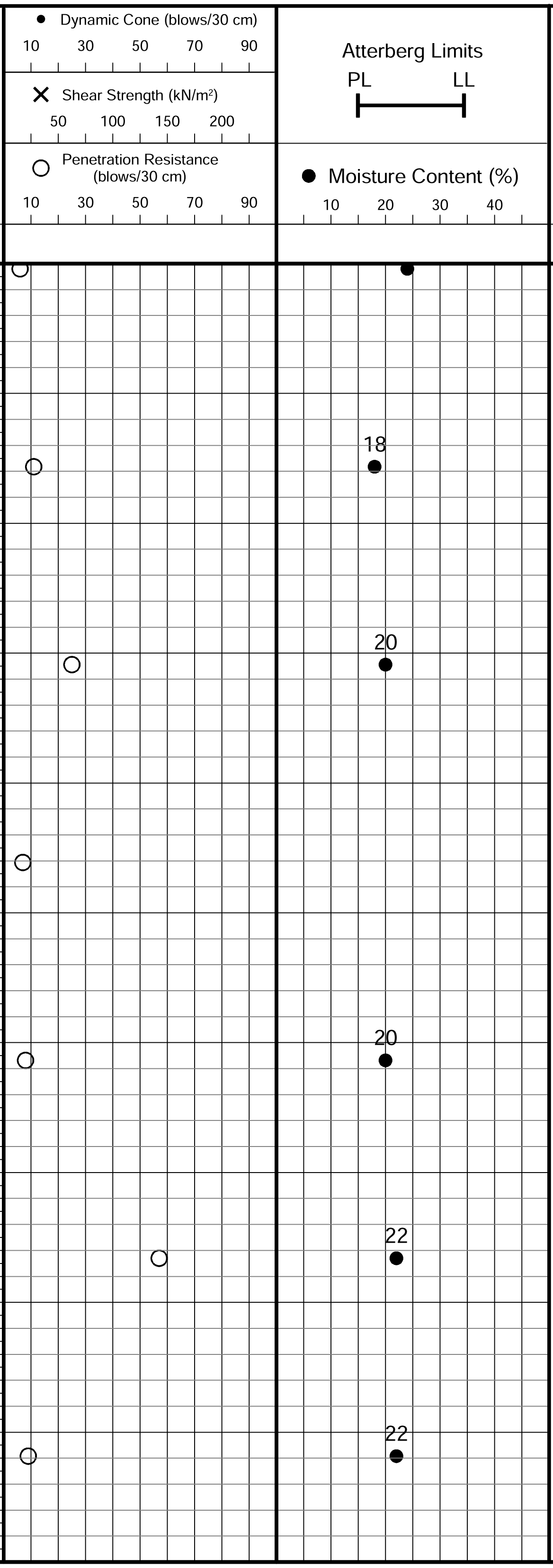
PROJECT DESCRIPTION: Proposed School Block

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
20.0	*(Continued)* Grey, firm to hard **SILTY CLAY (varved)** a trace of sand with silt layers occ. gravel	16	DO	6	20
					21
		17	DO	11	
					22
		18	DO	25	23
					24
		19	DO	7	
					25
		20	DO	8	26
					27
		21	DO	57	
					28
		22	DO	9	29
242.6	*(Continued on next page)*				30



WATER LEVEL

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

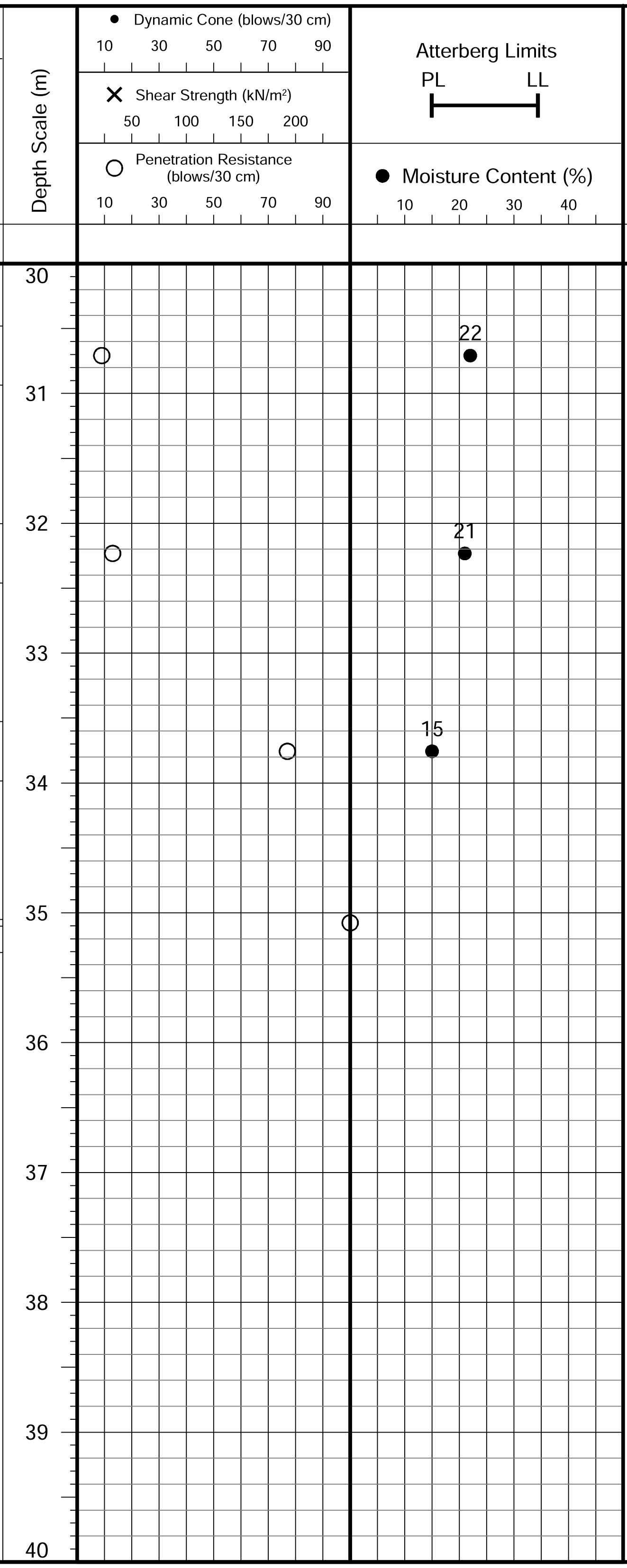
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

PROJECT LOCATION:
Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
30.0	*(Continued)* Grey, stiff to hard **SILTY CLAY (varved)** a trace to some sand with silt layers occ. gravel			
		23	DO	9
	silty clay till layer	24	DO	13
		25	DO	77
	cobbles/boulders/ hard augering/ spoon bouncing	26	DO	50/5
237.3 35.3	**END OF BOREHOLE (Refusal to Auger)**			



WATER LEVEL

Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

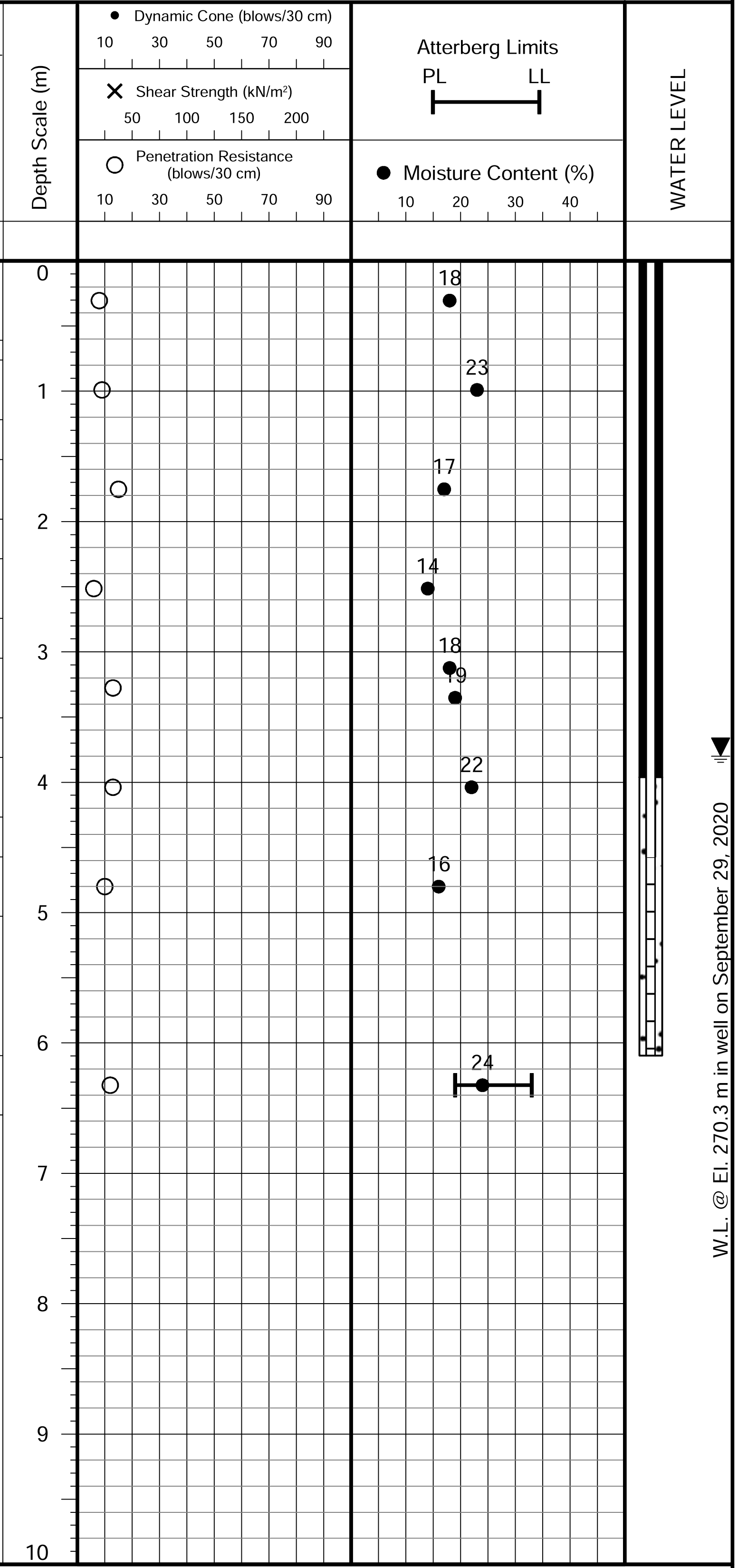
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
274.1	Ground Surface			
0.0	Brown **EARTH FILL** **(Topsoil, Silty Clay and Silt)** a trace to some sand	1	DO	8
	topsoil/silty clay mix	2	DO	9
	silty clay	3	DO	15
	silt	4	DO	6
	topsoil inclusions			
270.9 3.2	Brown, loose to compact **SILT** a traces to some clay a trace of sand occ. gravel	5A 5B	DO	13
		6	DO	13
		7	DO	10
269.1 5.0	Grey, very stiff **SILTY CLAY** some sand occ. gravel	8	DO	12
267.5 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206D

FIGURE NO.: 6A

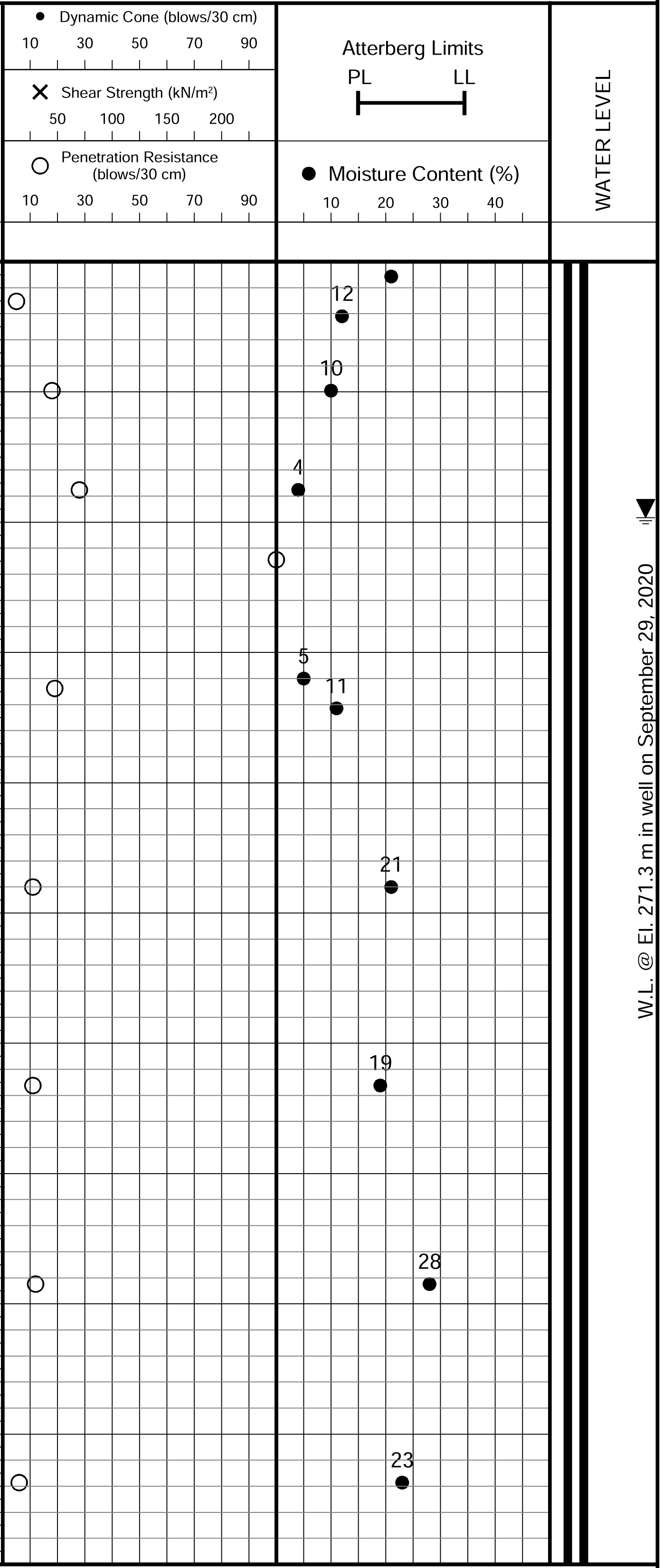
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16 to 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
273.3	Ground Surface				
0.0	**23 cm TOPSOIL**	1A	DO	5	0
	Brown, loose to very dense **SAND**	1B			
	weathered fine and fine to medium grained a trace to some silt	2	DO	18	1
	fine grained	3	DO	28	
	hard augering/ gravelly/ cobbles and boulders	~~4~~	~~DO~~	~~50/0~~	2
	fine to medium grained	5A	DO	19	3
270.0 3.3	Firm to very stiff **SILTY CLAY** **(varved)** a trace of sand with sand and silt seams and layers	5B			
	silty clay till layer/ brown grey	6	DO	11	4
		7	DO	11	6
		8	DO	12	7
		9	DO	6	9
263.3	*(Continued on next page)*				10



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206D

FIGURE NO.: 6A

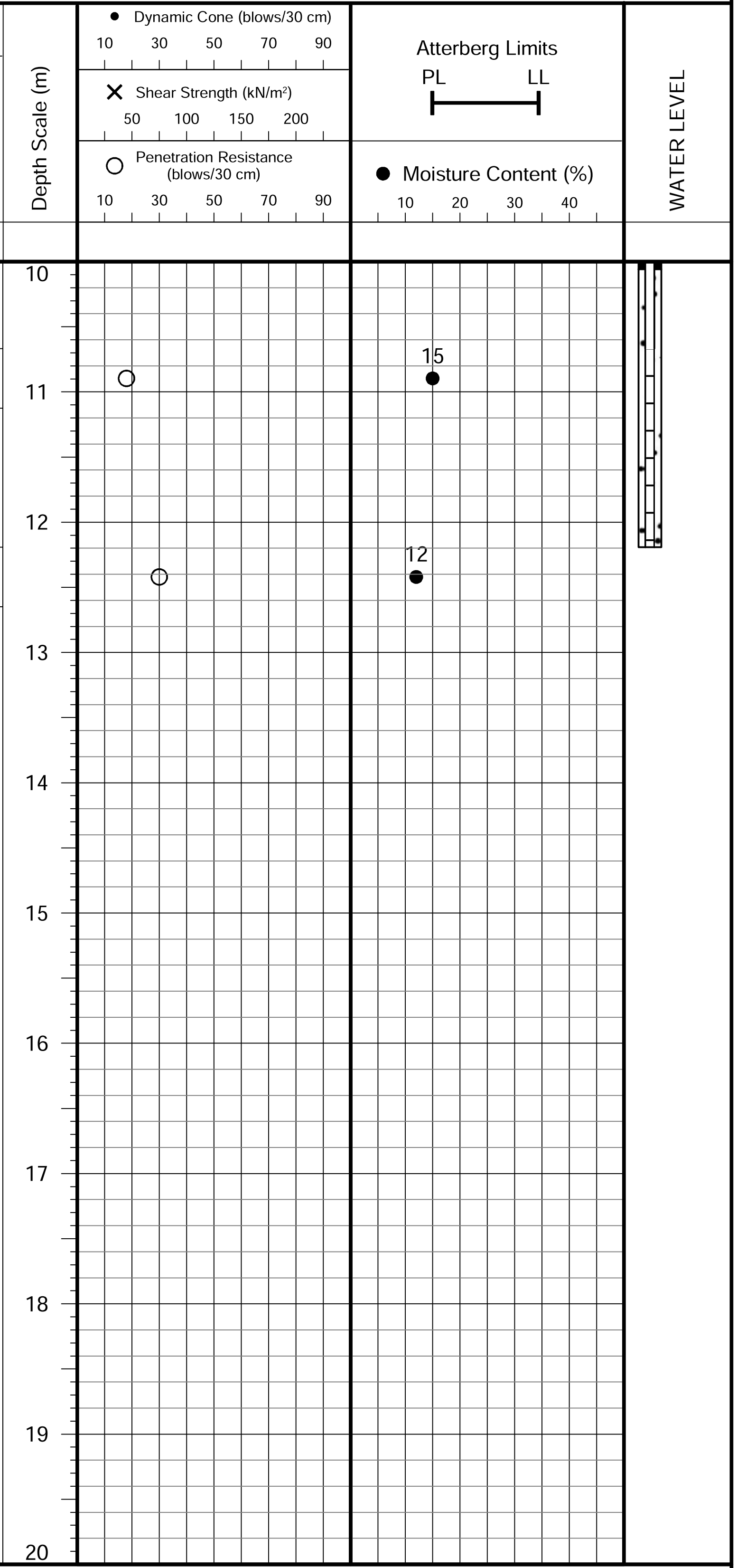
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16 to 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0	*(Continued)* Grey, very stiff **SILTY CLAY** **(varved)**			
	– – – – – –	10	DO	18
	a trace to some sand with silt layers occ. gravel sandy silt till layer			
	– – – – – –	11	DO	30
260.7 12.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 12.2 m (1.5 m screen) Sand backfill from 10.1 m to 12.2 m Bentonite holeplug from 0 m to 10.1 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206S

FIGURE NO.: 6B

PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17, 2020

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

✕ Shear Strength (kN/m²) 50 100 150 200

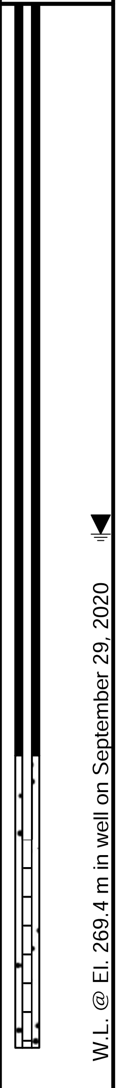
○ Penetration Resistance (blows/30 cm) 10 30 50 70 90

Atterberg Limits PL LL

● Moisture Content (%) 10 20 30 40

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
273.3	Ground Surface				
0.0	**STRAIGHT AUGERING FOR INSTALLATION OF NESTED WELL**				0 1 2 3 4 5 6 7
265.7 7.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 m to 7.6 m Bentonite holeplug from 0 m to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock				8 9 10

WATER LEVEL



W.L. @ El. 269.4 m in well on September 29, 2020

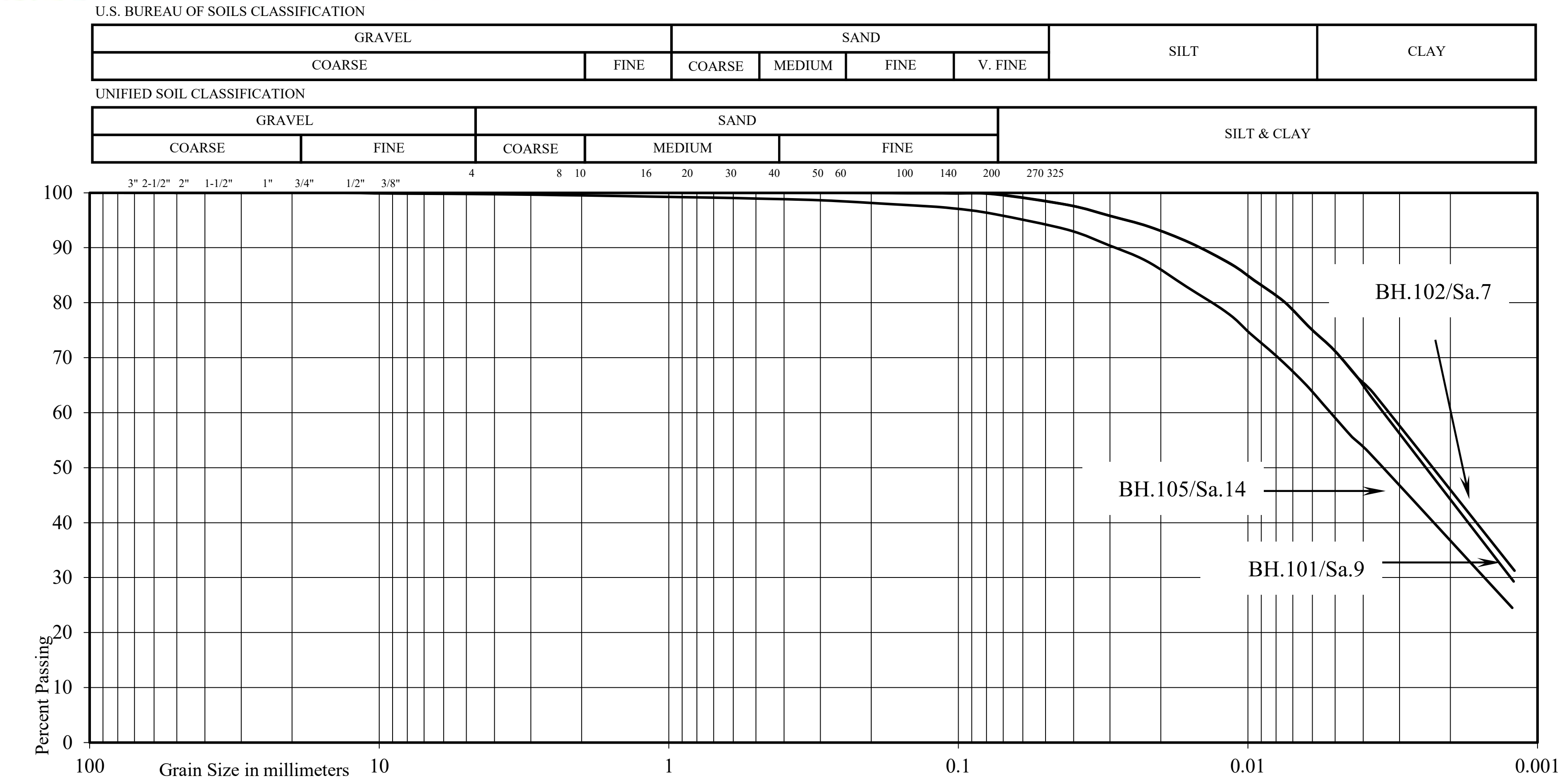
Soil Engineers Ltd.

Page: 1 of 1

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project: Proposed Residential Development

Location: Shining Hill Phase 3
162 St. John's Sideroad, Town of Aurora

Borehole No:	101	102	105
Sample No:	9	7	14
Depth (m):	9.4	4.8	17.0
Elevation (m):	255.6	260.1	249.8

BH./Sa.	101/9	102/7	105/14
Liquid Limit (%) =	45	46	40
Plastic Limit (%) =	22	23	20
Plasticity Index (%) =	23	23	20
Moisture Content (%) =	28	22	22
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

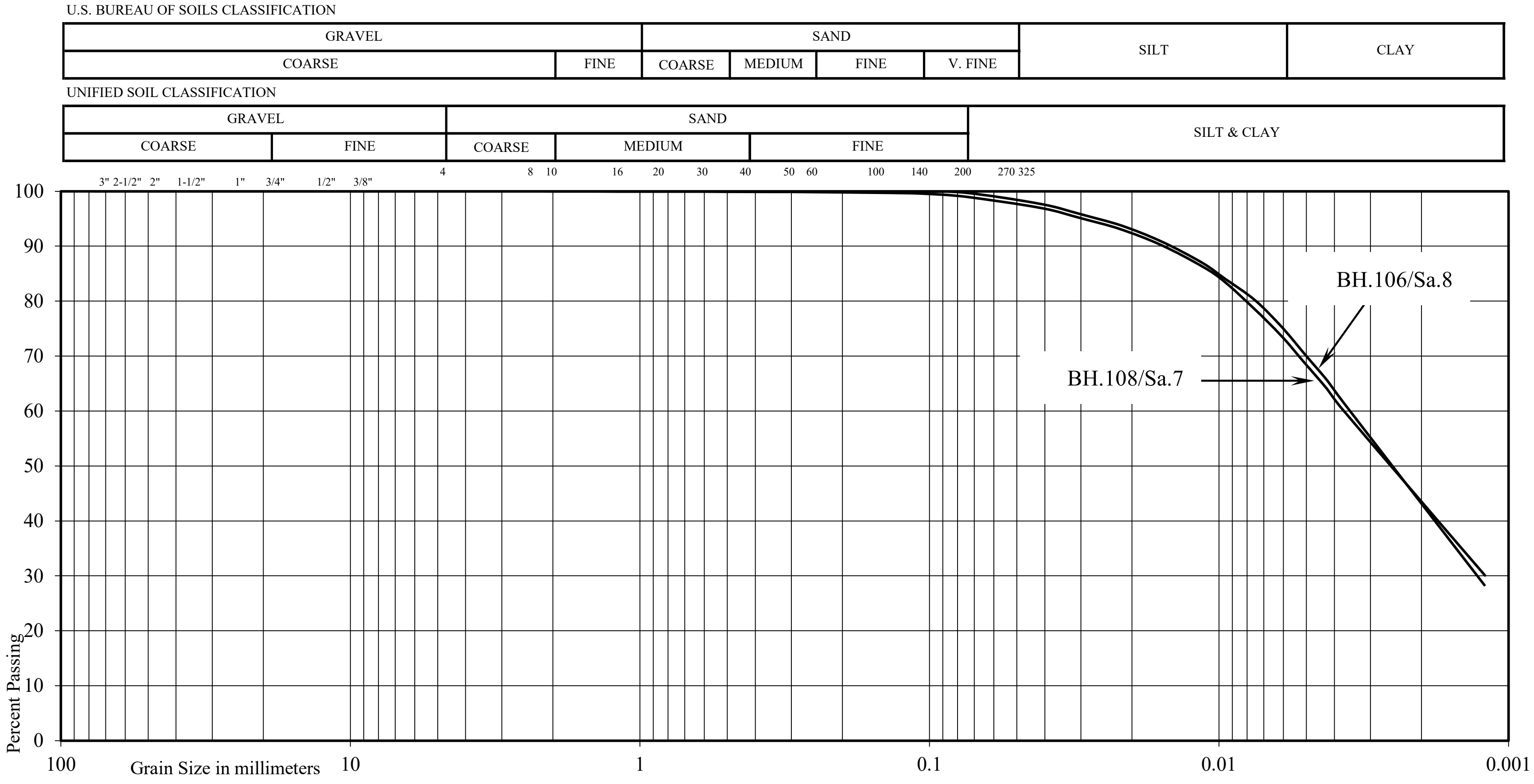
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace of sand

Figure: 9

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project: Proposed Residential Development

Location: Shining Hill Phase 3

162 St. John's Sideroad, Town of Aurora

Borehole No:	106	108
Sample No:	8	7
Depth (m):	7.8	6.3
Elevation (m):	257.5	263.0

BH./Sa.	106/8	108/7
Liquid Limit (%) =	43	-
Plastic Limit (%) =	21	-
Plasticity Index (%) =	22	-
Moisture Content (%) =	26	23
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

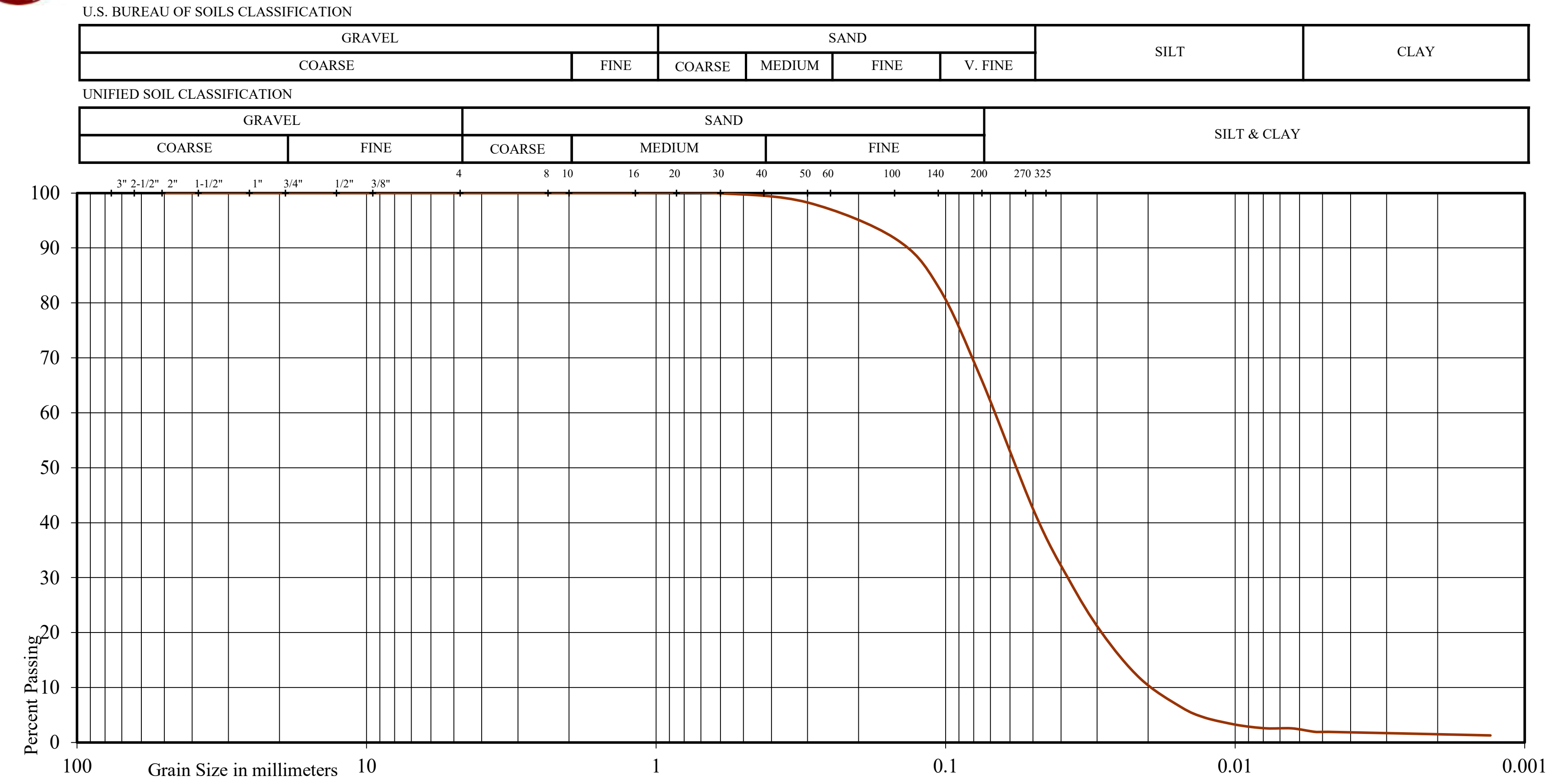
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace of sand

Figure: 10

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project:	Proposed Residential Development
Location:	Shining Hill Phase 3
	162 St. John's Sideroad, Town of Aurora
Borehole No:	103
Sample No:	5
Depth (m):	3.3
Elevation (m):	264.7

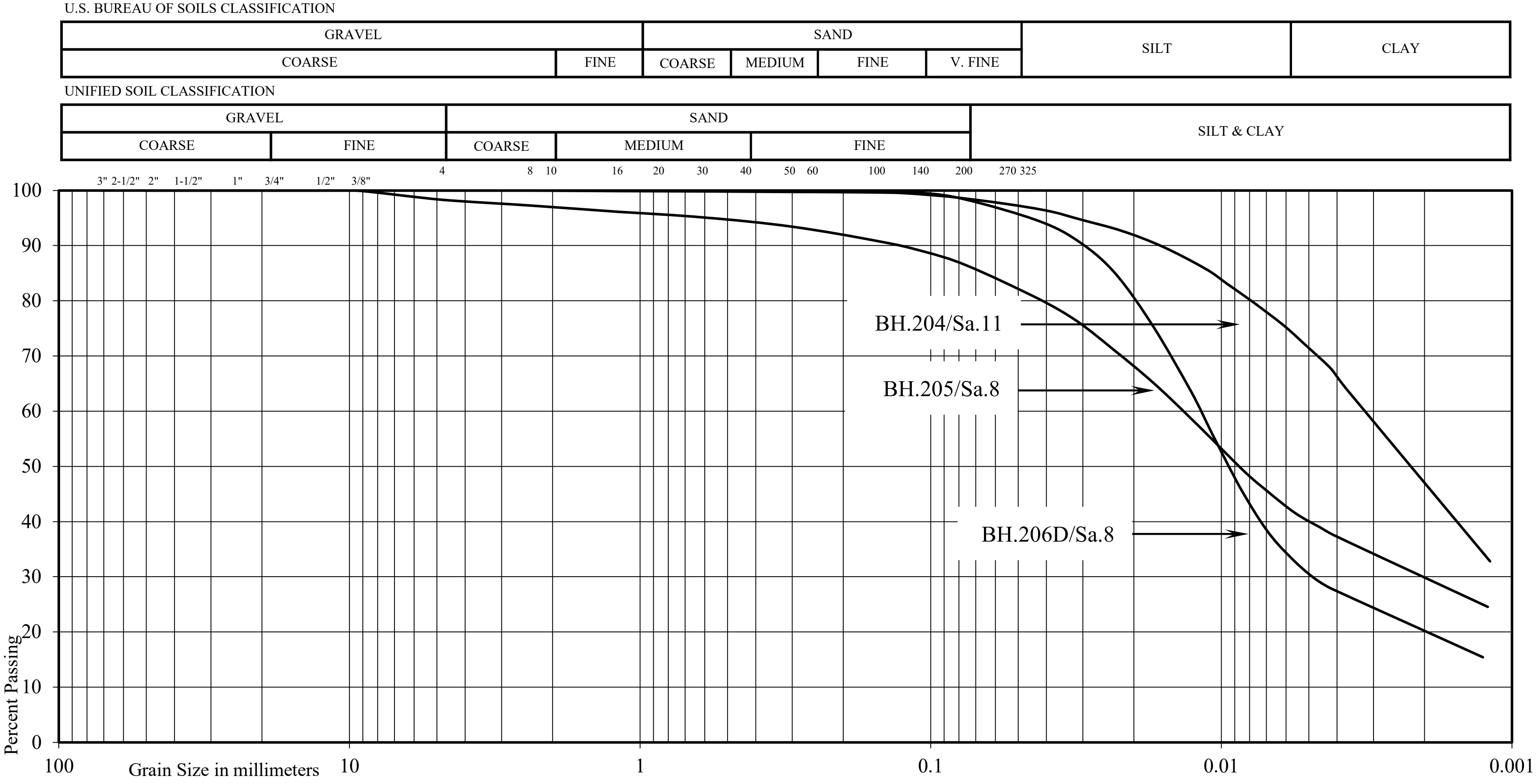
Liquid Limit (%) =	-
Plastic Limit (%) =	-
Plasticity Index (%) =	-
Moisture Content (%) =	21
Estimated Permeability (cm./sec.) =	10^{-3}

Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

Figure: 11

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project:	Proposed School Block		
Location:	Shinning Hill Phase 3		
	306 St. John's Sideroad, Town of Aurora		
Borehole No:	204	205	206D
Sample No:	11	8	8
Depth (m):	12.4	6.3	7.9
Elevation (m):	260.2	267.8	265.4

BH./Sa.	204/11	205/8	206D/8
Liquid Limit (%) =	47	33	-
Plastic Limit (%) =	23	19	-
Plasticity Index (%) =	24	14	-
Moisture Content (%) =	29	24	28
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

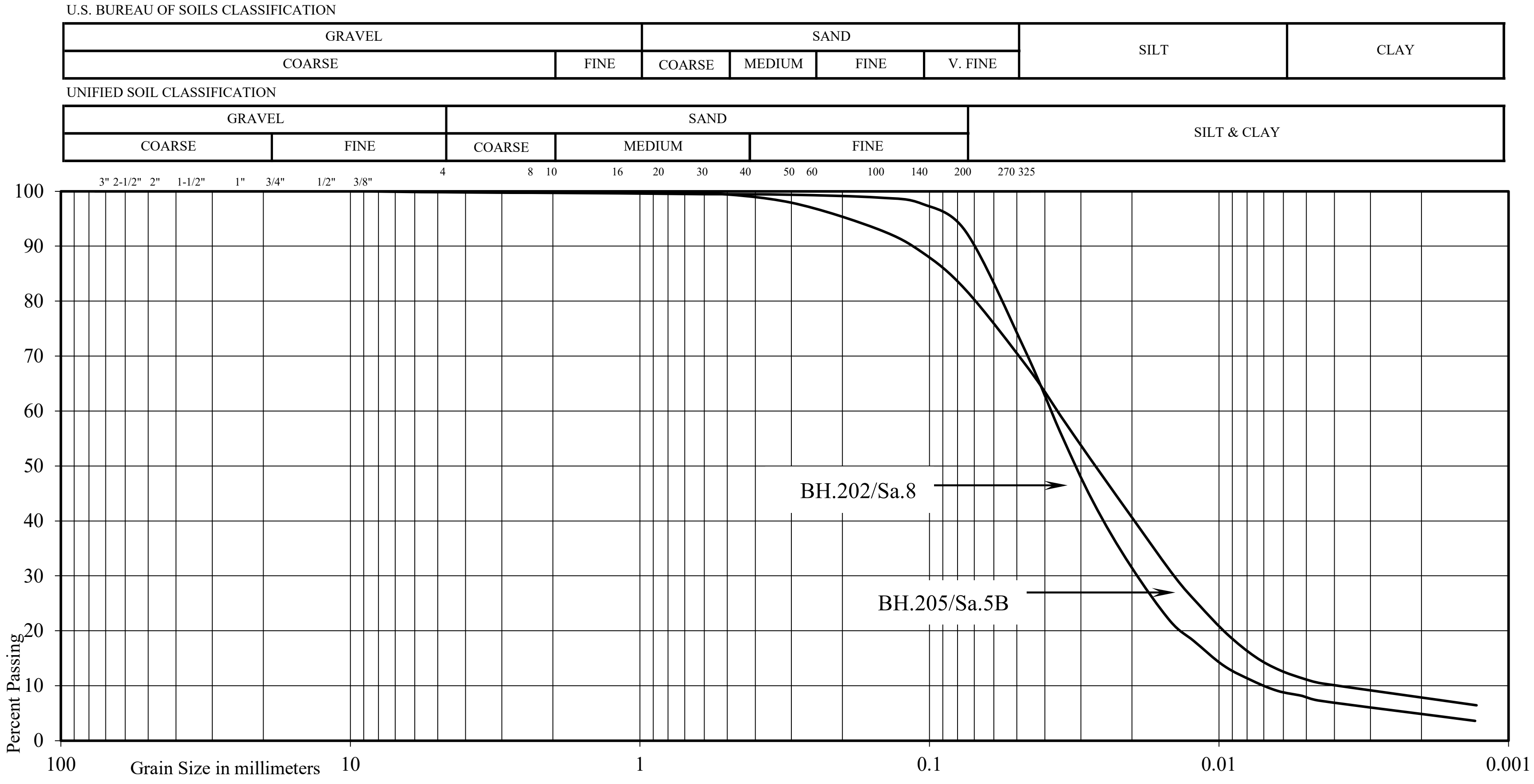
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace to some sand, occasional gravel

Figure: 7

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project: Proposed School Block

Location: Shinning Hill Phase 3

306 St. John's Sideroad, Town of Aurora

Borehole No:	202	205
Sample No:	8	5B
Depth (m):	6.3	3.4
Elevation (m):	265.0	270.7

BH./Sa.	202/8	205/5B
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	18	19
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-5}

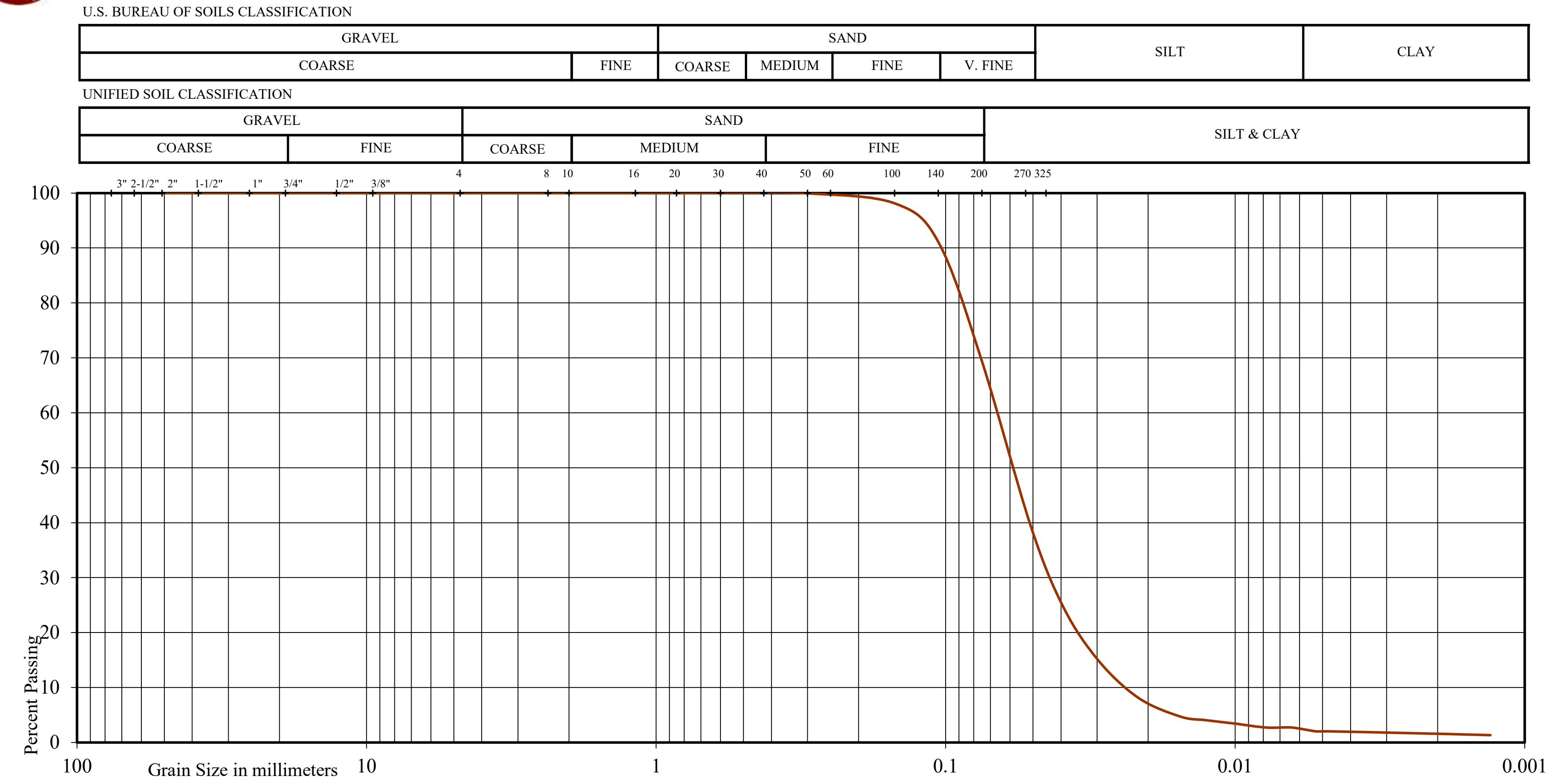
Classification of Sample [& Group Symbol]: SILT, a trace of clay, a trace to some sand

Figure: 8

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project: Proposed School Block

Location: Shinning Hill Phase 3

306 St. John's Sideroad, Town of Aurora

Borehole No: 201

Sample No: 6

Depth (m): 3.3

Elevation (m): 268.6

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 15

Estimated Permeability

(cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

Figure: 9

APPENDIX E

Water Level Measurements

Table E-1 - Water Level Depths and Elevations
Hydrogeological Investigation
Shining Hill, Aurora, Ontario

Monitoring Well ID	Ground Surface Elevation (masl)	29-Sep-20		16-Nov-20		24-Nov-20		01-Dec-20	
		Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)
BH101	265.00	4.50	260.50	4.13	260.87	4.19	260.81	3.89	261.11
BH102	264.90	2.80	262.10	2.66	262.24	2.67	262.24	2.48	262.42
BH103	268.00	2.50	265.50	2.40	265.61	2.40	265.61	2.26	265.75
BH104	267.30	2.70	264.60	2.24	265.06	2.24	265.06	2.18	265.12
BH105	266.80	7.20	259.60	6.78	260.02	6.72	260.08	6.60	260.20
BH106	265.30	DRY	DRY	6.92	258.38	5.92	259.38	3.69	261.61
BH107	262.50	4.20	258.30	3.56	258.94	3.61	258.89	2.82	259.68
BH108	269.30	3.20	266.10	3.08	266.22	3.10	266.20	2.97	266.34
BH202	271.30	4.60	266.70	4.69	266.61	4.70	266.61	4.64	266.67
BH205	274.10	3.80	270.30	3.97	270.13	4.00	270.10	3.78	270.33
BH206-D	273.30	2.00	271.30	1.83	271.48	1.84	271.47	1.73	271.57
BH206-S	273.30	3.90	269.40	3.92	269.38	3.92	269.38	3.89	269.42
P1	259.35			DRY	DRY	1.11	258.24	0.68	258.67
SG1	258.76			-0.27	259.03	-0.27	259.03	-0.29	259.05
P2	261.20								
SG2	261.22								
P3	250.37								
SG3	250.37								
P4	248.83								
SG4	248.89								

Notes:

1) mbgs = metres below ground surface

2) masl = metres above sea level

3) Monitoring wells 101 to 108, 202, 205 and 206D/S were installed by Soil Engineers Ltd. in September 2020. The elevations provided are understood to be referenced to a geodetic datum.

4) D = deep, S = shallow

5) P = piezometer, SG = staff gauge; P1/SG1 installed by Golder Associates Ltd. on November 16, 2020. P2/SG2 to P4/SG4 installed by Golder Associates Ltd. on June 2, 2021.

6) Elevation data for ground surface at the location of the P1/SG1 to P4/SG4 were surveyed by Golder Associates Ltd. and are referenced to a geodetic datum.

7) Groundwater level data from September 29, 2020, were measured by Soil Engineers Ltd.

8) Stabilized groundwater conditions may not have been present at BH106 on Sept. 29, Nov. 16, Nov. 24, and Dec. 1, 2020.

Input by: AGB/JJG
Checked by: CMK

Table E-1 - Water Level Depths and Elevations
Hydrogeological Investigation
Shining Hill, Aurora, Ontario

Monitoring Well ID	Ground Surface Elevation (masl)	19-Jan-21		08-Apr-21		02-Jun-21		09-Jun-21	
		Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)
BH101	265.00	3.20	261.80	-	-	4.19	260.81	-	-
BH102	264.90	1.97	262.93	1.82	263.09	2.63	262.27	2.72	262.18
BH103	268.00	1.82	266.18	1.57	266.43	2.02	265.99	-	-
BH104	267.30	1.33	265.97	-	-	1.81	265.50	-	-
BH105	266.80	6.06	260.74	-	-	5.76	261.04	-	-
BH106	265.30	2.24	263.07	-	-	2.77	262.53	-	-
BH107	262.50	2.24	260.26	-	-	2.88	259.62	-	-
BH108	269.30	2.25	267.05	-	-	2.70	266.60	-	-
BH202	271.30	4.35	266.95	-	-	4.21	267.10	-	-
BH205	274.10	3.38	270.72	-	-	2.84	271.26	-	-
BH206-D	273.30	1.62	271.68	-	-	1.63	271.67	-	-
BH206-S	273.30	3.57	269.73	-	-	3.34	269.97	-	-
P1	259.35	0.22	259.13	0.01	259.34	0.09	259.27	0.14	259.21
SG1	258.76	-0.26	259.02	-0.25	259.01	-0.23	258.99	-0.24	259.00
P2	261.20					DRY	DRY	DRY	DRY
SG2	261.22					DRY	DRY	DRY	DRY
P3	250.37					1.23	249.15	0.50	249.87
SG3	250.37					DRY	DRY	DRY	DRY
P4	248.83					0.91	247.93	0.30	248.53
SG4	248.89					DRY	DRY	DRY	DRY

Notes:

1) mbgs = metres below ground surface

2) masl = metres above sea level

3) Monitoring wells 101 to 108, 202, 205 and 206D/S were installed by Soil Engineers Ltd. in September 2020. The elevations provided are understood to be referenced to a geodetic datum.

4) D = deep, S = shallow

5) P = piezometer, SG = staff gauge; P1/SG1 installed by Golder Associates Ltd. on November 16, 2020. P2/SG2 to P4/SG4 installed by Golder Associates Ltd. on June 2, 2021.

6) Elevation data for ground surface at the location of the P1/SG1 to P4/SG4 were surveyed by Golder Associates Ltd. and are referenced to a geodetic datum.

7) Groundwater level data from September 29, 2020, were measured by Soil Engineers Ltd.

8) Stabilized groundwater conditions may not have been present at BH106 on Sept. 29, Nov. 16, Nov. 24, and Dec. 1, 2020.

Table E-1 - Water Level Depths and Elevations
Hydrogeological Investigation
Shining Hill, Aurora, Ontario

Monitoring Well ID	Ground Surface Elevation (masl)	03-Sep-21		09-Sep-21		29-Sep-21		12-Nov-21	
		Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)
BH101	265.00	-	-	-	-	3.32	261.68	-	-
BH102	264.90	2.98	261.92	2.92	261.98	2.07	262.83	1.98	262.92
BH103	268.00	2.67	265.34	2.60	265.41	2.14	265.86	-	-
BH104	267.30	-	-	-	-	1.85	265.45	-	-
BH105	266.80	-	-	-	-	6.88	259.92	-	-
BH106	265.30	-	-	-	-	2.67	262.63	-	-
BH107	262.50	3.80	258.70	3.37	259.14	2.34	260.17	1.80	260.70
BH108	269.30	-	-	-	-	2.24	267.07	-	-
BH202	271.30	4.76	266.54	4.77	266.53	4.57	266.73	-	-
BH205	274.10	3.79	270.31	3.84	270.26	3.46	270.64	-	-
BH206-D	273.30	2.11	271.20	2.06	271.25	1.76	271.54	1.67	271.63
BH206-S	273.30	3.86	269.45	3.86	269.44	3.67	269.63	3.55	269.76
P1	259.35	0.83	258.52	0.85	258.51	0.55	258.80	0.10	259.25
SG1	258.76	-0.25	259.01	-0.25	259.01	-0.25	259.01	-0.26	259.02
P2	261.20	N/A	N/A	N/A	N/A	0.50	260.70	0.06	261.14
SG2	261.22	N/A	N/A	N/A	N/A	DRY	DRY	DRY	DRY
P3	250.37	1.05	249.32	0.74	249.64	0.14	250.23	-	-
SG3	250.37	DRY	DRY	DRY	DRY	DRY	DRY	-	-
P4	248.83	0.74	248.09	0.70	248.14	0.05	248.79	-	-
SG4	248.89	DRY	DRY	DRY	DRY	DRY	DRY	-	-

Notes:

1) mbgs = metres below ground surface

2) masl = metres above sea level

3) Monitoring wells 101 to 108, 202, 205 and 206D/S were installed by Soil Engineers Ltd. in September 2020. The elevations provided are understood to be referenced to a geodetic datum.

4) D = deep, S = shallow

5) P = piezometer, SG = staff gauge; P1/SG1 installed by Golder Associates Ltd. on November 16, 2020. P2/SG2 to P4/SG4 installed by Golder Associates Ltd. on June 2, 2021.

6) Elevation data for ground surface at the location of the P1/SG1 to P4/SG4 were surveyed by Golder Associates Ltd. and are referenced to a geodetic datum.

7) Groundwater level data from September 29, 2020, were measured by Soil Engineers Ltd.

8) Stabilized groundwater conditions may not have been present at BH106 on Sept. 29, Nov. 16, Nov. 24, and Dec. 1, 2020.

Figure E-2: BH102 Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario

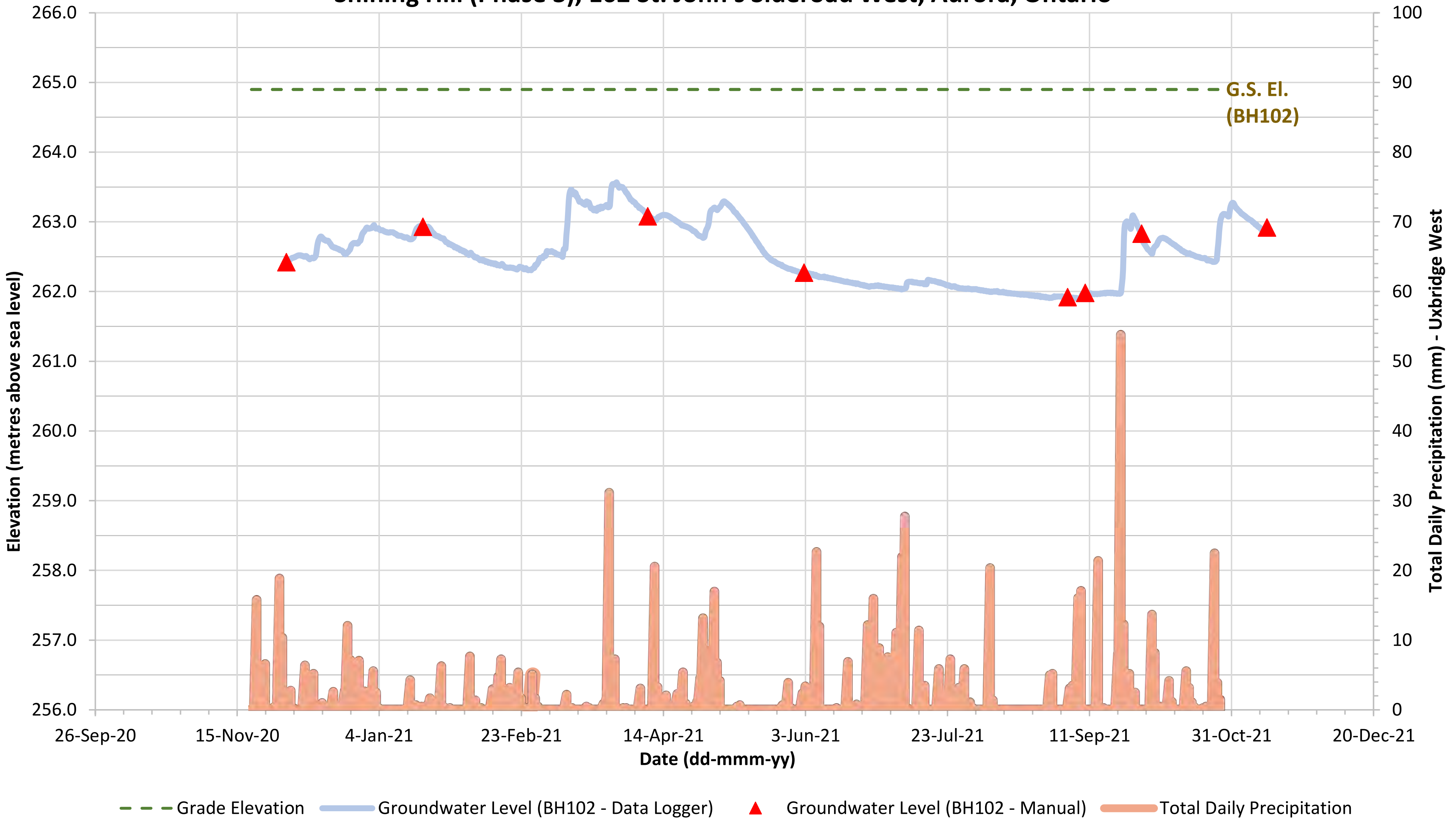
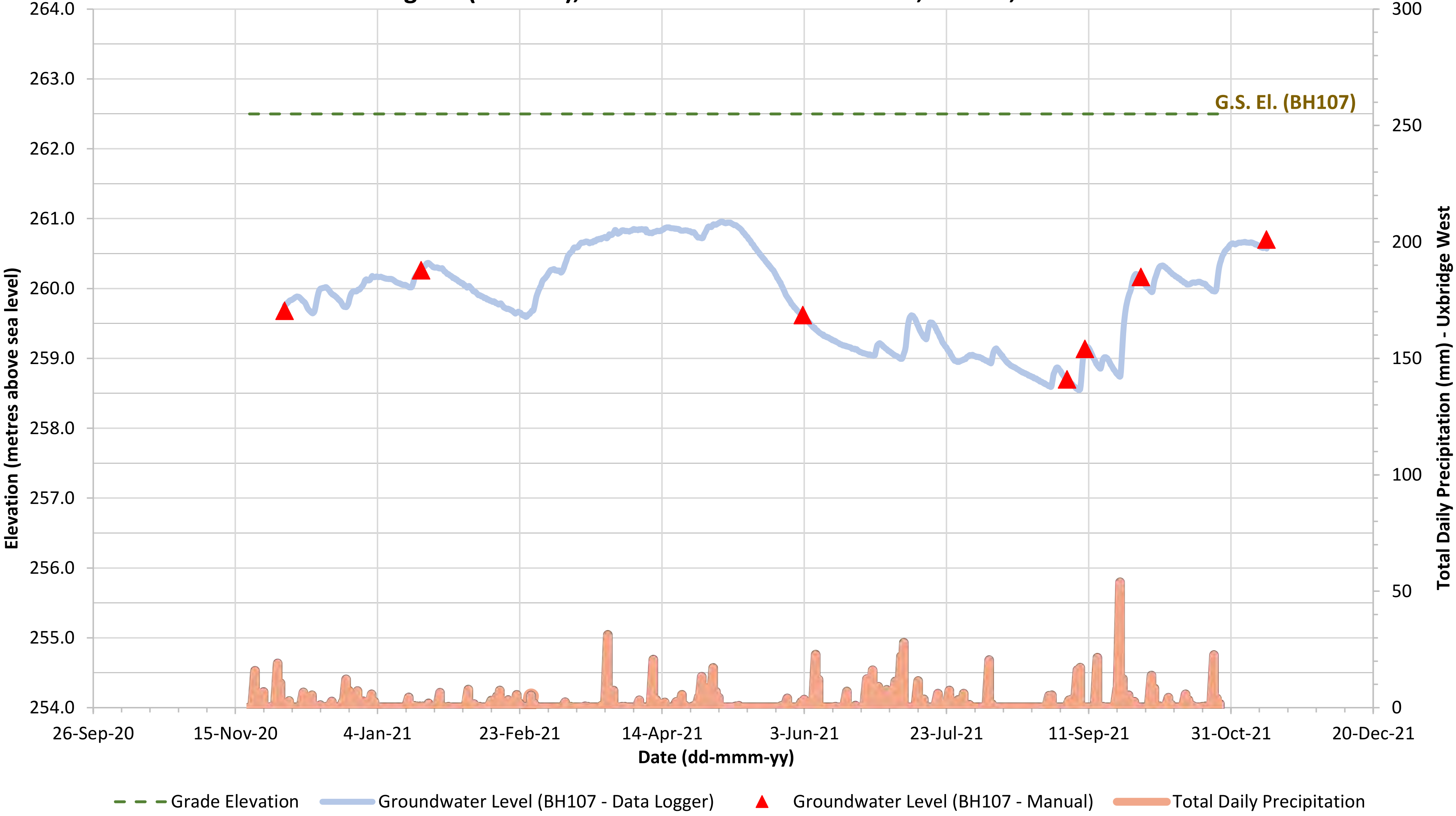
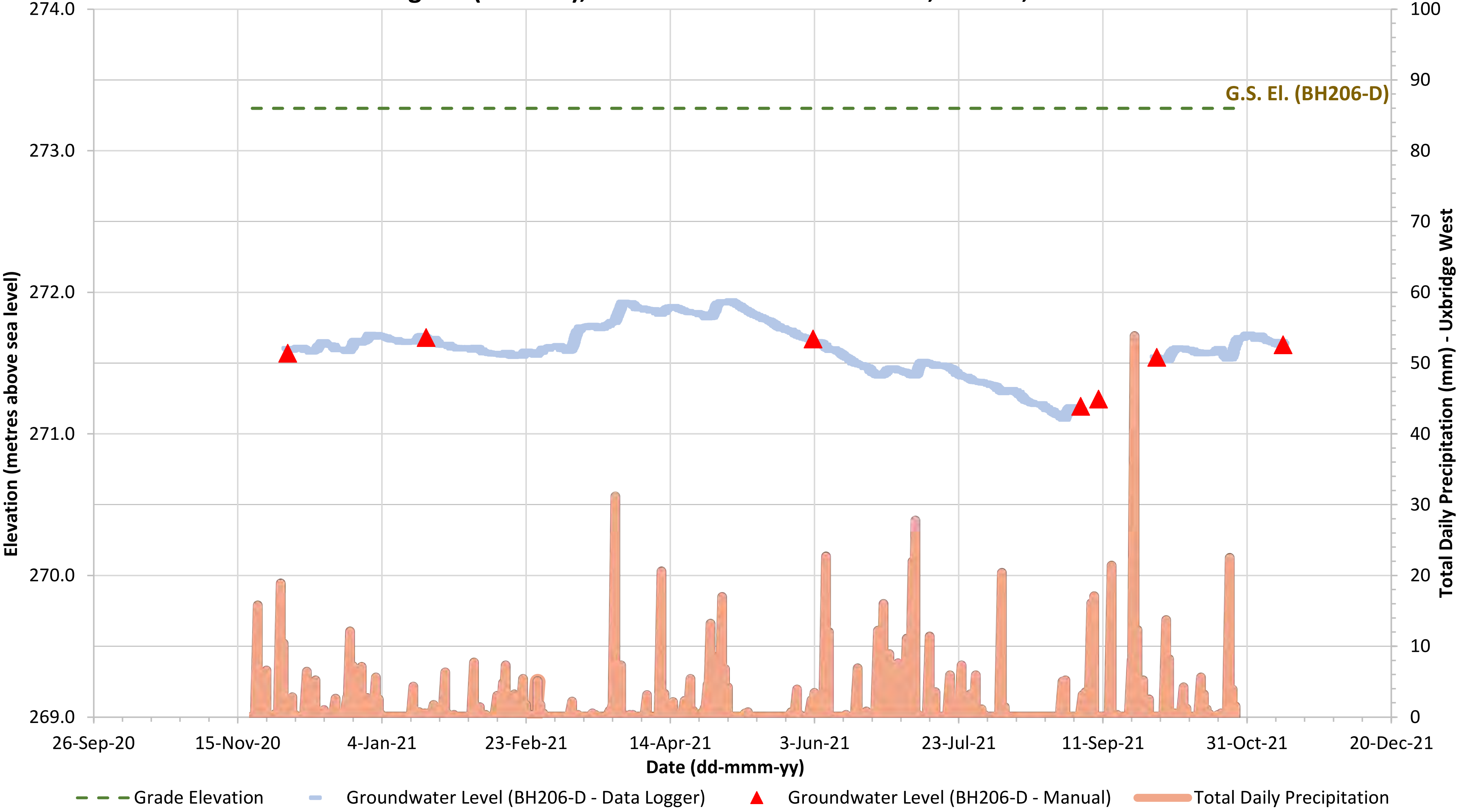


Figure E-3: BH107 Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



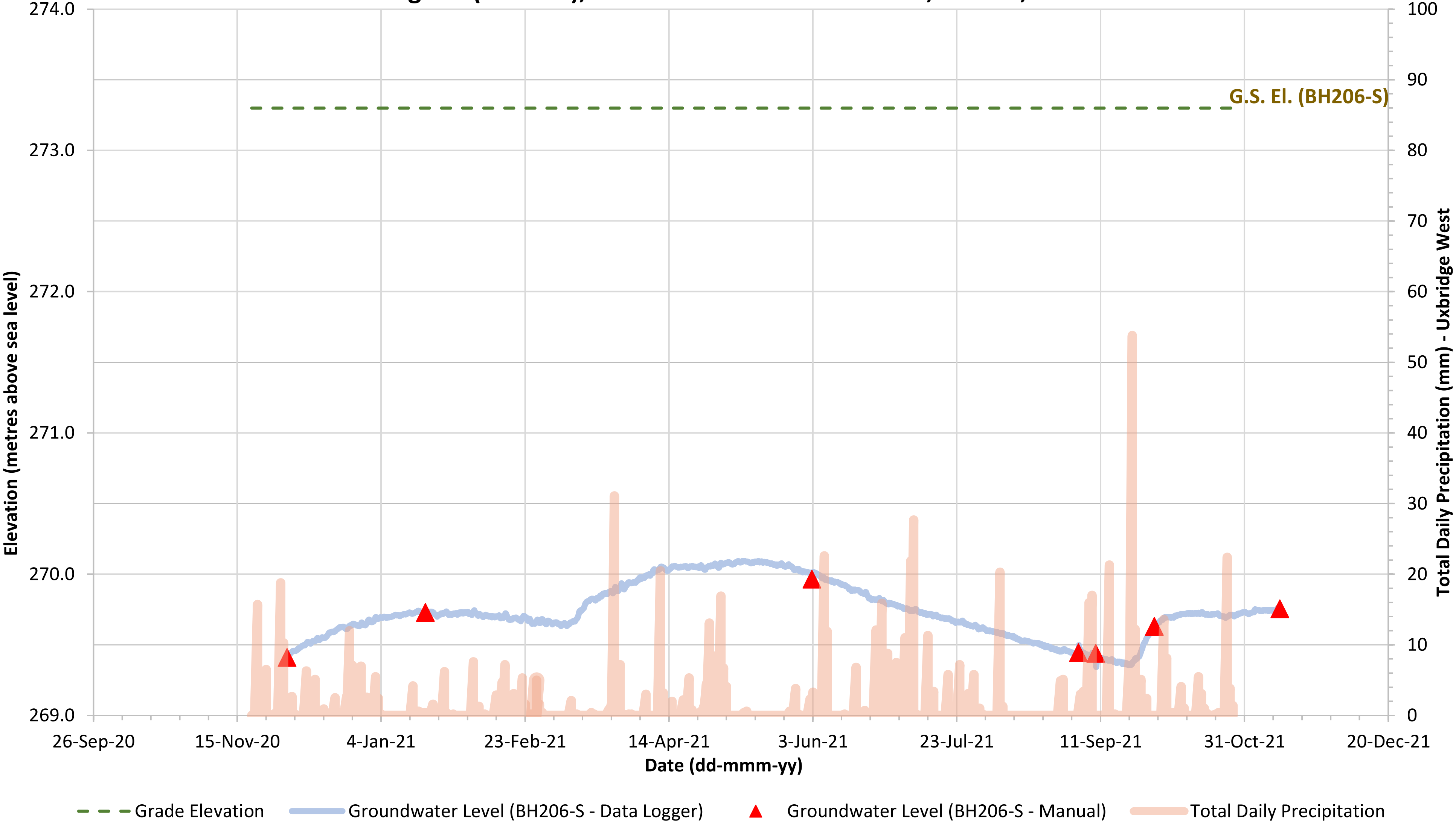
Entered by: AGB/JJG
Checked by: CMK

Figure E-4: BH206-D Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



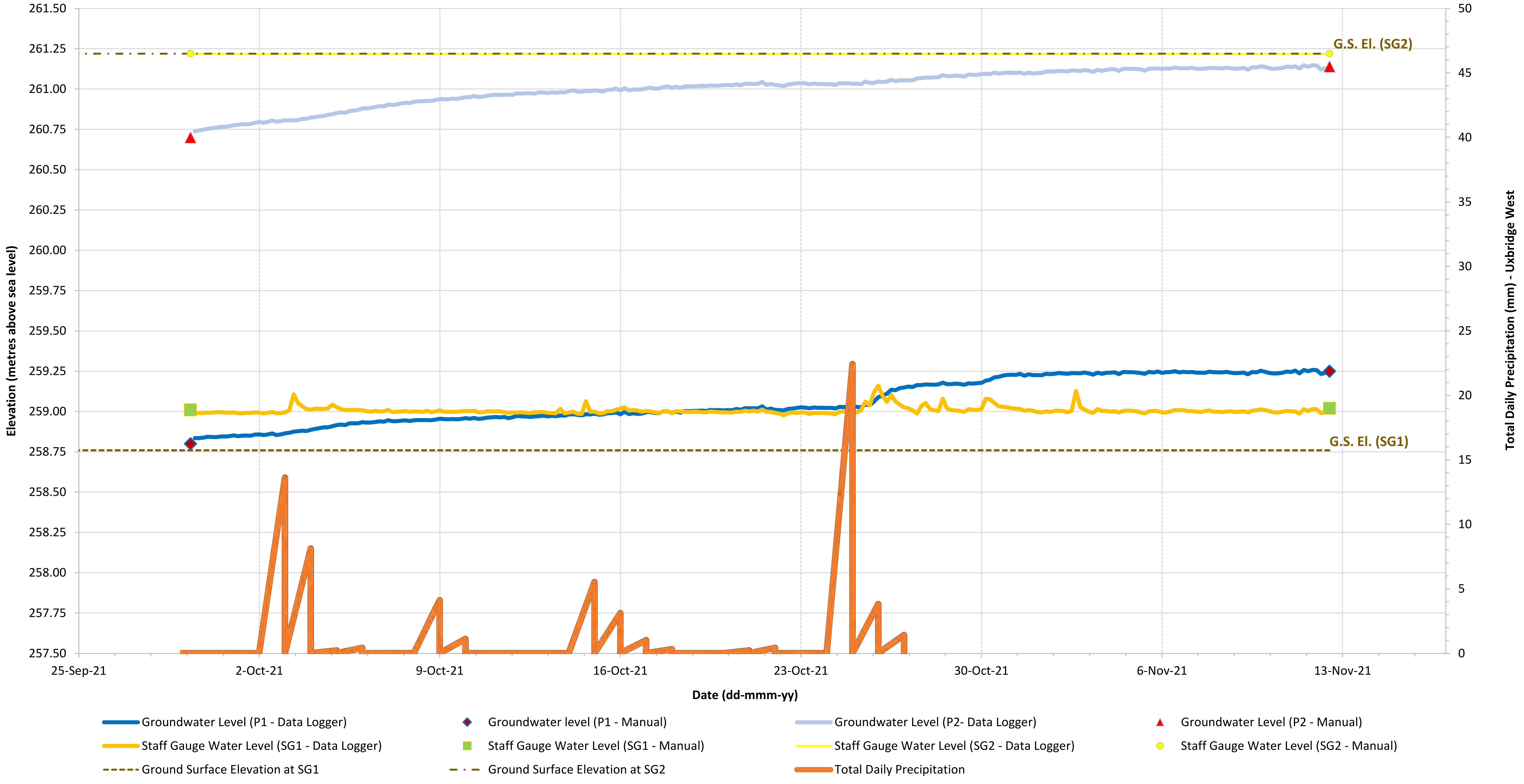
Entered by: AGB/JJG
Checked by: CMK

Figure E-5: BH206-S Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



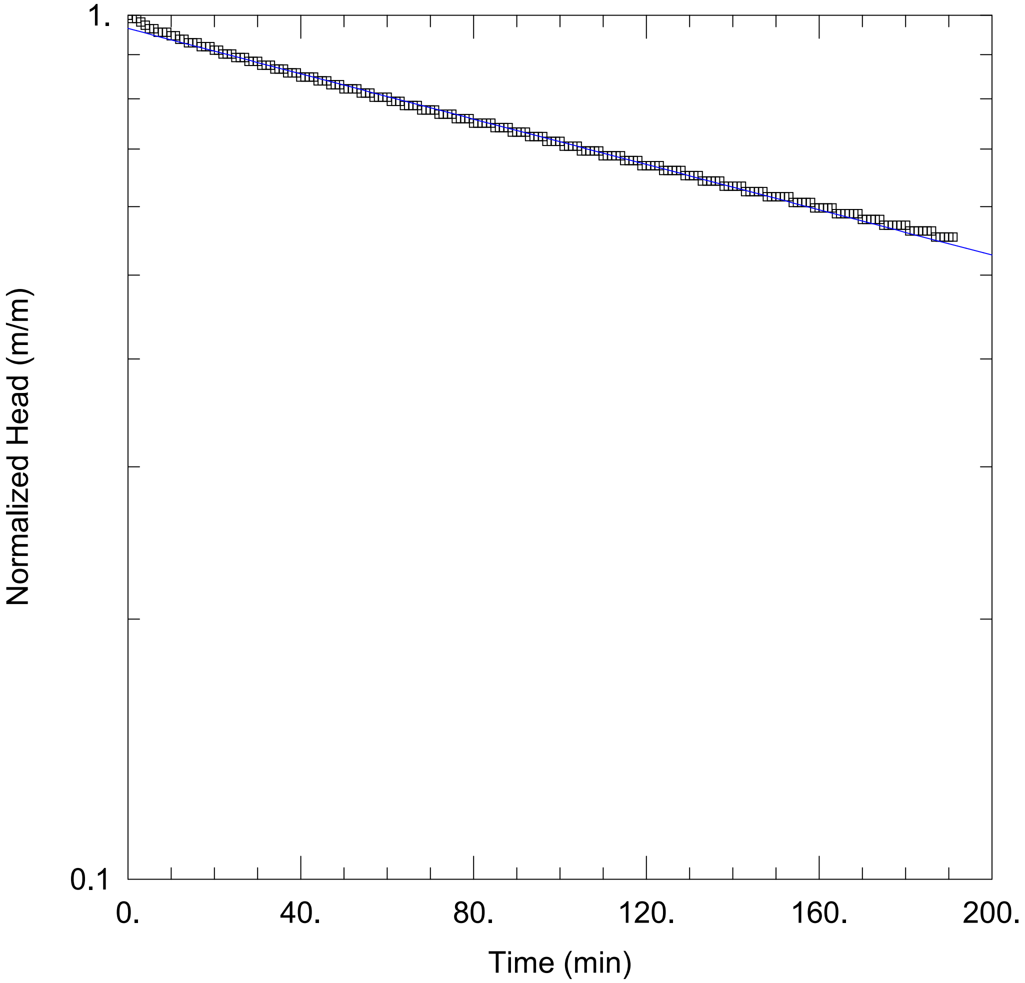
Entered by: AGB/JJG
Checked by: CMK

Figure E-6: Piezometer P1 / Staff Gauge SG1 & Piezometer P2 / Staff Gauge SG2 Hydrograph
Shining Hill (Phase 3), Aurora, Ontario



APPENDIX F

Hydraulic Conductivity Testing



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH101 (logger).aqt
Date: 03/04/21 Time: 16:10:21

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH101
Test Date: December 1, 2020

AQUIFER DATA

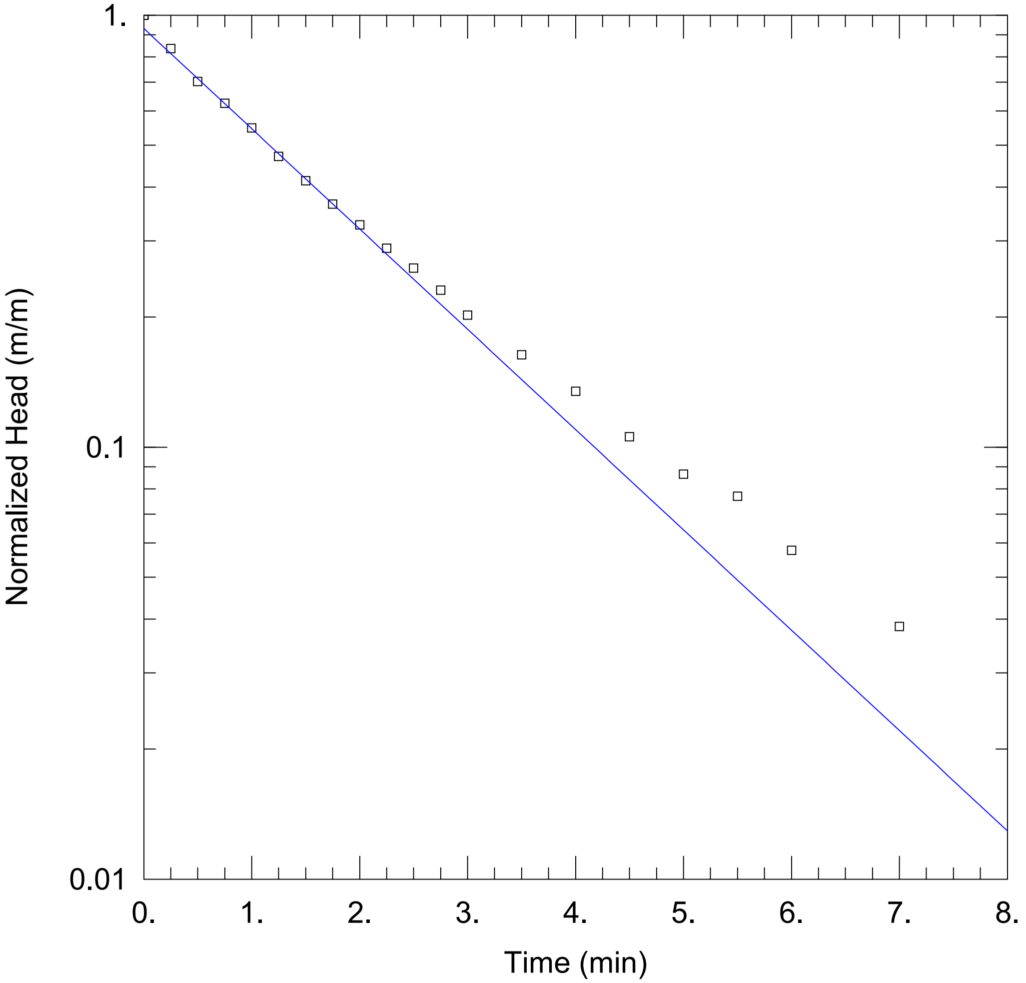
Saturated Thickness: 3.71 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH101)

Initial Displacement: 1.12 m
Total Well Penetration Depth: 3.7 m
Casing Radius: 0.025 m
Static Water Column Height: 3.71 m
Screen Length: 2.1 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.165E-6 cm/sec
y0 = 1.081 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH103.aqt
Date: 03/04/21 Time: 17:39:03

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH103
Test Date: November 16, 2020

AQUIFER DATA

Saturated Thickness: 2.21 m
Anisotropy Ratio (Kz/Kr): 1.

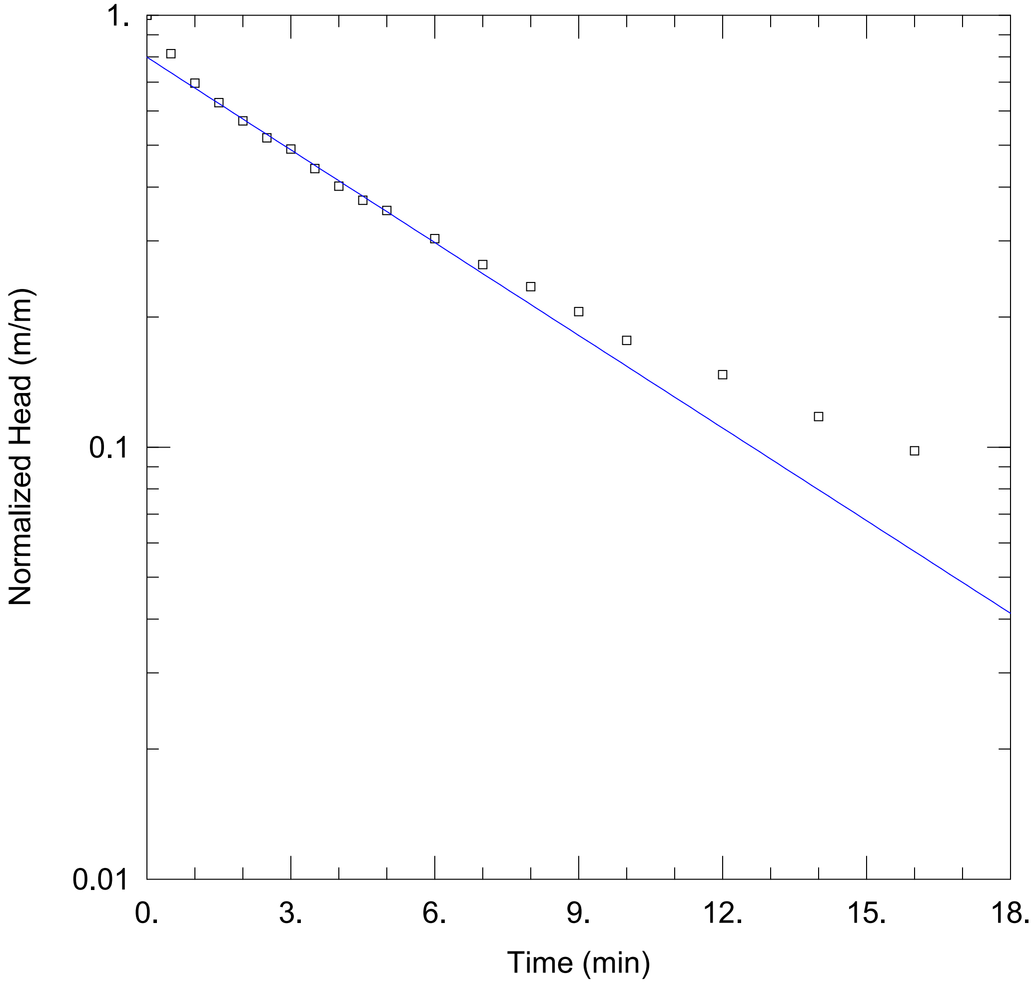
WELL DATA (BH103)

Initial Displacement: 1.04 m
Static Water Column Height: 2.21 m
Total Well Penetration Depth: 2.16 m
Screen Length: 2.16 m
Casing Radius: 0.047 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0011 cm/sec
y0 = 0.9682 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH108.aqt
Date: 03/04/21 Time: 16:39:23

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH108
Test Date: November 16, 2020

AQUIFER DATA

Saturated Thickness: 1.52 m
Anisotropy Ratio (Kz/Kr): 1.

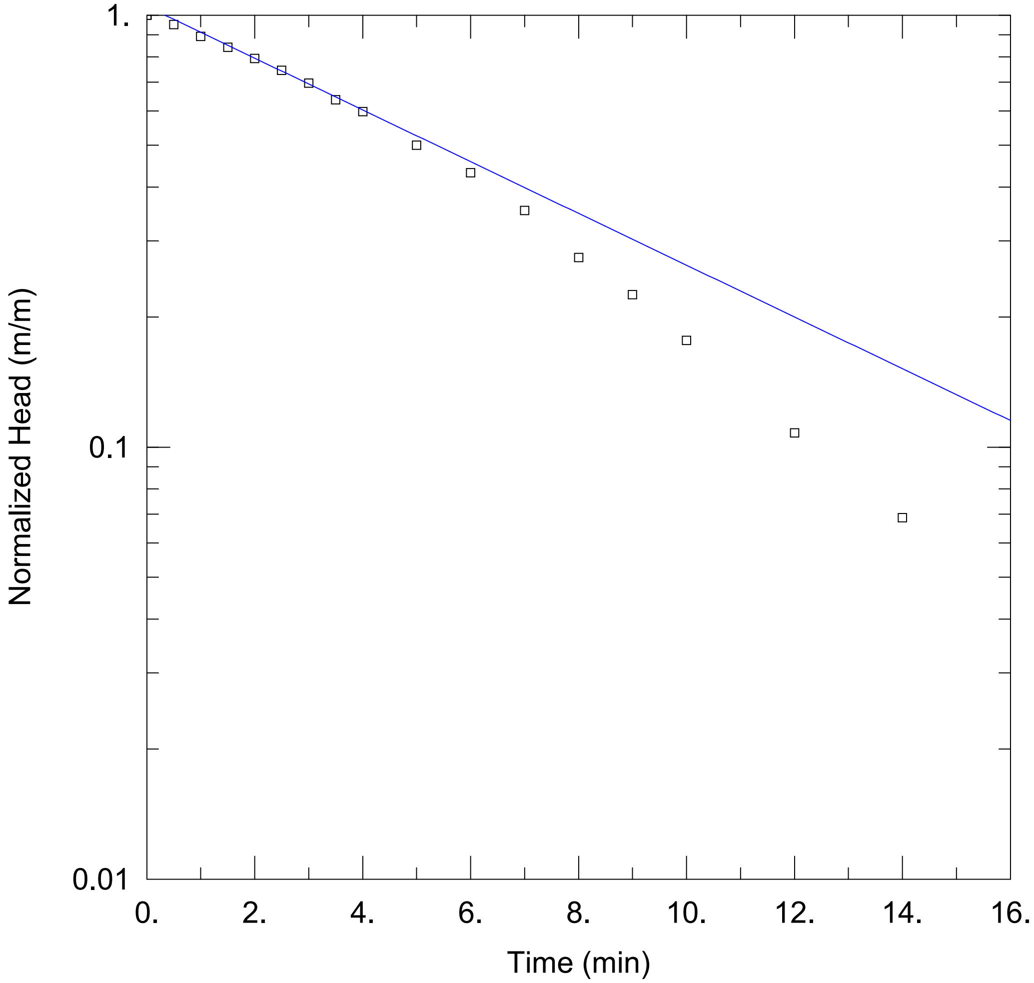
WELL DATA (BH108)

Initial Displacement: 1.02 m
Total Well Penetration Depth: 1.52 m
Casing Radius: 0.05 m
Static Water Column Height: 1.52 m
Screen Length: 1.52 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0004911 cm/sec
y0 = 0.8149 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH202.aqt
Date: 03/04/21 Time: 17:03:42

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH202
Test Date: November 16, 2020

AQUIFER DATA

Saturated Thickness: 1.91 m
Anisotropy Ratio (Kz/Kr): 1.

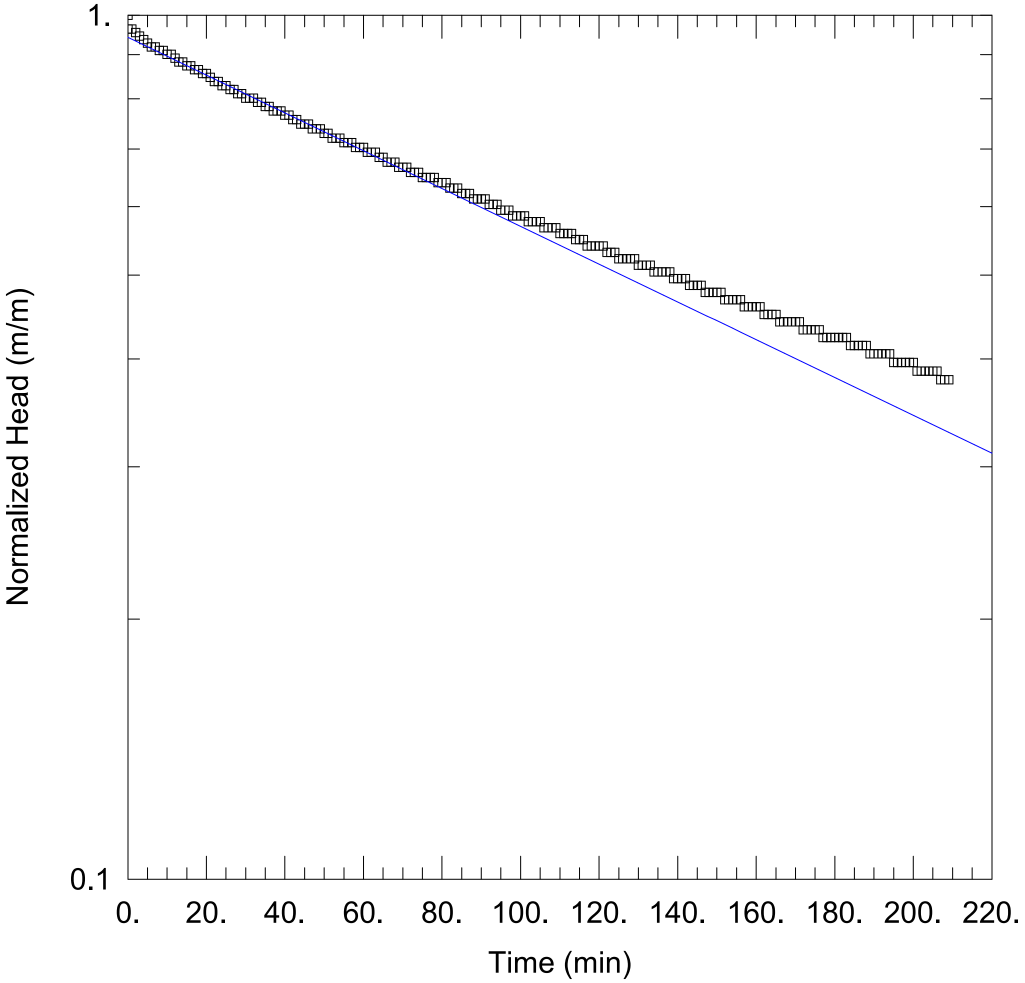
WELL DATA (BH202)

Initial Displacement: 1.02 m
Total Well Penetration Depth: 1.41 m
Casing Radius: 0.05 m
Static Water Column Height: 1.91 m
Screen Length: 1.41 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0003809 cm/sec
y0 = 1.068 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH206-S (logger).aqt
Date: 03/04/21 Time: 17:15:18

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH206-S
Test Date: December 1, 2020

AQUIFER DATA

Saturated Thickness: 3.72 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH206-S)

Initial Displacement: 1.11 m
Static Water Column Height: 3.72 m
Total Well Penetration Depth: 3.72 m
Screen Length: 2.1 m
Casing Radius: 0.025 m
Well Radius: 0.08 m

SOLUTION

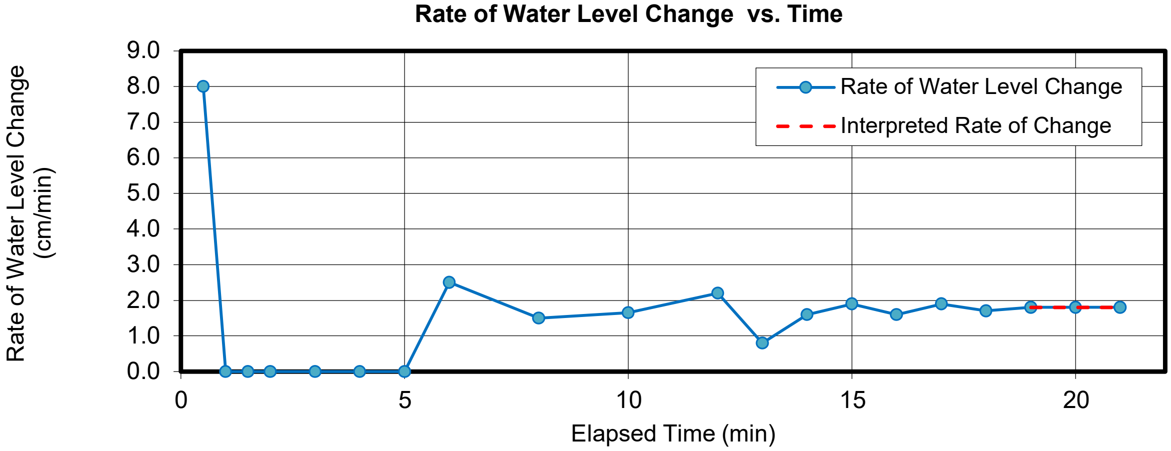
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 3.498E-6 cm/sec
y0 = 1.046 m

Constant Head Permeameter Test Report - Test GP-101

Figure F-1

Approximate Location: 30 m southwest of BH-101
Test Depth: 1.0 mbgs



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	2.5	-	-
0.5	6.5	4.0	8.0
1.0	6.5	0.0	0.0
1.5	6.5	0.0	0.0
2.0	6.5	0.0	0.0
3.0	6.5	0.0	0.0
4.0	6.5	0.0	0.0
5.0	6.5	0.0	0.0
6.0	9.0	2.5	2.5
8.0	12.0	3.0	1.5
10.0	15.3	3.3	1.7
12.0	19.7	4.4	2.2
13.0	20.5	0.8	0.8
14.0	22.1	1.6	1.6
15.0	24.0	1.9	1.9
16.0	25.6	1.6	1.6
17.0	27.5	1.9	1.9
18.0	29.2	1.7	1.7
19.0	31.0	1.8	1.8
20.0	32.8	1.8	1.8
21.0	34.6	1.8	1.8

Soil Type 3 - Inferred
SILTY SAND (FILL)

Interpreted Rate of:

Water Level Change (R_1) =	3.0E-02	cm/s
Steady Intake Water Rate (Q_1) =	6.5E-02	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	7.5	cm
Shape factor for H_1/a = (C_1) =	1.06	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

Single Head Analysis

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{\alpha^*}}$$

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **9E-05** cm/s

🟩 =input data

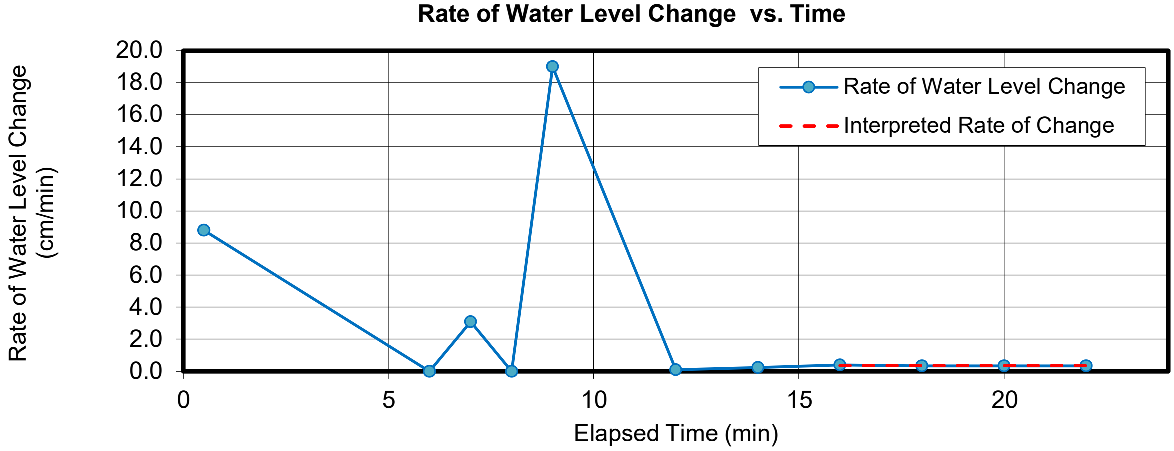
DATE: 2020-11-24
PROJECT: 20360612

PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-102

Figure F-2

Approximate Location: **1 m north of BH-102**
Test Depth: **0.7 mbgs**



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	3.0	-	-
0.5	7.4	4.4	8.8
6.0	7.4	0.0	0.0
7.0	10.5	3.1	3.1
8.0	10.5	0.0	0.0
9.0	29.5	19.0	19.0
12.0	29.8	0.3	0.1
14.0	30.3	0.5	0.3
16.0	31.1	0.8	0.4
18.0	31.8	0.7	0.4
20.0	32.5	0.7	0.4
22.0	33.2	0.7	0.4

🟩 =input data

Soil Type 3 - SILT

Interpreted Rate of:

Water Level Change (R_1) = 6.0E-03 cm/s

Steady Intake Water Rate (Q_1) = 1.3E-02 cm^3/s

hole radius (a) = 3 cm

Water column height in hole (H_1) = 14 cm

Shape factor for H_1/a = (C_1) = 1.60 -

Soil Type Coefficient α^* = 0.12 cm^{-1}

Single Head Analysis

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{a^*}}$$

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **1E-05** cm/s

DATE: 2020-11-24
PROJECT: 20360612

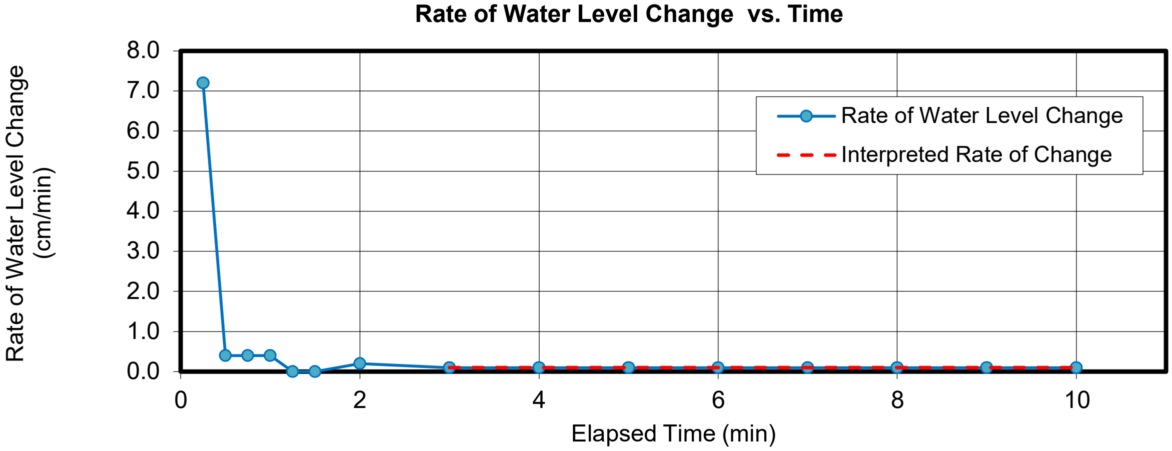
GOLDER

PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-105

Figure F-3

Approximate Location: **2 m north of BH-105**
Test Depth: **0.8 mbgs**



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	3.2	-	-
0.25	5.0	1.8	7.2
0.5	5.1	0.1	0.4
0.75	5.2	0.1	0.4
1.0	5.3	0.1	0.4
1.25	5.3	0.0	0.0
1.5	5.3	0.0	0.0
2.0	5.4	0.1	0.2
3.0	5.5	0.1	0.1
4.0	5.6	0.1	0.1
5.0	5.7	0.1	0.1
6.0	5.8	0.1	0.1
7.0	5.9	0.1	0.1
8.0	6.0	0.1	0.1
9.0	6.1	0.1	0.1
10.0	6.2	0.1	0.1

🟩 =input data

Soil Type 3 - SAND

Interpreted Rate of:

Water Level Change (R_1) =	1.7E-03	cm/s
Steady Intake Water Rate (Q_1) =	5.9E-02	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm
Shape factor for H_1/a = (C_1) =	0.80	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

Single Head Analysis

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{\alpha^*}}$$

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **1E-04** cm/s

DATE: 2020-11-24
PROJECT: 20360612

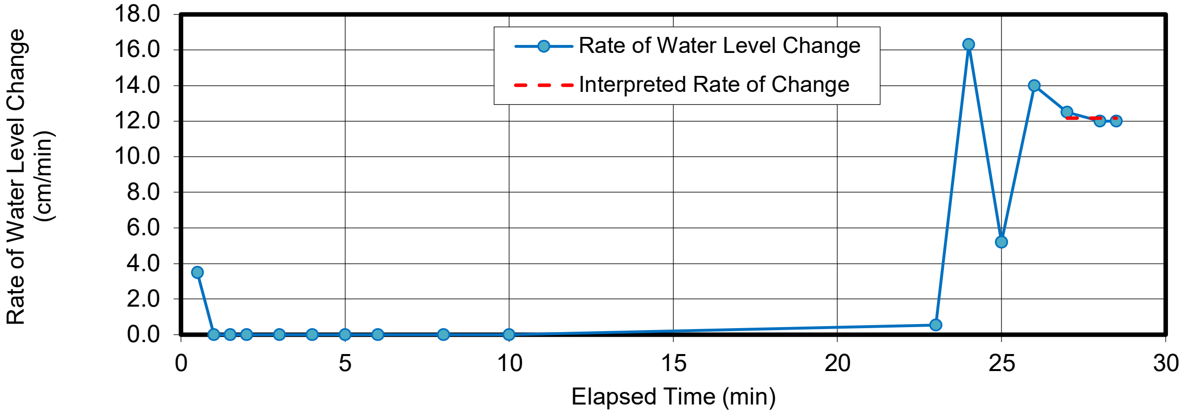
PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-106

Figure F-4

Approximate Location: 1 m north of BH-106
Test Depth: 1.1 mbgs

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	1.3	-	-
0.5	3.0	1.8	3.5
1.0	3.0	0.0	0.0
1.5	3.0	0.0	0.0
2.0	3.0	0.0	0.0
3.0	3.0	0.0	0.0
4.0	3.0	0.0	0.0
5.0	3.0	0.0	0.0
6.0	3.0	0.0	0.0
8.0	3.0	0.0	0.0
10.0	3.0	0.0	0.0
23.0	10.0	7.0	0.5
24.0	26.3	16.3	16.3
25.0	31.5	5.2	5.2
26.0	45.5	14.0	14.0
27.0	58.0	12.5	12.5
28.0	70.0	12.0	12.0
28.5	76.0	6.0	12.0

Soil Type 3 - Inferred
SILTY FINE SAND

Interpreted Rate of:

Water Level Change (R_1) =	2.0E-01	cm/s
Steady Intake Water Rate (Q_1) =	4.4E-01	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	19	cm
Shape factor for H_1/a = (C_1) =	1.92	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

Single Head Analysis

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{\alpha^*}}$$

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **3E-04** cm/s

🟩 =input data

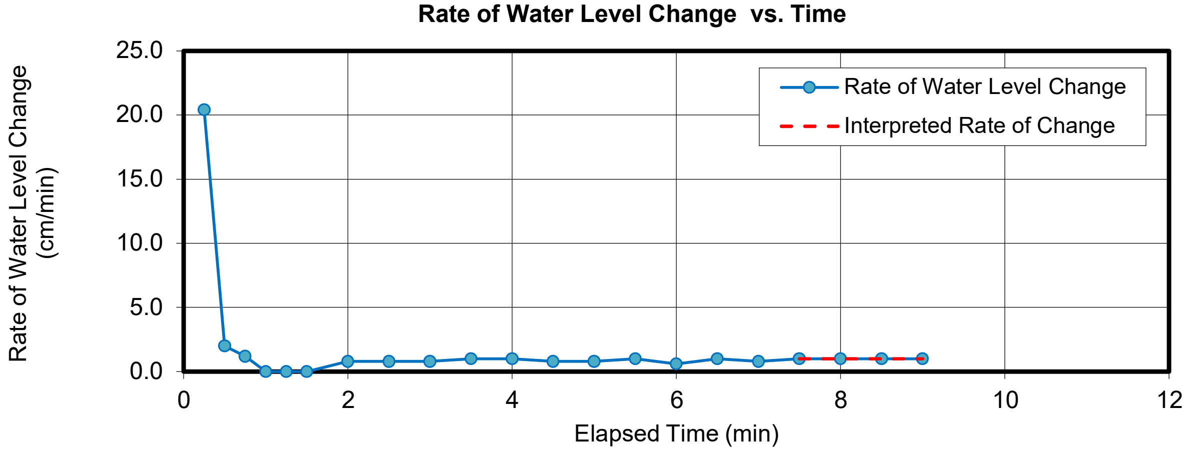
DATE: 2020-11-24
PROJECT: 20360612

PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-206

Approximate Location: **2.5 m south of BH-206**
Test Depth: **0.7 mbgs**

Figure F-5



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	1.9	-	-
0.25	7.0	5.1	20.4
0.5	7.5	0.5	2.0
0.75	7.8	0.3	1.2
1.0	7.8	0.0	0.0
1.25	7.8	0.0	0.0
1.5	7.8	0.0	0.0
2.0	8.2	0.4	0.8
2.5	8.6	0.4	0.8
3.0	9.0	0.4	0.8
3.5	9.5	0.5	1.0
4.0	10.0	0.5	1.0
4.5	10.4	0.4	0.8
5.0	10.8	0.4	0.8
5.5	11.3	0.5	1.0
6.0	11.6	0.3	0.6
6.5	12.1	0.5	1.0
7.0	12.5	0.4	0.8
7.5	13.0	0.5	1.0
8.0	13.5	0.5	1.0
8.5	14.0	0.5	1.0
9.0	14.5	0.5	1.0

🟩 =input data

Soil Type 3 - SAND

Interpreted Rate of:

Water Level Change (R_1) =	1.7E-02	cm/s
Steady Intake Water Rate (Q_1) =	5.9E-01	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm
Shape factor for H_1/a = (C_1) =	0.80	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

Single Head Analysis

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{\alpha^*}}$$

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **1E-03** cm/s

DATE: 2020-11-24
PROJECT: 20360612

PREPARED BY: AGB
REVIEW: CMK

APPENDIX G

Water Balance Results

Table G-1
Meteorological Data

Buttonville A Water Budget Means for the period 1986-2017 6158409

Water Holding Capacity	125	mm
Heat Index	39.55	
Lower Zone	75	mm
A	1.122	
Date Range	1986	2017

Date	Temperature	Precipitation	Rain	Melt	Potential Evapo-transpiration	Actual Evapo-transpiration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(°C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	38	27	124	272
February	-5.6	51	20	24	1	1	0	42	33	125	323
March	-0.4	55	36	49	10	10	0	75	4	125	378
April	6.7	75	71	7	34	34	0	45	0	124	453
May	13.4	80	80	0	80	80	0	15	0	110	534
June	18.7	90	90	0	116	116	0	8	0	76	622
July	21.3	82	82	0	136	118	-18	0	0	40	705
August	20.3	77	77	0	120	87	-33	4	0	27	777
September	16.0	83	83	0	80	68	-12	7	0	35	855
October	9.2	73	73	0	40	38	-2	7	0	63	73
November	3.2	74	68	5	13	13	0	20	0	103	148
December	-2.6	64	37	15	3	3	0	32	12	119	211
Average	7.8										
Total		864	743	119	635	570	-65	293			

Entered by: MR
Checked by: MK

Table G-1
Meteorological Data

Water Holding Capacity	250	mm
Heat Index	39.55	
Lower Zone	150	mm
A	1.122	
Date Range	1986	2017

Date	Temperature	Precipitation	Rain	Melt	Potential Evapo-transpiration	Actual Evapo-transpiration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(°C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	22	27	236	272
February	-5.6	51	20	24	1	1	0	34	33	244	323
March	-0.4	55	36	49	10	10	0	69	4	250	378
April	6.7	75	71	7	34	34	0	45	0	249	453
May	13.4	80	80	0	80	80	0	15	0	235	534
June	18.7	90	90	0	116	116	0	8	0	201	622
July	21.3	82	82	0	136	135	-2	0	0	148	705
August	20.3	77	77	0	120	109	-11	4	0	113	777
September	16.0	83	83	0	80	73	-7	7	0	116	855
October	9.2	73	73	0	40	38	-2	6	0	144	73
November	3.2	74	68	5	13	13	0	11	0	193	148
December	-2.6	64	37	15	3	3	0	26	12	216	211
Average	7.8										
Total		864	743	119	635	614	-22	247			

Table G-1
Meteorological Data

Water Holding Capacity	400	mm
Heat Index	39.55	
Lower Zone	240	mm
A	1.122	
Date Range	1986	2017

Date	**Temperature**	**Precipitation**	**Rain**	**Melt**	**Potential Evapo-transpiration**	**Actual Evapo-transpiration**	**Deficit**	**Surplus**	**Snow**	**Soil**	**Accumulated Precipitation**
	(°C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	21	27	371	272
February	-5.6	51	20	24	1	1	0	28	33	385	323
March	-0.4	55	36	49	10	10	0	62	4	398	378
April	6.7	75	71	7	34	34	0	44	0	399	453
May	13.4	80	80	0	80	80	0	15	0	384	534
June	18.7	90	90	0	116	116	0	8	0	350	622
July	21.3	82	82	0	136	136	0	0	0	296	705
August	20.3	77	77	0	120	118	-2	3	0	252	777
September	16.0	83	83	0	80	77	-3	7	0	251	855
October	9.2	73	73	0	40	39	-1	6	0	279	73
November	3.2	74	68	5	13	13	0	10	0	328	148
December	-2.6	64	37	15	3	3	0	24	12	353	211
Average	7.8										
Total		864	743	119	635	629	-6	228			

Entered by: MR
Checked by: MK

Table G-2
Annual Infiltration Rates - Site Wide

PRE-DEVELOPMENT SCENARIO

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Recreational Buildings	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Private Property - Residence	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Private Property - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50
Grassed - Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Asphalt Roads & Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Gravel Pathways	90% Precip	Gravel	Impervious	0.00	0.0	0.0	0.00
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.15	0.3	0.1	0.55
Thicket / Forest / Hedgerows / Plantations	400 mm	Mature Forest	Silt Loam	0.15	0.3	0.2	0.65
Mineral Marsh	Precip - PET	Pond	Silt Loam	0.0	0.0	0.0	0.00

POST-DEVELOPMENT SCENARIO

Type	WHC	Type of Material	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Residential Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park - Recreational Amenities / Walkways	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Underground SWM Facility / Trail Head	125 mm	Urban Lawns	Silt Loam	0.0	0.0	0.0	0.00
Single Detached - Roofs	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Single Detached - Driveways	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Townhouses - Roofs	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Townhouses - Driveways	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Saint Anne's School - Buildings	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Saint Anne's School - Paved / Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Saint Anne's School - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.2	0.3	0.1	0.55
Forest / Hedgerows	400 mm	Mature Forest	Silt Loam	0.2	0.3	0.2	0.65
Roads, Sidewalks, Parking & Paths	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00

Table G-2
Annual Infiltration Rates - Site Wide

POST-DEVELOPMENT MITIGATION SCENARIO

Type	WHC	Type of Material	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Residential Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park - Lawn	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park - Recreational Amenities / Walkways	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Underground SWM Facility / Trail Head	125 mm	Urban Lawns	Silt Loam	0.0	0.0	0.0	0.00
Single Detached - Roofs (to Downspout Disconnection)	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.25
Single Detached - Driveways (to Catchbasin Filtration Trench)	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Roadways (to Catchbasin Filtration Trench)	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Single Detached - Roofs (to Rear Yard Infiltration Trench)	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.76
Townhouse - Roofs (to Rear Yard Infiltration Trench)	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.76
Roadways (to Bioswale Filtration Trench)	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Townhouse - Roofs	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Townhouse - Roofs (to Bioswale Infiltration)	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.68
Townhouse - Driveways (to Bioswale Infiltration)	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.68
Roadways (to Bioswale Infiltration)	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.68
Saint Anne's School - Buildings	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Saint Anne's School - Buildings (to Vegetated Filter Strip)	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.25
Saint Anne's School - Paved / Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Saint Anne's School - Paved / Concrete Structures (to Vegetated Filter Strip)	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.25
Saint Anne's School - Paved / Concrete Structures (to Enhanced Grassed	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.10
Saint Anne's School - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.2	0.3	0.1	0.55
Forest / Hedgerows	400 mm	Mature Forest	Silt Loam	0.2	0.3	0.2	0.65
Roads, Sidewalks, Parking & Paths	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00

Notes:
WHC - Water Holding Capacity
The infiltration factor is estimated by summing a factor for topography, soils and cover

Entered by: MR
Checked by: MK

Table G-3
Summary of Results - Site Wide

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	**(mm/yr) (m^3/yr)**	**(mm/yr) (m^3/yr)**	**(mm/yr) (m^3/yr)**	**(mm/yr) (m^3/yr)**
Recreational Buildings	4,520	(864) 3,905	(86) 390	(778) 3,515	(0) 0	(778) 3,515
Private Property - Residence	1,168	(864) 1,010	(86) 100	(778) 910	(0) 0	(778) 910
Private Property - Driveways / Concrete Structures	5,500	(864) 4,750	(86) 475	(778) 4,275	(0) 0	(778) 4,275
Private Property - Lawns	28,108	(864) 24,285	(570) 16,020	(293) 8,235	(147) 4,115	(147) 4,120
Grassed - Lawns	22,255	(864) 19,230	(570) 12,685	(293) 6,520	(161) 3,585	(132) 2,935
Asphalt Roads & Concrete Structures	8,998	(864) 7,775	(86) 775	(778) 6,995	(0) 0	(778) 6,995
Gravel Pathways	1,072	(864) 925	(86) 95	(778) 835	(0) 0	(778) 835
Mineral Meadow	40,983	(864) 35,410	(614) 25,165	(247) 10,125	(136) 5,570	(111) 4,555
Thicket / Forest / Hedgerows / Plantations	23,419	(864) 20,235	(629) 14,730	(228) 5,340	(148) 3,470	(80) 1,870
Mineral Marsh	2,078	(864) 1,795	(635) 1,320	(229) 475	(0) 0	(229) 475
Total	**138,100**	**119,320**	**71,755**	**47,225**	**16,740**	**30,485**

Table G-3
Summary of Results - Site Wide

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	27,175	(864) 23,480	(570) 15,490	(293) 7,960	(161) 4,380	(132) 3,580
Neighbourhood Park	2,415	(864) 2,085	(570) 1,375	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs	24,952	(864) 21,560	(86) 2,155	(778) 19,405	(0) 0	(778) 19,405
Single Detached - Driveways	1,879	(864) 1,625	(86) 160	(778) 1,460	(0) 0	(778) 1,460
Townhouses - Roofs	3,007	(864) 2,600	(86) 260	(778) 2,340	(0) 0	(778) 2,340
Townhouses - Driveways	449	(864) 390	(86) 40	(778) 350	(0) 0	(778) 350
Saint Anne's School - Buildings	2,333	(864) 2,015	(86) 200	(778) 1,815	(0) 0	(778) 1,815
Saint Anne's School - Paved / Concrete Structures	10,288	(864) 8,890	(86) 890	(778) 8,000	(0) 0	(778) 8,000
Saint Anne's School - Lawns	23,729	(864) 20,500	(570) 13,525	(293) 6,950	(147) 3,475	(147) 3,475
Mineral Meadow	1,242	(864) 1,070	(614) 765	(247) 305	(136) 170	(111) 135
Forest / Hedgerows	5,208	(864) 4,500	(629) 3,280	(228) 1,190	(148) 770	(80) 420
Roads, Sidewalks, Parking & Paths	20,038	(864) 17,310	(86) 1,730	(778) 15,580	(0) 0	(778) 15,580
Total	**138,100**	**119,320**	**42,020**	**77,205**	**9,185**	**68,020**

Table G-3
Summary of Results - Site Wide

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	**Area**	**Precipitation**	**Evapo-transpiration**	**Surplus**	**Infiltration**	**Runoff**
	(m^2)	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**
Residential Lawns	27,175	(864) 23,480	(570) 15,490	(293) 7,960	(161) 4,380	(132) 3,580
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,375	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs (to Downspout Disconnection)	24,306	(864) 21,000	(86) 2,100	(778) 18,900	(194) 4,725	(583) 14,175
Single Detached - Driveways (to Catchbasin Filtration Trench)	1,879	(864) 1,625	(86) 160	(778) 1,460	(0) 0	(778) 1,460
Roadways (to Catchbasin Filtration Trench)	16,225	(864) 14,020	(86) 1,400	(778) 12,620	(0) 0	(778) 12,620
Single Detached - Roofs (to Rear Yard Infiltration Trench)	646	(864) 560	(86) 55	(778) 500	(591) 380	(187) 120
Townhouse - Roofs (to Rear Yard Infiltration Trench)	977	(864) 845	(86) 85	(778) 760	(591) 575	(187) 185
Roadways (to Bioswale Filtration Trench)	1,695	(864) 1,460	(86) 145	(778) 1,320	(0) 0	(778) 1,320
Townhouse - Roofs	526	(864) 455	(86) 50	(778) 410	(0) 0	(778) 410
Townhouse - Roofs (to Bioswale Infiltration)	1,503	(864) 1,300	(86) 130	(778) 1,170	(529) 795	(249) 375
Townhouse - Driveways (to Bioswale Infiltration)	449	(864) 390	(86) 40	(778) 350	(529) 240	(249) 110
Roadways (to Bioswale Infiltration)	1,443	(864) 1,245	(86) 125	(778) 1,120	(529) 765	(249) 355
Saint Anne's School - Buildings	1,554	(864) 1,340	(86) 135	(778) 1,210	(0) 0	(778) 1,210
Saint Anne's School - Buildings (to Vegetated Filter Strip)	779	(864) 675	(86) 65	(778) 605	(194) 150	(583) 455
Saint Anne's School - Paved / Concrete Structures	6,718	(864) 5,805	(86) 580	(778) 5,225	(0) 0	(778) 5,225
Saint Anne's School - Paved / Concrete Structures (to Vegetated Filter Strip)	935	(864) 810	(86) 80	(778) 725	(194) 180	(583) 545
Saint Anne's School - Paved / Concrete Structures (to Enhanced Grassed Swale)	2,635	(864) 2,275	(86) 230	(778) 2,050	(78) 205	(700) 1,845
Saint Anne's School - Lawns	23,729	(864) 20,500	(570) 13,525	(293) 6,950	(147) 3,480	(147) 3,470
Mineral Meadow	1,242	(864) 1,075	(614) 765	(247) 305	(136) 170	(111) 135
Forest / Hedgerows	5,208	(864) 4,500	(629) 3,275	(228) 1,190	(148) 770	(80) 420
Roads, Sidewalks, Parking & Paths	675	(864) 580	(86) 60	(778) 525	(0) 0	(778) 525
Total	**138,100**	**119,320**	**42,020**	**77,205**	**17,205**	**60,000**

Entered by: MR
Checked by: MK

Table G-4
Summary of Results - Tannery Creek West Tributary

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Grassed - Lawns	11,602	(864) 10,020	(570) 6,610	(293) 3,400	(161) 1,870	(132) 1,530
Private Property - Residence	1,046	(864) 905	(86) 90	(778) 815	(0) 0	(778) 815
Private Property - Driveways / Concrete Structures	4,372	(864) 3,780	(86) 380	(778) 3,400	(0) 0	(778) 3,400
Private Property - Lawns	17,223	(864) 14,880	(570) 9,815	(293) 5,050	(147) 2,520	(147) 2,530
Asphalt Roads	2,309	(864) 1,995	(86) 200	(778) 1,795	(0) 0	(778) 1,795
Mineral Meadow	16,965	(864) 14,660	(614) 10,415	(247) 4,190	(136) 2,305	(111) 1,885
Thicket / Forest / Hedgerows / Plantations	11,905	(864) 10,285	(629) 7,490	(228) 2,710	(148) 1,765	(80) 945
Mineral Marsh	2,078	(864) 1,795	(635) 1,320	(229) 475	(0) 0	(229) 475
Total	**67,500**	**58,320**	**36,320**	**21,835**	**8,460**	**13,375**

Entered by: MR
Checked by: MK

Table G-4
Summary of Results - Tannery Creek West Tributary

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	11,512	(864) 9,945	(570) 6,560	(293) 3,370	(161) 1,855	(132) 1,515
Single Detached - Roofs	11,361	(864) 9,815	(86) 980	(778) 8,835	(0) 0	(778) 8,835
Single Detached - Driveways	820	(864) 710	(86) 70	(778) 640	(0) 0	(778) 640
Saint Anne's School - Buildings	1,618	(864) 1,400	(86) 140	(778) 1,260	(0) 0	(778) 1,260
Saint Anne's School - Paved / Concrete Structures	5,651	(864) 4,880	(86) 490	(778) 4,395	(0) 0	(778) 4,395
Saint Anne's School - Lawns	14,098	(864) 12,180	(570) 8,035	(293) 4,130	(147) 2,065	(147) 2,065
Forest / Hedgerows	3,333	(864) 2,880	(629) 2,095	(228) 760	(148) 495	(80) 265
Roads, Sidewalks, Parking & Paths	5,208	(864) 4,500	(86) 450	(778) 4,050	(0) 0	(778) 4,050
Total	**53,600**	**46,310**	**18,820**	**27,440**	**4,415**	**23,025**

Entered by: MR
Checked by: MK

Table G-4
Summary of Results - Tannery Creek West Tributary

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	11,512	(864) 9,945	(570) 6,560	(293) 3,375	(161) 1,855	(132) 1,520
Single Detached - Roofs (to Downspout Disconnection)	11,202	(864) 9,680	(86) 970	(778) 8,710	(194) 2,180	(583) 6,530
Single Detached - Driveways (to Catchbasin Filtration Trench)	820	(864) 710	(86) 70	(778) 635	(0) 0	(778) 635
Roadways (to Catchbasin Filtration Trench)	4,985	(864) 4,305	(86) 430	(778) 3,875	(0) 0	(778) 3,875
Single Detached - Roofs (to Rear Yard Infiltration Trench)	158	(864) 135	(86) 15	(778) 125	(591) 95	(187) 30
Saint Anne's School - Buildings	839	(864) 725	(86) 70	(778) 655	(0) 0	(778) 655
Saint Anne's School - Buildings (to Vegetated Filter Strip)	779	(864) 670	(86) 65	(778) 605	(194) 150	(583) 455
Saint Anne's School - Paved / Concrete Structures	2,081	(864) 1,800	(86) 180	(778) 1,620	(0) 0	(778) 1,620
Saint Anne's School - Paved / Concrete Structures (to Vegetated Filter Strip)	935	(864) 810	(86) 80	(778) 725	(194) 180	(583) 545
Saint Anne's School - Paved / Concrete Structures (to Enhanced Grassed Swale)	2,635	(864) 2,275	(86) 230	(778) 2,050	(78) 205	(700) 1,845
Saint Anne's School - Lawns	14,098	(864) 12,180	(570) 8,035	(293) 4,130	(147) 2,065	(147) 2,065
Forest / Hedgerows	3,333	(864) 2,880	(629) 2,095	(228) 760	(148) 495	(80) 265
Roads, Sidewalks, Parking & Paths	223	(864) 195	(86) 20	(778) 175	(0) 0	(778) 175
Total	**53,600**	**46,310**	**18,820**	**27,440**	**7,225**	**20,215**

Entered by: MR
Checked by: MK

Table G-5
Summary of Results - Tannery Creek North Tributary

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Recreational Buildings	2,358	(864) 2,040	(86) 205	(778) 1,840	(0) 0	(778) 1,840
Private Property - Residence	122	(864) 105	(86) 10	(778) 95	(0) 0	(778) 95
Private Property - Driveways / Concrete Structures	1,128	(864) 975	(86) 95	(778) 875	(0) 0	(778) 875
Private Property - Lawns	10,886	(864) 9,405	(570) 6,205	(293) 3,190	(147) 1,595	(147) 1,595
Grassed - Lawns	2,421	(864) 2,090	(570) 1,380	(293) 710	(161) 390	(132) 320
Asphalt Roads & Concrete Structures	3,474	(864) 3,000	(86) 300	(778) 2,700	(0) 0	(778) 2,700
Gravel Pathways	1,021	(864) 880	(86) 90	(778) 795	(0) 0	(778) 795
Mineral Meadow	15,635	(864) 13,510	(614) 9,600	(247) 3,860	(136) 2,125	(111) 1,735
Hedgerows	9,757	(864) 8,430	(629) 6,135	(228) 2,220	(148) 1,445	(80) 775
Total	**46,800**	**40,435**	**24,020**	**16,285**	**5,555**	**10,730**

Entered by: MR
Checked by: MK

Table G-5
Summary of Results - Tannery Creek North Tributary

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	5,456	(864) 4,710	(570) 3,110	(293) 1,600	(161) 880	(132) 720
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,380	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs	2,073	(864) 1,790	(86) 180	(778) 1,610	(0) 0	(778) 1,610
Single Detached - Driveways	157	(864) 135	(86) 15	(778) 120	(0) 0	(778) 120
Townhouses - Roofs	2,932	(864) 2,535	(86) 255	(778) 2,280	(0) 0	(778) 2,280
Townhouses - Driveways	449	(864) 390	(86) 40	(778) 350	(0) 0	(778) 350
Saint Anne's School - Buildings	715	(864) 615	(86) 60	(778) 555	(0) 0	(778) 555
Saint Anne's School - Paved / Concrete Structures	4,637	(864) 4,005	(86) 400	(778) 3,605	(0) 0	(778) 3,605
Saint Anne's School - Lawns	9,631	(864) 8,320	(570) 5,490	(293) 2,820	(147) 1,410	(147) 1,410
Mineral Meadow	1,242	(864) 1,075	(614) 760	(247) 305	(136) 170	(111) 135
Hedgerows	1,875	(864) 1,620	(629) 1,180	(228) 430	(148) 275	(80) 155
Roads, Sidewalks, Parking & Paths	6,734	(864) 5,820	(86) 580	(778) 5,235	(0) 0	(778) 5,235
Total	**53,700**	**46,400**	**15,600**	**30,760**	**3,125**	**27,635**

Entered by: MR
Checked by: MK

Table G-5
Summary of Results - Tannery Creek North Tributary

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	5,456	(864) 4,715	(570) 3,110	(293) 1,600	(161) 880	(132) 720
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,375	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs (to Downspout Disconnection)	2,073	(864) 1,790	(86) 180	(778) 1,610	(194) 405	(583) 1,205
Single Detached - Driveways (to Catchbasin Filtration Trench)	157	(864) 135	(86) 15	(778) 120	(0) 0	(778) 120
Roadways (to Catchbasin Filtration Trench)	4,461	(864) 3,855	(86) 385	(778) 3,470	(0) 0	(778) 3,470
Townhouse - Roofs (to Rear Yard Infiltration Trench)	977	(864) 845	(86) 85	(778) 760	(591) 575	(187) 185
Roadways (to Bioswale Filtration Trench)	656	(864) 565	(86) 60	(778) 510	(0) 0	(778) 510
Townhouse - Roofs	451	(864) 390	(86) 40	(778) 350	(0) 0	(778) 350
Townhouse - Roofs (to Bioswale Infiltration)	1,503	(864) 1,300	(86) 130	(778) 1,170	(529) 795	(249) 375
Townhouse - Driveways (to Bioswale Infiltration)	449	(864) 390	(86) 40	(778) 350	(529) 240	(249) 110
Roadways (to Bioswale Infiltration)	1,443	(864) 1,250	(86) 125	(778) 1,120	(529) 760	(249) 360
Saint Anne's School - Buildings	715	(864) 615	(86) 60	(778) 555	(0) 0	(778) 555
Saint Anne's School - Paved / Concrete Structures	4,637	(864) 4,005	(86) 400	(778) 3,605	(0) 0	(778) 3,605
Saint Anne's School - Lawns	9,631	(864) 8,320	(570) 5,490	(293) 2,820	(147) 1,410	(147) 1,410
Mineral Meadow	1,242	(864) 1,075	(614) 760	(247) 305	(136) 170	(111) 135
Hedgerows	1,875	(864) 1,620	(629) 1,180	(228) 430	(148) 275	(80) 155
Roads, Sidewalks, Parking & Paths	175	(864) 150	(86) 15	(778) 135	(0) 0	(778) 135
Total	**53,700**	**46,400**	**15,600**	**30,760**	**5,900**	**24,860**

Entered by: MR
Checked by: MK

Table G-6

Summary of Results - Tannery Creek (Including Tannery Creek North Tributary Contribution)

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Recreational Buildings	2,162	(864) 1,870	(86) 190	(778) 1,680	(0) 0	(778) 1,680
Grassed - Lawns	8,231	(864) 7,110	(570) 4,690	(293) 2,415	(161) 1,325	(132) 1,090
Asphalt Roads	3,215	(864) 2,780	(86) 280	(778) 2,500	(0) 0	(778) 2,500
Gravel Pathways	51	(864) 40	(86) 5	(778) 40	(0) 0	(778) 40
Mineral Meadow	8,383	(864) 7,245	(614) 5,145	(247) 2,070	(136) 1,140	(111) 930
Hedgerows / Plantations	1,757	(864) 1,520	(629) 1,105	(228) 400	(148) 260	(80) 140
Total - Tannery Creek Sub Catchment	**23,800**	**20,565**	**11,415**	**9,105**	**2,725**	**6,380**
Total - Tannery Creek North Tributary Catchment	**46,800**	**40,435**	**24,020**	**16,285**	**5,555**	**10,730**
Total - Tannery Creek Total Catchment	**70,600**	**61,000**	**35,435**	**25,390**	**8,280**	**17,110**

Summary of Results - Tannery Creek (Including Tannery Creek North Tributary Contribution)

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	10,207	(864) 8,820	(570) 5,820	(293) 2,990	(161) 1,645	(132) 1,345
Single Detached - Roofs	11,519	(864) 9,950	(86) 995	(778) 8,960	(0) 0	(778) 8,960
Single Detached - Driveways	903	(864) 780	(86) 80	(778) 700	(0) 0	(778) 700
Townhouses - Roofs	75	(864) 65	(86) 5	(778) 60	(0) 0	(778) 60
Roads, Sidewalks, Parking & Paths	8,096	(864) 6,995	(86) 700	(778) 6,295	(0) 0	(778) 6,295
Total - Tannery Creek Sub Catchment	**30,800**	**26,610**	**7,600**	**19,005**	**1,645**	**17,360**
Total - Tannery Creek North Tributary Catchment	**53,700**	**46,400**	**15,600**	**30,760**	**3,125**	**27,635**
Total - Tannery Creek Total Catchment	**84,500**	**73,010**	**23,200**	**49,765**	**4,770**	**44,995**

Entered by: MR
Checked by: MK

Summary of Results - Tannery Creek (Including Tannery Creek North Tributary Contribution)

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	10,207	(864) 8,820	(570) 5,820	(293) 2,990	(161) 1,645	(132) 1,345
Single Detached - Roofs (to Downspout Disconnection)	11,031	(864) 9,530	(86) 955	(778) 8,580	(194) 2,145	(583) 6,435
Single Detached - Driveways (to Catchbasin Filtration Trench)	903	(864) 780	(86) 80	(778) 700	(0) 0	(778) 700
Roadways (to Catchbasin Filtration Trench)	6,957	(864) 6,010	(86) 600	(778) 5,410	(0) 0	(778) 5,410
Single Detached - Roofs (to Rear Yard Infiltration Trench)	488	(864) 420	(86) 40	(778) 375	(591) 290	(187) 85
Roadways (to Bioswale Filtration Trench)	1,040	(864) 900	(86) 90	(778) 810	(0) 0	(778) 810
Townhouse - Roofs	75	(864) 65	(86) 5	(778) 60	(0) 0	(778) 60
Roads, Sidewalks, Parking & Paths	100	(864) 85	(86) 10	(778) 80	(0) 0	(778) 80
Total - Tannery Creek Sub Catchment	**30,800**	**26,610**	**7,600**	**19,005**	**4,080**	**14,925**
Total - Tannery Creek North Tributary Catchment	**53,700**	**46,400**	**15,600**	**30,760**	**5,900**	**24,860**
Total - Tannery Creek Total Catchment	**84,500**	**73,010**	**23,200**	**49,765**	**9,980**	**39,785**

Entered by: MR
Checked by: MK

Table G-7
Summary of Results - Southern Wetland

Table 1: Pre-development Scenario Water Balance Results

Catchment	**Area (m^2)**	**Precipitation**	**Evapo-transpiration**	**Surplus**	**Infiltration**	**Runoff**
		(mm/yr) **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**	**(mm/yr)** **(m^3/yr)**
Grassed - Lawns	1,487	(864) 1,285	(570) 845	(293) 435	(161) 240	(132) 195
Private Property - Residence	431	(864) 375	(86) 35	(778) 335	(0) 0	(778) 335
Private Property - Driveways / Concrete Structures	2,194	(864) 1,895	(86) 190	(778) 1,705	(0) 0	(778) 1,705
Private Property - Lawns	6,515	(864) 5,630	(570) 3,715	(293) 1,910	(147) 955	(147) 955
Asphalt Roads	433	(864) 375	(86) 40	(778) 335	(0) 0	(778) 335
Forest / Hedgerows	2,070	(864) 1,790	(629) 1,300	(228) 470	(148) 305	(80) 165
Total	**13,130**	**11,350**	**6,125**	**5,190**	**1,500**	**3,690**

Table G-7
Summary of Results - Southern Wetland

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	1,920	(864) 1,660	(570) 1,095	(293) 560	(161) 310	(132) 250
Single Detached - Roofs	1,285	(864) 1,110	(86) 110	(778) 1,000	(0) 0	(778) 1,000
Saint Anne's School - Buildings	458	(864) 395	(86) 40	(778) 355	(0) 0	(778) 355
Saint Anne's School - Paved / Concrete Structures	2,669	(864) 2,305	(86) 230	(778) 2,075	(0) 0	(778) 2,075
Saint Anne's School - Lawns	5,888	(864) 5,090	(570) 3,355	(293) 1,725	(147) 860	(147) 865
Forest / Hedgerows	943	(864) 815	(629) 595	(228) 215	(148) 140	(80) 75
Total	**13,163**	**11,375**	**5,425**	**5,930**	**1,310**	**4,620**

Table G-7
Summary of Results - Southern Wetland

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	1,920	(864) 1,660	(570) 1,095	(293) 560	(161) 310	(132) 250
Single Detached - Roofs (to Downspout Disconnection)	1,285	(864) 1,110	(86) 110	(778) 1,000	(194) 250	(583) 750
Saint Anne's School - Buildings	458	(864) 395	(86) 40	(778) 355	(0) 0	(778) 355
Saint Anne's School - Paved / Concrete Structures	35	(864) 30	(86) 5	(778) 25	(0) 0	(778) 25
Saint Anne's School - Paved / Concrete Structures (to Enhanced Grassed Swale)	2,635	(864) 2,275	(86) 225	(778) 2,050	(78) 205	(700) 1,845
Saint Anne's School - Lawns	5,888	(864) 5,090	(570) 3,355	(293) 1,725	(147) 860	(147) 865
Forest / Hedgerows	943	(864) 815	(629) 595	(228) 215	(148) 140	(80) 75
Total	**13,163**	**11,375**	**5,425**	**5,930**	**1,765**	**4,165**

Entered by: MR
Checked by: MK

Table G-8
Summary of Results - Northern Wetland

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Recreational Buildings	1,266	(864) 1,095	(86) 110	(778) 985	(0) 0	(778) 985
Private Property - Driveways / Concrete Structures	588	(864) 510	(86) 50	(778) 455	(0) 0	(778) 455
Private Property - Lawns	1,912	(864) 1,650	(570) 1,090	(293) 560	(147) 280	(147) 280
Grassed - Lawns	1,639	(864) 1,415	(570) 935	(293) 480	(161) 265	(132) 215
Asphalt Roads & Concrete Structures	2,500	(864) 2,160	(86) 215	(778) 1,945	(0) 0	(778) 1,945
Gravel Pathways	436	(864) 375	(86) 40	(778) 340	(0) 0	(778) 340
Mineral Meadow	14,222	(864) 12,290	(614) 8,730	(247) 3,515	(136) 1,930	(111) 1,585
Hedgerows	1,436	(864) 1,240	(629) 905	(228) 325	(148) 215	(80) 110
Total	**24,000**	**20,735**	**12,075**	**8,605**	**2,690**	**5,915**

Table G-8
Summary of Results - Northern Wetland

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	5,456	(864) 4,715	(570) 3,110	(293) 1,600	(161) 880	(132) 720
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,380	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs	2,073	(864) 1,790	(86) 180	(778) 1,610	(0) 0	(778) 1,610
Single Detached - Driveways	157	(864) 135	(86) 15	(778) 120	(0) 0	(778) 120
Townhouses - Roofs	2,932	(864) 2,535	(86) 250	(778) 2,280	(0) 0	(778) 2,280
Townhouses - Driveways	449	(864) 390	(86) 40	(778) 350	(0) 0	(778) 350
Saint Anne's School - Buildings	279	(864) 240	(86) 25	(778) 215	(0) 0	(778) 215
Saint Anne's School - Paved / Concrete Structures	3,045	(864) 2,630	(86) 265	(778) 2,370	(0) 0	(778) 2,370
Saint Anne's School - Lawns	818	(864) 705	(570) 465	(293) 240	(147) 120	(147) 120
Hedgerows	338	(864) 290	(629) 210	(228) 75	(148) 50	(80) 25
Roads, Sidewalks, Parking & Paths	6,734	(864) 5,820	(86) 580	(778) 5,235	(0) 0	(778) 5,235
Total	**40,080**	**34,630**	**8,670**	**25,945**	**1,440**	**24,505**

Entered by: MR
Checked by: MK

Table G-8
Summary of Results - Northern Wetland

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	5,456	(864) 4,715	(570) 3,110	(293) 1,600	(161) 880	(132) 720
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,375	(293) 710	(161) 390	(132) 320
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,180	(778) 10,640	(0) 0	(778) 10,640
Underground SWM Facility / Trail Head	1,700	(864) 1,470	(570) 970	(293) 500	(0) 0	(293) 500
Single Detached - Roofs (to Downspout Disconnection)	2,073	(864) 1,790	(86) 180	(778) 1,610	(194) 400	(583) 1,210
Single Detached - Driveways (to Catchbasin Filtration Trench)	157	(864) 135	(86) 15	(778) 120	(0) 0	(778) 120
Roadways (to Catchbasin Filtration Trench)	4,461	(864) 3,855	(86) 385	(778) 3,470	(0) 0	(778) 3,470
Townhouse - Roofs (to Rear Yard Infiltration Trench)	977	(864) 845	(86) 85	(778) 760	(591) 575	(187) 185
Roadways (to Bioswale Filtration Trench)	656	(864) 565	(86) 55	(778) 510	(0) 0	(778) 510
Townhouse - Roofs	451	(864) 390	(86) 40	(778) 350	(0) 0	(778) 350
Townhouse - Roofs (to Bioswale Infiltration)	1,503	(864) 1,300	(86) 130	(778) 1,170	(529) 795	(249) 375
Townhouse - Driveways (to Bioswale Infiltration)	449	(864) 390	(86) 40	(778) 350	(529) 240	(249) 110
Roadways (to Bioswale Infiltration)	1,443	(864) 1,250	(86) 125	(778) 1,120	(529) 765	(249) 355
Saint Anne's School - Buildings	279	(864) 240	(86) 25	(778) 215	(0) 0	(778) 215
Saint Anne's School - Paved / Concrete Structures	3,045	(864) 2,630	(86) 260	(778) 2,370	(0) 0	(778) 2,370
Saint Anne's School - Lawns	818	(864) 705	(570) 465	(293) 240	(147) 120	(147) 120
Hedgerows	338	(864) 290	(629) 215	(228) 75	(148) 50	(80) 25
Roads, Sidewalks, Parking & Paths	175	(864) 150	(86) 15	(778) 135	(0) 0	(778) 135
Total	**40,080**	**34,630**	**8,670**	**25,945**	**4,215**	**21,730**

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