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Appendix R - Part 1

Hydrogeological Assessment Report

BURNSIDE

Hydrogeological Assessment Report for Warden Avenue and Kennedy Road Environmental Assessment Studies between Major Mackenzie Drive East and Elgin Mills Road East

Regional Municipality of York
Markham, Ontario

Hydrogeological Assessment Report for Warden Avenue and Kennedy Road Environmental Assessment Studies between Major Mackenzie Drive East and Elgin Mills Road East

Regional Municipality of York
Markham, Ontario

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February 2023
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Record of Revisions

Revision	Date	Description
0	September 9, 2022	Draft Submission to Regional Municipality of York
1	December 15, 2022	First Submission to Regional Municipality of York
2	February 27, 2023	Second Submission to Regional Municipality of York

R.J. Burnside & Associates Limited

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Disclaimer

1.0 Introduction

R.J. Burnside & Associates Limited has been retained by the Regional Municipality of York (York Region) to provide hydrogeological services in support of the Class Environmental Assessment (EA) Studies for the proposed improvements to Warden Avenue and Kennedy Road from Major Mackenzie Drive to Elgin Mills Road. The purpose of this report is to characterize existing groundwater conditions in the area of the proposed work, identify any potential hydrogeological impacts from the proposed improvements to Warden Avenue and Kennedy Road and assess dewatering requirements at watercourse crossings.

1.1 Site Description

The Study Areas for the Class EA studies are illustrated in Figure 1 and include lands within 500 m of the subject roads of Warden Avenue and Kennedy Road between Major Mackenzie Drive East and Elgin Mills Road in the City of Markham. The Kennedy Road study area also includes a segment of road 120 m north of Elgin Mills Road and the Warden Avenue study area includes 65 m south of Major Mackenzie Drive. The proposed road improvements will be limited to the right-of-way (ROW) along the roads and will not extend into private properties. The width of the right-of-way in the areas to be improved is expected to be 41 m mid-block and 43 m at intersections.

2.0 Background Review

This report has been completed based on a review of published geological and hydrogeological information including topography, physiography, surficial geology and bedrock geology mapping as well as existing geotechnical and hydrogeological reports completed within the Study Areas.

The main reports used to complete this desktop study of existing hydrogeological conditions are listed below:

- Berczy Glen Master Environmental Servicing Plan, Berczy Glen Landowners Group, Stonybrook Consulting Inc., et al., 2020.
- Angus Glen Master Environmental Servicing Plan, Stonybrook Consulting Inc., et al., October 2017.
- Robinson Glen Master Environmental Servicing Plan, Stonybrook Consulting Inc., et al., 2017.
- Geotechnical Investigation, Schedule C Class EA Study for Improvements to Warden Avenue, From Major Mackenzie Drive to North of Elgin Mills Road, Markham, Ontario. Golder Associates, August 6, 2021.

- Geotechnical Investigation, Schedule C Class EA Study for Improvements to Kennedy Road, From Major Mackenzie Drive to North of Elgin Mills Road, Markham, Ontario. Golder Associates, August 30, 2021.
- Berczy, Bruce, Eckardt and Robinson Creeks Subwatershed Study (AMEC Foster Wheeler, 2019).

Hydrogeological data within these reports include geotechnical information, groundwater level monitoring, surface water monitoring, hydraulic conductivity testing and water quality sampling. The data collected as part of previous studies have been incorporated into the analyses and interpretations conducted as part of the current assessment. A complete list of references used for this report is included in Section 8.0.

3.0 Topography and Drainage

The Study Areas are characterized by flat to rolling topography with slopes generally being southwards towards the watercourse valleys. Along Warden Avenue, the ground elevations range from 229 meters above sea level (masl) at Elgin Mills Road down to 210 masl at Major Mackenzie Drive East. Along Kennedy Road, ground elevations range from 225 masl near Elgin Mills Road down to 205 masl at Major Mackenzie Drive (Figure 1).

The Study Areas are in the Rouge River watershed within the jurisdiction of the Toronto and Region Conservation Authority (TRCA) and occupy portions of the Berczy Creek, Bruce Creek and Robinson Creek subwatersheds. Along Warden Avenue a tributary of Bruce Creek crosses under the ROW approximately 825 m north of Major Mackenzie Drive flowing southeast and the main branch of Berczy Creek flows under Warden Avenue just south of Major Mackenzie Drive. Along Kennedy Road there is a watercourse crossing over Bruce Creek just north of Elgin Mills Road.

Parts of the provincially significant Bruce and Berczy Creek Wetland Complex are mapped within the Study Areas. The wetlands are mostly located along the Bruce and Berczy Creek watercourses and only a small portion of the wetland extends to the ROW. Groundwater monitoring completed within the wetlands as part of MESP studies indicate seasonal discharge of groundwater occurs in the wetlands and along watercourses.

4.0 Geology

The Study Areas are located within the physiographic region known as the Peel Plain (Chapman and Putnam, 1984). The Peel Plain consists of a thin veneer of lacustrine silt and clay deposited over glacial till with a flat to rolling topography with generally more incised slopes in the vicinity of the watercourses.

Regional surficial geology mapping published by the Ontario Geological Survey (2011) show the surficial sediments within the Study Areas include silty sand glacial till, coarse textured glaciolacustrine deposits (sand/silt), fine textured glaciolacustrine deposits (silt/clay) and modern alluvial deposits along Bruce Creek (Figure 2).

Soil information obtained by local drilling was used to refine the surficial geology interpretation in the Subwatershed Study (SWS) (AMEC Foster Wheeler, 2019). The results of the refinement were generally consistent with the published regional mapping with respect to overall soil types however discrepancies with respect to the spatial distribution of various surficial soil types were noted in the SWS (AMEC Foster Wheeler, 2019). The published mapping suggests large areas of sand at surface however, based on drilling programs the dominant sediment type found at surface across the area was till.

Bedrock beneath the Study Areas consists of layered grey shale bedrock of the Blue Mountain Formation (OGS, 1991). Bedrock is generally found at an elevation of approximately 120 masl to 130 masl (approximately 100 m below ground surface).

4.1 Local Geology

Local drilling programs completed in the Study Areas as part of previous studies indicate that shallow soils consist generally of till with interbedded layers of sand, silty sand, and silt (Golder, 2021, Stonybrook Consulting Inc., et al., 2017). The locations of boreholes and monitoring wells within the Study Areas are shown in Figures 3 and 4. Borehole logs with soil descriptions are provided in Appendix A.

In 2021, Golder completed a total of 17 boreholes along Warden Avenue within the Study Area ranging in depth from 2 metres below ground surface (mbgs) to 9 mbgs. A total of 24 boreholes were drilled along Kennedy Road within the Study Area by Golder in 2021. The boreholes ranged in depths from 2.0 m to 17.1 mbgs. The geotechnical drilling confirmed that the shallow soils encountered in the Study Areas generally consist of glaciolacustrine silt and clay and sandy silt to silty sand till with interbedded layers of sand, silty sand and silt.

4.2 Stratigraphy

The stratigraphy in the Markham area including the Study Areas was modelled by the TRCA for the Rouge River Watershed Plan (2007) and further refined during the Berczy, Bruce, Eckardt and Robinson Creeks Subwatershed Study (AMEC Foster Wheeler, 2019) and Berczy Glen MESP (Stonybrook et al., 2020), Angus Glen MESP and Robinson Glen MESP (Stonybrook et al., 2017). There are three major overburden

aquifer systems identified in the vicinity of the Study Areas. The overburden aquifers are described in order of increasing depth as the:

- Oak Ridges Aquifer Complex (ORAC), formed within the Oak Ridges Moraine (ORM) sediments and sometimes referred to as the Upper Aquifer.
- Thorncliffe Aquifer (or Middle Aquifer), formed by the sandy sediments of the Thorncliffe Formation and generally separated from the overlying ORAC by the Newmarket till aquitard.
- Scarborough Aquifer (Lower Aquifer), formed by sandy sediments of the Scarborough Formation overlying the bedrock, and separated from the Thorncliffe Aquifer by the Sunnybrook aquitard.

In the North Markham area, the ORAC tends to be thin and sporadic as the aquifer is pinching off to the south. Within the Study Areas, the ORAC has been identified as isolated layers and lenses of sand/gravel and silty sand within 5 m to 15 m below ground surface (Angus Glen MESP and Robinson Glen MESP, 2017).

Site-specific geological information obtained from the geotechnical boreholes and groundwater monitoring wells drilled within the Study Areas (Appendix A) and local MECP well records (Appendix B) have been used to prepare schematic cross-sections along Warden and Kennedy Road within the Study Areas to illustrate the shallow stratigraphy. The cross-section locations are shown in Figures 3 and 4 and the cross-sections are provided in Figures 5 and 6.

The cross-section along Warden Avenue (Figure 5) shows a thick layer of fine-grained soils (glaciolacustrine silt and clay and glacial till deposits) at surface, interspersed with lenses and layers of sand of variable thickness and extent. The sand layers are interpreted to be discontinuous lenses of ORAC sediments separated by finer grained layers of silty sand and silty sand till. Because of the discontinuous nature of the occurrence of ORAC sediments, the aquifer is not interpreted to be present in this location.

The cross-section along Kennedy Road (Figure 6) also shows a layer of fine-grained soils overlying a layer of sand/gravel and silty sand at depths of 1 m to 10 mbgs and a thickness of 5 to 10 m. The coarse-grained layer is interpreted to be the ORAC and is generally continuous across the Study Area.

The Thorncliffe aquifer is interpreted to be generally found between elevations 160 masl and 180 masl (i.e., more than 35 mbgs) in the vicinity of the Study Areas (Figures 5 and 6). (Stonybrook et al., 2020). The Scarborough aquifer was interpreted to be found between 120 masl and 130 masl (Stonybrook et al., 2020).

5.0 Hydrogeology

5.1 Local Groundwater Use

The Study Areas are situated immediately north of the currently urbanized area of Markham and properties in the Study Areas north of Major Mackenzie Drive still rely on private wells for water supply. The Ministry of the Environment, Conservation and Parks (MECP) maintains a database that provides geological records of wells drilled in the province. The locations of MECP well records for water supply wells within the Study Areas (500 m from road alignment) are illustrated in Figures 7 and 8. It is noted that the well locations listed in the MECP records are approximations only and may not be representative of the actual well locations in the field.

Within the Warden Avenue Study Area, 88 well records are listed as water supply wells (Figure 7). The majority of the water supply wells are drilled wells screened in the overburden at depths ranging from 15 mbgs to 97 mbgs. Eight of the wells were bored wells with depths of 4 to 12 mbgs. Three of the wells were completed in the bedrock at depths of approximately 72 m to 99.7 mbgs. Most of the well records are located south of Major Mackenzie within a rural subdivision (Figure 7).

Within the Kennedy Road Study Area, 38 of the well records are listed as water supply wells (Figure 8). The majority of the water supply wells are drilled wells screened in the overburden at depths ranging from 9 mbgs to 177 mbgs. Eleven of the wells were bored wells with depths of 5 to 12 mbgs. Two of the wells were completed in the bedrock at depths of approximately 53 m to 71 mbgs.

The MECP well records suggest that most of the local private wells within the Study Areas tap the Thorncliffe Aquifer (more than 30 m below ground surface) for water supply; however, some shallow wells are completed in the ORAC sediments. The reported well yields are generally considered good and sufficient for typical domestic use with yields ranging from 0.2 L/s to 15 L/s (2 gpm to 200 gpm).

The Study Area is within the North Markham Future Urban Area (FUA) and the majority of the private wells identified will be decommissioned and residents will be connected to municipal water.

Based on review of available MECP data there is only one active Permit to Take Water (PTTW) identified within 500 m of the Study Areas. The permit is associated with irrigation wells located on the Angus Glen Golf Club Ltd.

5.2 Groundwater Levels

The shallow groundwater in the Study Areas has been observed in hydrogeological and geotechnical studies (see Section 2.0). The locations of monitoring wells in or near the Study Areas are shown in Figures 3 and 4 and hydrographs showing groundwater level data are provided in Appendix C.

Groundwater levels were also measured in wells along the road alignments by the Region in May 2021. The Region's groundwater level data is provided in Table C-1, Appendix C.

A review of available groundwater data indicates that along Warden Avenue groundwater elevations range from 212 masl to 227 masl with depths ranging from <1 mbgs to 5 mbgs (Appendix C). It should be noted that the groundwater levels were measured in wells screened at depths from 6 mbgs to 12 mbgs and shallow groundwater levels may be reflective of an upward gradient in the till. The interpreted depth to groundwater within the Warden Study Area is illustrated in Figure 9. The depth to water table varies with topography being shallower in areas of low topography and deeper in areas of high topography. There were no flowing wells identified in the groundwater monitoring data.

A review of available groundwater data indicates that along Kennedy Road groundwater elevations range from 202 masl to 221 masl with depths ranging from <1 mbgs to 9 mbgs (Appendix C). It should be noted that the groundwater levels were measured in wells screened at depths from 4 mbgs to 12 mbgs and shallow groundwater levels are reflective of an upward gradient in the till. Water was not encountered during drilling until depths of at least 4 mbgs (see borehole logs Appendix A). There were no flowing wells identified in the groundwater monitoring data.

The interpreted depth to groundwater within the Kennedy study area is illustrated in Figure 10. Most of the land along Kennedy Road is shown as having groundwater levels between 2 m and greater than 4 mbgs. Some shallow levels are mapped on the southern portion of Kennedy Road just north of the Major Mackenzie Drive East intersection (Figure 10).

5.3 Water Quality

A review of groundwater quality reported in the Berczy Glen, Angus Glen and Robinson Glen MESP studies was completed. Impacts from agricultural land use is observed in some wells with reported nitrate concentrations ranging from 0.12 mg/L up to 18.5 mg/L. Elevated sodium and chloride have been observed in monitoring wells located near Warden Avenue and Kennedy Road with chloride concentrations ranging from 55 mg/L to 361 mg/L and sodium concentrations ranging from 7 mg/L up to 227 mg/L.

5.4 Source Protection

The Study Area is located in the Toronto and Region Source Protection Area. Municipal supply for Markham is sourced from Lake Ontario, therefore, there are no well head protection areas in the vicinity of the Study Area. Mapping from the MECP Source Protection Information Atlas indicates that the Study Area includes lands mapped as highly vulnerable aquifer (HVA) and significant groundwater recharge areas (SGRA) as illustrated in Figures 11 and 12.

Aquifer vulnerability refers to the susceptibility of an aquifer to potential contamination. Some degree of protection for groundwater quality from natural and human impacts is provided by the soil above the water table. The degree of protection is dependent upon the depth to the water table (for unconfined aquifers) or the depth of the aquifer (for confined aquifers) and the type of soil above the water table of aquifer. As these two properties vary over any given area, the degree of protection or vulnerability of the groundwater to contamination also varies. The surficial soils of the Study Area are generally low hydraulic conductivity, fine grained soils, so the shallow depth to the ORAC is the primary reason that the area would be considered to have high vulnerability.

Mapping of HVAs were completed by TRCA on a regional scale and should only be used as a guide, and not site-specific planning decisions. The results of the site-specific geological and hydrogeological work completed for previous studies (see Section 2.0) suggests that there are some areas where aquifer layers are close to surface within the Study Areas however a review of water well indicates that the deeper Thorncliffe Aquifer is the main aquifer used for private well supplies and the shallow sediments of the ORAC are not used extensively.

SGRAs are shown on the MECPs Source Protection Atlas based on analyses completed by the TRCA in 2016. The areas mapped as SGRAs generally correspond to areas shown to have surficial sand on the OGS surficial geology mapping. Site-specific drilling within the Study Area did not encounter surficial sands but rather silt and clay or sandy silt/silty sand glacial till soils which limit significant recharge from occurring.

As part of this assessment, Burnside also reviewed Areas of Concern for York Region based on mapping available on the York Region's Source Water Protection website. Our review indicated that there are no areas of concern for groundwater in the Study Areas and that the closest Area of Concern is located over 3 km northwest of Warden Avenue at Highway 404.

5.5 Hydrogeological Conceptual Model

A hydrogeological conceptual model is not a physical nor a numerical model but is an interpretation of the local and regional hydrogeological conditions and a description of how the various components of the system relate to each other. It can be simplified to be an interpretation of the groundwater flow conditions and directions within an area. In the Study Areas, groundwater is interpreted to infiltrate within the surficial low permeability fine grained sediments and will tend to move vertically to recharge the ORAC sediments. It is expected that in areas where ORAC sediments are not encountered minimal groundwater will occur. As noted above in Section 5.2, water levels measured in the Study Area are reflective of conditions in the vicinity of well screens that are a minimum of 4 m to 6 m below grade and excavations that are shallower than these depths may not encounter groundwater.

Upward gradients that have been identified in the above sections may be due to groundwater being encountered in association with the ORAC sediments or in close proximity to watercourses/low topographic areas where groundwater from shallow sediments is discharged. The above hydrogeological conceptual model therefore indicates that groundwater conditions may only be a concern in areas where road work is deep enough to encounter ORAC sediments or in topographic low spots such as around watercourses.

6.0 Construction Dewatering

6.1 Watercourse Crossings

There are two watercourse crossings within the Warden Avenue study area and one watercourse crossing within the Kennedy Road study area. A summary of the crossings are provided in Table 1 below.

Table 1: Watercourse Crossings within Study Areas

Watercourse Crossings	Existing Structure	Proposed	Dewatering Required
Warden Avenue - Berczy Creek, 50 m south of Major Mackenzie Drive East	Structural plate corrugated steel pipe culvert.	Structure is recommended for replacement but will be constructed separate from the road construction.	Yes, but will not be completed as part of road reconstruction.

Watercourse Crossings	Existing Structure	Proposed	Dewatering Required
Warden Avenue - Tributary of Bruce Creek, 845 m north of Major Mackenzie Drive East	Two 0.6 m diameter PVC culverts.	Replacement with road construction.	Yes.
Kennedy Road - Bruce Creek, north of intersection of Elgin Mills Road and Kennedy Road	Concrete arched soffit bridge.	Existing structure will remain.	None.

6.2 Water Crossing at Tributary of Bruce Creek, Warden Avenue

An estimate of dewatering volumes required for the installation of a new culvert where the tributary of Bruce Creek crosses Warden Avenue was completed as part of a Dewatering Assessment Report completed by Burnside in December 2021 (Burnside, 2021). Details on the dewatering assessment and assumptions used in the calculations are provided in Appendix D. Based on soils information and an estimated hydraulic conductivity, a maximum dewatering volume of about 11,300 L/day was estimated with a zone of influence of 11 m (Burnside, 2021). This volume is below the requirement for an Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW).

6.3 Installation of Services

Municipal servicing including watermain, storm sewer and sanitary sewers may be installed during road improvements in support of the Markham Future Urban Area redevelopment. Based on groundwater levels for the Study Areas, some dewatering of sediments may be required during the installation of underground infrastructure. An assessment of dewatering requirements will be completed on a project basis to support necessary permits. Dewatering volumes will be calculated based on the proposed depth of excavation, dimensions of the excavated area and the hydraulic properties of the soils encountered. Depending on the dewatering volumes predicted, water taking permits will be required such as an EASR or a PTTW from the MECP. An assessment of potential impacts from dewatering is required to obtain these permits as well as monitoring and mitigation plans to address potential impacts. These impacts should be further evaluated based on more detailed information on service installation depths obtained later in the design process.

7.0 Potential Impacts

Based on the hydrogeological conditions of the Study Areas, potential receptors that could be impacted by road construction and short-term construction dewatering include private wells and surface water features. It is noted that these impacts are likely to be of short duration and limited to the period during which actual construction is taking place. After construction it is expected that the area should return to pre-construction conditions as no adverse changes are predicted.

7.1 Impacts on Private Wells

Road construction may impact shallow groundwater wells that are located in close proximity to the construction. Potential impacts include the cutting off or removal of sand lenses that contribute to the well or damage to the well integrity due to vibrations or heavy machinery use. It is expected that only shallow wells in close vicinity to the construction may be impacted in this way. Wells completed within 15 m of surface have been considered the most vulnerable to potential impacts from development as excavations associated to road construction and installation of services will generally be within the first 15 m of the overburden. Wells with depths recorded as less than 15 m are shown in Figures 7 and 8.

There are no water well records mapped within the zone of influence for the watercourse crossing along Warden Avenue.

It is noted that the locations for wells listed in the MECP records are approximations only and may not be representative of the precise well locations in the field. There may also be wells present that are not documented in the MECP database. To confirm the potential for construction impacts, the locations of the wells should be confirmed in a well survey conducted within each Study Area to identify any shallow wells in close proximity to the road widening that could be potentially impacted by the construction. The well survey is recommended to be completed during the detailed design phase of the project. Any wells identified as being susceptible to impacts should have baseline water quality and water levels collected and be monitored through construction.

A well interference and reporting protocol should be established before construction that outlines the actions taken should a complaint from a private well owner be received and ensures that a supply of water is provided for the private resident. Mitigation measures should include the following:

- Notification of residents of construction with contact information.
- A reporting and investigation protocol to address complaints.
- Supply of alternate water source in case of confirmed impact.

7.2 Impacts to Surface Water

The estimated dewatering volumes for the Bruce Creek Tributary crossing are minor and temporary in duration. Impacts to the watercourse are not anticipated.

7.3 Long-Term Impacts

Runoff from winter maintenance activities on roads can infiltrate into the groundwater resulting in elevated sodium and chloride in the groundwater. Additional lanes on the road will result in greater surface area for application of road salt and therefore a greater loading of sodium and chloride to groundwater. These impacts may be mitigated by the implementation best management practices for road salt application.

Potential impacts to groundwater discharge in wetlands or watercourses at road crossings are not anticipated but can be mitigated through the use of Low Impact Development (LID) features in the improved road corridors which will be considered as part of these EA studies. Groundwater flow may occur at increased rates along trenches and excavations constructed as part of the servicing works. Industry best practices for construction of service trenches, including the building of cut off walls will ensure that groundwater flow is not re-directed along trenches.

8.0 References

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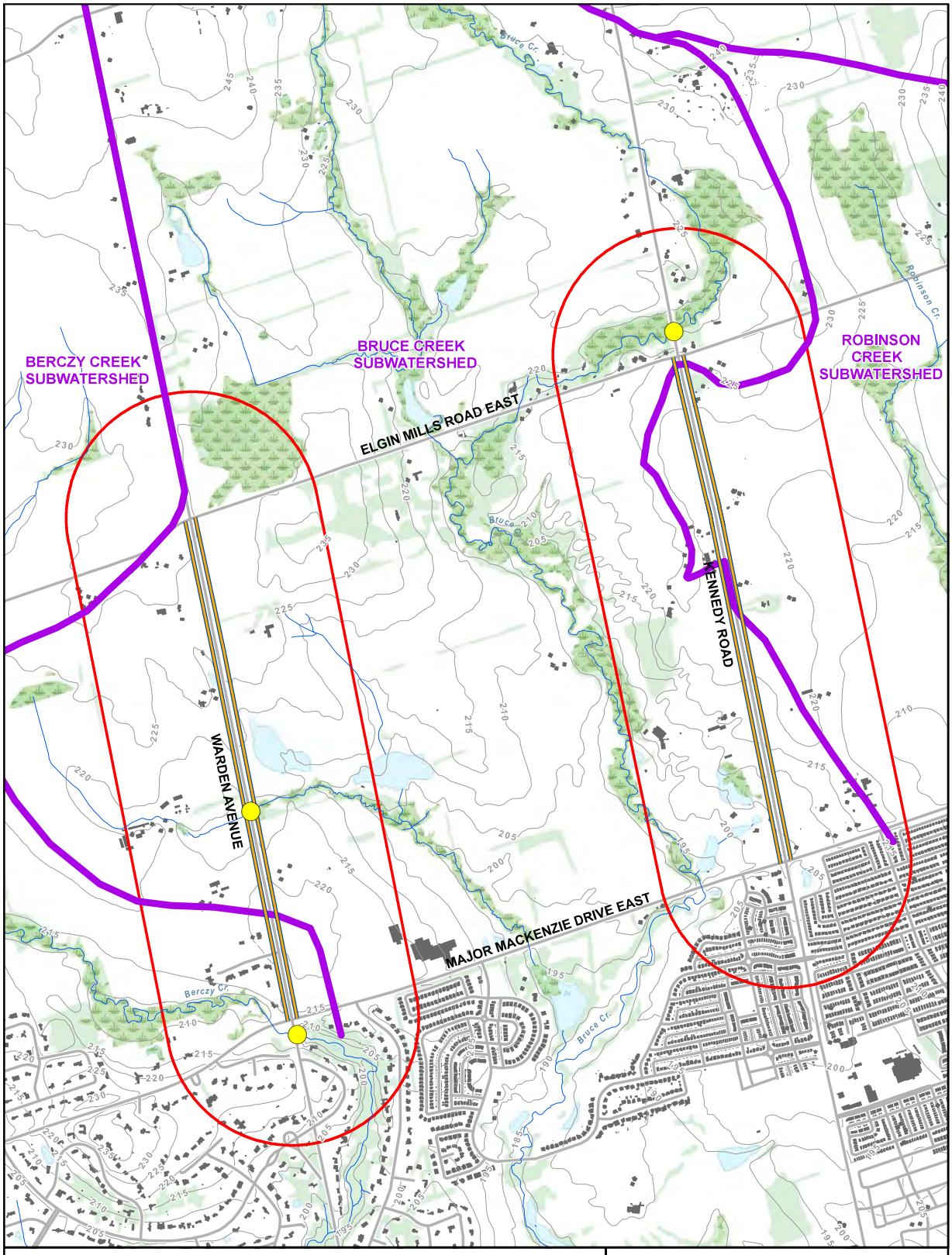
Figures



LEGEND

- STUDY AREAS
- SUBWATERSHED BOUNDARY
- BUILDING
- ROADWAY
- CONTOUR (5m intervals - masl)
- WATERCOURSE
- WETLAND
- OPEN WATER
- WOODED AREA
- WATERCOURSE CROSSING
- PROPOSED RIGHT-OF-WAY (ROW)
  WARDEN AVENUE ROW = 41 m
  KENNEDY ROAD ROW = 43 m

Sources:
1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

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WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

STUDY AREAS

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LEGEND

- STUDY AREAS
- WATERCOURSE
- CONTOUR (5m intervals - masl)
- ROADWAY
- 5b: Till: Stone-poor, carbonate-derived silty to sandy till
- 8a: Fine-textured glaciolacustrine deposits: Massive-well laminated
- 9c: Coarse-textured glaciolacustrine deposits: Foreshore-basinal deposits
- 19: Modern alluvial deposits
- 20: Organic deposits
- PROPOSED RIGHT-OF-WAY (ROW)
  WARDEN AVENUE ROW = 41 m
  KENNEDY ROAD ROW = 43 m

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Metres

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WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

SURFICIAL GEOLOGY

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LEGEND

- PROPOSED RIGHT-OF-WAY (ROW - 41m)
- MONITORING WELL (RJB, 2015)
- MONITORING WELL (YORK REGION)
- MONITORING WELL (RJB, 2013)
- MONITORING WELL (EXP, 2020)
- MONITORING WELL (GOLDER, 2021)
- MONITORING WELL (GOLDER, 2020)
- BOREHOLE (GOLDER, 2021)
- BOREHOLE (GOLDER, 2020)
- A A' CROSS-SECTION LOCATION KEY
- BOREHOLE (SOIL ENG., JULY 2014)
- BOREHOLE (SOIL ENG., DECEMBER 2014)
- MECP WELL RECORD LOCATION

0 100 200 400 600
Metres

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REGIONAL MUNICIPALITY OF YORK

WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

BOREHOLE, MONITORING WELL AND CROSS-SECTION LOCATIONS (WARDEN AVENUE)

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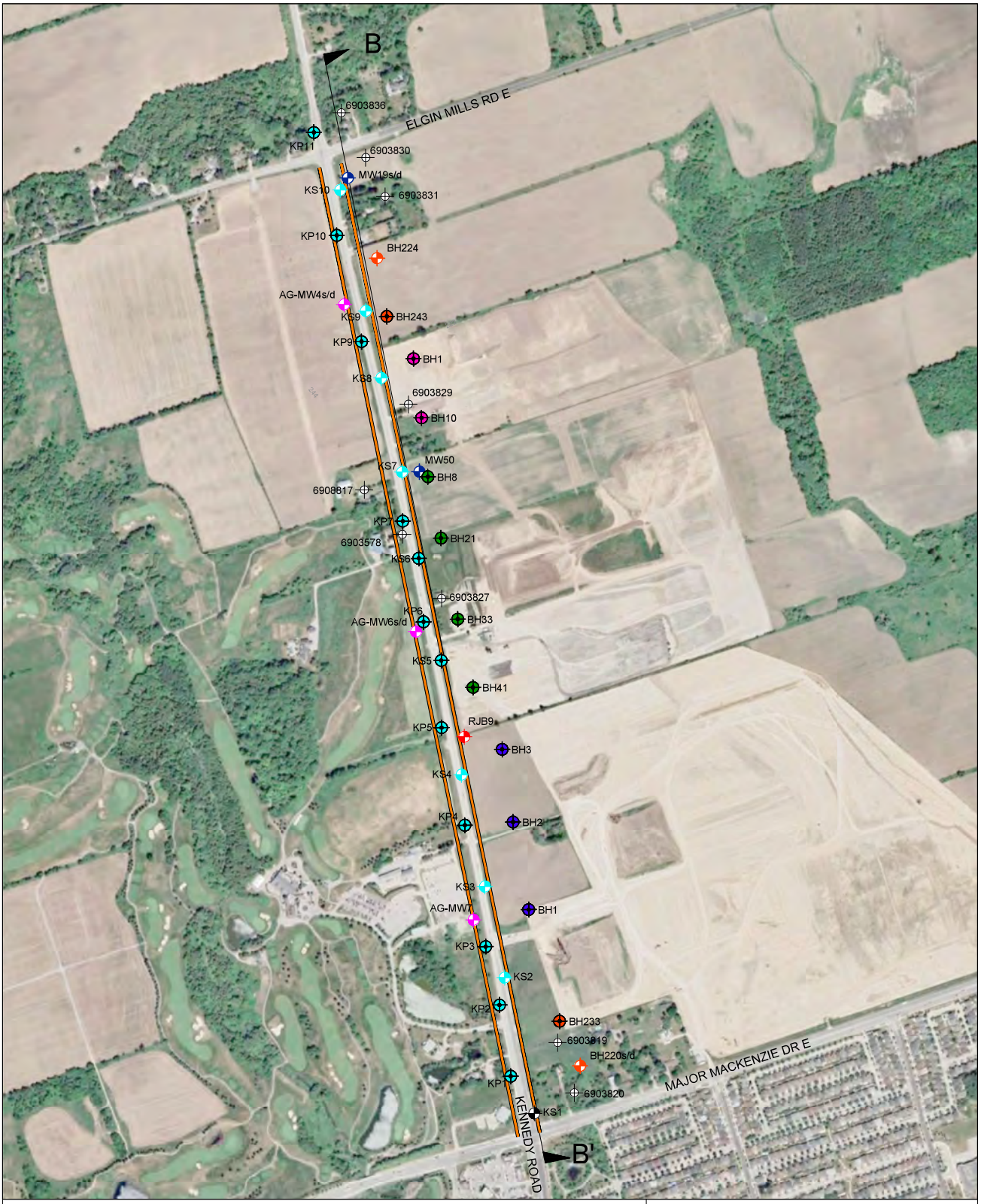

LEGEND

- PROPOSED RIGHT-OF-WAY (ROW - 43m)
- MONITORING WELL (RJB, 2015)
- MONITORING WELL (YORK REGION)
- MONITORING WELL (SOIL ENG., 2013)
- MONITORING WELL (GOLDER, 2021)
- MONITORING WELL (NO LOG)
- BOREHOLE (GOLDER, 2021)
- BOREHOLE (SOIL ENG., 2013)
- BOREHOLE (SOIL ENG., 2004)
- BOREHOLE (PML, 2014)
- BOREHOLE (AMEC, 2012)

MECP WELL RECORD LOCATION

A A' CROSS-SECTION LOCATION KEY

0 100 200 400 600
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WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title
BOREHOLE, MONITORING WELL AND CROSS-SECTION LOCATIONS (KENNEDY ROAD)

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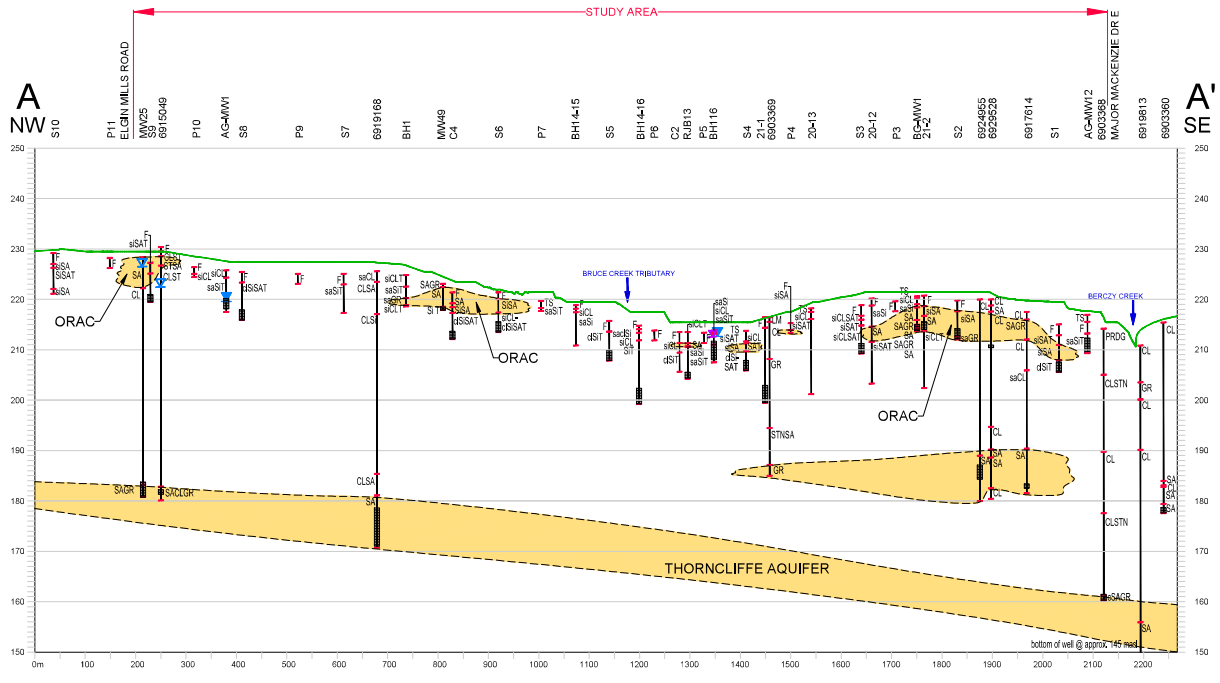


LEGEND

- MW9 — WELL IDENTIFICATION
- EXISTING GROUNDLINE
- GEOLOGICAL STRATIGRAPHY CONTACT
- STATIC WATER LEVEL (MECP WELL RECORD)
- MEASURED WATER LEVEL (APRIL 2016)
- WELL SCREEN
- INTERPRETED GEOLOGICAL CONTACT
- SAND / GRAVEL / SILT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil
LM	Loam
CL	Clay
Si	Silt
SA	Sand
GR	Gravel
ST	Stones
BLD	Boulder
LMSN	Limestone

BURNSIDE

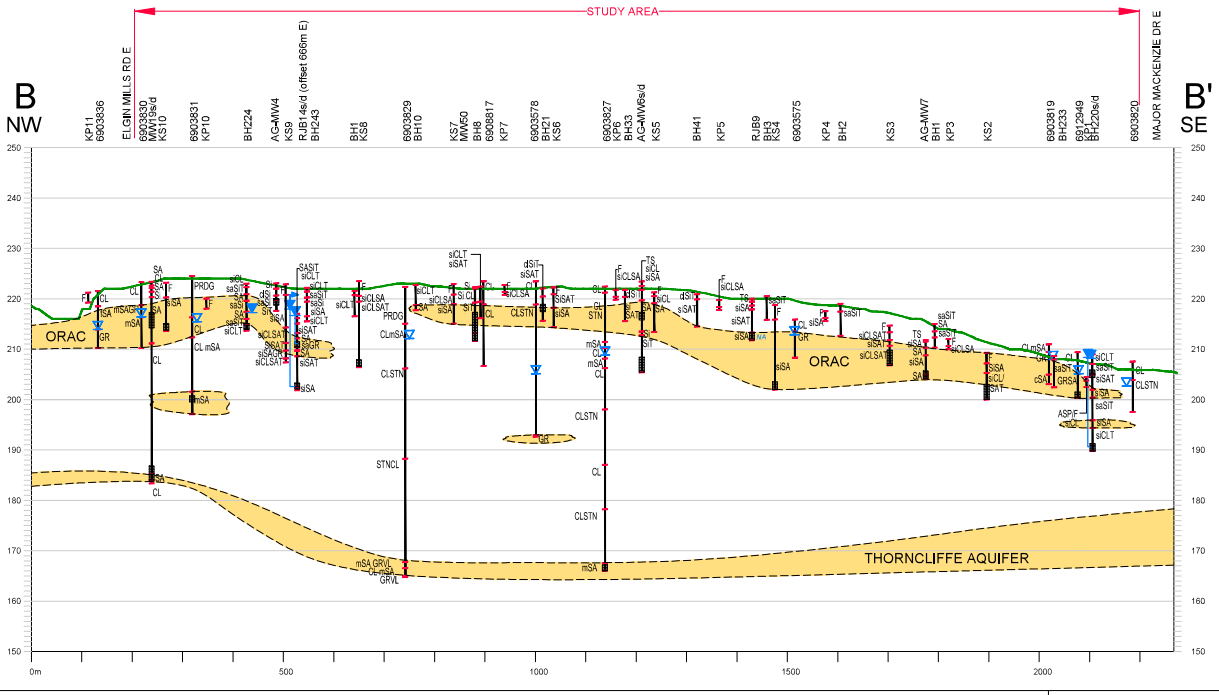
Client / Report
REGIONAL MUNICIPALITY OF YORK

WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title
INTERPRETED GEOLOGICAL CROSS-SECTION A-A' (WARDEN AVENUE)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	5
Scale: 1:7,500		Project No.: 300052314	

File Name: 052314 Warden Kennedy EA.dwg Date Plotted: February 24, 2023 - 12:27 PM



LEGEND

- MW9 — WELL IDENTIFICATION
- EXISTING GROUNDLINE
- GEOLOGICAL STRATIGRAPHY CONTACT
- STATIC WATER LEVEL (MECP WELL RECORD)
- MEASURED WATER LEVEL (APRIL 2016)
- WELL SCREEN
- INTERPRETED GEOLOGICAL CONTACT
- SAND / GRAVEL / SILT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil
LM	Loam
CL	Clay
Si	Silt
SA	Sand
GR	Gravel
ST	Stones
BLD	Boulder
LMSN	Limestone

BURNSIDE

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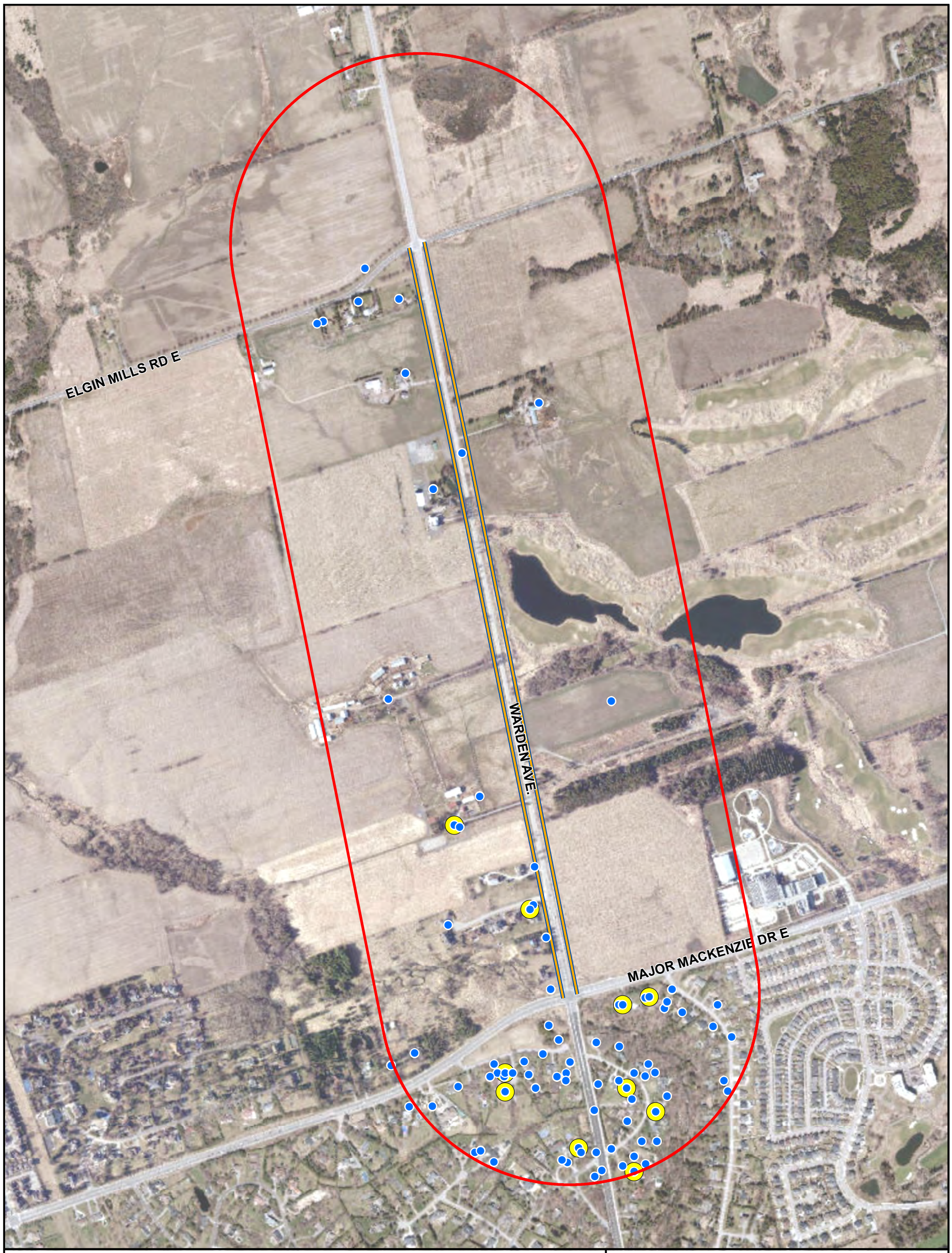
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title
INTERPRETED GEOLOGICAL CROSS-SECTION B-B' (KENNEDY ROAD)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	6
Scale		Project No.	
1:7,500		300052314	

File Name: 052314 Warden Kennedy EA.dwg Date Plotted: February 24, 2023 - 12:30 PM



LEGEND

- STUDY AREA
- PROPOSED RIGHT-OF-WAY (ROW - 41m)

WELL STATUS:

- WATER SUPPLY
- WATER SUPPLY WELLS THAT ARE LESS THAN 15m DEEP

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

N

0 100 200 300 400 500 600

Metres

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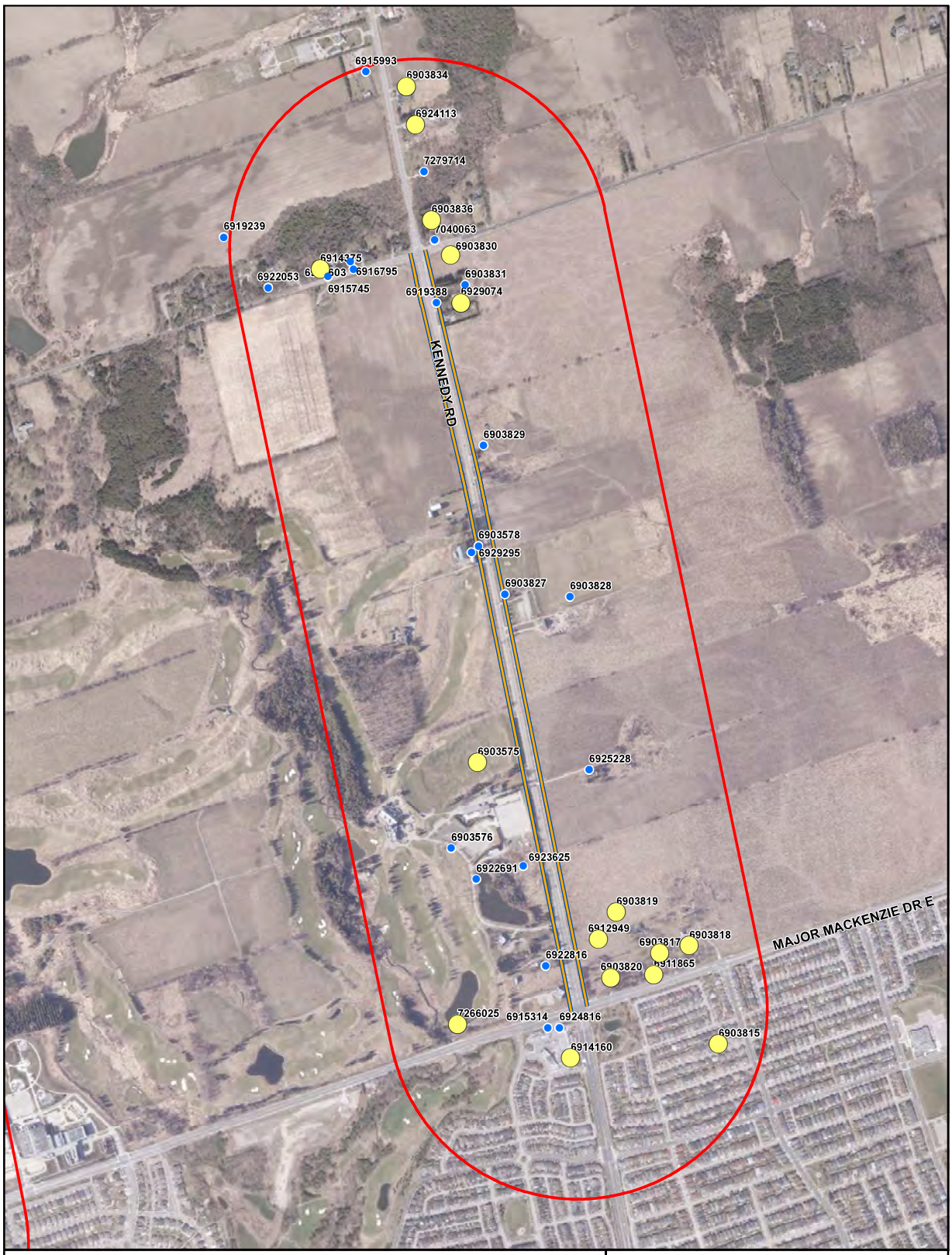
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

MECP WATER SUPPLY WELL RECORDS (WARDEN AVENUE)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	7
Scale		Project No.	
1:10,000		300052314	

File Path: Nigel/Shared Work Areas/A:\052314 Warden Kennedy Road Widening\06_GIS\Warden Kennedy EA\052314 Warden MECP Locations.mxd Print Date: 2023/02/24 Time: 12:41 PM



LEGEND

- STUDY AREAS
- PROPOSED RIGHT-OF WAY (ROW - 43m)

WELL STATUS:

- WATER SUPPLY
- WATER SUPPLY WELLS THAT ARE LESS THAN 15m DEEP

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

N

0 100 200 300 400 500 600
Metres

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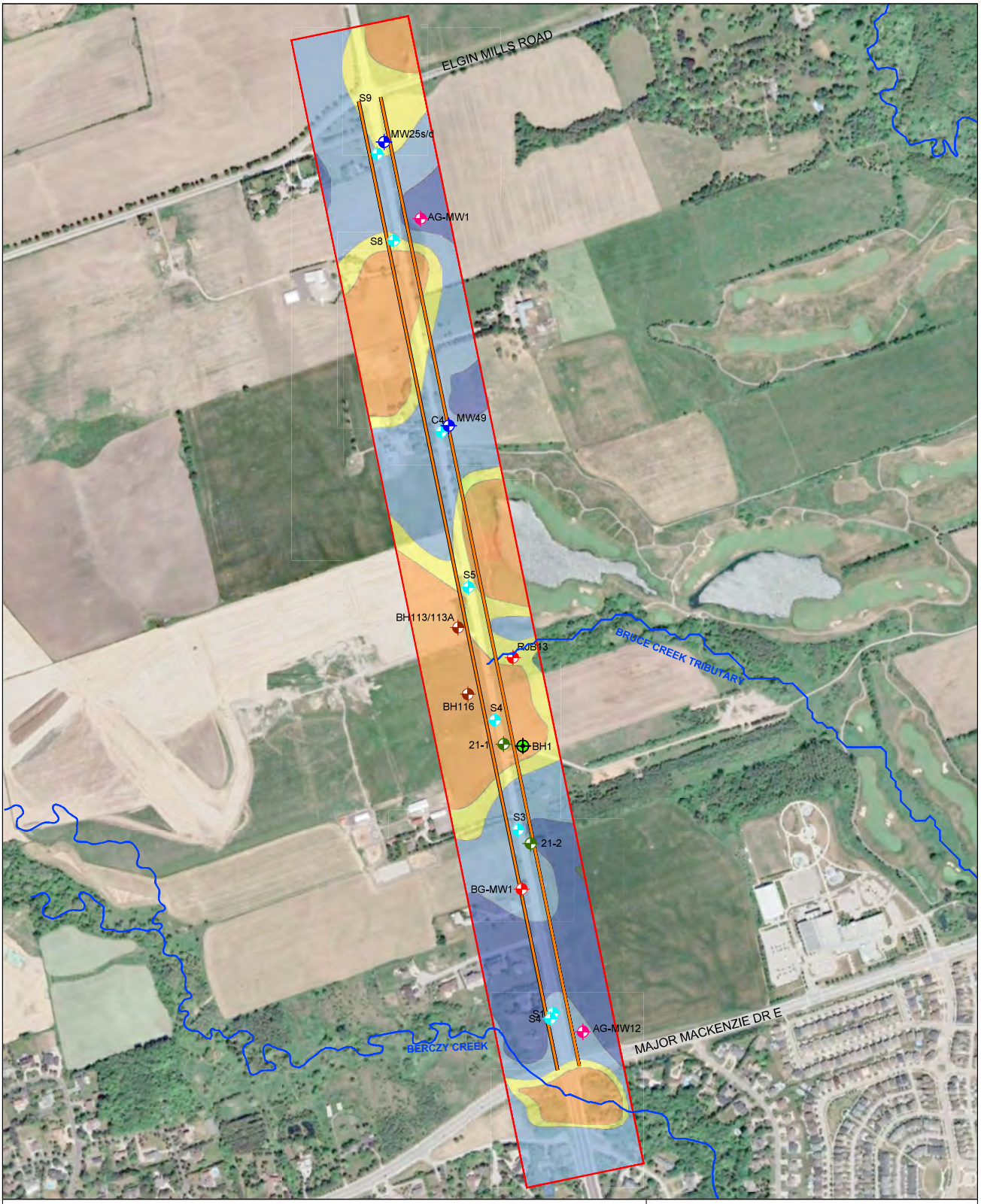
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

MECP WATER SUPPLY WELL RECORDS (KENNEDY ROAD)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	8
Scale		Project No.	
1:10,000		300052314	

File Path: Nigal/Shared Work Areas/A \052314 Warden Kennedy Road Widening\05_GIS\Warden Kennedy EA\052314 Kennedy MECP Locations.mxd Print Date: 2023/02/24 Time: 12:45 PM



LEGEND

- 100m BUFFER AROUND ROW
- PROPOSED RIGHT-OF-WAY (ROW - 41m)
- WATERCOURSE
- MONITORING WELL (RJB, 2015)
- MONITORING WELL (YORK REGION)
- MONITORING WELL (SOIL ENG., 2013)
- MONITORING WELL (GOLDER, 2021)

DEPTH TO GROUNDWATER:

- 0 TO 1m BELOW GRADE
- 1 TO 2m BELOW GRADE
- 2 TO 4m BELOW GRADE
- >4m BELOW GRADE

0 100 200 400 600
Metres

N

BURNSIDE

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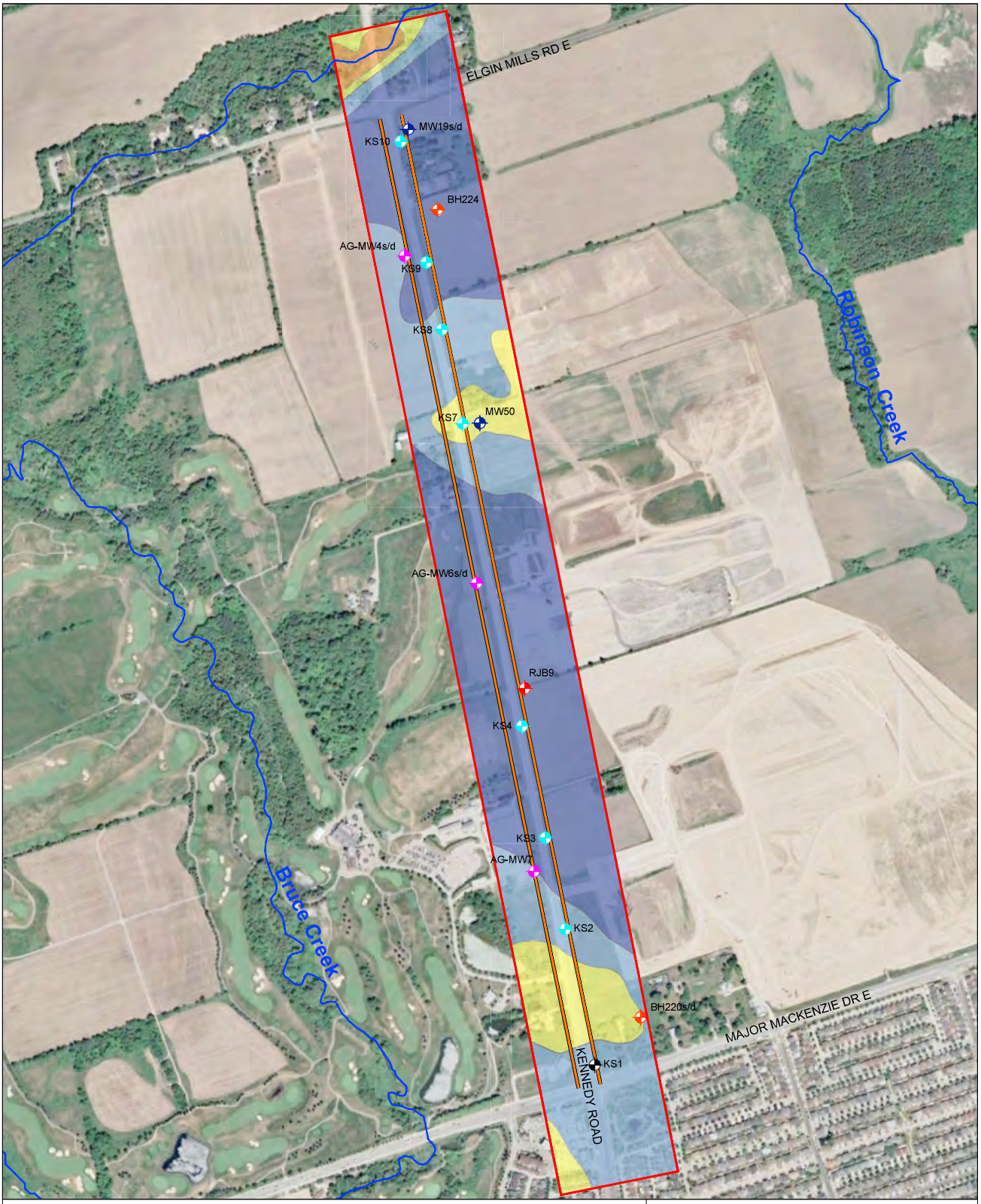
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title
INTERPRETED DEPTH TO GROUNDWATER (WARDEN AVENUE)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	9
Scale		Project No.	
1:7,500		300052314	

File Name: Nigel\Shared Work Areas\035564 Highmark\02_Production\ 052314 Warden Kennedy EA.dwg Date Plotted: February 24, 2023 - 12:46 PM



LEGEND

- 100m BUFFER AROUND ROW
- PROPOSED RIGHT-OF-WAY (ROW - 43m)
- WATERCOURSE
- MONITORING WELL (RJB, 2015)
- MONITORING WELL (YORK REGION)
- MONITORING WELL (SOIL ENG., 2013)
- MONITORING WELL (GOLDER, 2021)
- MONITORING WELL (NO LOG)

DEPTH TO GROUNDWATER:

- 0 TO 1m BELOW GRADE
- 1 TO 2m BELOW GRADE
- 2 TO 4m BELOW GRADE
- >4m BELOW GRADE

0 100 200 400 600
Metres

N

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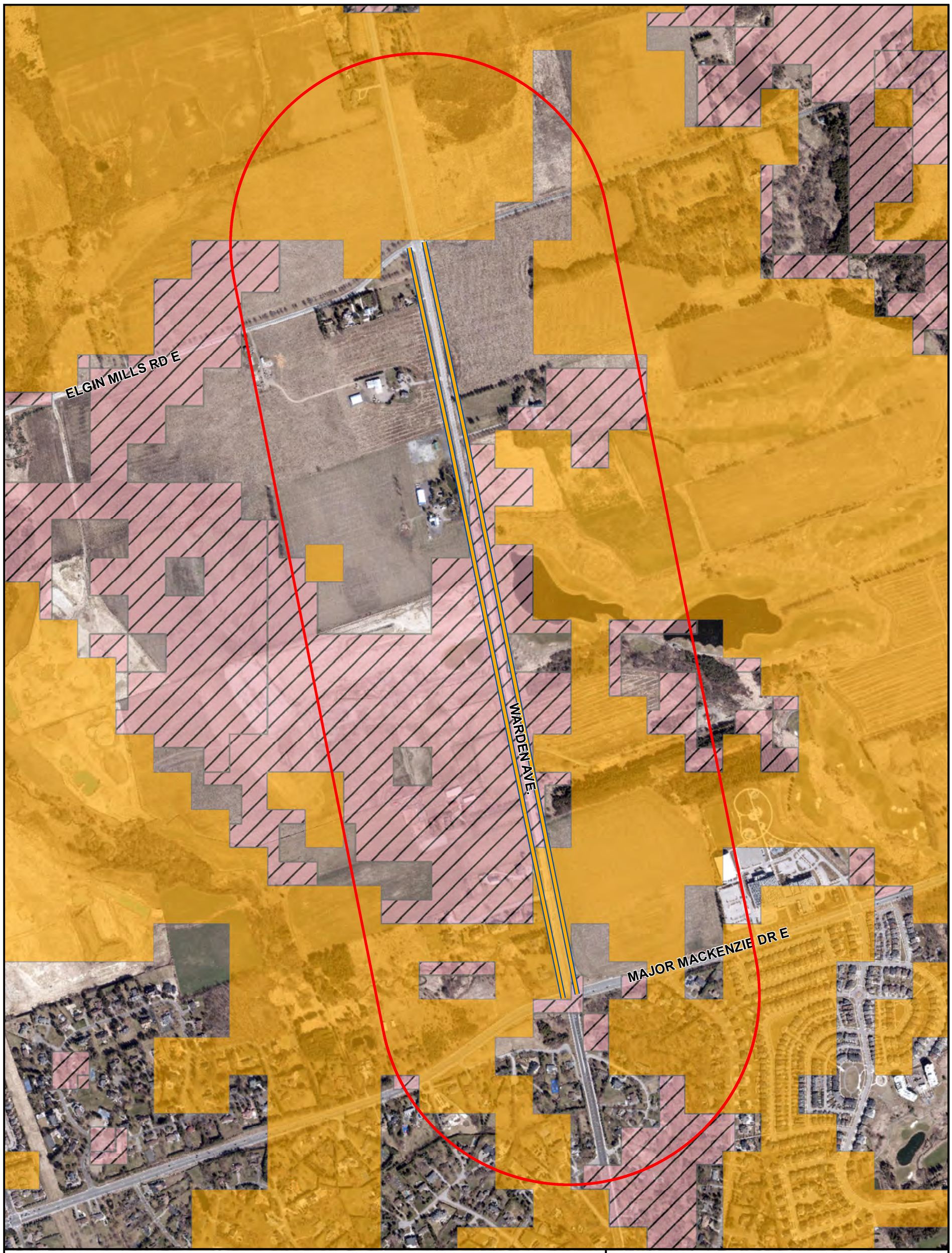
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title
INTERPRETED DEPTH TO GROUNDWATER (KENNEDY ROAD)

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	10
Scale		Project No.	
1:7,500		300052314	

File Name:NigelShared Work Areas\035564 Highmark\02_Production\ 052314 Warden Kennedy EA.dwg Date Plotted: February 24, 2023 - 12:47 PM



LEGEND

- STUDY AREA
- PROPOSED RIGHT-OF WAY (ROW - 41m)
- Highly Vulnerable Aquifers TRCA
- Significant Groundwater Recharge Areas TRCA

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

N

0 100 200 300 400 500 600

Metres

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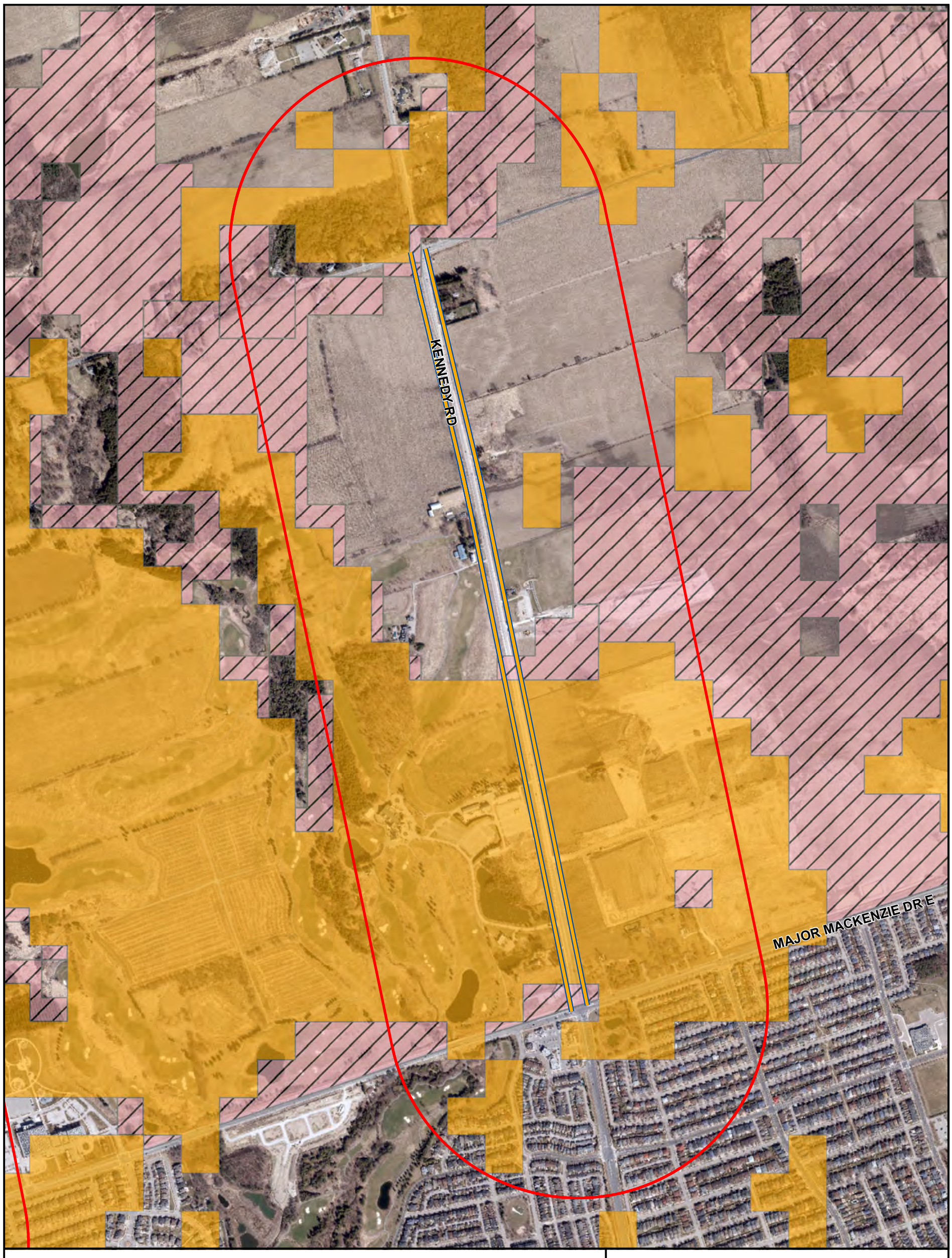
WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

VULNERABLE AREAS (SGRA & HVA) WARDEN AVENUE

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	11
Scale		Project No.	
1:10,000		300052314	

File Path: Nigel/Shared Work Areas/A:\052314 Warden Kennedy Road Widening\06_GIS\Warden Kennedy EA\052314 Warden Vulnerable Areas.mxd Print Date: 2023/02/24 Time: 12:50 PM



LEGEND

- STUDY AREA
- PROPOSED RIGHT-OF-WAY (ROW - 41m)
- Highly Vulnerable Aquifers TRCA
- Significant Groundwater Recharge Areas TRCA

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario
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N

0 100 200 300 400 500 600

Metres

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WARDEN AVENUE & KENNEDY ROAD EA STUDIES
HYDROGEOLOGICAL ASSESSMENT

Figure Title

VULNERABLE AREAS (SGRA & HVA)
KENNEDY ROAD

Drawn	Checked	Date	Figure No.
SK	SC	FEBRUARY 2023	12
Scale		Project No.	
1:10,000		300052314	

File Path: Nigel/Shared Work Areas/A:\052314 Warden Kennedy Road Widening\06_GIS\Warden Kennedy EA\052314 Kennedy Vulnerable Areas.mxd Print Date: 2023/02/24 Time: 12:52 PM

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Borehole Logs

PROJECT: 20146456

RECORD OF BOREHOLE: C1

SHEET 1 OF 1

LOCATION: N 4862071.08; E 632899.94

BORING DATE: January 13, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		213.50							
0	Truck Mount B57 150 mm O.D. Hollow Stem Augers	ASPHALT (210 mm thick)		0.00 / 213.29							
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.21	1	AS	-				
				212.67							
1		FILL - (CI) sandy SILTY CLAY, some gravel, dark brown and grey; cohesive, w>PL, firm to soft		0.83	2	SS	8		○		
					3	SS	3				
2				211.37							
		(CL) SILTY CLAY, brown to grey; cohesive, w>PL, stiff to very stiff		2.13	4	SS	10		○		
3		- Becoming grey at a depth of 2.9 m			5	SS	16				
4				209.46							
		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		4.04	6	SS	50/ 0.13		○		
5											
6					7	SS	50/ 0.13				
7											
				205.65	8	SS	50/ 0.08		○		
8		END OF BOREHOLE		7.85							
		NOTES:									
		1. Water was encountered at a depth of 3.1 m during drilling.									
		2. Water measured in open borehole at a depth of 4.3 m (El. 209.2m) upon completion of drilling.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: C2

SHEET 1 OF 1

LOCATION: N 4862076.92; E 632892.20

BORING DATE: January 12, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		213.50							
0	Truck Mount B57; 150 mm O.D. Hollow Stem Augers	ASPHALT (315 mm thick)		0.00 / 213.18							
		Crushed granular; brown		0.32 / 212.76	1	AS	-				
1		FILL - (CI) sandy SILTY CLAY, some gravel, dark brown and grey; cohesive, w>PL, stiff to firm		0.74	2	SS	13		Wp ⊢ ○ W ⊣ Wl	MH	
					3	SS	4				
2				211.37							
		(CL) SILTY CLAY, brown; cohesive, w>PL, very stiff to stiff		2.13	4	SS	16		○		
3					5	SS	14				
4				209.46							
		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		4.04	6	SS	70		○		
5											
6					7	SS	50/ 0.13				
7											
				205.68	8	SS	50/ 0.05		○		
8		END OF BOREHOLE		7.82							
		NOTES:									
9		1. Water was encountered at a depth of 6.1 m during drilling.									
		2. Water measured in open borehole at a depth of 4.3 m (El. 209.2m) upon completion of drilling.									
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4861296.93; E 633061.47

RECORD OF BOREHOLE: P1

BORING DATE: January 20, 2021

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		213.50							
0	Truck Mount B57; 150 mm O.D. Hollow Stem Augers	ASPHALT (340 mm thick)		0.00 / 213.16							
		Crushed granular; brown		0.34	1A	AS	-				
		FILL - (SP) SAND, some gravel; trace fines; brown; moist		0.51 / 212.79	1B						
1		(CL) SILTY CLAY and SAND, some gravel; brown (TILL); cohesive, w<PL, very stiff to hard		0.71	2	SS	22				
					3	SS	97		O——	MH	
2		END OF BOREHOLE		211.52 / 1.98							
		NOTE: 1. Borehole open and dry upon completion of drilling.									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4861450.81; E 633030.53

RECORD OF BOREHOLE: P2

SHEET 1 OF 1

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		217.60							
0	Truck Mount B57, 200 mm O.D. Hollow Stem Augers	ASPHALT (200 mm thick)		0.00 / 217.40							
		Crushed granular; brown		0.20 / 216.85	1	AS	-				
1		FILL - (SP) SAND, trace fines; brown; non-cohesive, moist, compact		0.75 / 216.23	2	SS	17				
		(ML) SILT and SAND, trace gravel; brown; non-cohesive, moist, compact		1.37 / 215.62	3	SS	15			MH NP	
2		END OF BOREHOLE		1.98							
		NOTES:									
		1. Borehole was open and dry upon completion of drilling.									
		2. NP= Non-plastic									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: P3

SHEET 1 OF 1

LOCATION: N 4861664.23; E 632982.24

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		219.80							
0	Truck Mount B57, 200 mm O.D. Hollow Stem Augers	ASPHALT (230 mm thick)		0.00 / 219.57							
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.23 / 219.30	1	AS	-				
1		FILL - (CI) sandy SILTY CLAY, some gravel; brown and dark grey; cohesive, w>PL, stiff		0.50	2	SS	11				
					3	SS	10		○		
2				217.82							
		END OF BOREHOLE		1.98							
		NOTE:									
		1. Borehole was open and dry upon completion of drilling.									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4861851.29; E 632945.93

RECORD OF BOREHOLE: P4

SHEET 1 OF 1

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		216.50							
0	Truck Mount B57, 150 mm O.D. Hollow Stem Augers	ASPHALT (60 mm thick)		0.00							
		Crushed ganular; brown		0.06	1	AS	-				
				215.98							
		FILL - (CI) sandy SILTY CLAY, some sand, some gravel; dark grey, organic inclusions; cohesive, w>PL, stiff		0.52							
1					2	SS	8		W		
				215.13							
		(SM) SILTY SAND, some gravel; brown; non-cohesive, moist, compact		1.37							
					3	SS	19			MH	
2				214.52							
		END OF BOREHOLE		1.98							
		NOTE:									
		1. Borehole was open and dry upon completion of drilling.									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4862041.54; E 632903.86

RECORD OF BOREHOLE: P5

SHEET 1 OF 1

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		213.50							
0	Truck Mount B57, 150 mm O.D. Hollow Stem Augers	ASPHALT (220 mm thick)		0.00 213.28							
		Crushed granular; brown		0.22 212.84	1	AS	-				
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.66 212.65	2A	SS	12				
1		FILL - (CI) sandy SILTY CLAY, some gravel; black and grey, organic inclusions; cohesive, w>PL, stiff to firm		0.85	2B						
					3	SS	4		O		
2				211.52							
		END OF BOREHOLE NOTE: 1. Borehole was open and dry upon completion of drilling		1.98							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: P6

SHEET 1 OF 1

LOCATION: N 4862147.36; E 632884.51

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		214.10							
0	Truck Mount B57 150 mm O.D. Hollow Stem Augers	ASPHALT (150 mm thick)		0.00							
		Crushed granular; brown		0.15	1A	AS	-				
		FILL - (SP) SAND, some gravel; trace fines; brown; moist		213.62 0.48 213.44	1B						
		FILL - (CI) SILTY CLAY, some sand, some gravel; dark brown, organic inclusions; cohesive, w~PL to w>PL, stiff		0.66	2	SS	9		○		
1											
					3	SS	9				
2				212.12							
		END OF BOREHOLE		1.98							
		NOTE:									
		1. Borehole was open and dry upon completion of drilling									
3											
4											
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6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4862351.03; E 632840.88

RECORD OF BOREHOLE: P7

SHEET 1 OF 1

BORING DATE: January 6, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		219.20							
0	Truck Mount B57 150 mm O.D. Hollow Stem Augers	ASPHALT (230 mm thick)		0.00 / 218.97							
		Crushed granular; brown		0.23	1A	AS	-				
		FILL - (SP) SAND, some gravel; trace fines; brown; moist		0.39 / 218.54	1B						
1		FILL - (CI) sandy SILTY CLAY, some gravel; brown and dark grey, organic inclusions; cohesive, w>PL, very stiff		0.66 / 217.83	2	SS	19				
		(ML) sandy SILT, some gravel; brown (TILL); non-cohesive, moist, compact		1.37 / 217.22	3	SS	22		O		
2		END OF BOREHOLE		1.98							
		NOTE:									
		1. Borehole was open and dry upon completion of drilling									
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: S1

SHEET 1 OF 2

LOCATION: N 4861359.73; E 633031.43

BORING DATE: January 15, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		215.10							
0	Truck Mount B57 / 200 mm O.D. Hollow Stem Augers	ASPHALT (125 mm thick)		0.00							
		Crushed granular; brown		0.13 / 214.68	1	AS	-				50 mm Dia. PVC Monitoring Well
		FILL - (SP) SAND, brown, trace fines; non-cohesive, moist, dense		0.42							
1					2	SS	39				
					3	SS	37				
2				212.97							
		(SM) SILTY SAND, some gravel; brown (TILL); non-cohesive, moist, very dense		2.13	4	SS	64				
3					5	SS	71				
											January 29, 2021
4				211.06							
		(SM) SILTY SAND, some gravel; brown to grey; non-cohesive, wet, very dense		4.04	6	SS	79				
5											Bentonite
		- Becoming grey at a depth of 5.6 m									
6					7	SS	83				
7				208.01							
		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		7.09							Sand
8					8	SS	50/ 0.08				
											Sand and Screen
9					9	SS	50/ 0.13				
				205.68							
		END OF BOREHOLE		9.42							
		NOTES:									
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: S1

SHEET 2 OF 2

LOCATION: N 4861359.73; E 633031.43

BORING DATE: January 15, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*											
		1. Water was encountered at a depth of 4.6 m during drilling. 2. Groundwater level was measured at a depth of 4.4 mbgs (El. 210.7m) after well installation. 3. Groundwater level was measured in monitoring well at a depth of 3.7 mbgs (El. 211.4m) on January 29, 2021.											
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

PROJECT: 20146456

RECORD OF BOREHOLE: S2

SHEET 1 OF 1

LOCATION: N 4861546.26; E 633002.39

BORING DATE: January 15, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		219.80							
0	Truck Mount B57 / 150 mm O.D. Hollow Stem Augers	ASPHALT (120 mm thick)		0.00							
		FILL - (SM) gravelly SILTY SAND, brown; non-cohesive, moist		0.12	1	AS	-			M	
				219.05							
1		FILL - (CI) sandy SILTY CLAY, some gravel; brown and black, organic inclusions; cohesive, w>PL, stiff		0.75	2	SS	11				
					3	SS	9				
2				217.67							
		(SM) SILTY SAND, trace to some gravel; brown; non-cohesive, moist to wet, dense to very dense		2.13	4	SS	35				
3					5	SS	54				
4		- Becoming wet at a depth of 4.6 m			6	SS	48				
5											
6					7	SS	50/0.1				
7				212.71							
		(GP) sandy GRAVEL, trace fines; grey; non-cohesive, wet, very dense		7.09							
				212.05	8	SS	50/0.13				
		END OF BOREHOLE		7.75							
8		NOTE:									
		1. Water was encountered at a depth of 4.6 m during drilling.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: S3

SHEET 1 OF 2

LOCATION: N 4861732.90; E 632961.79

BORING DATE: January 13, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		218.90							
	Truck Mount B57 / 200 mm O.D. Hollow Stem Augers	ASPHALT (200 mm thick)		0.00 218.70							
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.20 218.20	1	AS	-				50 mm Dia. PVC Monitoring Well
1		FILL - (CI) sandy SILTY CLAY, trace gravel, brown and black; organic inclusions; cohesive, w>PL, firm to stiff		0.70 216.77	2	SS	7			MH	
					3	SS	13				
2		(CL) SILTY CLAY and SAND, some gravel; brown (TILL); cohesive, w~PL, stiff		2.13 216.00	4	SS	13				
3		(SM) SILTY SAND, some gravel; brown (TILL); non-cohesive, moist, dense		2.90 214.86	5	SS	44				January 29, 2021
4		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		4.04	6	SS	50/ 0.15				
5											Bentonite
6					7	SS	77				
7											Sand
8					8	SS	65				
9											Sand and Screen
					9	SS	90/ 0.13				
		END OF BOREHOLE		209.32 9.58							
10		NOTES:									
		CONTINUED NEXT PAGE									

DEPTH SCALE
1 : 50

GOLDER

LOGGED: YS
CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: S3

SHEET 2 OF 2

LOCATION: N 4861732.90; E 632961.79

BORING DATE: January 13, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		1. Borehole was open and dry upon completion of drilling. 2. Groundwater level was measured in monitoring well at a depth of 3.5 mbgs (El. 215.4m) on January 29, 2021									
11											
12											
13											
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18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4861956.56; E 632915.36

RECORD OF BOREHOLE: S4

BORING DATE: January 13, 2021

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		213.80							
0	Truck Mount B57 150 mm O.D. Hollow Stem Augers	ASPHALT (215 mm thick)		0.00 / 213.58							
		Crushed granular; brown		0.22 / 213.34	1A	AS	-		○	M	50 mm Dia. PVC Monitoring Well
		FILL - (SP) SAND, some gravel, trace fines; brown, moist		0.46	1B						
		FILL - (CI) sandy SILTY CLAY, some gravel; brown and black, organic inclusions; cohesive, w>PL, stiff		0.63	2	SS	11		○		
1											
					3	SS	9				
2				211.67							
		(SM) gravelly SILTY SAND, brown (TILL); non-cohesive, moist, compact		2.13 / 211.29	4	SS	15		○	MH	January 29, 2021
		(SM) SILTY SAND, some gravel; grey; non-cohesive, moist, loose		2.51							Bentonite
3					5	SS	8				
				209.76							
4		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		4.04							
					6	SS	89		○		
5											
											Sand
6					7	SS	80				
											Sand and Screen
7				205.95	8	SS	50/ 0.08		○		
		END OF BOREHOLE		7.85							
8		NOTES:									
		1. Water was encountered at a depth of 2.3 m during drilling.									
		2. Groundwater level was measured at a depth of 5.3 mbgs (El. 208.5m) after well installation.									
9		3. Groundwater level was measured in monitoring well at 2.4 mbgs (El. 211.5m) on January 29, 2021.									
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

LOCATION: N 4862226.60; E 632859.96

RECORD OF BOREHOLE: S5

BORING DATE: January 12, 2021

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		215.70							
0	Truck Mount B57 / 200 mm O.D. Hollow Stem Augers	ASPHALT (200 mm thick)		0.00 / 215.50							
		Crushed granular; brown		0.20 / 215.23	1A	AS	-				50 mm Dia. PVC Monitoring Well
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.47 / 215.02	1B						
		FILL - (CI) sandy SILTY CLAY, some gravel; brown; cohesive, w>PL, stiff to very stiff		0.68	2	SS	14				
1											
					3	SS	16		○		
2				213.57							
		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; brown to grey (TILL); cohesive, w<PL, hard		2.13	4	SS	86/ 0.23				
											Bentonite
3					5	SS	50/ 0.13		○		
4											
					6	SS	50/ 0.15				
5		- Becoming grey at a depth of 5.5 m									
											Sand
6					7	SS	50/ 0.1		○		
											January 29,2021
7											Sand and Screen
				207.85	8	SS	50/ 0.08				
8		END OF BOREHOLE		7.85							
		NOTES:									
		1. Borehole was open and dry upon completion of drilling.									
		2. Groundwater level was measured in monitoring well at a depth of 6.8 mbgs (El.208.9m) on January 29, 2021.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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PROJECT: 20146456

RECORD OF BOREHOLE: S6

SHEET 1 OF 1

LOCATION: N 4862442.27; E 632817.44

BORING DATE: January 12, 2021

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		221.40							
0	Truck Mount B57 / 150 mm O.D. Hollow Stem Augers	ASPHALT (255 mm thick)		0.00 / 221.14							
		FILL - (SP) SAND, some gravel, trace fines; brown; moist		0.26 / 220.65	1	AS	-				
1		FILL - (CI) sandy SILTY CLAY, some gravel; dark brown; cohesive, w~PL, stiff		0.75 / 220.03	2	SS	10				
		(ML) SILT and SAND, brown; non-cohesive, moist to wet, compact to dense		1.37 / 217.36	3	SS	18		Wp, W	MH	
2					4	SS	32				
3					5	SS	49		W		
4		(CL-ML) SILTY CLAY-CLAYEY SILT and SAND, some gravel; grey (TILL); cohesive, w<PL, hard		4.04 / 213.53	6	SS	57				
5		- Auger grinding between depths of 5.5 m and 5.8 m									
6					7	SS	96				
7					8	SS	50/0.1				
8		END OF BOREHOLE		7.87							
		NOTES:									
		1. Water measured in open borehole at a depth of 2.7 m upon completion of drilling.									
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: YS

CHECKED: TO

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LOG OF DRILLING OPERATIONS

BG-MW1

BURNSIDE

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

Client: **Berczy Glen Landowners Group**	Project Name: **Berczy Glen Lands**	Logged by: **C. Dinulescu**
Project No.: **300033248**	Location: **Markham, ON**	Ground (m amsl): **220.2**
Drilling Co.: **Lantech Drilling Services Inc.**	Date Started: **9/18/2013**	Static Water Level Depth (m):
Drilling Method: **Hollow Stem Auger**	Date Completed: **9/18/2013**	Sand Pack Depth (m) : **4.57 - 6.86**

Surface Elevation (m): **220.20**

Stratigraphic Description	Depth (m)
TOPSOIL - dark brown loam	
SILTY CLAY - with sand, trace fine subrounded gravel, pockets of fine to medium grained sand, damp, weakly plastic, lught brown, soft, iron staining	0.35
SANDY SILT - trace clay, trace fine gravel, light brown, weakly plastic, soft, damp	1.57
SAND - very fine to fine grained , trace silt, occasional gravel, uniform, light brown, damp to wet, loose.	2.21
SANDY GRAVEL - trace clay, trace silt, well graded, wet to saturated, loose, fine to large.	4.70
SAND - medium to very coarse grained, trace fine gravel, trace silt, uniform, light brown, loose, saturated, well graded	5.64
SANDY GRAVEL - fine to coarse grained subangular to subrounded, trace silt, trace clay, cobbles, saturated, loose	6.25
SAND - fine to coarse grained, trace silt, trace gravel, uniform, light brown, saturated, cobbles and boulders	6.45
Stone refusal at 6.86 m	6.86

SAMPLE

Num.	Type	Int.	N.Val.
	SS	X	24
1	SS	X	21
2	SS	X	24
3	SS	X	82/10"
4	SS	X	55/6"
5	SS	X	105
6	SS	X	77
7	SS	X	
8	SS	X	

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

Prepared By: **S. Charity** Checked By: **C. Dinulescu** Date Prepared: **10/7/2013**

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

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

LOG OF DRILLING OPERATIONS

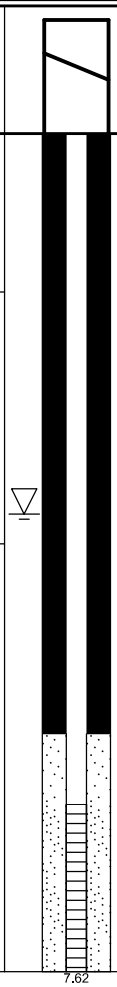
AG-MW12

BURNSIDE

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

Client: **Angus Glen Developments Inc.**	Project Name: **Angus Glen MESP**	Logged by: **C. D.**
Project No.: **300034937**	Location: **Markham, ON**	Ground (m amsl): **217.20**
Drilling Co.: **Lantech Drilling Services Inc.**	Date Started: **2/25/2015**	Static Water Level Depth (m): **3.46**
Drilling Method: **Hollow Stem Auger**	Date Completed: **2/25/2015**	Sand Pack Depth (m) : **5.46 - 7.62**

Depth Scale (ft)	Depth Scale (m)	Stratigraphic Description (Surface Elevation (m): 217.20)	Strat. Plot	Elev. Depth (m)
		TOPSOIL Dark brown sandy silt, weathered small pieces of rocks, dry		
5.0	1.0			215.76 1.44
	2.0	FILL Gravel and Sand, fragments of rocks, loose to compact, dry, trace silt		
10.0	3.0			213.47 3.73
	4.0	Sandy Silt TILL Grey, stiff, dry, some clay, trace gravel (<2 cm diameter) subangular to subrounded, occasional pockets with medium sand		
15.0	5.0	becomes harder with depth		
20.0	6.0			209.58 7.62
25.0	7.0			



SAMPLE Num.	Type	Int.	N.Val.
1	SS		frozen
2	SS		29
3	SS		>100
4	SS		>50/3"
5	SS		>50/4"
6	SS		>50/2"
7	SS		>50/4"
8	SS		>50/5"
9	SS		>50/4"

Prepared By: **C. D.** Checked By: **J. S.** Date Prepared: **7/26/2015**

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

LEGEND
- Water found @ time of drilling
- Static Water Level - 6/16/2015

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

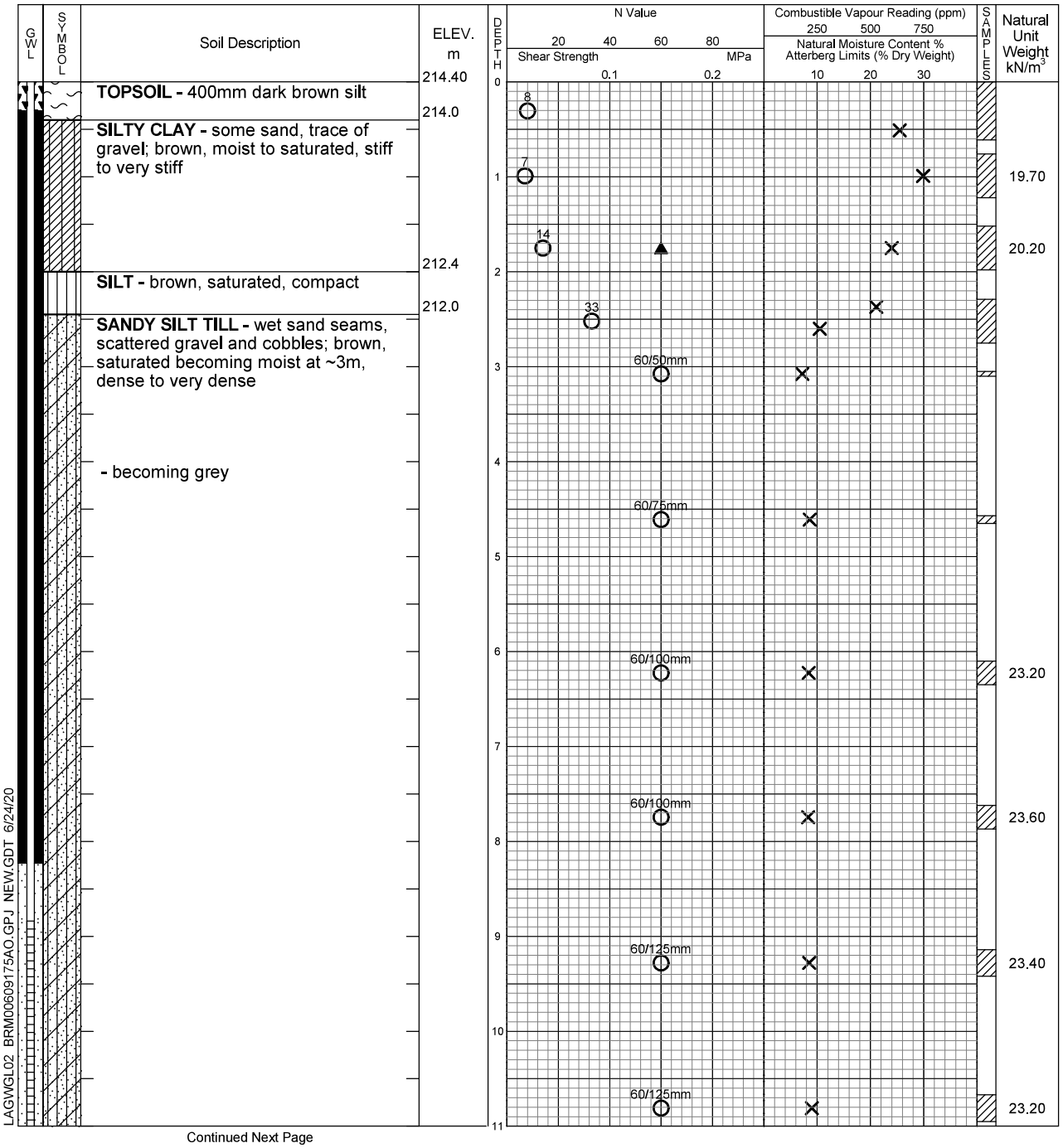
SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

Log of Borehole 113

Project No. BRM-00609175-AO
Drawing No. 16
Project: Geotechnical Investigation - Berczy Warden Subdivision
Sheet No. 1 of 2
Location: 10206 and 10348 Warden Avenue, Markham, Ontario

Date Drilled: May 19 and 22, 2020
Drill Type: Dietrich 120
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
On completion	3.96	Borehole
After 4 hours	0.61	Well
After 5 days	0.58	Well

Log of Borehole 113

Project No. BRM-00609175-AO

Drawing No. 16

Project: Geotechnical Investigation - Berczy Warden Subdivision

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
			203.40	11	20 40 60 80 / 0.1 0.2	250 500 750 / 10 20 30		
				12	50/150mm			23.30
			201.9					

END OF BOREHOLE

NOTES:

1. Groundwater monitoring well installed to 11.89m; sealed with bentonite from 0.3 to 8.23m.

LAGWGL02 BRM00609175AO.GPJ NEW.GDT 6/24/20

Time	Water Level (m)	Depth to Cave (m)
On completion	3.96	Borehole
After 4 hours	0.61	Well
After 5 days	0.58	Well

Log of Borehole 113A

Project No. BRM-00609175-AO
Drawing No. 17
Project: Geotechnical Investigation - Berczy Warden Subdivision
Sheet No. 1 of 1
Location: 10206 and 10348 Warden Avenue, Markham, Ontario

Date Drilled: May 22, 2020
Drill Type: Dietrich 120
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		TOPSOIL - 400mm dark brown silt	214.40	0
		SILTY CLAY - some sand, trace of gravel; brown, moist to saturated, stiff to very stiff	214.0	
		SILT - brown, saturated, compact	212.4	2
		SANDY SILT TILL - wet sand seams, scattered gravel and cobbles; brown, saturated becoming moist at ~3m, dense to very dense	212.0	3
		- becoming grey		4
		END OF BOREHOLE	207.2	7

N Value: 20 40 60 80
Shear Strength: 0.1 MPa 0.2
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight kN/m³

NOTES:
1. Groundwater monitoring well installed to 7.19m; sealed with bentonite from 0.3 to 3.53m.

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	Borehole
After 4 hours	1.14	Well
After 5 days	1.09	Well

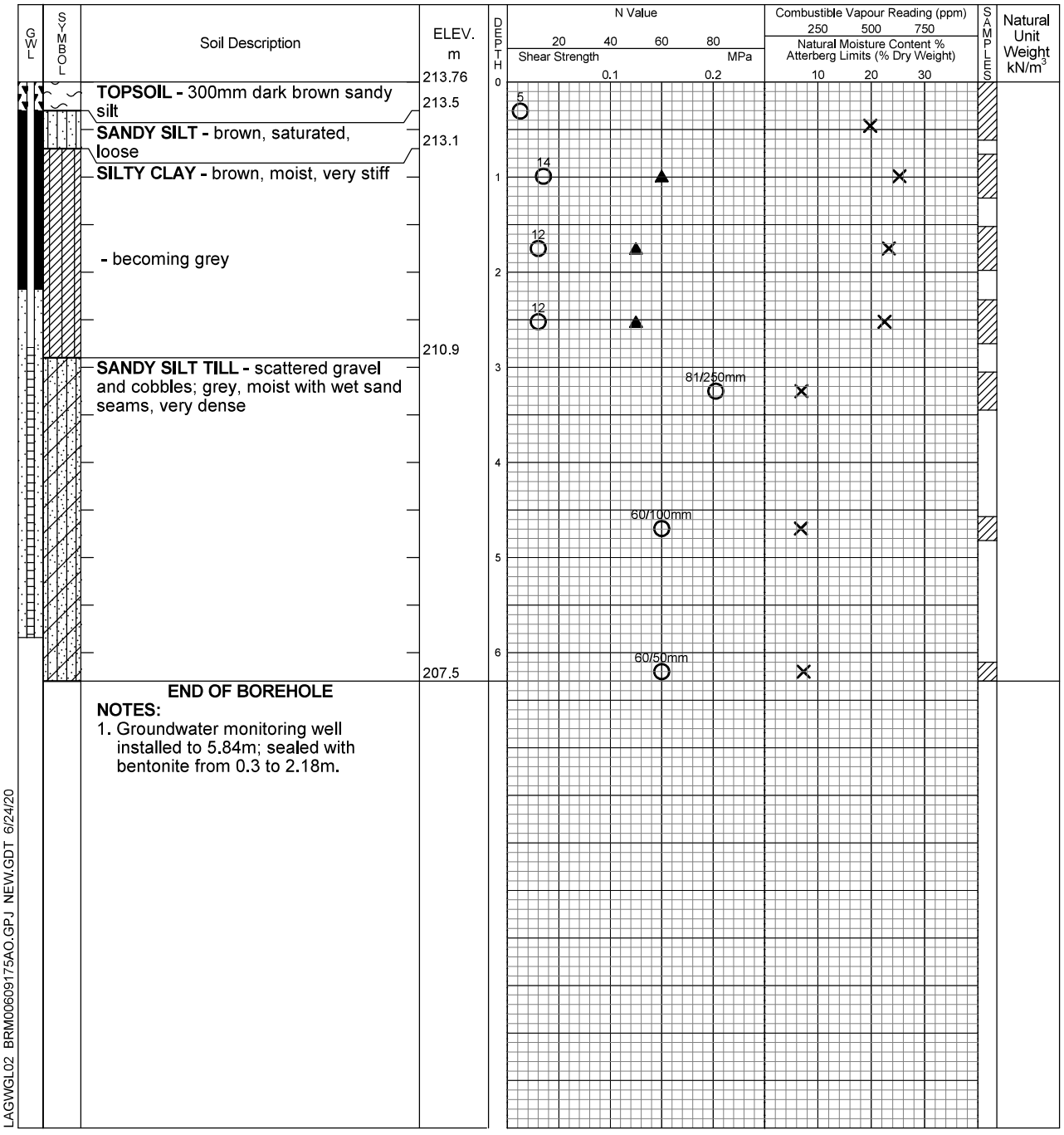
LAGWGL02 BRM00609175AO.GPJ NEW.GDT 6/24/20

Log of Borehole 116

Project No. BRM-00609175-AO
Drawing No. 20
Project: Geotechnical Investigation - Berczy Warden Subdivision
Sheet No. 1 of 1
Location: 10206 and 10348 Warden Avenue, Markham, Ontario

Date Drilled: May 13, 2020
Drill Type: Dietrich 120
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



END OF BOREHOLE

NOTES:
1. Groundwater monitoring well installed to 5.84m; sealed with bentonite from 0.3 to 2.18m.

Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	Borehole
After 9 days	0.97	Well
After 14 days	0.99	Well

LAGWGL02 BRM00609175AO.GPJ NEW.GDT 6/24/20

RECORD OF BOREHOLE: 14-16

PROJECT: 14-1186-0012
LOCATION: See Figure 2
BORING DATE: May 8, 2014
SHEET 1 OF 2
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

BORING METHOD: TRACK MOUNTED CME 55, Hollow Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	214.70
FILL - (ML) CLAYEY SILT, some sand, organic inclusions; dark brown; cohesive, W<PL to W~PL, firm	0.00
(ML) sandy CLAYEY SILT; pale brown, with oxidation staining; cohesive, W<PL, stiff	214.01 / 0.69
(CI) SILTY CLAY, some sand; grey, with oxidation staining; cohesive, W>PL, firm to stiff Very thinly bedded with fine sand below a depth of approximately 2.1 m below existing ground surface	213.33 / 1.37
(ML) sandy SILT, some clay to clayey, trace gravel, with pockets of medium sand; grey (TILL); non-cohesive, moist, very dense	211.80 / 2.90

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	5	
2	SS	9	
3	SS	7	PL
4	SS	12	
5	SS	83	
6	SS	50/.05	
7	SS	50/.13	
8	SS	50/.08	
9	SS	50/.13	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl: 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION
Concrete
Bentonite Seal

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50
LOGGED: JG
CHECKED: AM

Golder Associates

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PROJECT: 14-1186-0012

LOCATION: See Figure 2

RECORD OF BOREHOLE: 14-16

BORING DATE: May 8, 2014

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*— CONTINUED FROM PREVIOUS PAGE —*									
	TRACK MOUNTED CME 55; Hollow Stem Augers	(ML) sandy SILT, some clay to clayey, trace gravel, with pockets of medium sand; grey (TILL); non-cohesive, moist, very dense			10	SS	50/.13				Bentonite Seal
11											
12					11	SS	50/.13				
13		Becoming more moist below a depth of approximately 13.1 m below ground surface									
14					12	SS	99/.13				Silica Sand Filter
15		Augers grinding below a depth of approximately 14.9 m below ground surface. Inferred cobble/boulder			13	SS	50/.13				
				199.16							
				15.54							
		AUGER REFUSAL ON INFERRED COBBLE/BOULDER END OF BOREHOLE									1. Water level measured at a depth of 3.87 m below ground surface, June 20/14
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JG

CHECKED: AM

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PROJECT: 19119989 (2000)

LOCATION: See Figure 1

RECORD OF BOREHOLE: 20-12

BORING DATE: July 10, 2020

SHEET 1 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		220.20							
0	Mobile B-45 220 mm O.D. Hollow Stem Augers	FILL - (CL) SILTY CLAY, some sand, trace rootlets, trace gravel; brown; cohesive, w<PL, stiff		0.00 / 219.59	1	SS	12				
1		FILL - (CL) SILTY CLAY, trace gravel, some sand; brown; oxidation staining; cohesive, w<PL, firm		0.61 / 218.83	2	SS	7				
2		(ML) sandy SILT, trace gravel; brown; oxidation staining; non-cohesive, moist to wet, compact to very dense		1.37	3	SS	21				
3					4	SS	69				
4					5	SS	73			MH	
5					6	SS	57				
6		(SP) SAND, some gravel; brown; non-cohesive, wet, dense to very dense		214.64 / 5.56	7	SS	40				
7											
8	110 mm Tricone with Mud				8	SS	50/ 0.05				
9		(SM) gravelly SILTY SAND; grey (TILL), contains cobbles and boulders; non-cohesive, moist, very dense		211.60 / 8.60	9	SS	50/ 0.08				
10		CONTINUED NEXT PAGE		210.24							

DEPTH SCALE

1 : 50

GOLDER
MEMBER OF WSP

LOGGED: MJB/BD

CHECKED: KN

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