HYDROGEOLOGICAL INVESTIGATION

BOLTON NORTH HILL
OPTION 1 & OPTION 2 LANDS

TOWN OF CALEDON
REGION OF PEEL

PREPARED FOR:

BOLTON NORTH HILL LANDOWNERS GROUP

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1.0 Introduction

C.F. Crozier a& Associates Inc. (Crozier) was retained by Bolton North Hill Landowners Group to prepare a hydrogeological investigation to support the proposed Bolton Residential Expansion Settlement (BRES) Option 1 & Option 2 Lands (subject lands). The subject lands are located generally north of the Highway 50 and Columbia Way intersection in the Community of Bolton, Town of Caledon, Region of Peel.

The following report has been prepared to characterize the local hydrogeological regime and delineate any hydrogeological constraints for future development of the Option 1 & Option 2 lands. This study has been prepared in accordance with the Toronto and Region Conservation Authority (TRCA) Hydrogeological Assessment Guidelines (June 2013) and all applicable Town of Caledon and Region of Peel Guidelines.

The following background studies and reports have been reviewed in preparation of this report:

- Preliminary Hydrogeological Investigation prepared by DS Consultants LTD. (DS Consultants, February 2021).
- Concept Plan prepared by Bousfields Inc. (Bousfields, December 2021).
- Schedule C – Bolton Land Use Plan prepared by the Town of Caledon (Town of Caledon, April 2018).
- Approved Source Protection Plan: CTC Source Protection Region prepared by CTC Source Protection Committee (CTC, March 2022).
- Humber River Watershed Scenario Modelling and Analysis Report prepared by Toronto Region Conservation Authority (TRCA) (TRCA, 2008a).
- Humber River State of the Watershed Report – Geology and Groundwater Resources prepared by TRCA (TRCA, 2008b).
- The Physiography of Southern Ontario (Chapman and Putnam, 1984).

2.0 Site Description

The following sections describe the plans for the development, the existing land use on and in the vicinity of the subject lands, and information regarding the Source Protection of the site.

2.1 Site Location

The Option 1 and Option 2 lands (subject lands) are generally located in the north end of Bolton, Region of Peel. The Option 1 lands are approximately 171 ha and contain land parcels north of Highway 50 and Columbia Way, north and south of Emil Kolb Parkway and east and west of Duffy's Lane. The Option 2 lands are approximately 4.3 ha and are bounded by Columbia Way to the south and Mount Hope Road to the west. The subject lands are currently characterized by agricultural and rural properties, as shown in Figure 1.

The subject lands are composed by many separate properties under separate ownership. Please refer to Figure 1 for land ownership boundaries.

Based on the Concept Plan provided by Bousfields Inc. dated December 20, 2021, the elements envisioned for this development include:

- 90.41 ha of residential developments including single dwellings, semi-detached dwellings, townhomes and apartments
- 4.90 ha of school area
- 1.55 ha of commercial space
- 18.32 ha of parks, open space and woodlots
- 9.64 ha of storm water management ponds
- 53.75 ha of roads

2.2 Land Use

The subject lands are currently designated as "Rural Area" by the Region of Peel Official Plan and "Agricultural Area" by the Town of Caledon Official Plan. Presently, the majority of the subject lands are utilized for agriculture. Many parcels within the subject lands contain single family dwellings and barns. John's Nursery Gardens is also located within the subject lands boundaries, on the east side of Highway 50.

The subject lands are bounded by residential use to the south and rural land use to the north. includes residential land use to the south and rural land to the north. A large residential subdivision containing detached and semi-detached homes is located south of Columbia Way, and St. Michael Catholic Secondary School is located north of Columbia Way. The Humber Valley Heritage Trail is located southwest of the site and extends from Highway 50 to Emil Kolb Parkway.

2.3 Source Protection

The subject lands are located within the Toronto and Region Source Protection Area and are part of the Credit Valley, Toronto and Region and Central Lake Ontario (CTC) Source Protection Plan Area (MECP, 2022).

According to provincial Source Protection mapping, there are no wellhead protection areas, intake protection zones, or issue contributing areas located within the study area. The subject lands are located within a significant groundwater recharge area (SGRA) and a highly vulnerable aquifer (HVA) both with a vulnerability index score ranging from 2 to 6. However, there are no significant threats associated with a SGRA or HVA with an index score of 2 – 6 and thus, for the subject lands there are no legally binding Source Protection Policies that exist under Section 31 of the Clean Water Act. In accordance with the CTC Source Protection Plan, within the HVA areas, the property owner is encouraged to have a salt management plan that includes a reduction of future salt use (SAL-10).

Although no significant drinking water threats are identified in the CTC Source Protection Plan, there are several activities that pose low to moderate drinking water threats to drinking water. The following low to moderate activities have been identified and best management practices must be applied to prevent future drinking water threats in the area:

- Operation and maintenance of a waste disposal site.
- Operation, storage, and maintenance of systems that collect, treat, or transmit wastewater including stormwater management facilities, sanitary pipes and onsite sewage treatment systems.
- Handling, storage, and application of agricultural source material (ASM).
- Use of category 2 and category 3 non-agricultural source materials (NASM) under Schedule 4 of Ontario Regulation 267/03 including but not limited to industrial organic food waste, culled crops, sewage biosolids and paunch manure.
- Application of commercial fertilizers and pesticides.
- Excluding domestic usage, application, and storage of road salt.
- Use of dense non-aqueous phase liquids (DNAPLs) and organic solvents.
- The handling and storage of a DNAPL and/or fuel.
- The handling, storage, and application of an organic solvent, road salt, and/or pesticide to land.
- The storage of snow.

No additional threats to local drinking water are identified within the CTC Source Protection Plan. Best management practices and consideration of low to moderate threat activities previously outlined should be adhered to.

3.0 Geology

The following Section describes the local and regional geology of the subject lands.

3.1 Physiography, Drainage, and Topography

As shown in Figure 3, the subject lands are located within the physiographic region known as the South Slope, extending south of the Oak Ridges Moraine, and north of the Peel Plain (Chapman and Putnam, 1984).

The South Slope is bounded by the Oak Ridges Moraine in the north and extends from the Niagara Escarpment in the west to the Trent River in the east. This physiographic region consists of a smooth, faintly drumlinized, clay till plain, which resulted from the movement and deposition of glacial material (Chapman and Putnam, 1984). Landforms of the area include drumlins and flute features. Drumlins are characterized by tear-shaped hills composed of glacial till where flutes are elongated ridges of glacial till. According to Ontario Geological Survey (OGS) mapping, the nearest drumlin features are located northwest of the subject lands in the area known as the Guelph Drumlin Fields, and the nearest flutes are located east of Bolton, on the Oak Ridges Moraine in northern Richmond Hill.

The subject lands are located within the Main Humber River Subwatershed of the regional Humber River Watershed (TRCA, 2008a), The nearest major surface water feature to the subject lands is the Humber River, situated approximately 750 m southwest of the site. A number of drainage features

cross the subject property in the form of creeks and streams as shown in Figure 1. Based on field observations, the creeks and streams appear to be intermittently flowing and seasonally driven.

An environmental assessment of the wetland and surface water features is currently being completed by Dillon Consulting Limited and Crozier to identify and determine the potential impact of the proposed development on wetland features within or near the subject lands. According to Figure 1: Draft Wetland Communities prepared by Dillon Consulting Ltd. dated March 1, 2022, eight (8) unique wetlands have been delineated within or near the subject property boundary. Two (2) surface water ponds were identified on the subject lands and appear to be ephemeral, as shown on Figure 1.

Regionally, surface drainage is interpreted to be northwest to southeast in the direction of Lake Ontario. On the subject lands, a natural drainage split runs north-south along the west side of Highway 50, dividing two secondary catchments (TRCA, 2008a). The north catchment drains towards the north and the south catchment drains towards the south. Surface topography of the subject lands range from approximately 245 metres above sea level (masl) at the border of the Oak Ridges Moraine in the north to approximately 220 masl at the border of the Peel Plain in the south (TRCA, 2008b). Figure 4 presents the topography of the subject lands and the surrounding area.

3.2 Regional Geology

The bedrock geology of the area includes the shales, limestones, dolostones, and siltstones of the Georgian Bay Formation according to OGS mapping. Geological evidence exists that an underground buried channel extends from Georgian Bay to Lake Ontario known as the Laurentian Valley. The Lawrentian Channel is estimated to be up to 1.5 km wide and 70 m deep, however, it has since been in-filled with sediments (TRCA, 2008b).

Geologic mapping indicates that local overburden consists primarily of clay to silt textured till derived from glaciolacustrine deposits or shale (OGS, 2022). Near existing river channels, modern and older alluvial deposits made up of clay, silt, sand, and gravel are found. Figures 5 and 6 present the bedrock and surficial geology of the general area. OGS mapping is consistent with the findings of Crozier staff during the construction and installation of twenty (20) monitoring wells across the property in November 2021.

3.3 Local Geology

To characterize the hydrogeological regime and establish a baseline for future studies, a field investigation and drilling program was undertaken under the supervision of Crozier in November 2021. From November 1 to November 11 2021, a total of twenty (20) monitoring wells were installed across the subject property. Further discussion of the field investigation is found in Section 5 and monitoring well logs are found in Appendix A.

Table 1 displays the soils encountered during the field investigation in stratigraphic order.

Table 1: Local Geology at Onsite Monitoring Well Locations

Monitoring Wells	Local Surficial Material Observations	Depth (mbgs) [1]
MW1, MW2, MW3	• Dark brown, moist, topsoil with abundant rootlets	0.00 - 0.02
	• Brown silty clay with grey silt seams	0.02 –4.00
	• Grey clayey silt till with minor gravel	4.00 – 5.00
	• Grey silty clay with minor grey clay seam	5.00 – 6.00
MW5, MW6, MW8, MW9, MW10	• Dark brown, moist, topsoil with abundant rootlets	0.00 - 0.02
	• Brown/grey silty clay with grey silt seams	0.2 - 3.70
	• Grey silt with minor sand	3.70 – 4.60
	• Grey silty clay	4.60 – 6.00
MW4, MW7, MW11, MW12, MW13, MW14, MW15, MW17	• Dark brown, moist, topsoil with abundant rootlets	0.00 - 0.02
	• Brown silty clay	0.02 – 1.80
	• Grey sandy silt	1.80 – 2.50
	• Grey silty clay	2.50 – 3.50
	• Grey silt	3.50 – 5.25
	• Grey silty clay	5.35 – 6.00
MW16, MW18, MW19, MW20	• Dark brown, moist, topsoil with abundant rootlets	0.00 - 0.02
	• Brown silty clay with minor gravel	0.02 – 4.00
	• Grey silty clay with trace gravel	4.00 – 6.00

1. Approximate depth of material interpreted from monitoring well logs in meters below ground surface (mbgs).

Findings during the field investigation are consistent with OGS mapping and local and regional soils investigations.

4.0 Hydrogeology

4.1 MECP Wells

A review of the MECP Well Record Database identified a total of 206 wells records within 500 m of the subject lands boundaries as shown on Figure 7. A summary table of the well records is included in Appendix B. In general, the identified well records can be summarized as follows:

- Of the 206 well records identified, 153 are domestic supply, domestic/irrigation, or domestic/livestock wells, 13 are monitoring wells, 2 are public wells, 1 well is used for commercial purposes. The remainder are identified as abandoned or testholes.

- Twenty-two (22) existing wells are identified within the subject property boundary.

- Seven (7) well records are constructed within limestone bedrock and the remainder are screened within the overburden aquifer or are unidentified.

- The wells in the general area have an average static water level of 19.0 mbgs and an average depth of 42.3 mbgs.

- Well ID 7172324 corresponds to a cluster of seven (7) monitoring wells with depths ranging from 6.1 mbgs to 30.5 mbgs installed 2011 and are located along Duffy's Lane.

- The well records of the area indicate the surficial material of the study area is primarily brown silty clay covering grey silty clay.

4.2 Groundwater Properties

A review of available groundwater reports and studies indicates that regional groundwater flow in the Humber River Watershed flows in a southeasterly direction towards Lake Ontario (TRCA, 2008b). Local deflections in flow direction occur at major topographic changes and buried channels. Therefore, the direction of shallow groundwater flow across the subject lands is interpreted to follow topography be northwest to southeast across the site towards the tributaries of the Humber River.

In 2004 and 2005, TRCA conducted groundwater sampling at a number of monitoring well locations within the Provincial Groundwater Monitoring Network (PGMN) to establish a groundwater quality baseline across Ontario. The results of the 2004-2005 testing noted elevated levels of iron (Fe), hardness, total dissolved solids (TSS), total manganese (Mn) and total phosphorus (P) in the area around the subject lands (TRCA, 2008b). Elevated levels of manganese and hardness are noted to be naturally occurring within the Humber Watershed. Concentrations of TSS and iron could be elevated in groundwater based on sampling methods during the groundwater sampling program.

The Ontario Drinking Water Standards (ODWS) outline the standards for iron and manganese as operational guidelines for water system operators. Thus, elevated concentrations of manganese and iron in groundwater not pose a risk related to human health. Elevated hardness values are reported in the region (<200 mg/L) which the ODWS classifies as an aesthetic objective as it creates scaling within plumbing fixates.

4.3 Aquifer Properties

The hydrostratigraphic framework of the Humber River Watershed has been outlined by the TRCA in the Humber River State of the Watershed Report (2008b). Table 2 summarizes the hydrostratigraphy of the subject lands and surrounding area.

Table 2: Summary of Regional Hydrostratigraphy in the Humber River Watershed (TRCA, 2008b)

Layer	Name	Function	Material	Thickness (m)	Water Supply
Youngest - 1	Surficial Lacustrine Deposits	Aquitard	sand, silt, clay		
2	Halton Till	Aquitard	sandy silt to clayey silt till	3-6	
3	Oak Ridges Moraine Aquifer and Mackinaw Interstadial Deposits	Aquifer	gravel, sand, silt, clay	10-100	Domestic
4	Tunnel Channels	Aquifer	interbedded gravel and sand		Domestic, Town of Caledon
5	Newmarket Till	Aquitard	sand, silty sand, silt	1-60	
6	Thorncliffe Formation	Aquifer	sand, silty sand, silt, clay	1-60	
7	Sunnybrook Drift	Aquitard	silt, clay	10-20	
8	Scarborough Formation	Aquifer	silt, clay	1-60	
Oldest – 9	Weathered Bedrock	Aquifer	interbedded limestone and shale		

As shown in Table 2, within the Humber River Watershed, there are major aquifer complexes defined: the Oak Ridges Moraine Aquifer, the Thorncliffe Formation, and the Scarborough Formation. In isolated areas, the Tunnel Channel Aquifer exists within the area near the Laurentian Channel (TRCA, 2008b).

There are four well-based municipal drinking water systems in the Town of Caledon which are owned and operated by the Region of Peel. While there are also many privately owned wells in Caledon, regional water distributed to Bolton residents is drawn from Lake Ontario.

5.0 Field Work

Sections 5 and 6 outline the field investigation conducted by Crozier to date as part of this hydrogeological investigation. Please note that the results presented in Section 6 are primarily and supplemental data will be provided at a later date.

5.1 Monitoring Well Construction

From November 1 to November 11, 2021, Crozier staff supervised the drilling and installation of twenty (20) groundwater monitoring wells on the subject lands. The monitoring wells were constructed using 50 mm (2-in) Schedule 40 PVC pipe with #10 slot PVC screen. The monitoring well locations were selected to establish subsurface conditions for each parcel and create a detailed groundwater monitoring network (Figure 8)

All wells were constructed at a depth of 6.1 m and screened at 3.05 mbgs. Upon completion of drilling, water was found in twelve (12) of the twenty (20) wells. Static water levels ranged from

2.3 mbgs to 5.0 mbgs following drilling. The most common materials observed during drilling included silty clay, silty sand, sandy silt, and silt. Monitoring well logs are presented in Appendix A.

5.2 Groundwater Monitoring

At the time of preparation of this report, two (2) rounds of groundwater monitoring has been completed by Crozier since well installation. Manual measurements were collected using an electronic water meter. Automatic water level recording devices were deployed in eleven (11) of twenty (20) wells to collect a comprehensive dataset and predict seasonally high groundwater conditions. Level loggers were set to record water levels on an hourly basis. Results of the groundwater monitoring are presented in Section 6.1 below.

6.0 Results

6.1 Groundwater Levels

Manual measurements were collected from February 8 – February 24, 2022 and March 22, 2022 and are presented in Appendix C.

Observed groundwater levels range from 258.4 masl to 217.2 masl across the subject lands. Manual measurements are noted to be the highest in the centre of the subject lands (MW7, MW8 and MW9) and decrease to the northwest (MW18) and southeast (MW1).

Hydrographs displaying the automatic water levels measured since installation are presented in Appendix D. In general, water levels have increased in all wells with the exception of MW6 since installation. The water level in MW6 has remained consistent since February 8. On March 22 when the logger from MW6 was downloaded, a significant amount of sediment was noted on the equipment. Given this observation, it is likely that there was sediment at the bottom of the well and the water level was not permitted to fluctuate normally within the monitor. The logger was removed, and the monitoring well was developed until approximately 3 well volumes were removed from the well.

Precipitation data from the King City Climate Data Station (Environment Canada, 2022) is plotted on each hydrograph. Large, sharp upward water level trends in the graph found at MW3, MW9 MW15 and MW20, corresponding to 5 mm and greater rainfall events. The remainder of the hydrographs display a gradual upward trend and the response to rainfall event is minimal. The difference between wells and individual precipitation response could be attributed to heterogeneity of materials across all well locations and varying depths of water bearing material. However, it should be noted that the hydrographs in Appendix D display a data "snapshot" for approximately a one-month monitoring period. Therefore, the difference in precipitation response of the monitoring wells is likely to narrow over time and similar response trends across all wells should be seen.

All monitoring wells installed during the 2021 drilling program were installed within the first water bearing unit at each location. In all cases, the unit was grey silty clay to clayey silt with saturated seams of silt to sandy silt material, encountered at a depth ranging from approximately 2.0 mbgs to 3.5 mbgs. Given the confined to semi-confined nature of the water bearing unit, a slight increase in water levels due to spring thaw or precipitation events is expected.

Given the confined to semi-confined nature of the water bearing unit across the subject lands, it is anticipated that the water levels presented in Section 6 and Appendix C are not representative of the water table but a potentiometric surface. In other words, any excavation above the water bearing seams should not encounter groundwater. Therefore, groundwater during construction is

not expected to be encountered until a depth of approximately 2.0 mbgs to 3.5 mbgs. Further discussion of design constraints is presented in Section 8.

Figure 9 displays seasonally high groundwater contours to date and interpreted direction of groundwater flow. Based on current monitoring data, groundwater flow is interpreted to be from northwest to southeast across the subject lands.

Anticipated seasonally high water levels are presented in Section 8.0. Groundwater monitoring at all monitoring well locations is ongoing by Crozier throughout Spring 2022. A monitoring data update will be provided for review at a later date.

7.0 Site Water Balance Assessment

A site-wide water balance assessment was completed for the subject lands to determine the effect of the proposed development on pre-development infiltration conditions and design criteria for infiltration technologies in achieving site water balance. Please note following water balance assessment was completed using the most recent Concept Plan (Bousfields Inc. December 2021) and was completed for the entire study area. Water balance requirements for each landowner property should be reviewed at a detailed site plan level and mitigation methods should be tailored to the individual property use.

Table 3 below summarizes the results of the assessment. Detailed calculations are described in Section 7.1 to Section 7.4 and Appendix E.

Table 3: Summary of Site-Wide Water Balance Assessment

Pre-Development Infiltration Volume (m^3/yr)	**Post-Development Infiltration Volume without Mitigation** (m^3/yr)	**Infiltration Deficit** (m^3/yr)
199,128	73,526	125,602

7.1 Background Information

The water balance assessment was conducted in accordance with the accepted site condition values from Table 6.3 of the Urban Storm Drainage Criteria Manual: Volume 1 (Urban Drainage and Flood Control District, 2016) and Table 3.1 of the Stormwater Management Planning and Design Manual (MECP, 2003). The appropriate reference tables are provided in Appendix E.

The overall water balance of the subject lands can be described using the following equation:

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

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

The components of the water balance equation are estimated using field observations of drainage conditions, land cover, soil types, groundwater conditions and local climate records. The site-specific components of the water balance are discussed in detail in the sections below.

7.1.1 Precipitation (P)

The nearest climate station is located 2.6 km east of the study area and is known as Environment Canada Bolton North Climate Station Number 615S004 (43°55'00.00" N, 79°45'00.00" W, elevation of 261.0 masl). Monthly average precipitation and climate data from 1996 - 2001 was used to complete the water balance calculations for the subject lands. The long-term monthly average for precipitation and climate is shown in Table 4.

Table 4: Climate Data (1996-2001) for Bolton North Climate Station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Precipitation (mm)	70	53	60	56	86	113	73	74	78	40	54	62	**817**[1]
Temperature (°C)	-6.5	-4.2	0.7	6.2	13.1	18.3	19.7	19.4	15.5	8.9	2.3	- 2.8	**7.6**[2]

1. Total average annual precipitation from 1996 - 2001.
2. Average annual temperature from 1996 - 2001.

Therefore, based on the data above, the long-term annual average precipitation for the study area is **817 mm/year**.

7.1.2 Storage (S)

Long-term groundwater storage is assumed to be negligible as no evidence of groundwater impact on significant groundwater pumping or withdrawal is noted in regional studies of the area. The seasonal changes in water levels are expected to balance annually.

7.1.3 Evaporation/Evapotranspiration (ET)

The rate of evapotranspiration is a function of the water holding capacity of the soil, soil and vegetation type and overall land cover. Using a soil moisture balance approach and local climate data, the Potential Evapotranspiration (PET) and the Actual Evapotranspiration (AET) at the subject lands can be calculated (see Appendix E). PET refers to a loss of water to the atmosphere given an unlimited water supply. The AET is generally found to be less than the PET due to local climate effects such as soil moisture deficit in the summer months. Therefore, based on local climate conditions the mean annual actual evapotranspiration (AET) is calculated to be **595 mm/year.**

7.1.4 Water Surplus (R + I)

The difference between mean annual precipitation (P) and mean annual actual evapotranspiration (AET) outputs the amount of water surplus for the site. The water surplus either infiltrates (I) into the soil or travels across the site as runoff (R).

The distribution of water that infiltrates into the soil is a function of an infiltration factor as described in Table 3.1 of the Stormwater Management Planning and Design Manual (MECP, 2003). The study area was divided into two separate land use categories—agricultural/residential and woodlot. A separate infiltration factor was assigned to each land use and applied in the calculations (see Table 1 & Table 2 in Appendix E).

The infiltration factor for the agricultural land of the subject lands is assumed to be 0.50 based on topographic factor of 0.2 for rolling land, a soils factor of 0.2 for silty soils and a land cover factor of 0.1 for agricultural lands. The calculated water surplus available for infiltration and for runoff is approximately **222 mm/year.** Using the infiltration factor according to MECP methodology, the

potential infiltration and potential runoff are **111 mm/year** and **111 mm/year** respectively. Temperature is in independently considered in determining evapotranspiration and is excluded from determination of potential infiltration and potential runoff.

The infiltration factor for woodlots was determined to be 0.6, based on a topographic factor of 0.2 for rolling land, a soils factor of 0.2 for silty soils and a land cover factor of 0.2 for forested areas. Therefore, using MECP methodology, the potential infiltration and potential runoff, independent of temperature, are **133 mm/year** and **89 mm/year** respectively.

7.2 Methodology

Using monthly soil-moisture calculations, the pre-development infiltration and runoff volumes were determined for the existing area conditions. This method assumes that the soil does not release water as potential recharge while a soil moisture deficit exists. In the wet season, excess precipitation first restores soil moisture than infiltrates through the soil and is considered indirect runoff or soil recharge.

A soil moisture capacity of 200 mm was assigned to the agricultural areas and 400 mm was used for the wooded areas of the study area using Table 3.1 of the Stormwater Management and Design Manual (MECP, 2003). The soil moisture capacity values were chosen based on soil type and land use. Using 200 mm of retention for agricultural lands and 400 mm of retention for forested lands, the monthly potential evapotranspiration (PET) was calculated using latitude and temperature conditions. The actual evapotranspiration (AET) and water surplus was calculated based on monthly average precipitation and soil moisture conditions. The water balance components were used to estimate the pre-development and post-development water balance scenarios for the entire study area. Detailed water balance calculations for the site are presented in Appendix E.

7.3 Pre-Development Infiltration

Using aerial imagery, the existing land use areas for the subject lands were determined. An impervious fraction was assigned to each area based on Table 3.1 of the Stormwater Management and Design Manual (MECP, 2003) and field observations (Table 5). Please note the land use areas were estimated using satellite imagery available through Region of Peel GIS mapping and have been rounded up in some cases to represent a more conservative estimate of pre-infiltration volumes.

Table 5: Existing Land Use

Land Use	Impervious Fraction	Approximate Land Area (m^2)
Agricultural Lands	0.00	1,507,825
Existing Infrastructure and Driveways/Parking	1.00	27,960
Wooded Areas	0.02	229,891
Existing Water Features (ponds, streams)	0.02	20,025

The pre-development water balance calculations are presented in Table 3 of Appendix E. Based on the water balance components, the pre-development infiltration value for the subject lands is calculated to be approximately **199,128 m^3/year.**

7.4 Post-Development Infiltration

The proposed development plan is presented in the Concept Plan prepared by Bousfields Inc. dated December 20, 2021. Table 6 describes the proposed land uses and total areas across the subject lands based on the most recent Concept Plan. Each land use was assigned an impervious fraction using Table 3.1 of the Stormwater Management and Design Manual (MECP, 2003). Please note the land uses have been assigned a maximum impervious fraction. It is the opinion of Crozier that the estimated post-development infiltration volume calculated is conservative.

Table 6: Proposed Land Use (Bousfields Inc., December 2021)

Land Use	Approximate Land Area (m^2)	Quantity (number of units)	Impervious Fraction
Low Density Residential [1]	460,400	1554	0.45
Medium Density Residential [2]	260,800	1334	0.65
High Density Residential [3]	182,900	1248	0.85
Commercial	15,500	2	0.85
Schools	49,000	2	0.55
Parks	103,000	7	0.15
Open Space [4]	39,200	2	0.00
Woodlot	41,000	1	0.02
Roads	537,500	-	1.00
SWM Ponds	96,400	11	0.04

1. Assumed to represent single home dwellings of lot size 0.25 ha to 0.75 ha.
2. Includes townhomes of lot size < 0.25 ha.
3. Includes back-to-back townhomes and apartment buildings.
4. Includes elevated tank area.

The post-development drainage is proposed to mimic existing conditions and is discussed further in Servicing and Stormwater Management Report prepared by Crozier (December 2021).

Based on the water balance components above, the calculated post-development infiltration volumes are estimated to be **73,526 m^3/year** across the subject lands, creating an infiltration deficit of **125,602 m^3/yr**. Without any mitigation methods implemented, the proposed development has the potential to reduce infiltration by **63%** compared to pre-development conditions.

An analysis of potential low impact development structures and technologies was prepared by Crozier (under separate cover) to provide options for addressing the infiltration deficit and achieve overall water balance across the subject lands. The options analysis is presented in the Functional Servicing and Stormwater Management Report prepared by Crozer dated December 17, 2021. Details of the proposed low impact development measures will be provided as the Concept Plan is refined and further details of each proposed development is provided.

8.0 Design Considerations

Groundwater monitoring is ongoing and seasonally high conditions will be reviewed following the end of the monitoring period.

As previously discussed, seasonally high groundwater elevations across the subject lands are estimated to range from 2.0 mbgs – 3.5 mbgs or at an elevation of 258.6 masl to 269.7 masl based on the confined to semi-confined nature of the water bearing unit. Anticipated seasonally high groundwater elevations across the subject lands with respect to the proposed stormwater

management ponds is presented in Table 7. Please note that Table 7 should be used for preliminary design purposes only. Estimated seasonally high groundwater elevations in Table 7 below are subject to change following the end of the data collection period.

Table 7: Anticipated Seasonally High Groundwater Elevations

SWM Pond Identity[1]	**Nearest Monitoring Well**	**Estimated Seasonally High Groundwater Elevation for Design Purposes** (masl)
200	MW20	260.7
201	MW18	257.3
202	MW18	257.3
203	MW19	260.4
204	MW16	261.2
205	MW8	262.8
208	MW9	263.3
209	MW12/MW14	267.0
210	MW6	261.8
211	MW5	260.4
212	MW3	257.4

1. Refer to Preliminary Storm Drainage Plan Drawing C706 within the 2021 Functional Servicing and Stormwater Management Report prepared by Crozier dated December 2021 (under separate cover).

It is estimated that infiltration may decrease from 199,128 m^3/yr to 73,526 m^3/yr from pre- to post- development respectively. Given that regions of highly vulnerable aquifer and significant groundwater recharge area are noted within the subject property boundary, water balance must be achieved post-development to maintain pre-development conditions. Low impact development (LID) structures or alternative solutions should be implemented to mitigate the infiltration deficit of 125,602 m^3/yr. As previously mentioned, an LID options analysis was presented in the Functional Servicing and Stormwater Management Report prepared by Crozier (December 2021) submitted under a separate cover.

Given the estimated seasonally high groundwater elevations across the property, it is anticipated that construction dewatering and/or long-term dewatering may be required on the subject lands. Following the receipt of Spring 2022 groundwater data, dewatering estimates will be prepared and discussed within future submissions.

9.0 Conclusions

Based on the findings above, Crozier is prepared to make the following conclusions:

- The subject lands are characterized by silty clay to silt textured till derived from glaciolacustrine tills as identified by geological mapping, MECP well records, and Crozier staff.
- A well records search identified 206 wells within 500 m of the subject lands. The wells are mainly used for domestic water supply and there have been no reported concerns of water quality or quantity issues.
- Locally, the shallow groundwater flow direction is interpreted to flow from northwest to southeast across the subject property towards the tributaries of the Humber River.
- The water bearing zones in the shallow aquifer are confined or semi confined in nature. Water is expected to be found at 2.0 – 3.5 mbgs and is being held in grey silty sand to silt seams.
- The seasonal high groundwater elevations are estimated to range from approximately 257 masl to 267 masl across the subject property. Note, seasonally high conditions will be revisited following receipt of Spring 2022 groundwater data.
- Based on the Concept Plan (Bousfields Inc. 2021), it is estimated that infiltration may decrease from 199,128 m^3/yr to 73,526 m^3/yr from pre- to post- development respectively. LID or alternate solutions to mitigate an infiltration deficit of 125,602 m^3/a must be explored to maintain pre-development conditions. Please note, design of LID structures is by others.
- It is anticipated that dewatering may be required for some of the proposed developments. Once Spring 2022 data has been analysed, basic construction dewatering, and long-term dewatering estimates will be prepared for the proposed developments.

Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Caitlyn MacPhee, E.I.T., GIT
Hydrogeology

C.F. CROZIER & ASSOCIATES INC.

Chris Gerrits, M.Sc., P.Eng.
Senior Project Manager

CM/MD/AL/cj

N:\700\708-Bolton NH Landowners Grp\3446-Bolton North Hill\Reports\2022.04.01 Hydrogeology\2022.04.01 - BNH Hydrogeology Report.docx

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APPENDIX A

Monitoring Well Logs

MONITORING WELL MW1-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 9948 Columbia Way, Bolton
DRILLING DATE 21/11/01
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0601388 4861570
COORD SYS UTM
SURFACE ELEVATION 265 masl
WELL TOC 0.81 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/01
CASING PVC
SCREEN PVC

COMMENTS Columbia Way parcel, near 'Columbia Way' Sign

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt seams, minor gravel		Very Stiff	264.5
1		SS 2.5 - 4.5ft	SS							264
1.5		SS 5.0 - 7.0ft	SS							263.5
2										263
2.5		SS 7.5 - 9.5ft	SS				CLAYEY SILT TILL: Brown, clayey silt till to silty clay till, minor gravel, dense, moist		Hard	262.5
3										262
3.5		SS 10.0 -12.0ft	SS							261.5
4										261
4.5		SS 15.0 - 17.0ft	SS							260.5
5										260
5.5							SILTY CLAY: Grey, silty clay, moist, dense, minor gravel, seam		Very Stiff	259.5
6										259
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			258.5
7	AU									258
7.5										257.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW2-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 9948 Columbia Way, Bolton
DRILLING DATE 21/11/01
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0601218 4861366
COORD SYS UTM
SURFACE ELEVATION 263 masl
WELL TOC 0.89 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/01
CASING PVC
SCREEN PVC

COMMENTS Corner of Columbia Way and Mount Hope Road

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt seams, minor gravel, @3.05m grey silty clay		Very Stiff	262.5
1		SS 2.5 - 4.5ft	SS							262
1.5		SS 5.0 - 7.0ft	SS							261.5
2										261
2.5		SS 7.5 - 9.5ft	SS							260.5
3		SS 10.0 -12.0ft	SS							260
3.5										259.5
4							CLAYEY SILT TILL: Grey, clayey silt till to silty clay till, minor gravel, dense, moist			259
4.5		SS 15.0 - 17.0ft	SS							258.5
5							SILTY CLAY: Grey, silty clay, moist, dense, grey clay seam @6.10m			258
5.5									Stiff	257.5
6										257
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			256.5
7	AU									256
7.5										255.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW3-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Mount Hope Road, Bolton
DRILLING DATE 21/11/02
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0600800 4861761
COORD SYS UTM
SURFACE ELEVATION 265 masl
WELL TOC 0.91 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/02
CASING PVC
SCREEN PVC

COMMENTS Behind "No Trespassing" Sign

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt seams, minor gravel		Very Stiff	264.5
1		SS 2.5 - 4.5ft	SS							264
1.5		SS 5.0 - 7.0ft	SS							263.5
2										263
2.5		SS 7.5 - 9.5ft	SS							262.5
3	AU	SS 10.0 -12.0ft	SS							262
3.5										261.5
4							SILTY CLAY: Grey, silty clay, moist, dense, grey clay seams			261
4.5		SS 15.0 - 17.0ft	SS	▽				Wet	Stiff	260.5
5										260
5.5										259.5
6										259
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			258.5
7										258
7.5										257.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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MONITORING WELL MW4-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Lot 12, Concession 7, Albion
DRILLING DATE 21/11/11
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0600161 4861208
COORD SYS UTM
SURFACE ELEVATION 261 masl
WELL TOC 0.99 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/10
CASING PVC
SCREEN PVC

COMMENTS Near tree line, mid field near stream

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, medium dense, minor gravel		Medium	260.5
1		SS 2.5 - 4.5ft	SS							260
1.5		SS 5.0 - 7.0ft	SS				SILTY SAND: Brown, silty sand, saturated	Wet		259.5
2										259
2.5		SS 7.5 - 9.5ft	SS				SILTY CLAY: Brown, silty clay, grey silty clay seams, medium dense, moist, trace gravel	Moist		258.5
3	AU	SS 10.0 -12.0ft	SS	▽			SILTY SAND: Brown, silty sand, saturated	Wet		258
3.5										257.5
4							SILTY CLAY: Grey, silty clay, trace gravel	Moist		257
4.5		SS 15.0 - 17.0ft	SS							256.5
5										256
5.5										255.5
6										255
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			254.5
7										254
7.5										253.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW5-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Lot 12, Concession 7, Albion
DRILLING DATE 21/11/02
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0600122 4861032
COORD SYS UTM
SURFACE ELEVATION 264 masl
WELL TOC 0.97 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/02
CASING PVC
SCREEN PVC

COMMENTS Near High School scoreboard, North of fence

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0	AU			▽			TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt seams, minor gravel		Very Stiff	263.5
1		SS 2.5 - 4.5ft	SS							263
1.5		SS 5.0 - 7.0ft	SS							262.5
2										262
2.5		SS 7.5 - 9.5ft	SS							261.5
3		SS 10.0 -12.0ft	SS							261
3.5										260.5
4							SILT: Grey, silt, minor sand, saturated, 1.2 m seam	Wet	Medium	260
4.5		SS 15.0 - 17.0ft	SS							259.5
5							SILTY CLAY: Grey, silty clay, stone poor, moist	Moist	Stiff	259
5.5										258.5
6										258
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			257.5
7										257
7.5										256.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW6-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Lot 12, Concession 7, Albion
DRILLING DATE 21/11/02
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599914 4860896
COORD SYS UTM
SURFACE ELEVATION 264 masl
WELL TOC 0.98 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/02
CASING PVC
SCREEN PVC

COMMENTS North edge of field behind autoshop

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0	AU						TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	264
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt seams, minor gravel		Very Stiff	263.5
1		SS 2.5 - 4.5ft	SS							263
1.5										262.5
2		SS 5.0 - 7.0ft	SS							262
2.5		SS 7.5 - 9.5ft	SS							261.5
3										261
3.5		SS 10.0 -12.0ft	SS				SILT: Grey, silt, minor sand, saturated, approximately 0.60 m seam	Wet	Medium	260.5
4							SILTY CLAY: Grey, silty clay, stone poor, moist	Moist	Very Stiff	260
4.5		SS 15.0 - 17.0ft	SS							259.5
5				▽						259
5.5										258.5
6										258
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			257.5
7										257
7.5										256.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW7-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14337 Highway 50, Bolton
DRILLING DATE 21/11/03
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599802 4861249
COORD SYS UTM
SURFACE ELEVATION 268 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/03
CASING PVC
SCREEN PVC

COMMENTS Garden centre field along fence line

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	268
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt, minor clay seams, minor gravel		Very Stiff	267.5
1		SS 2.5 - 4.5ft	SS							267
1.5		SS 5.0 - 7.0ft	SS							266.5
2							SANDY SILT: Grey, sandy silt, saturated, approximately 0.60 m seam	Wet	Medium	266
2.5		SS 7.5 - 9.5ft	SS				SILTY CLAY: Grey, silty clay, stone poor, moist	Moist	Stiff	265.5
3	AU	SS 10.0 -12.0ft	SS							265
3.5							SILT: Grey, silt minor sand, saturated	Wet	Medium	264.5
4										264
4.5		SS 15.0 - 17.0ft	SS							263.5
5										263
5.5							SILTY CLAY: Grey, silty clay, dense, moist	Moist	Stiff	262.5
6										262
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			261.5
7										261
7.5										260.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW8-21

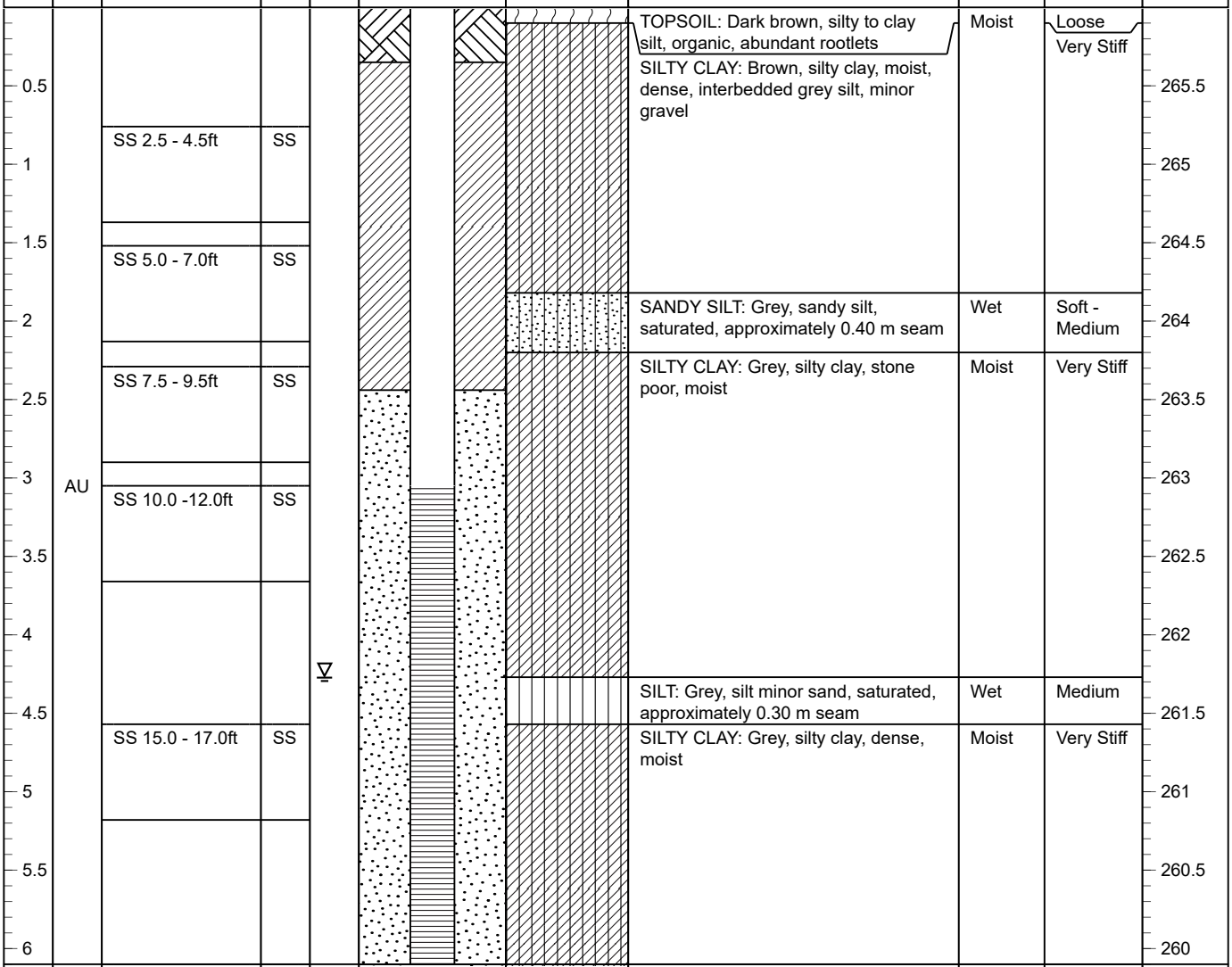
PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14337 Highway 50, Bolton
DRILLING DATE 21/11/03
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599628 4861023
COORD SYS UTM
SURFACE ELEVATION 266 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/03
CASING PVC
SCREEN PVC

COMMENTS Northwest corner of field near garden centre



Depth (m)	Drilling Method	Samples	Sample Type	Water	Material Description	Moisture	Consistency	Elevation (m)
0					TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5					SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt, minor gravel		Very Stiff	265.5
1		SS 2.5 - 4.5ft	SS					265
1.5		SS 5.0 - 7.0ft	SS					264.5
2					SANDY SILT: Grey, sandy silt, saturated, approximately 0.40 m seam	Wet	Soft - Medium	264
2.5		SS 7.5 - 9.5ft	SS		SILTY CLAY: Grey, silty clay, stone poor, moist	Moist	Very Stiff	263.5
3	AU	SS 10.0 -12.0ft	SS					263
3.5								262.5
4				▽				262
4.5		SS 15.0 - 17.0ft	SS		SILT: Grey, silt minor sand, saturated, approximately 0.30 m seam	Wet	Medium	261.5
5					SILTY CLAY: Grey, silty clay, dense, moist	Moist	Very Stiff	261
5.5								260.5
6								260
6.5		SS 20.0 - 22.0ft	SS		Termination Depth at:6.10 m			259.5
7								259
7.5								258.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW9-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14475 Highway 50, Bolton
DRILLING DATE 21/11/04
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599496 4861220
COORD SYS UTM
SURFACE ELEVATION 270 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/04
CASING PVC
SCREEN PVC

COMMENTS By existing barn, north edge of field

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt, minor gravel		Very Stiff	269.5
1		SS 2.5 - 4.5ft	SS							269
1.5		SS 5.0 - 7.0ft	SS							268.5
2										268
2.5		SS 7.5 - 9.5ft	SS							267.5
3	AU	SS 10.0 -12.0ft	SS				SILTY CLAY: Grey, silty clay, dense, moist			267
3.5										266.5
4										266
4.5		SS 15.0 - 17.0ft	SS	▽						265.5
5							SILT: Grey, silt minor sand, saturated, approximately 0.30 m seam	Wet	Soft - Medium	265
5.5							SILTY CLAY: Grey, silty clay, dense, moist	Moist	Very Stiff	264.5
6										264
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			263.5
7										263
7.5										262.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW10-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14475 Highway 50, Bolton
DRILLING DATE 21/11/04
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599679 4861517
COORD SYS UTM
SURFACE ELEVATION 263 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/04
CASING PVC
SCREEN PVC

COMMENTS South bank of pond in middle of property

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, interbedded grey silt, minor gravel		Very Stiff	262.5
1		SS 2.5 - 4.5ft	SS							262
1.5		SS 5.0 - 7.0ft	SS							261.5
2										261
2.5		SS 7.5 - 9.5ft	SS							260.5
3	AU	SS 10.0 -12.0ft	SS							260
3.5										259.5
4										259
4.5				▽			SILT: Grey, silt minor sand, saturated, approximately 0.30 m seam	Wet	Soft - Medium	258.5
		SS 15.0 - 17.0ft	SS				SILTY CLAY: Grey, silty clay, dense, moist	Moist	Very Stiff	
5										258
5.5										257.5
6										257
		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			
6.5										256.5
7										256
7.5										255.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW11-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14475 Highway 50, Bolton
DRILLING DATE 21/11/04
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599248 4861525
COORD SYS UTM
SURFACE ELEVATION 270 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/04
CASING PVC
SCREEN PVC

COMMENTS Northwest corner of property along fence line

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0	AU						TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	270
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel, trace sand		Very Stiff	267.5
1		SS 2.5 - 4.5ft	SS							267
1.5		SS 5.0 - 7.0ft	SS							266.5
2										266
2.5		SS 7.5 - 9.5ft	SS							265.5
3		SS 10.0 -12.0ft	SS							265
3.5										264.5
4				▽			SILTY CLAY: Grey, silty clay, dense, moist, trace gravel			264
4.5		SS 15.0 - 17.0ft	SS							263.5
5										263
5.5							SANDY SILT: Grey, silt minor sand, saturated, approximately 0.80 m seam	Wet	Soft - Medium	262.5
6										262
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			261.5
7										261
7.5										260.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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MONITORING WELL MW12-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14475 Highway 50, Bolton
DRILLING DATE 21/11/04
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599417 4861745
COORD SYS UTM
SURFACE ELEVATION 268 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/04
CASING PVC
SCREEN PVC

COMMENTS Edge of field, NE parcel, along fence line

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, moist, dense, minor gravel, trace sand		Very Stiff	267.5
1		SS 2.5 - 4.5ft	SS							267
1.5		SS 5.0 - 7.0ft	SS							266.5
2										266
2.5		SS 7.5 - 9.5ft	SS							265.5
3	AU	SS 10.0 -12.0ft	SS	▽			SANDY SILT: Grey, silt minor sand, saturated, approximately 0.80 m seam	Wet	Soft - Medium	265
3.5										264.5
4							SILTY CLAY: Grey, silty clay, dense, moist, trace gravel	Moist	Very Stiff	264
4.5		SS 15.0 - 17.0ft	SS							263.5
5							SILT: Brown to grey, silt, saturated	Wet	Medium	263
5.5							SILTY CLAY: Grey, silty clay, dense, moist, stone poor	Moist	Stiff	262.5
6										262
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			261.5
7										261
7.5										260.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

produced by ESlog.ESdat.net on 11 Feb 2022

MONITORING WELL MW13-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14685 Highway 50, Bolton
DRILLING DATE 21/11/08
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599098 4861591
COORD SYS UTM
SURFACE ELEVATION 270 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/08
CASING PVC
SCREEN PVC

COMMENTS Near farm silos

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel, trace sand		Very Stiff	269.5
1		SS 2.5 - 4.5ft	SS							269
1.5		SS 5.0 - 7.0ft	SS							268.5
2										268
2.5		SS 7.5 - 9.5ft	SS							267.5
3	AU	SS 10.0 -12.0ft	SS	▽						267
3.5							SILTY CLAY: Grey, silty clay, grey silty clay seams, dense, moist, trace gravel			266.5
4										266
4.5		SS 15.0 - 17.0ft	SS							265.5
5							SANDY SILT: Grey, silty sand to sandy silt, saturated, approximately 0.60 m seam	Wet	Medium	265
5.5							SILTY CLAY: Grey, silty clay to clay, dense, moist, trace gravel	Moist	Stiff	264.5
6										264
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			263.5
7										263
7.5										262.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW14-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14685 Highway 50, Bolton
DRILLING DATE 21/11/05
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0599114 4862349
COORD SYS UTM
SURFACE ELEVATION 269 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/05
CASING PVC
SCREEN PVC

COMMENTS Northeast corner of parcel along fence by woodlot and east cornfield

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0	AU						TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel, trace sand		Very Stiff	268.5
1		SS 2.5 - 4.5ft	SS							268
1.5		SS 5.0 - 7.0ft	SS							267.5
2				▽						267
2.5		SS 7.5 - 9.5ft	SS				SANDY SILT: Brown, silty sand to sandy silt, saturated, approximately 0.50 m seam	Wet	Medium	266.5
3		SS 10.0 -12.0ft	SS				SILTY CLAY: Brown, silty clay, dense, moist, trace gravel	Moist	Stiff	266
3.5										265.5
4							SANDY SILT: Brown, sandy silt, saturated, approximately 1 m	Wet	Medium	265
4.5		SS 15.0 - 17.0ft	SS							264.5
5							SILTY CLAY: Grey, silty clay to clay, dense, moist, trace gravel	Moist	Stiff	264
5.5										263.5
6										263
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			262.5
7										262
7.5										261.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW15-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14685 Highway 50, Bolton
DRILLING DATE 21/11/05
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598811 4861951
COORD SYS UTM
SURFACE ELEVATION 271 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/05
CASING PVC
SCREEN PVC

COMMENTS Northwest corner of the property, behind red brick

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel, trace sand		Very Stiff	270.5
1		SS 2.5 - 4.5ft	SS							270
1.5										269.5
2		SS 5.0 - 7.0ft	SS							269
2.5		SS 7.5 - 9.5ft	SS							268.5
3	AU			▽						268
3.5		SS 10.0 -12.0ft	SS				SANDY SILT: Brown, silty sand to sandy silt, saturated, approximately 0.50 m seam	Wet	Medium	267.5
4							SILTY CLAY: Brown, silty clay, grey silty clay seams, dense, moist, trace gravel	Moist	Stiff	267
4.5		SS 15.0 - 17.0ft	SS				SANDY SILT: Brown, sandy silt, saturated, approximately 0.2 m	Wet	Medium	266.5
5							SILTY CLAY: Grey, silty clay to clay, dense, moist, trace gravel	Moist	Stiff	266
5.5										265.5
6										265
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			264.5
7										264
7.5										263.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW16-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Hwy 50 and Hwy 150 Parcel
DRILLING DATE 21/11/08
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598956 4861168
COORD SYS UTM
SURFACE ELEVATION 268 masl
WELL TOC
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/08
CASING PVC
SCREEN PVC

COMMENTS Southwest corner of field by treeline

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel		Very Stiff	267.5
1		SS 2.5 - 4.5ft	SS							267
1.5										266.5
2		SS 5.0 - 7.0ft	SS							266
2.5		SS 7.5 - 9.5ft	SS							265.5
3	AU									265
3.5		SS 10.0 -12.0ft	SS							264.5
4										264
4.5		SS 15.0 - 17.0ft	SS				SILTY CLAY: Grey, silty clay, grey silty clay seams, dense, moist, trace gravel			263.5
5										263
5.5										262.5
6										262
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			261.5
7										261
7.5										260.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW17-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS Hwy 50 and Hwy 150 Parcel
DRILLING DATE 21/11/09
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598998 4861490
COORD SYS UTM
SURFACE ELEVATION 269 masl
WELL TOC 1.03 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/09
CASING PVC
SCREEN PVC

COMMENTS North of roundabout, northeast corner of property

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, dense, minor gravel		Very Stiff	268.5
1		SS 2.5 - 4.5ft	SS							268
1.5		SS 5.0 - 7.0ft	SS							267.5
2							SANDY SILT: Brown, sandy silt to silt, minor clay, saturated	Wet	Medium	267
2.5		SS 7.5 - 9.5ft	SS				SILTY CLAY: Brown, silty clay, grey silty clay to silt seams, moist, dense, minor gravel	Moist	Stiff	266.5
3	AU	SS 10.0 -12.0ft	SS				SILTY CLAY: Grey, silty clay, grey silty clay seams, dense, moist, trace gravel			266
3.5										265.5
4										265
4.5		SS 15.0 - 17.0ft	SS							264.5
5										264
5.5										263.5
6										263
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			262.5
7										262
7.5										261.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW18-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14601 Duffy's Lane
DRILLING DATE 21/11/09
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598210 4860598
COORD SYS UTM
SURFACE ELEVATION 261 masl
WELL TOC 1.03 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/09
CASING PVC
SCREEN PVC

COMMENTS Behind gravel area, willow farm

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, medium dense, minor gravel		Medium	260.5
1		SS 2.5 - 4.5ft	SS							260
1.5		SS 5.0 - 7.0ft	SS							259.5
2										259
2.5		SS 7.5 - 9.5ft	SS				CLAY: Grey clay, trace gravel, iron staining, moist, medium dense			258.5
3	AU									258
3.5		SS 10.0 -12.0ft	SS				SILTY CLAY: Grey, silty clay, grey silty clay seams, dense, moist, trace gravel		Stiff	257.5
4										257
4.5		SS 15.0 - 17.0ft	SS							256.5
5										256
5.5										255.5
6										255
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			254.5
7										254
7.5										253.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

MONITORING WELL MW19-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14601 Duffy's Lane
DRILLING DATE 21/11/10
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598395 4861011
COORD SYS UTM
SURFACE ELEVATION 262 masl
WELL TOC 0.95 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/10
CASING PVC
SCREEN PVC

COMMENTS South field, east fence at the start of south treeline

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, medium dense, minor gravel		Medium	261.5
1		SS 2.5 - 4.5ft	SS							261
1.5		SS 5.0 - 7.0ft	SS							260.5
2										260
2.5		SS 7.5 - 9.5ft	SS							259.5
3	AU	SS 10.0 -12.0ft	SS				SILTY CLAY: Grey, silty clay, grey silty clay seams, medium dense, moist, trace gravel			259
3.5										258.5
4										258
4.5		SS 15.0 - 17.0ft	SS							257.5
5										257
5.5										256.5
6										256
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			255.5
7										255
7.5										254.5

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MONITORING WELL MW20-21

PROJECT NUMBER 0708 - 3446
PROJECT NAME Bolton North Hill
CLIENT Bolton North Hill Landowner Group
ADDRESS 14601 Duffy's Lane
DRILLING DATE 21/11/10
LICENCE NO. 7725

DRILLING COMPANY ACE Environmental Drilling
DRILLER John/Nick
DRILL RIG GT3126 Geoprobe
DRILLING METHOD Augering Hollow Flight
TOTAL DEPTH 6.1 m
DIAMETER 51 mm

COORDINATES 17T 0598001 4861283
COORD SYS UTM
SURFACE ELEVATION 265 masl
WELL TOC 1.01 m
LOGGED BY CM
CHECKED BY CG

COMPLETION21/11/10
CASING PVC
SCREEN PVC

COMMENTS In between two iron posts northeast corner of the property

Depth (m)	Drilling Method	Samples	Sample Type	Water	Well Installation	Graphic Log	Material Description	Moisture	Consistency	Elevation (m)
0							TOPSOIL: Dark brown, silty to clay silt, organic, abundant rootlets	Moist	Loose	
0.5							SILTY CLAY: Brown, silty clay, grey silty clay seams, moist, medium dense, minor gravel		Medium	264.5
1		SS 2.5 - 4.5ft	SS							264
1.5		SS 5.0 - 7.0ft	SS							263.5
2										263
2.5		SS 7.5 - 9.5ft	SS							262.5
3	AU	SS 10.0 -12.0ft	SS							262
3.5							SILTY CLAY: Grey, silty clay, grey silty clay seams, medium dense, moist, trace gravel			261.5
4										261
4.5		SS 15.0 - 17.0ft	SS							260.5
5										260
5.5										259.5
6										259
6.5		SS 20.0 - 22.0ft	SS				Termination Depth at:6.10 m			258.5
7										258
7.5										257.5

Disclaimer This bore log is intended for environmental not geotechnical purposes.

APPENDIX B

MECP Well Summary Table

MECP WATER WELL RECORD SUMMARY TABLE

Project Number: 708-3446
Prepared by: MD

Address: Bolton North Hill Lands
Date completed: 2022-02-01

Key Number	Well ID	Diameter (mm)	Depth (m)	Static Level (m)	Material(s)	Aquifer[1]	Location[2]	Use	Notes
1	4900332	762	29.9	26.2	sand/sandy clay	OB	W of Highway 50	commercial	
2	7286178	51	12.2	-	sand/silt/clay	OB	W of Caledon King Townline	monitoring	
3	4904789	152	52.7	13.7	gravel/sand/clay	OB	E of Duffy's Lane	domestic	
4	4900283	168	47.5	21.3	sand/silt/clay	OB	W of Duffy's Lane	domestic/livestock	
5	4900477	127	54.9	40.8	sand/silt/clay	OB	W of Caledon King Townline	domestic	
6	4905726	127	55.5	18.3	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
7	7194829	159	48.8	24.1	sand/silt/clay	OB	S of Castlederg Side Rd	-	water supply
8	4910321	63	161.0	80.2	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
9	7224081	51	5.5	-	sand/silt	OB	E of Highway 50	monitoring	test hole
10	4905679	152	45.1	21.0	gravel/sand/clay	OB	E of Highway 50	domestic	
11	4910352	50	5.8	-	sand/silt/clay	OB	E of Mt Hope Rd	-	test hole
12	4906519	127	33.5	17.7	gravel/sand/silt/clay	OB	S of Mount Hope Rd	domestic	
13	4908660	152	52.7	21.3	gravel/sand/clay	OB	E of Mt Hope Rd	domestic	
14	4907928	203	59.4	14.6	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
15	4903434	762	10.4	4.3	sand/clay	OB	E of Humber Station Rd	domestic	
16	7104790	159	47.5	25.2	sand/silt/clay	OB	E of Highway 50	domestic/livestock	
17	4908023	152	43.0	22.9	sand/clay	OB	W of Highway 50	domestic	
18	4906535	127	54.3	25.3	sand/clay	OB	N of Castlederg Side Rd	domestic	
19	7264367	150	51.8	-	-	-	S of Castlederg Side Rd	-	abandoned
20	4900390	762	10.1	7.3	sand/clay	OB	S of Castlederg Side Rd	domestic	
21	4904464	127	47.2	19.8	sand/silt/clay	OB	W of Highway 50	domestic	
22	4909470	216	65.2	7.4	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
23	4909893	152	42.7	21.9	sand/clay	OB	W of Mt Hope Rd	domestic	
24	7172324	25	45.7	-	sand/clay	OB	W of Emily Kolb Pkwy	monitoring	test hole/cluster
25	4905187	152	34.1	16.1	sand/clay	OB	N of Castlederg Side Rd	monitoring	
26	4905297	127	33.5	22.6	gravel/sand/clay	OB	S of Columbia Way	domestic	
27	4907617	152	62.5	35.0	sand/silt/clay	OB	W of Caledon King Townline	domestic	
28	4900395	157	80.8	29.9	sand/clay	OB	N of Castlederg Side Rd	domestic	
29	4900388	102	64.0	24.4	sand/clay	OB	W of Mt Hope Rd	domestic/livestock	
30	4907963	152	57.3	25.6	sand/clay	OB	N of Castlederg Side Rd	domestic	
31	4904698	152	42.7	14.6	sand/clay	OB	W of Duffy's Lane	domestic	
32	4906317	152	49.1	25.9	gravel/sand/clay	OB	W of Highway 50	domestic/irrigation	
33	4905630	127	56.4	20.7	sand/clay	OB	W of Mt Hope Rd	domestic	
34	4904788	152	80.2	13.7	gravel/sand/clay	OB	E of Duffy's Lane	domestic	
35	4904097	127	52.1	25.6	sand/clay	OB	W of Highway 50	livestock	
36	7225352	152	25.6	1.0	sand/clay/shale	OB	S of Columbia Way	domestic	
37	7177341	100	39.8	25.9	gravel/sand/clay	OB	N of Castlederg Side Rd	-	abandoned
38	4900456	914	4.3	0.9	gravel/sand/clay	OB	E of Mt Hope Rd	domestic	
39	4904083	762	11.6	3.0	sand/clay	OB	W of Mt Hope Rd	domestic	
40	7164920	46	6.7	-	sand/silt/clay	OB	S of Columbia Way	monitoring	
41	4900281	102	39.0	0.9	gravel/sand/clay	OB	N of Castlederg Side Rd	domestic	
42	4903054	762	9.1	4.3	sand/clay	OB	E of Duffy's Lane	domestic	
43	4905801	152	51.8	21.0	sand/clay	OB	S of Castlederg Side Rd	domestic	
44	7133392	51	10.7	-	silt	OB	N of Emily Kolb Pkwy	monitoring	
45	7040135	152	15.2	-	-	-	E of Mt Hope Rd	-	abandoned
46	4900393	610	7.3	6.1	sand/clay	OB	N of Castlederg Side Rd	domestic	
48	4907092	152	44.2	18.9	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
49	4907329	152	46.3	14.6	sand/clay	OB	E of Duffy's Lane	domestic	
50	4906738	152	50.3	17.7	sand/silt/clay	OB	E of Highway 50	domestic	
51	4907401	152	60.7	18.3	gravel/silt/clay	OB	N of Castlederg Side Rd	domestic	
52	4900285	102	46.6	18.2	gravel/silt/clay	OB	N of Castlederg Side Rd	domestic	
53	4900331	127	51.8	-	sand/clay	OB	W of Highway 50	domestic	
54	4908373	76	43.3	-	-	-	W of Highway 50	-	abandoned
56	4903668	127	52.4	28.0	sand/silt/clay	OB	W of Caledon King Townline	domestic	
57	7234751	159	50.9	23.8	sand/silt/clay	OB	S of Castlederg Side Rd	-	water supply

Key Number	Well ID	Diameter (mm)	Depth (m)	Static Level (m)	Material(s)	Aquifer[1]	Location[2]	Use	Notes
58	7267797	159	30.5	11.9	sand/clay	OB	W of Duffy's Lane	domestic	
59	4910340	159	54.2	25.2	sand/silt/clay	OB	W of Highway 50	domestic/livestock	
60	7328807	51	10.1	-	sand/silt/clay	OB	W of Caledon King Townline	monitoring	
61	4904790	152	60.4	13.7	sand/clay	OB	E of Duffy's Lane	domestic	
62	4907637	152	71.6	18.3	gravel/sand/clay	OB	S of Castlederg Side Rd	domestic	
63	4910341	159	25.9	14.6	sand/clay	OB	W of Duffy's Lane	domestic	
64	4903446	127	49.7	19.8	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
65	7224105	52	6.1	-	sand/silt	OB	E of Highway 50	monitoring	test hole
68	4903254	914	6.7	1.5	sand/clay	OB	N of Castlederg Side Rd	domestic	
69	4907148	168	33.5	-	sand/clay	OB	S of Castlederg Side Rd	-	unfinished
70	4906158	152	93.0	24.7	sand/clay/shale	BR	N of Columbia Way	domestic	
71	4906292	762	24.4	6.1	sand/clay	OB	W of The Gore Rd	domestic	
72	4908590	203	52.4	39.3	sand/clay	BR	W of Caledon King Townline	domestic	
73	4903756	914	17.1	13.4	sand/clay	OB	W of Highway 50	domestic	
74	4900473	127	54.3	41.1	sand/silt/clay	OB	W of Caledon King Townline	domestic	
75	4905782	127	52.7	14.3	sand/silt/clay	OB	W of Duffy's Lane	domestic	
77	4907307	152	48.2	38.7	sand/silt/clay	OB	W of Caledon King Townline	domestic	
78	4905731	762	15.2	10.4	sand/clay	OB	N of Columbia Way	domestic	
79	4903260	127	65.5	28.6	sand/clay	OB	N of Castlederg Side Rd	domestic	
80	4907120	152	40.2	16.8	gravel/sand/clay	OB	S of Castlederg Side Rd	domestic	
81	4900385	102	49.4	36.6	sand/clay	OB	E of Highway 50	domestic/livestock	
82	4905852	127	68.6	21.0	sand/silt/clay	OB	W of Mt Hope Rd	domestic	
83	4904036	127	47.2	18.0	sand/clay	OB	W of Caledon King Townline	domestic	
84	4900328	102	40.2	26.2	sand/clay	OB	W of Highway 50	domestic	
85	4903836	914	15.2	-	-	-	W of Mt Hope Rd	-	abandoned
86	4908423	152	54.9	28.0	-	-	S of Columbia Way	-	abandoned
87	4906009	152	52.4	25.6	sand/clay	OB	W of Highway 50	domestic/livestock	
88	4905592	152	57.9	28.6	sand/silt/clay	OB	W of Caledon King Townline	domestic	
89	6909363	127	32.9	21.3	sand/clay	OB	E of Highway 50	domestic/livestock	
90	4905323	-	5.8	0.9	sand/silt/clay	OB	S of Columbia Way	domestic	
91	4900389	127	36.6	25.0	sand/clay	OB	E of Highway 50	domestic	
92	4903055	762	8.5	5.5	sand/clay	OB	N of Castlederg Side Rd	domestic	
93	4909027	159	37.5	21.9	sand/clay	OB	W of Mt Hope Rd	domestic	
94	4906971	152	49.4	36.6	sand/silt/clay	OB	W of Caledon King Townline	domestic	
95	7152393	90	6.7	1.5	gravel/sand/clay	-	S of Castlederg Side Rd	-	abandoned
96	4904387	762	11.6	6.1	sand/clay	OB	W of Duffy's Lane	domestic	
97	4908661	203	49.7	25.9	gravel/silt/clay	OB	S of Castlederg Side Rd	domestic	
98	4908820	203	42.7	20.1	gravel/sand/clay	OB	N of Castlederg Side Rd	irrigation	
99	4907729	152	64.9	28.0	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
100	4900324	152	73.2	-	silt/clay	-	W of Highway 50	-	abandoned
101	4908498	203	39.6	21.9	gravel/sand/clay	OB	E of Mt Hope Rd	domestic	
102	7224082	51	5.5	-	sand/silt	OB	E of Highway 50	monitoring	test hole
103	4907252	152	35.7	18.9	sand/clay	OB	S of Columbia Way	domestic	
104	7130482	51	7.6	-	silt/clay	OB	W of Caledon King Townline	monitoring	
105	4907993	152	68.3	16.8	sand/silt/clay	OB	Castlederg Side Rd	domestic	
106	4907913	152	22.6	5.2	sand/silt/clay	OB	S of Columbia Way	domestic	
107	4900386	102	57.0	34.4	gravel/sand/clay	OB	S of Columbia Way	domestic/livestock	
109	4907791	127	46.9	20.7	gravel/sand/clay	OB	W of Mt Hope Rd	domestic	
110	4908497	203	38.7	21.3	gravel/sand/clay	OB	E of Mt Hope Rd	domestic	
111	4904451	127	24.7	17.7	gravel/sand/clay	OB	E of Mt Hope Rd	domestic	
112	4903485	914	6.1	1.8	sand/clay	OB	N of Castlederg Side Rd	domestic	
113	4904760	152	56.4	12.2	sand/clay	OB	E of Duffy's Lane	domestic	
114	4903191	127	50.0	38.1	sand/clay	OB	W of Caledon King Townline	domestic	
115	4900447	762	4.3	0.9	sand/clay	OB	S of Columbia Way	domestic	
116	4902960	219	35.0	1.8	sand/silt/clay	OB	W of Caledon King Townline	public	
118	4907989	152	60.4	38.1	sand/clay	OB	W of Caledon King Townline	domestic	
119	7169000	125	7.2	1.9	-	-	E of Highway 50	-	abandoned
120	4900323	127	53.0	23.8	sand/clay	OB	S of Columbia Way	domestic	
122	4908855	159	63.4	21.3	sand/silt/clay	OB	N of Castlederg Side Rd	domestic	
123	7050089	159	51.8	15.2	sand/clay	OB	N of Castlederg Side Rd	domestic	

Key Number	Well ID	Diameter (mm)	Depth (m)	Static Level (m)	Material(s)	Aquifer[1]	Location[2]	Use	Notes
124	4904180	127	44.2	18.0	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
125	7190725	152	54.3	14.6	sand/silt/clay	OB	Castlederg Side Rd	domestic	
126	4906968	152	54.6	38.7	sand/clay	OB	W of Caledon King Townline	-	water supply
127	4900326	127	34.1	20.1	sand/silt/clay	OB	S of Emily Kolb Pkwy	domestic/livestock	
129	4905146	127	55.2	39.6	sand/silt/clay	OB	W of Caledon King Townline	domestic	
130	4904747	152	64.0	15.8	gravel/sand/clay/shale	BR	E of Mt Hope Rd	domestic	
131	4906536	127	52.7	16.5	sand/clay	OB	S of Castlederg Side Rd	domestic/livestock	
132	4906046	152	70.1	17.1	sand/silt/clay	OB	W of Mt Hope Rd	domestic	
133	4900330	133	44.2	15.2	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
134	4900451	762	19.2	14.9	sand/clay	OB	N of Columbia Way	domestic	
135	4906893	152	68.9	14.3	sand/silt/clay	OB	E of Duffy's Lane	domestic	
136	4904697	152	42.7	15.2	sand/clay	OB	W of Duffy's Lane	domestic	
138	4900392	127	47.2	19.2	sand/clay	OB	W of Highway 50	domestic	
139	4908856	159	73.5	16.1	sand/clay	OB	E of Highway 50	domestic	
140	4905966	762	12.2	3.0	sand/clay	OB	E of Highway 50	domestic	
141	7297324	51	3.0	-	clay	OB	S of Columbia Way	monitoring	
142	4906568	159	44.2	15.8	sand/silt/clay	OB	W of Mt Hope Rd	domestic	
143	4900472	762	12.2	9.1	sand/clay	OB	W of Caledon King Townline	domestic	
144	4903539	178	47.5	18.3	gravel/sand/clay	OB	W of Highway 50	domestic	
146	4900387	127	28.4	19.8	sand/clay	OB	E of Highway 50	domestic/livestock	
147	7224080	52	5.5	-	sand/silt/clay	OB	E of Highway 50	monitoring	test hole
148	4900474	127	54.0	32.6	sand/silt/clay	OB	W of Caledon King Townline	domestic	
149	4903681	127	50.6	15.5	gravel/sand/clay	OB	N of Castlederg Side Rd	domestic	
150	4904695	152	42.4	15.5	sand/clay	OB	W of Duffy's Lane	domestic	
151	4900448	762	19.8	-	-	-	S of Columbia Way	-	abandoned
152	4900391	127	44.8	24.4	sand	OB	E of Highway 50	domestic	
153	4909074	159	49.7	25.0	sand/silt/clay	OB	N of Emily Kolb Pkwy	domestic	
155	7254974	152	51.2	19.7	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
157	4903505	762	25.3	22.6	sand/clay	OB	N of Castlederg Side Rd	domestic	
158	4905203	762	8.8	4.3	sand/clay	OB	N of Castlederg Side Rd	domestic	
159	7234742	159	54.9	37.2	sand/clay	OB	W of Caledon King Townline	domestic	
160	4908816	203	43.9	19.8	sand/clay	OB	E of Mt Hope Rd	domestic	
161	4905705	127	57.0	26.5	sand/clay	OB	W of Highway 50	domestic	
162	4900280	178	42.7	19.8	sand/clay	OB	W of Duffy's Lane	domestic/livestock	
163	4909424	152	58.8	21.9	gravel/sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
164	4906569	152	47.2	12.8	sand/silt/clay	OB	W of Mt Hope Rd	domestic	
165	4900284	914	6.7	3.0	sand/clay	OB	S of Castlederg Side Rd	domestic	
166	4908477	152	59.7	25.0	gravel/sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
168	4904184	127	44.5	18.9	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
169	4903555	178	60.7	7.0	sand/clay	OB	N of Castlederg Side Rd	domestic	
170	7297325	51	3.0	-	clay	OB	S of Columbia Way	monitoring	test hole
172	4907328	152	66.5	21.3	sand/silt/clay	OB	W of Duffy's Lane	domestic	
173	4904696	152	42.7	14.6	sand/clay	OB	W of Duffy's Lane	domestic	
174	7185451	159	45.7	14.9	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
175	4900452	127	89.0	-	gravel/silt/clay/shale	BR	E of Mt Hope Rd	-	test hole
176	4900454	102	51.8	12.2	sand/clay	OB	E of Mt Hope Rd	domestic/livestock	
177	4900450	152	60.0	28.4	gravel/sand/clay	OB	S of Columbia Way	domestic	
179	4908731	152	59.7	24.1	silt/clay/shale/limestone	BR	S of Columbia Way	domestic	
180	4907557	152	72.8	24.4	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
181	4900329	168	47.2	19.8	sand/silt/clay	OB	E of Duffy's Lane	domestic/livestock	
182	4908819	203	33.5	18.6	sand/clay	OB	E of Mt Hope Rd	domestic	
183	4900327	102	37.2	18.3	sand/clay	OB	W of Highway 50	domestic	
185	4900453	51	57.6	-	gravel/silt/clay	OB	W of Caledon King Townline	-	test hole
186	4906769	152	33.5	1.8	sand/clay/shale	BR	S of Columbia Way	domestic	
187	4906552	152	57.9	17.1	sand/clay	OB	W of Highway 50	-	water supply
188	4900325	127	79.9	27.7	sand/clay	OB	W of Highway 50	public	
189	4908818	203	48.8	18.9	sand/clay	OB	E of Mt Hope Rd	domestic	
190	7154765	159	38.7	22.3	-	-	S of Castlederg Side Rd	-	abandoned
191	7269814	152	52.7	22.7	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
192	4904599	178	48.5	23.5	gravel/sand/clay	OB	S of Castlederg Side Rd	domestic	

Key Number	Well ID	Diameter (mm)	Depth (m)	Static Level (m)	Material(s)	Aquifer[1]	Location[2]	Use	Notes
194	7101984	158	54.3	31.5	sand/silt/clay	OB	E of Highway 50	domestic	
195	4903224	127	45.7	13.7	gravel/silt/clay	OB	W of Highway 50	domestic	
196	4908693	152	58.5	20.7	sand/silt/clay	OB	S of Castlederg Side Rd	domestic	
197	4907122	152	44.5	32.0	sand/silt/clay	OB	W of Caledon King Townline	domestic	
198	4900384	610	24.1	19.5	sand/clay	OB	S of Columbia Way	domestic	
199	4905068	152	46.9	20.4	sand/clay	OB	S of Castlederg Side Rd	domestic	
200	4906518	152	43.6	18.9	sand/silt/clay	OB	E of Mt Hope Rd	domestic	
202	4900279	762	18.3	9.1	sand/clay	OB	W of Duffy's Lane	domestic	
203	7151771	152	48.2	21.7	sand/clay	OB	S of Castlederg Side Rd	domestic	
204	4903155	762	6.7	2.4	clay	OB	S of Castlederg Side Rd	domestic	
205	4903328	762	14.0	-	clay	-	E of Mt Hope Rd	-	abandoned
206	4900449	127	64.0	27.4	clay/shale	BR	S of Columbia Way	domestic	

Data Source: Ministry of the Environment, Conservation, and Parks, retrieved February 1st, 2022.
1. OB = overburden aquifer BR = bedrock aqufier
2. Highlighted - well record identified within the subject lands

APPENDIX C

Manual Water Level Measurements

MANUAL WATER LEVELS

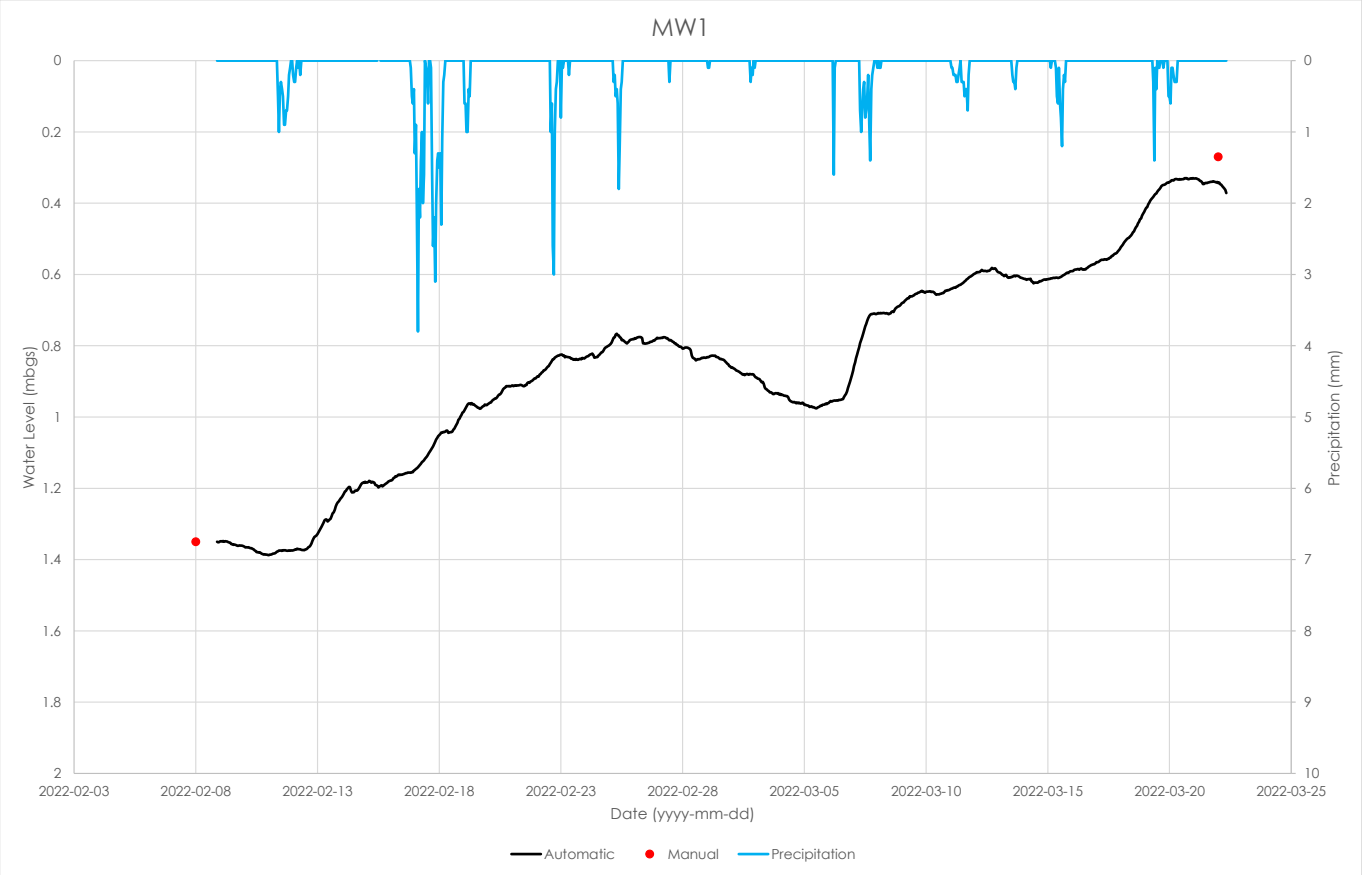
Project Number:	708-3446	Address:	Bolton North Hill Lands
Prepared by:	MD	Date completed:	2022-03-22
Checked by:	CM/CG		

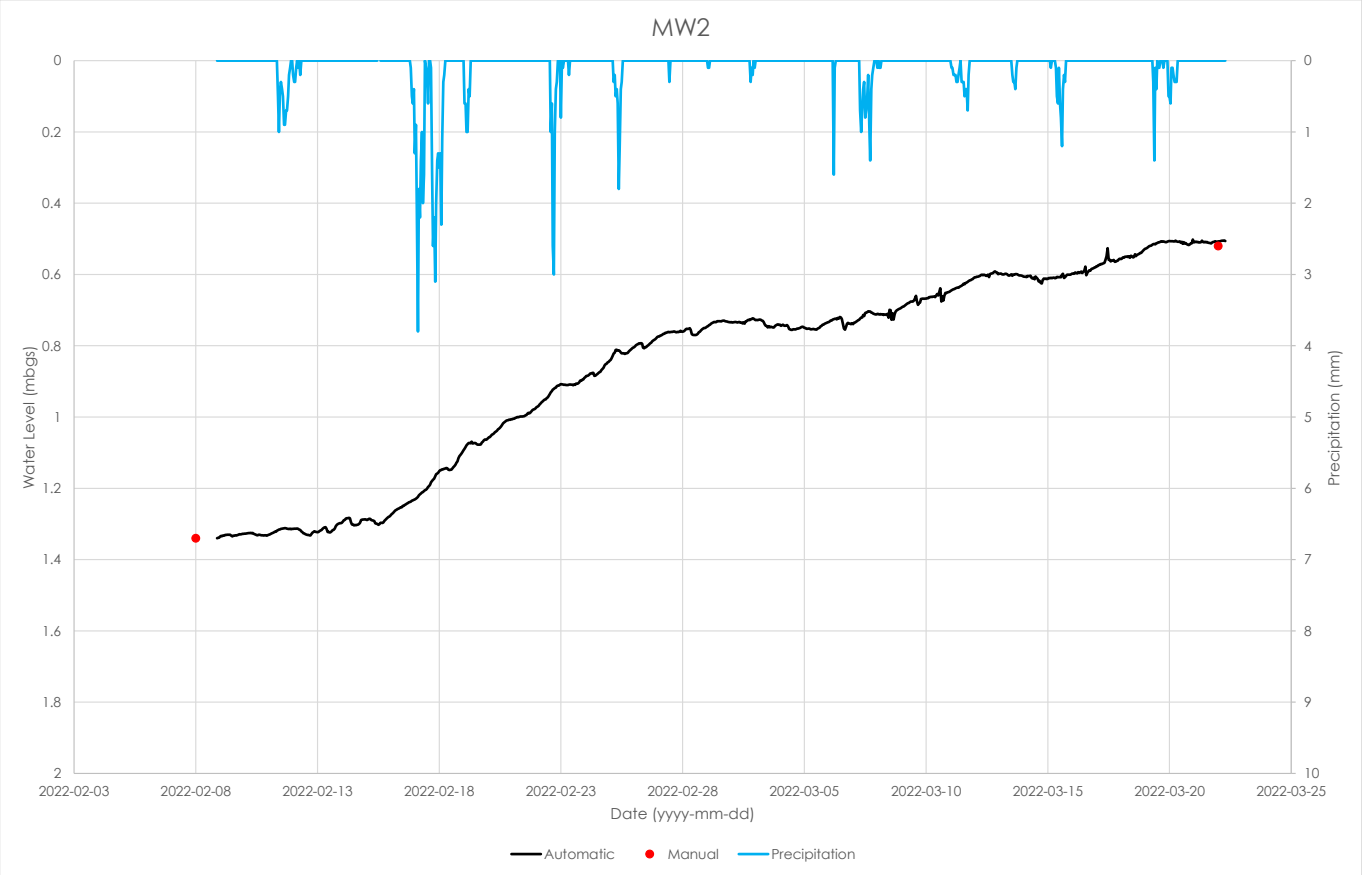
				February 8th - February 22nd 2022			March 22, 2022		
Monitoring Well	**Estimated Ground Elevation (masl)[1]**	**Depth (m)**	**Stick-Up (m)**	**Measured Water Level (m)**	**Water Level (mbgs)**	**Groundwater Elevation (masl)**	**Measured Water Level (m)**	**Water Level (mbgs)**	**Groundwater Elevation (masl)**
MW1-21	260.60	6.10	0.81	2.16	1.35	259.25	1.08	0.27	260.33
MW2-21	262.13	6.10	0.89	2.23	1.34	260.79	1.41	0.52	261.61
MW3-21	261.21	6.10	0.91	3.17	2.26	258.95	1.57	0.66	260.55
MW4-21	261.52	6.10	0.99	3.39	2.40	259.12	1.47	0.48	261.04
MW5-21	263.96	6.10	0.97	3.24	2.27	261.69	2.18	1.21	262.75
MW6-21	265.18	6.10	0.98	3.16	2.18	263.00	3.16	2.18	263.00
MW7-21	266.40	6.10	1.09	2.88	1.79	264.61	1.69	0.60	265.80
MW8-21	264.56	6.10	1.08	2.14	1.06	263.50	1.55	0.47	264.09
MW9-21	268.22	6.10	1.07	3.22	2.15	266.07	2.15	1.08	267.14
MW10-21	262.13	6.10	1.08	2.46	1.38	260.75	2.55	1.47	260.66
MW11-21	268.83	6.10	1.06	4.39	3.33	265.50	3.57	2.51	266.32
MW12-21	270.05	6.10	1.10	4.12	3.02	267.03	3.43	2.33	267.72
MW13-21	267.61	6.10	1.09	2.61	1.52	266.09	2.50	1.41	266.20
MW14-21	268.83	6.10	1.01	2.54	1.53	267.30	2.03	1.02	267.81
MW15-21	271.88	6.10	1.02	2.32	1.30	270.58	1.73	0.71	271.17
MW16-21	265.79	6.10	1.09	3.87	2.78	263.01	2.99	1.90	263.89
MW17-21	269.44	6.10	0.87	2.10	1.23	268.21	1.21	0.34	269.10
MW18-21	260.30	6.10	1.03	2.94	1.91	258.39	2.75	1.72	258.58
MW19-21	263.35	6.10	0.95	2.70	1.75	261.60	2.18	1.23	262.12
MW20-21	264.00	6.10	1.01	2.92	1.91	262.09	2.62	1.61	262.39

1. Estimated from Topographic Drone Survey completed by Drone Survey Canada in August 2021.

APPENDIX D

Hydrographs


MW1
Water Level (mbgs)
Precipitation (mm)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW2
Water Level (mbgs)
Precipitation (mm)
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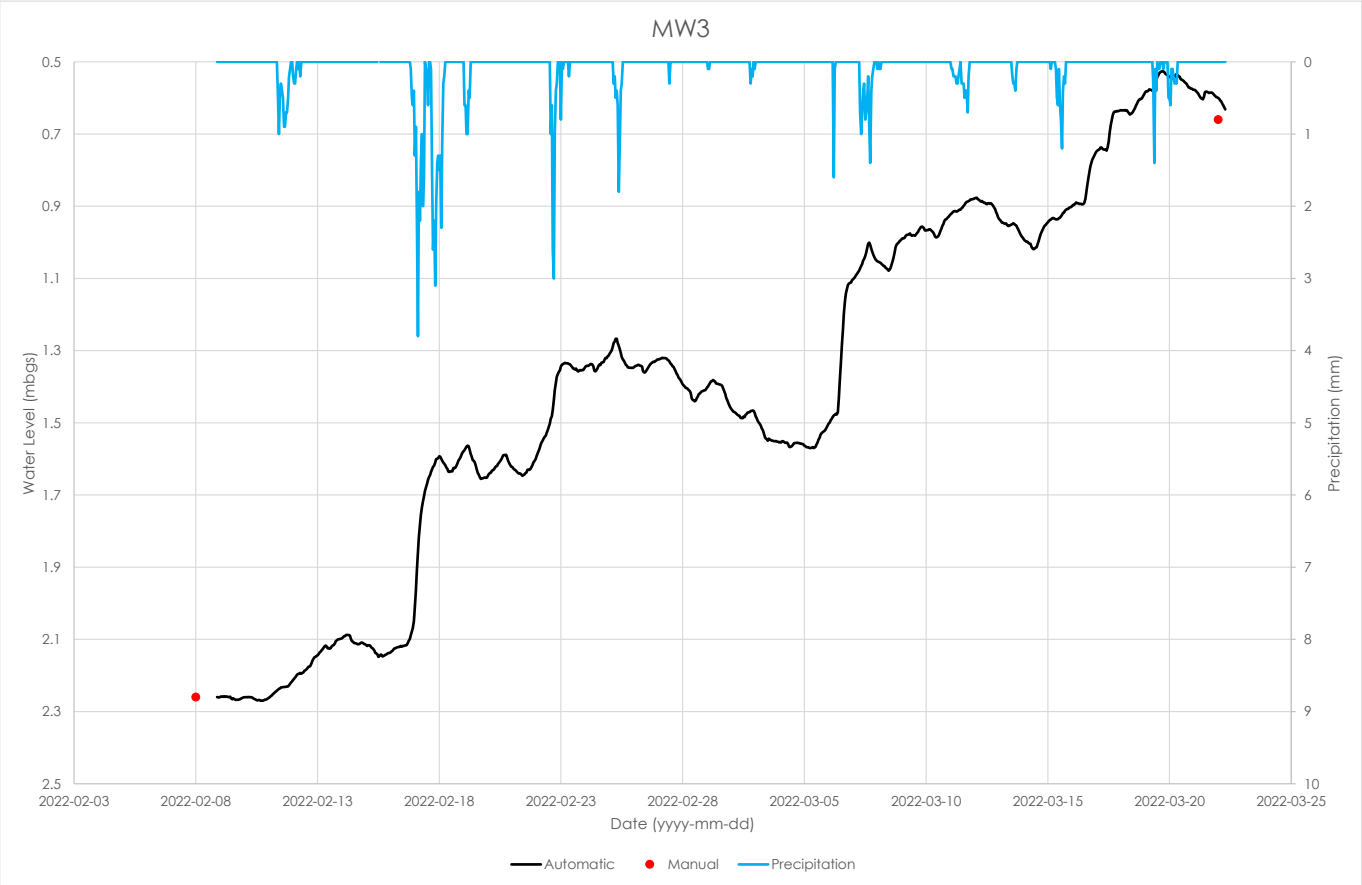
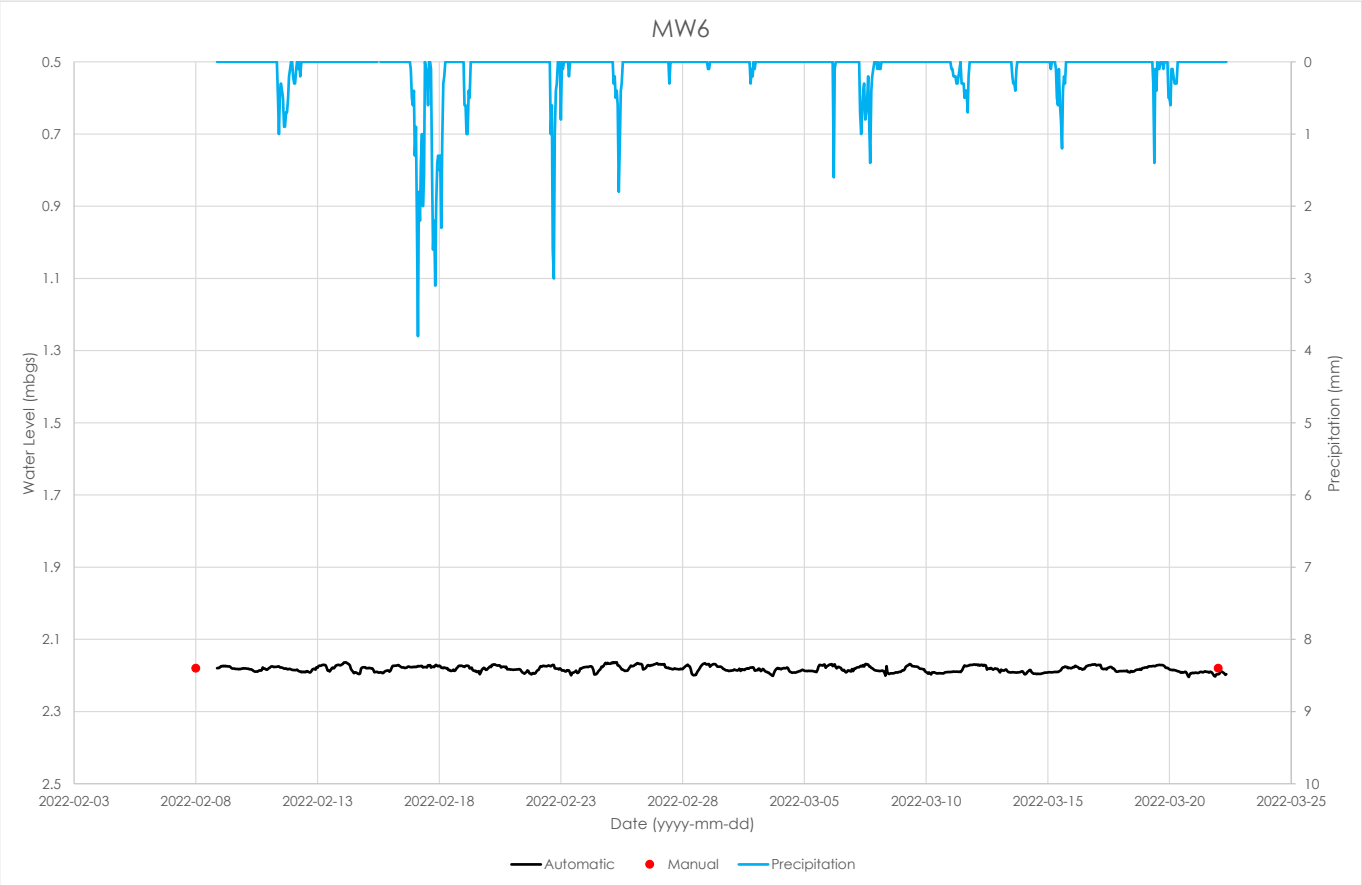
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW3
Water Level (mbgs)
0.5
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
2.5
Precipitation (mm)
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW6
Water Level (mbgs)
Precipitation (mm)
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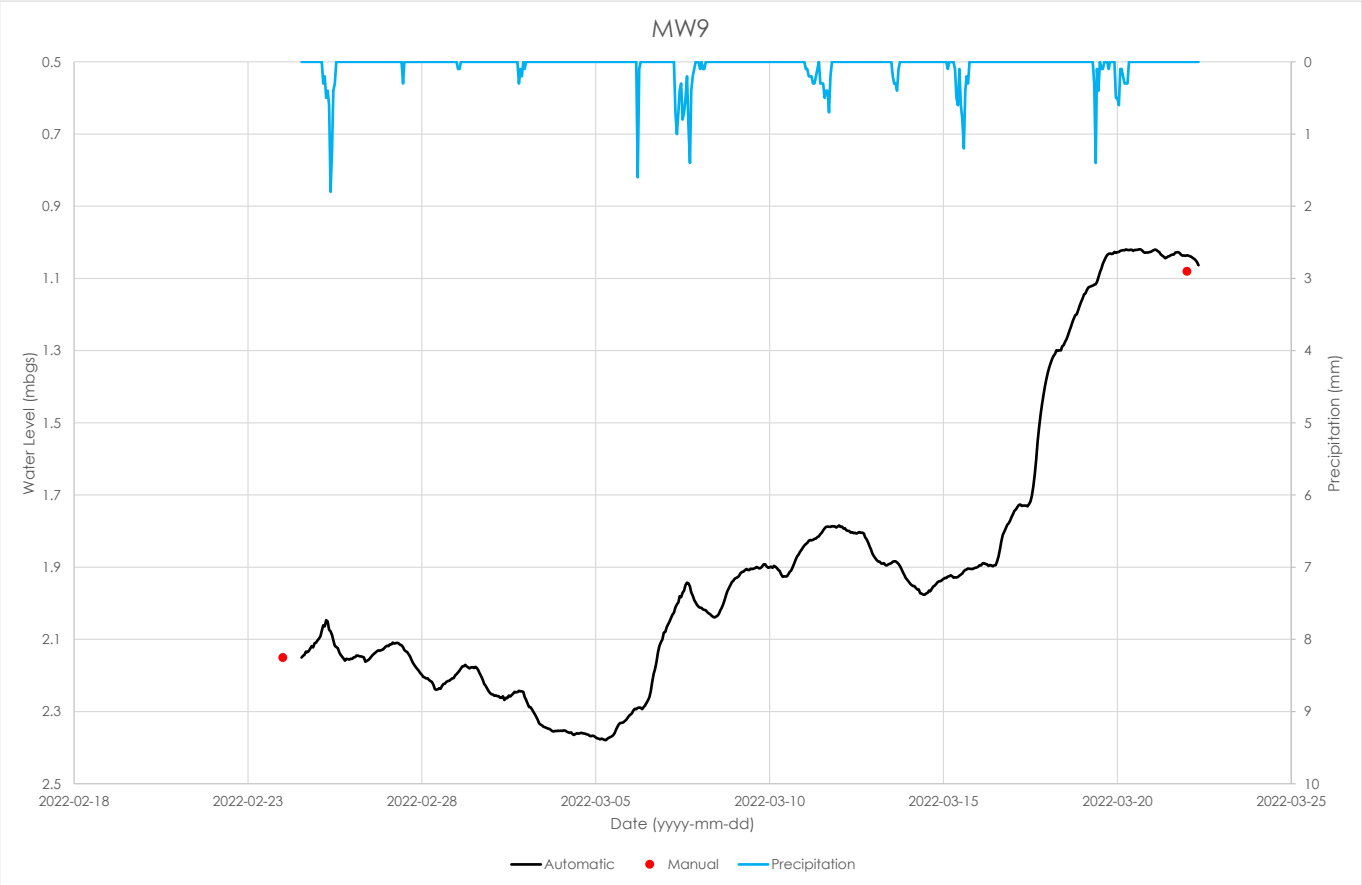
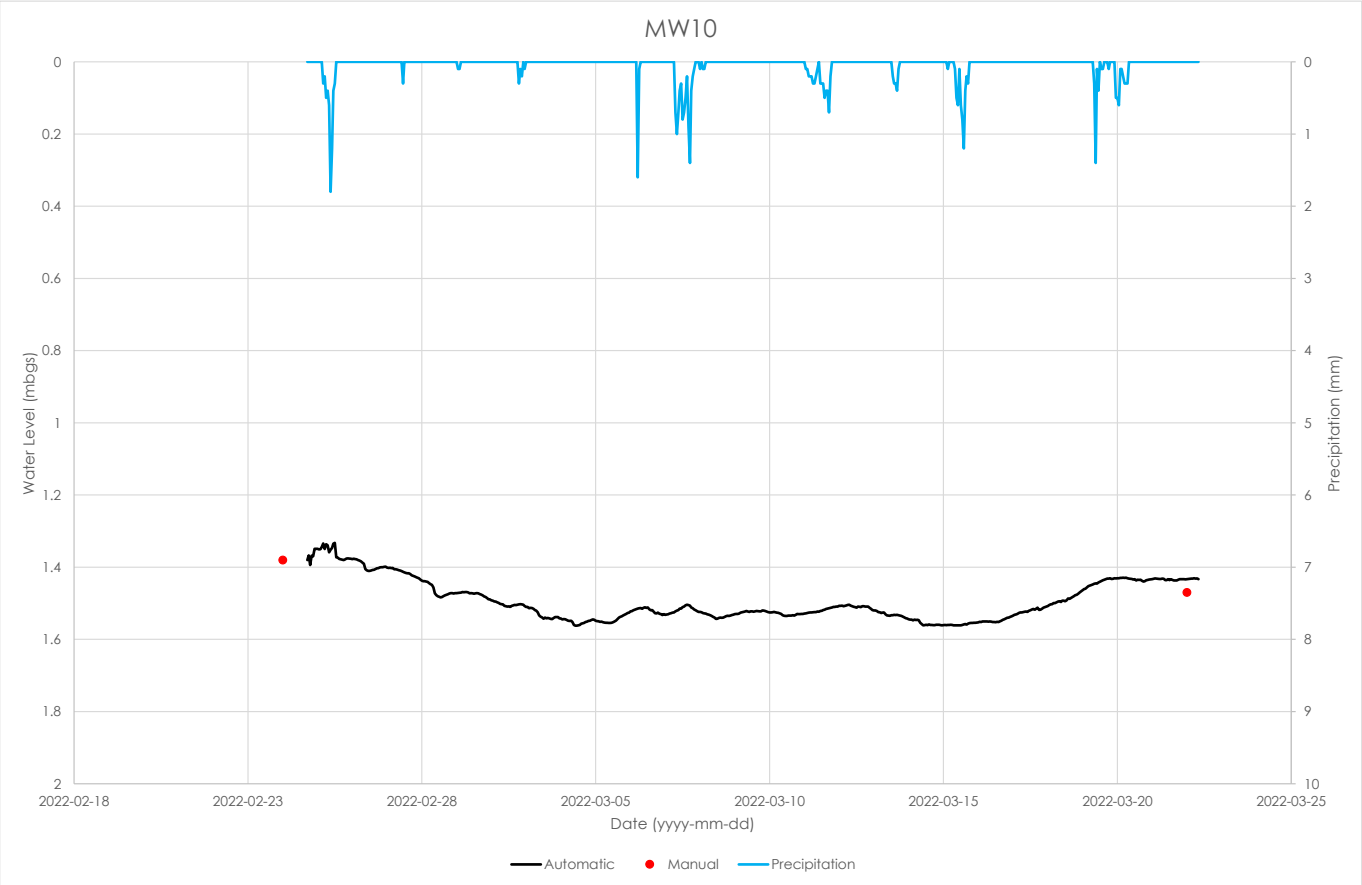
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
2.5
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW9
Water Level (mbgs)
0.5
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
2.5
Precipitation (mm)
0
1
2
3
4
5
6
7
8
9
10
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW10
Water Level (mbgs)
Precipitation (mm)
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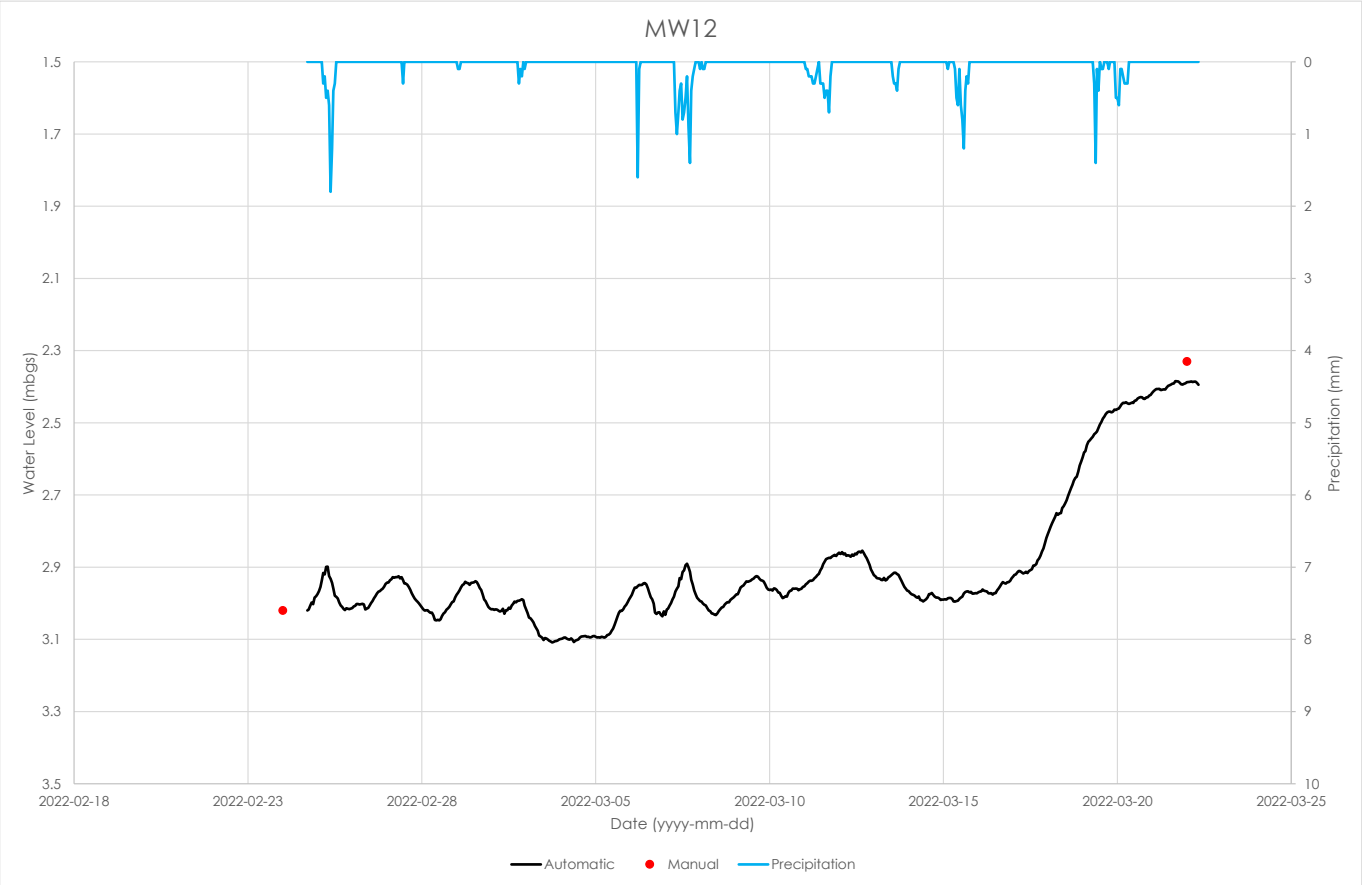
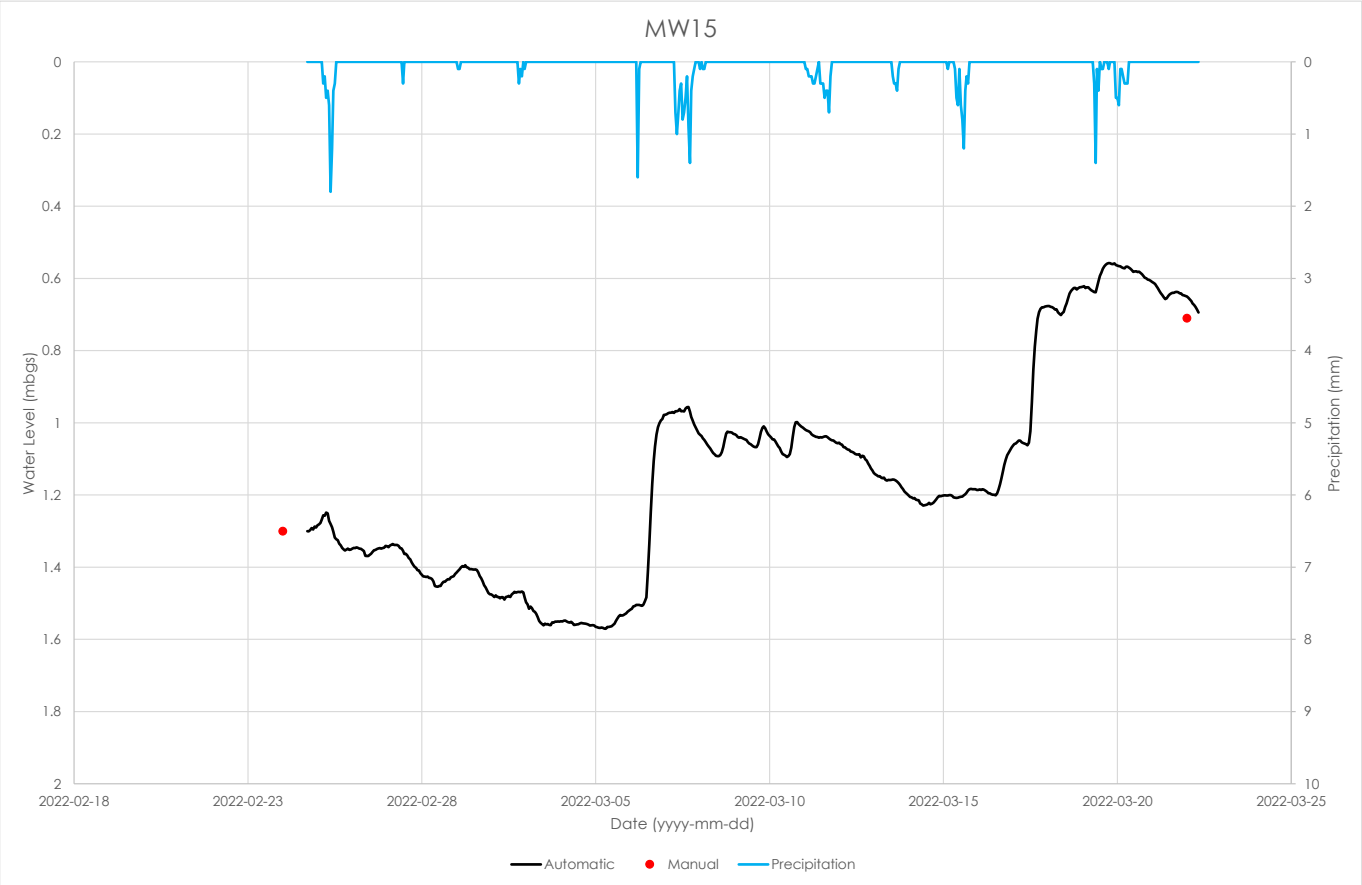
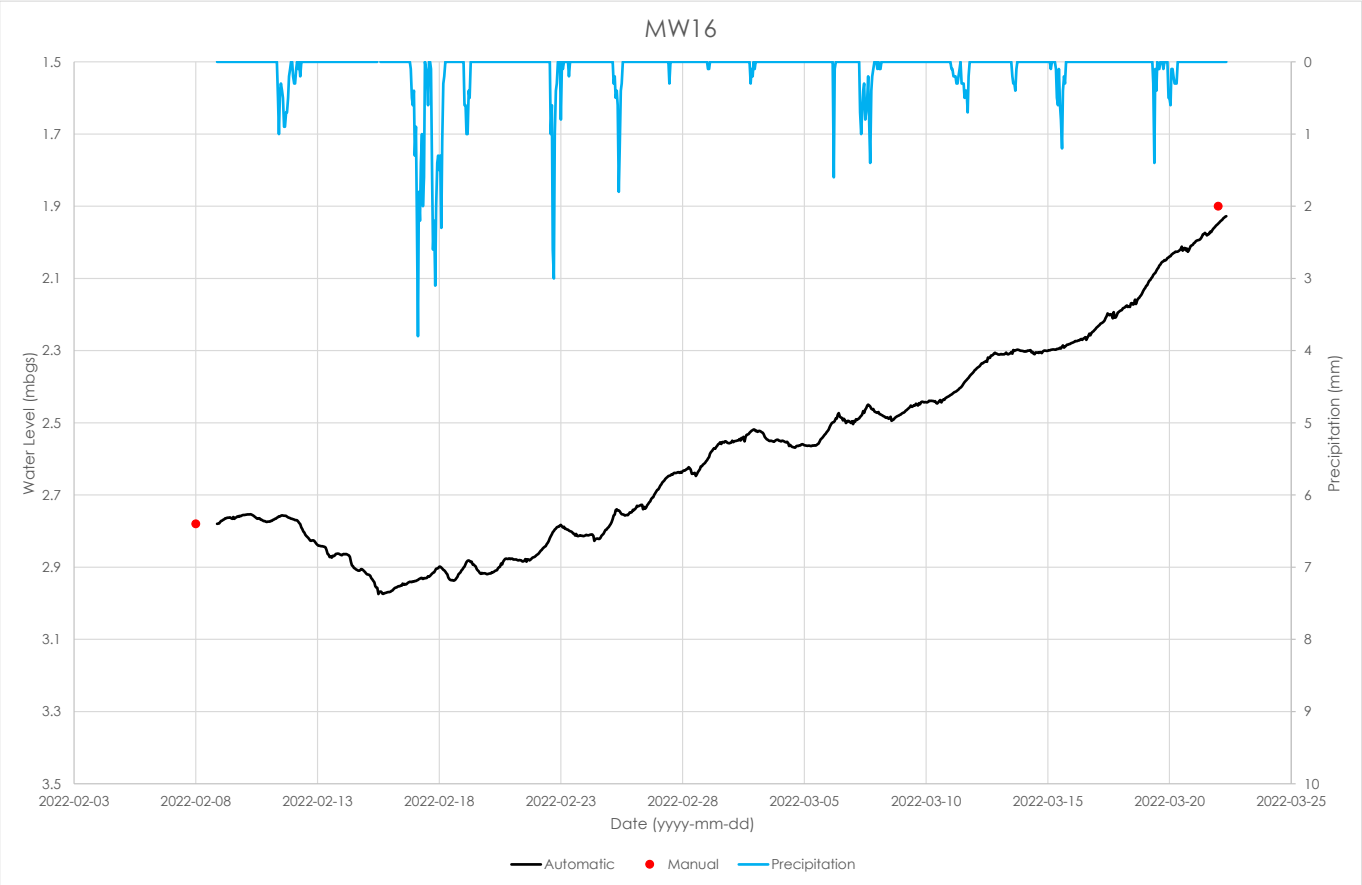
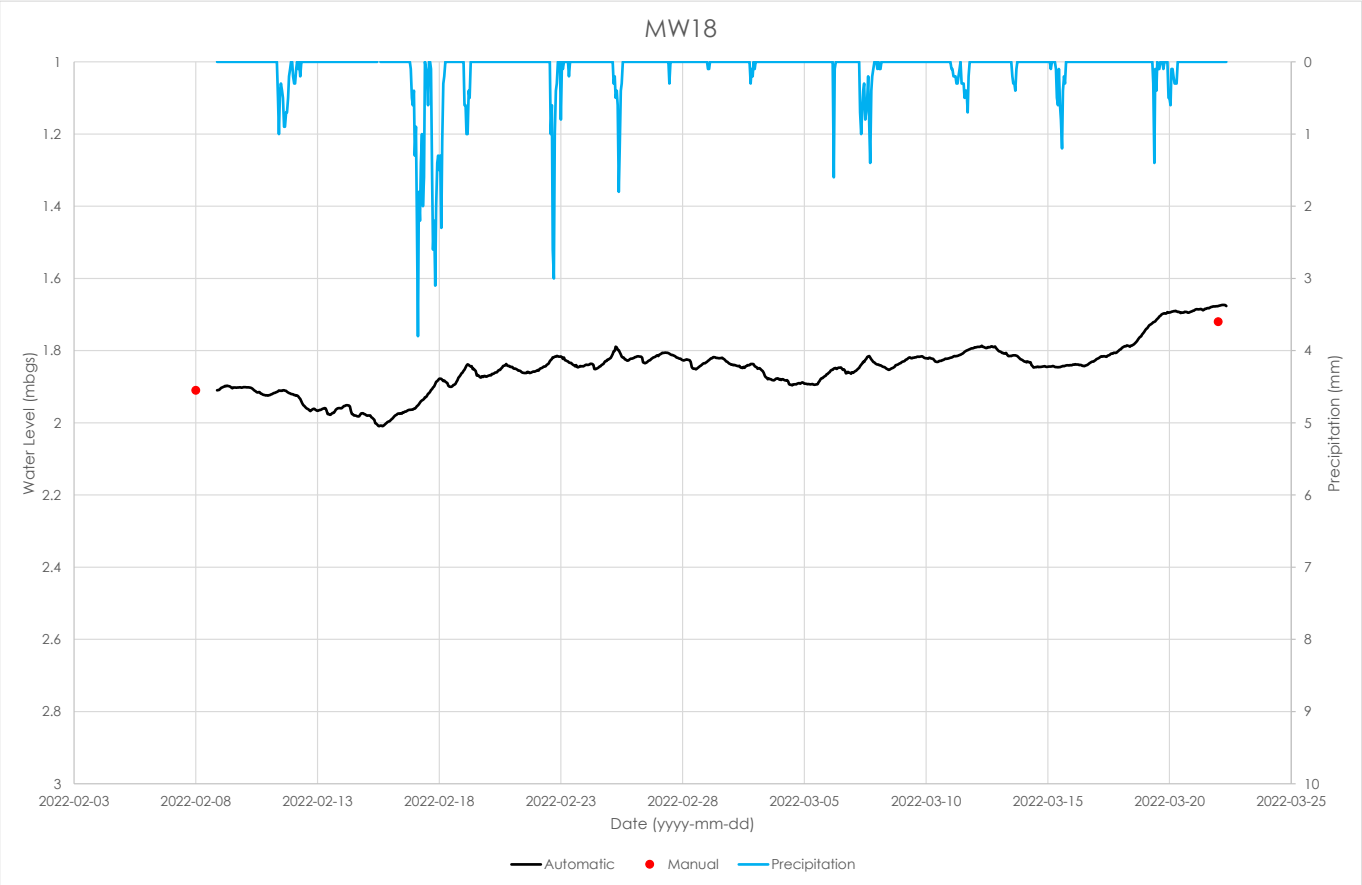
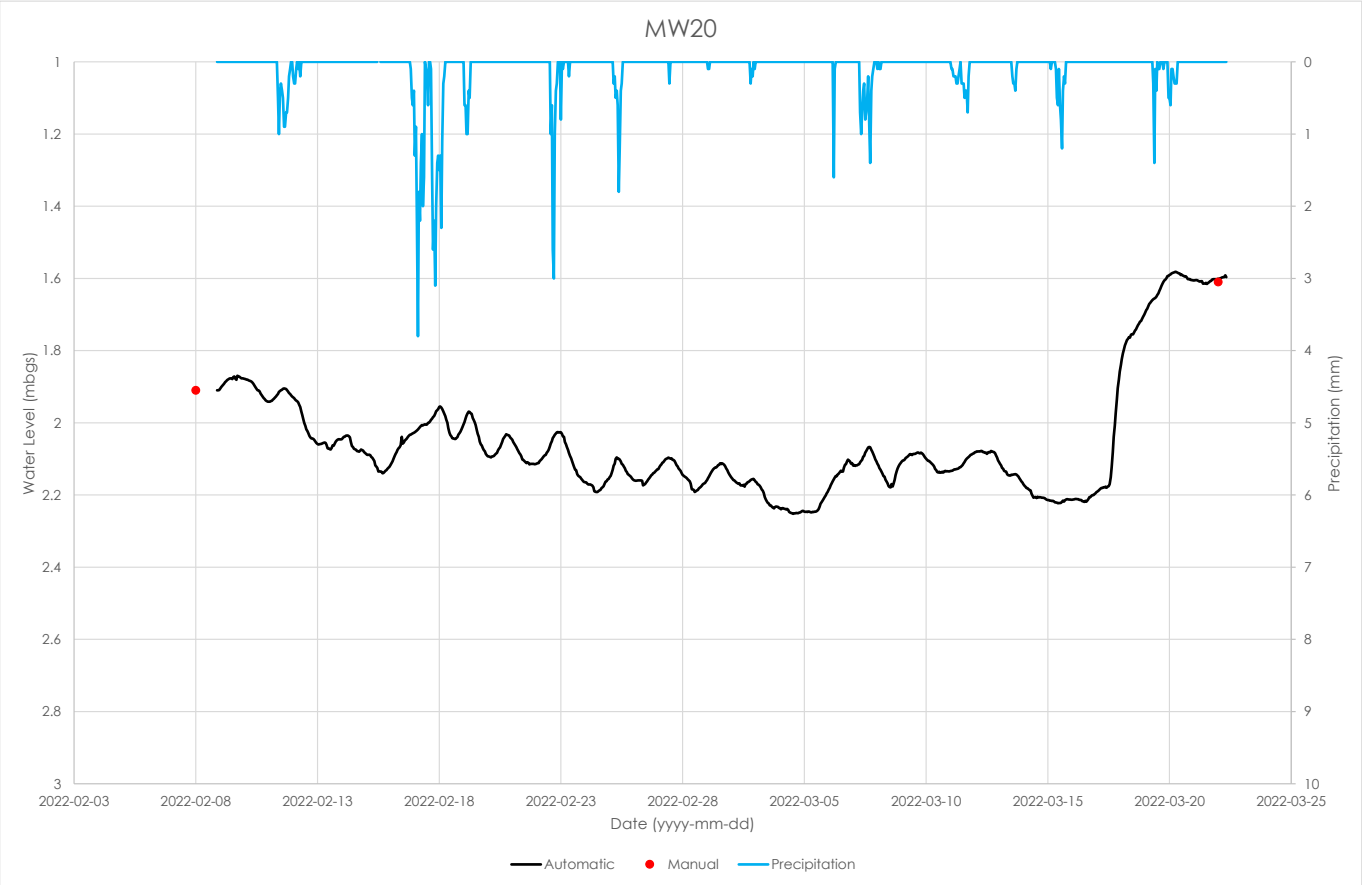
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
1
2
3
4
5
6
7
8
9
10
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW12
Water Level (mbgs)
1.5
1.7
1.9
2.1
2.3
2.5
2.7
2.9
3.1
3.3
3.5
Precipitation (mm)
0
1
2
3
4
5
6
7
8
9
10
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW15
Water Level (mbgs)
Precipitation (mm)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
1
2
3
4
5
6
7
8
9
10
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW16
Water Level (mbgs)
1.5
1.7
1.9
2.1
2.3
2.5
2.7
2.9
3.1
3.3
3.5
Precipitation (mm)
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW18
Water Level (mbgs)
Precipitation (mm)
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation


MW20
Water Level (mbgs)
Precipitation (mm)
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
0
1
2
3
4
5
6
7
8
9
10
2022-02-03
2022-02-08
2022-02-13
2022-02-18
2022-02-23
2022-02-28
2022-03-05
2022-03-10
2022-03-15
2022-03-20
2022-03-25
Date (yyyy-mm-dd)
Automatic
Manual
Precipitation

APPENDIX E

Site-Wide Water Balance Calculations

CROZIER & ASSOCIATES
Consulting Engineers

Project:	Bolton North Hill
Project No.:	708 -3446
Date:	2022-01-31
Created By:	CM
Checked By:	CG

TABLE 1

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 200 mm (moderately rooted crops in silt soils)

Precipitation data from Bolton North Climate Station (1996 - 2001)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-6.53	-4.20	0.73	6.22	13.08	18.28	19.68	19.40	15.55	8.98	2.36	-2.84	**7.6**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.05	1.39	4.29	7.12	7.96	7.79	5.57	2.43	0.32	0.00	**36.9**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	2.78	28.10	62.68	89.96	97.42	95.93	75.55	41.76	9.87	0.00	**504**	
Adjusting Factor for U (Latitude 43° 53' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	70	53	60	56	86	113	73	74	78	40	54	62	**817**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
P - PET	70	53	57	24	7	-2	-52	-41	-1	0	46	62	**222**	
Change in Soil Moisture Storage	0	0	0	0	0	-2	-52	-41	-1	0	46	51	**0**	
Soil Moisture Storage max 200 mm	200	200	200	200	200	198	145	104	103	103	149	200		
Actual Evapotranspiration (AET)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
Soil Moisture Deficit max 200 mm	0	0	0	0	0	2	55	96	97	97	51	0		
Water Surplus - available for infiltration or runoff	70	53	57	24	7	0	0	0	0	0	0	11	**222**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	35	27	28	12	3	0	0	0	0	0	0	5	**111**	
Potential Direct Surface Water Runoff (independent of temperature)	35	27	28	12	3	0	0	0	0	0	0	5	**111**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	817	mm/year												
Potential Evaporation (PE) from impervious areas (assume 15%)	123	mm/year												
P-PE (surplus available for runoff from impervious areas)	694	mm/year												

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 200 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - rolling land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - agricultural lands	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.5**	

Latitude of site (or climate station) 43 ° N.

CROZIER & ASSOCIATES
Consulting Engineers

Project:	Bolton North Hill
Project No.:	708 -3446
Date:	2022-01-31
Created By:	CM
Checked By:	CG

TABLE 2

Pre- and Post-Development Monthly Water Balance Components

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

Precipitation data from Bolton North Climate Station (1996 - 2001)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-6.53	-4.20	0.73	6.22	13.08	18.28	19.68	19.40	15.55	8.98	2.36	-2.84	**7.6**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.05	1.39	4.29	7.12	7.96	7.79	5.57	2.43	0.32	0.00	**36.9**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	2.78	28.10	62.68	89.96	97.42	95.93	75.55	41.76	9.87	0.00	**504**	
Adjusting Factor for U (Latitude 43° 53' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	70	53	60	56	86	113	73	74	78	40	54	62	**817**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
P - PET	70	53	57	24	7	-2	-52	-41	-1	0	46	62	**222**	
Change in Soil Moisture Storage	0	0	0	0	0	-2	-52	-41	-1	0	46	51	**0**	
Soil Moisture Storage max 400 mm	400	400	400	400	400	398	345	304	303	303	349	400		
Actual Evapotranspiration (AET)	0	0	3	31	79	115	126	115	79	40	8	0	**595**	
Soil Moisture Deficit max 400 mm	0	0	0	0	0	2	55	96	97	97	51	0		
Water Surplus - available for infiltration or runoff	70	53	57	24	7	0	0	0	0	0	0	11	**222**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	42	32	34	15	4	0	0	0	0	0	0	7	**133**	
Potential Direct Surface Water Runoff (independent of temperature)	28	21	23	10	3	0	0	0	0	0	0	4	**89**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	817	mm/year												
Potential Evaporation (PE) from impervious areas (assume 15%)	123	mm/year												
P-PE (surplus available for runoff from impervious areas)	694	mm/year												

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 400 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - rolling land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - wooded areas	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.6**	

Latitude of site (or climate station) 43 ° N.

Project:	Bolton North Hill
Project No.:	708 -3446
Date:	2022-01-31
Created By:	CM
Checked By:	CG

TABLE 3

Water Balance - Existing Conditions and Post-Development

Catchment Area	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use**	Estimated Impervious Area (m^2)	Runoff from Impervious Area*** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area*** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area*** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume to Feature (m^3/a)	Total Infiltration Volume (m^3/a)	
Exising Land Use													
Agricultural Lands	1,507,825	0.00	0	0.694	0	1,507,825	0.111	167,010	0.111	167,010	167,010	167,010	
Exising Infrastructure and Driveways	27,960	1.00	27,960	0.694	19,416	0	0.111	0	0.111	0	19,416	0	
Wooded Areas	229,891	0.02	4,598	0.694	3,193	225,293	0.089	19,963	0.133	29,945	23,156	29,945	
Water Features	20,025	0.02	401	0.694	278	19,625	0.111	2,174	0.111	2,174	2,452	2,174	
TOTAL PRE-DEVELOPMENT	**1,785,700**		0		**22,887**	**1,752,742**		**189,146**		**199,128**	**212,034**	**199,128**	
Post-Development Land Use													[1]
Low Density Residential	460,400	0.45	207,180	0.694	143,872	253,220	0.111	28,047	0.111	28,047	171,919	28,047	[2]
Medium Density Residential (Townhomes)	260,800	0.65	169,520	0.694	117,720	91,280	0.111	10,110	0.111	10,110	127,830	10,110	[3]
High Density Residential	182,900	0.85	155,465	0.694	107,959	27,435	0.111	3,039	0.111	3,039	110,998	3,039	[4]
Commerical	15,500	0.85	13,175	0.694	9,149	2,325	0.111	258	0.111	258	9,407	258	
Schools	49,000	0.55	26,950	0.694	18,715	22,050	0.111	2,442	0.111	2,442	21,157	2,442	
Parks	103,000	0.15	15,450	0.694	10,729	87,550	0.111	9,697	0.111	9,697	20,426	9,697	
Open Area	39,200	0.00	0	0.694	0	39,200	0.111	4,342	0.111	4,342	4,342	4,342	
Woodlot	41,000	0.02	820	0.694	569	40,180	0.089	3,560	0.133	5,341	4,130	5,341	
Roads	537,500	1.00	537,500	0.694	373,256	0	0.111	0	0.111	0	373,256	0	
SWM Ponds	96,400	0.04	3,856	0.694	2,678	92,544	0.111	10,250	0.111	10,250	12,928	10,250	
TOTAL POST-DEVELOPMENT	**1,785,700**		**1,129,916**		**784,647**	**655,784**		**71,746**		**73,526**	**856,393**	**73,526**	
									% Change from Pre to Post		404	63	
									Effect of development (with no mitigation)		4.04 times increase in runoff	63% reduction in infiltration	

[1] Based on Concept Plan prepared by Bousfields inc. Dec 20, 2021

[2] Assumed lot size of 0.25 - 0.75 ha

[3] Assumed lot size of <0.25 ha

[4] Included apartments, condo, back-to-back towns

To balance pre- to post-,
the infiltration target (m^3/a)= **125,602** **m^3/a**

Pre-Development Impervious Area

Area m^2	Type
[1] 229,890.50	forested area
1,507,824.50	agricultural area
20,025.00	surface water
27,960.00	existing dwellings

[1] estimated from aerial imagery

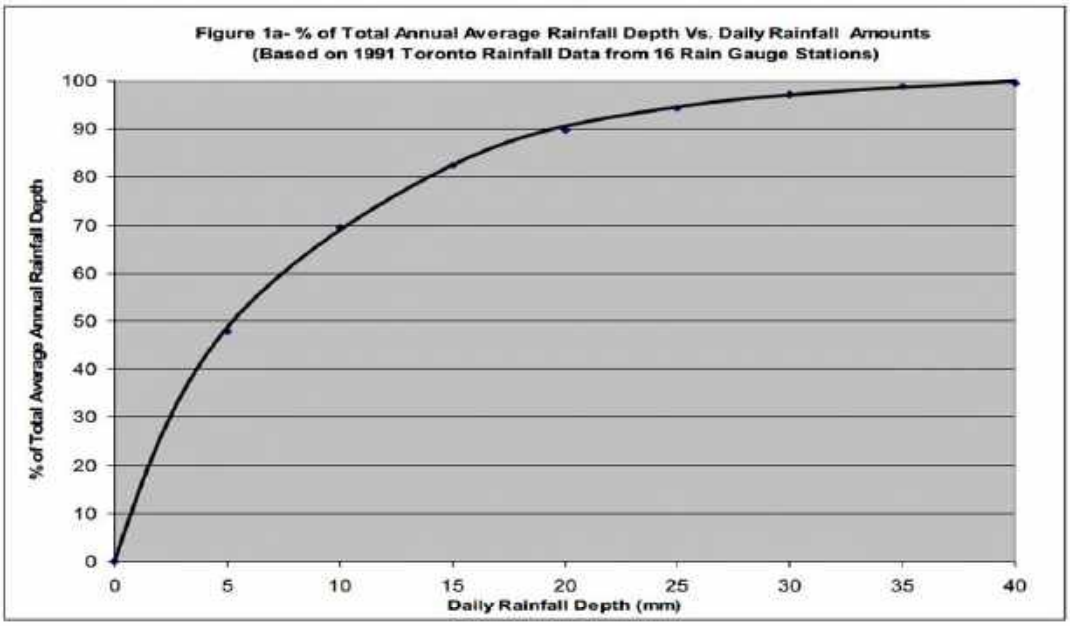
Post-Development Impervious Area

[2]

AREA TABLE (1619 - 107sk dated December 20, 2021)		
Low Density Residential		46.04 ha±
Townhouses		26.08
Back-to-Back Townhouses		6.93
Apartments		6.99
High Density Residential		4.37
Schools		4.90
Commercial		1.55
Park		10.30
SWMP		9.64
Open Space / Woodlot		7.70
Elevated Tank		0.32
Roads		53.75
Total		**178.57 ha±**
UNIT COUNT		
Singles	*37.6%*	1554
Townhouses	*32.3%*	1334
Back-to-Back Townhouses	*20.1%*	831
High Density Residential / Apartments	*10.1%*	417
Total	*100.0%*	**4136 u**

[2] from Concept Plan (Bousfields inc. December 20, 2021)

Source: Wet Weather Flow Management Guidelines
prepared by City of Toronto, November 2006



Adjustments factor related to hours of daylight for the calculation of the Eto of Thornthwaite

Latitude °C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50	0.74	0.78	1.02	1.15	1.33	1.36	1.37	1.25	1.06	0.92	0.76	0.70
49	0.75	0.79	1.02	1.14	1.32	1.34	1.35	1.24	1.05	0.93	0.76	0.71
48	0.76	0.80	1.02	1.14	1.31	1.33	1.34	1.23	1.05	0.93	0.77	0.72
47	0.77	0.80	1.02	1.14	1.30	1.32	1.33	1.22	1.04	0.93	0.78	0.73
46	0.79	0.81	1.02	1.13	1.29	1.31	1.32	1.22	1.04	0.94	0.79	0.74
45	0.80	0.81	1.02	1.13	1.28	1.29	1.31	1.21	1.04	0.94	0.79	0.75
44	0.81	0.82	1.02	1.13	1.27	1.29	1.30	1.20	1.04	0.95	0.80	0.76
43	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.20	1.04	0.95	0.81	0.77
42	0.82	0.83	1.03	1.12	1.26	1.27	1.28	1.19	1.04	0.95	0.82	0.79
41	0.83	0.83	1.03	1.11	1.25	1.26	1.27	1.19	1.04	0.96	0.82	0.80
40	0.84	0.83	1.03	1.11	1.24	1.25	1.27	1.18	1.04	0.96	0.83	0.81
39	0.85	0.84	1.03	1.11	1.23	1.24	1.26	1.18	1.04	0.96	0.84	0.82
38	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83
37	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83
36	0.87	0.85	1.03	1.10	1.21	1.22	1.24	1.16	1.03	0.97	0.86	0.84
35	0.87	0.85	1.03	1.09	1.21	1.21	1.23	1.16	1.03	0.97	0.86	0.85
34	0.88	0.85	1.03	1.09	1.20	1.20	1.22	1.16	1.03	0.97	0.87	0.86
33	0.88	0.86	1.03	1.09	1.19	1.20	1.22	1.15	1.03	0.97	0.88	0.86
32	0.89	0.86	1.03	1.08	1.19	1.19	1.21	1.15	1.03	0.98	0.88	0.87
31	0.90	0.87	1.03	1.08	1.18	1.18	1.20	1.14	1.03	0.98	0.89	0.88
30	0.90	0.87	1.03	1.08	1.18	1.17	1.20	1.14	1.03	0.98	0.89	0.88
29	0.91	0.87	1.03	1.07	1.17	1.16	1.19	1.13	1.03	0.98	0.90	0.89
28	0.91	0.88	1.03	1.07	1.16	1.16	1.18	1.13	1.02	0.98	0.90	0.90
27	0.92	0.88	1.03	1.07	1.16	1.15	1.18	1.13	1.02	0.99	0.90	0.90
26	0.92	0.88	1.03	1.06	1.15	1.15	1.17	1.12	1.02	0.99	0.91	0.91
25	0.93	0.89	1.03	1.06	1.15	1.14	1.17	1.12	1.02	0.99	0.91	0.91
20	0.95	0.90	1.03	1.05	1.13	1.11	1.14	1.11	1.02	1.00	0.93	0.94
15	0.97	0.91	1.03	1.04	1.11	1.08	1.12	1.08	1.02	1.01	0.95	0.97
10	1.00	0.91	1.03	1.03	1.08	1.06	1.08	1.07	1.02	1.02	0.98	0.99
5	1.02	0.93	1.03	1.02	1.06	1.03	1.06	1.05	1.01	1.03	0.99	1.02
0	1.04	0.94	1.04	1.01	1.04	1.01	1.04	1.04	1.01	1.04	1.01	1.04

Impervious Fraction

From Urban Storm Drainage Criteria Manual Volume 1
Link: https://udfcd.org/wp-content/uploads/uploads/vol1%20criteria%20manual/06_Runoff.pdf

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only):	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Water Holding Capacity & Infiltration

From MOE SWMPDM 2003
Link: https://www.ontario.ca/document/stormwater-management-planning-and-design-manual-0

Tables 3.1: hydrologic cycle component values

Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)

Soil group	Water Holding Capacity(mm)	Hydrologic Soil Group	Precipitation (mm)	Evapo-transpiration (mm)	Runoff (mm)	Infiltration* (mm)
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145

Moderately Rooted Crops (corn and cereal grains)

Soil group	Water Holding Capacity(mm)	Hydrologic Soil Group	Precipitation (mm)	Evapo-transpiration (mm)	Runoff (mm)	Infiltration* (mm)
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	100	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160

Pasture and Shrubs

Soil group	Water Holding Capacity(mm)	Hydrologic Soil Group	Precipitation (mm)	Evapo-transpiration (mm)	Runoff (mm)	Infiltration* (mm)
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179

Mature Forests

Soil group	Water Holding Capacity(mm)	Hydrologic Soil Group	Precipitation (mm)	Evapo-transpiration (mm)	Runoff (mm)	Infiltration* (mm)
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

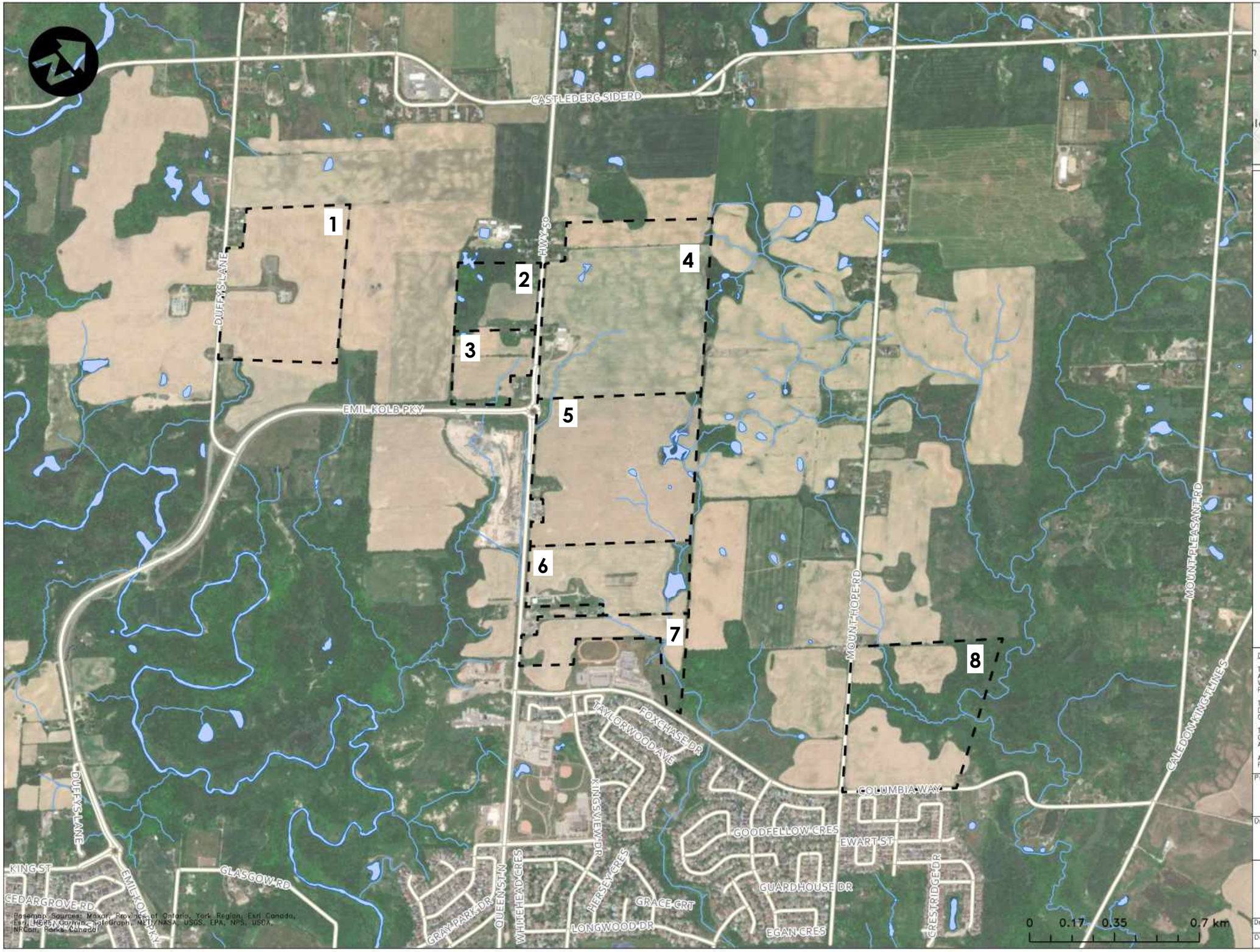
* This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.

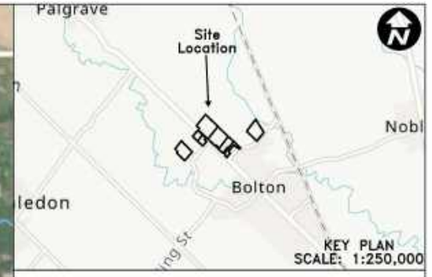
Topography	
Flat Land, average slope < 0.6 m/km	0.3
Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
Hilly Land, average slope 28 m to 47 m/km	0.1

Soils	
Tight impervious clay	0.1
Medium combinations of clay and loam	0.2
Open Sandy loam	0.4

Cover	
Cultivated Land	0.1
Woodland	0.2

FIGURES





LEGEND

- Roads
- Waterbody
- Watercourse
- Accessible Lands
- 1 Pacific Lands
- 2 Polsinelli Lands
- 3 Pacific Lands
- 4 Country Homes Lands
- 5 Oakbank Estates Inc. Lands
- 6 Marhome Ventures Lands
- 7 Wyndcliffe Developments Inc. Lands
- 8 Cold Creek Developments Lands

Project

BOLTON NORTH HILL
TOWN OF CALEDON

Drawing

SITE LOCATION PLAN

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Dwg. FIG. 1

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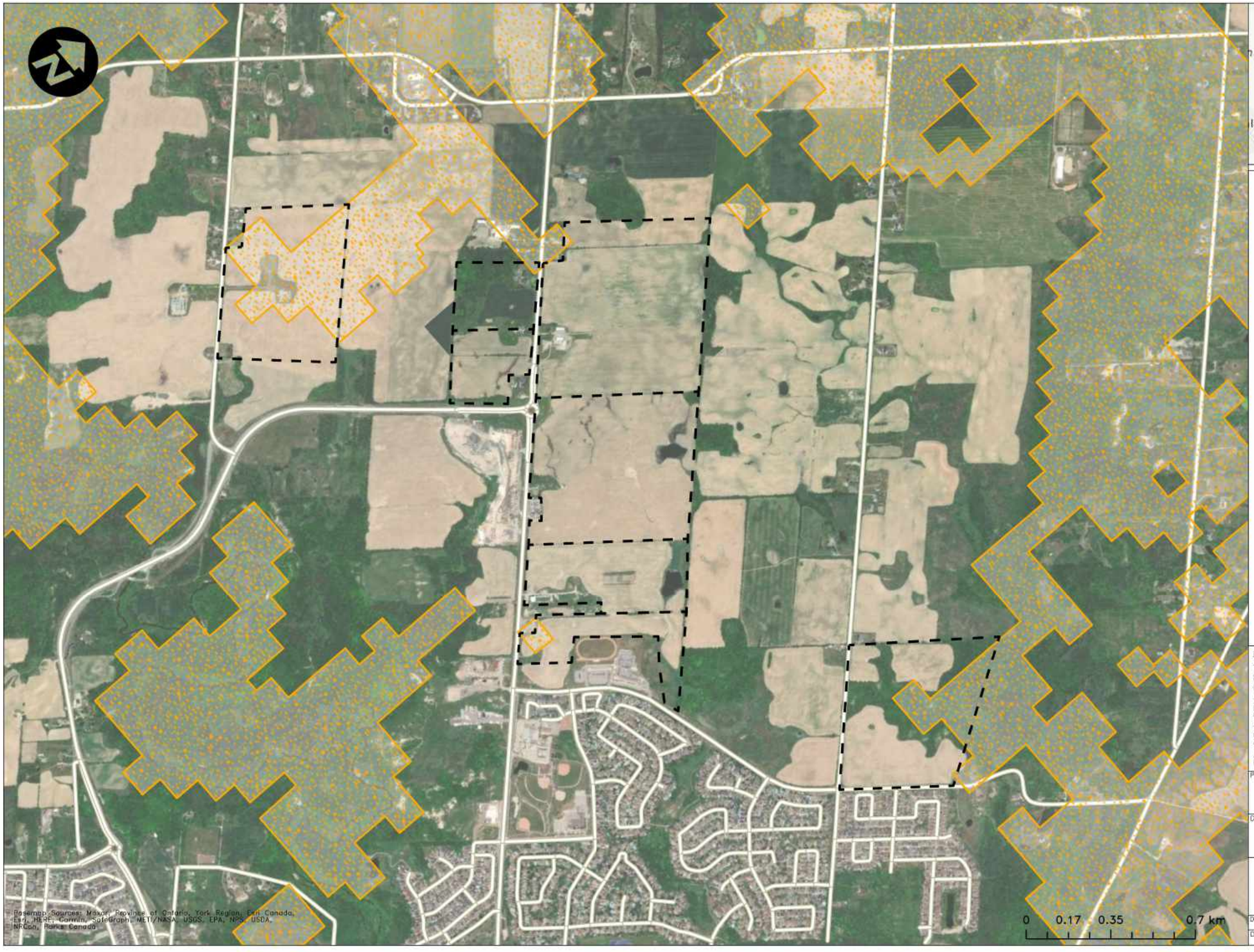

LEGEND

- Roads
- Accessible Lands
- Highly Vulnerable Aquifers

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HIGHLY VULNERABLE AQUIFERS

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Dwg. FIG. 2

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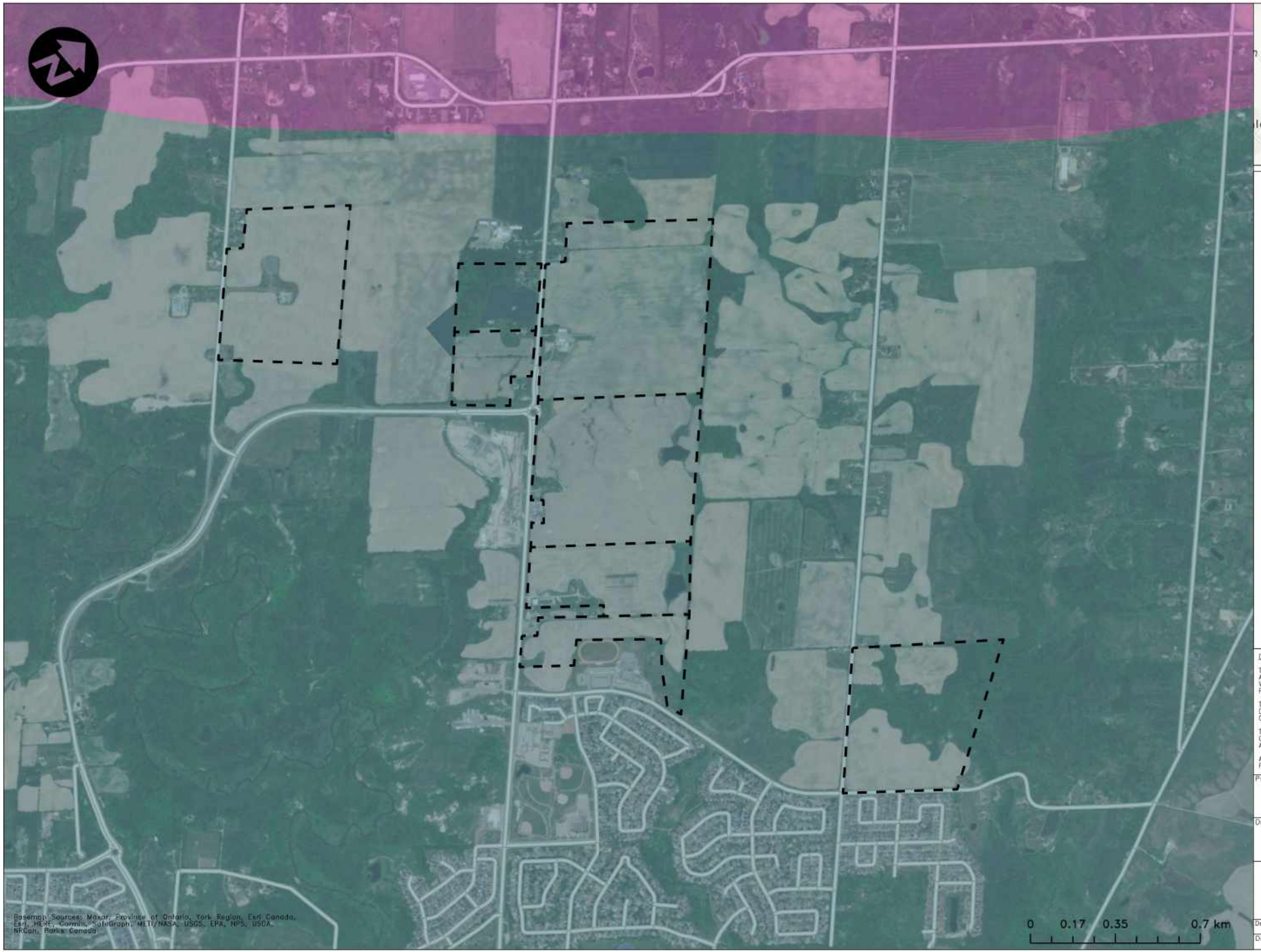

LEGEND

- Roads
- Accessible Lands

Physiographic Regions:

Unit Number, Region Name

- 30, Oak Ridges Moraine
- 32, South Slope

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Dwg. FIG. 3

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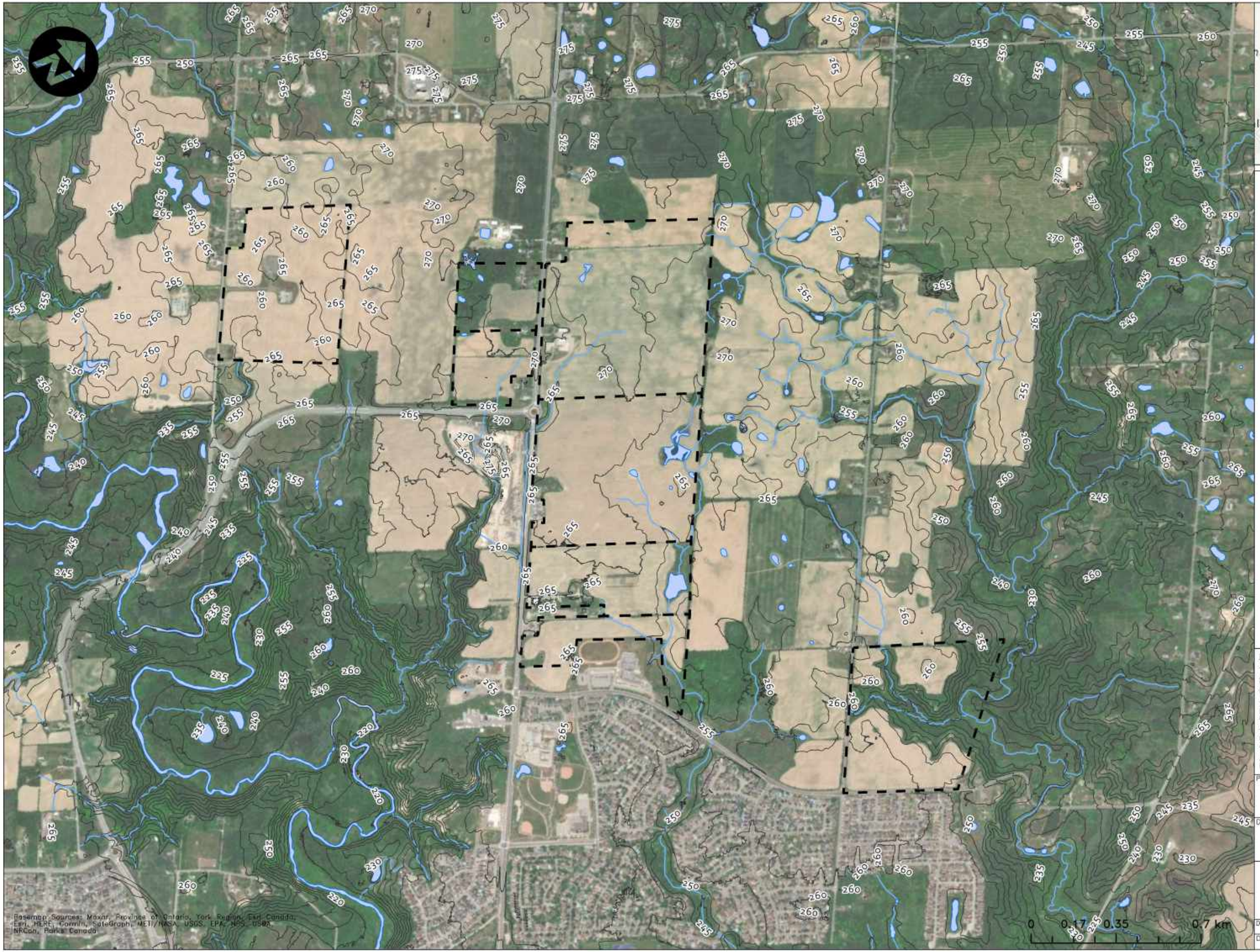

LEGEND

- Waterbody
- Watercourse
- 5 m Contours
- Accessible Lands

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22-02-25	EPSG:26917	1:15,000	FIG. 4

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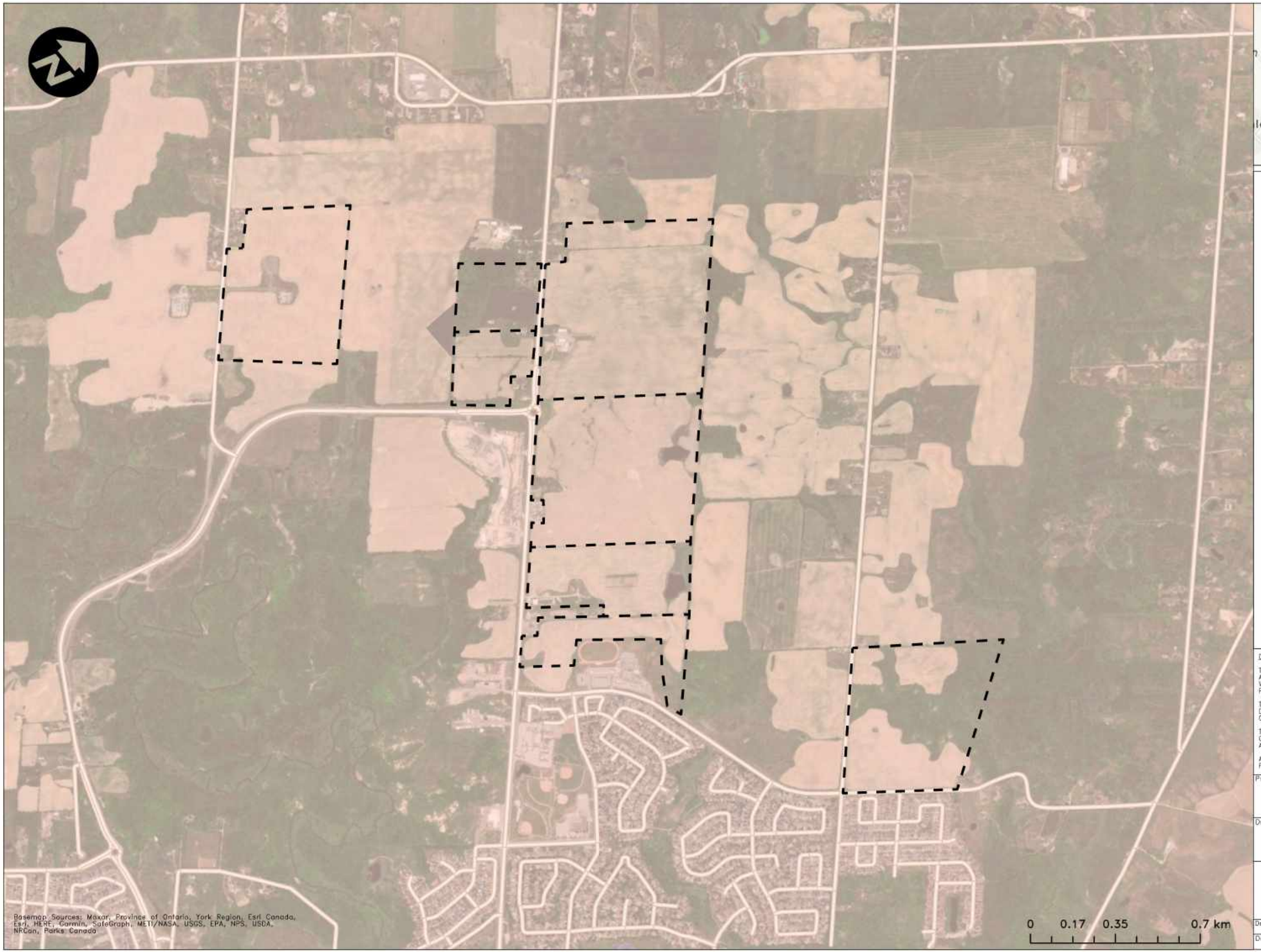

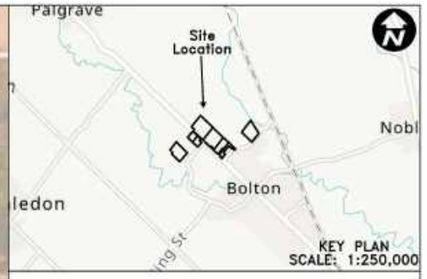

LEGEND

- Roads
- Accessible Lands

Bedrock Geology:

Stratigraphic Unit

- Georgian Bay Formation; Blue Mountain Formation; Billings Formation; Collingwood Member; Eastview Member
- Queenston Formation

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BEDROCK GEOLOGY

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Dwg. FIG. 5

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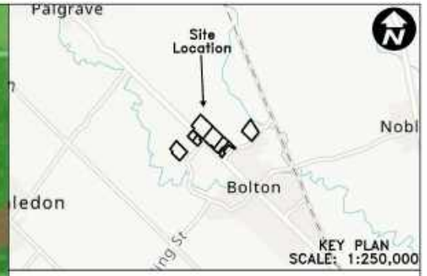

LEGEND

- Roads
- Accessible Lands

Surficial Geology Unit:

- 12: Older alluvial deposits
- 19: Modern alluvial deposits
- 20: Organic deposits
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits

Basemap Sources: Maxar, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada

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SURFICIAL GEOLOGY

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Dwg. FIG. 6

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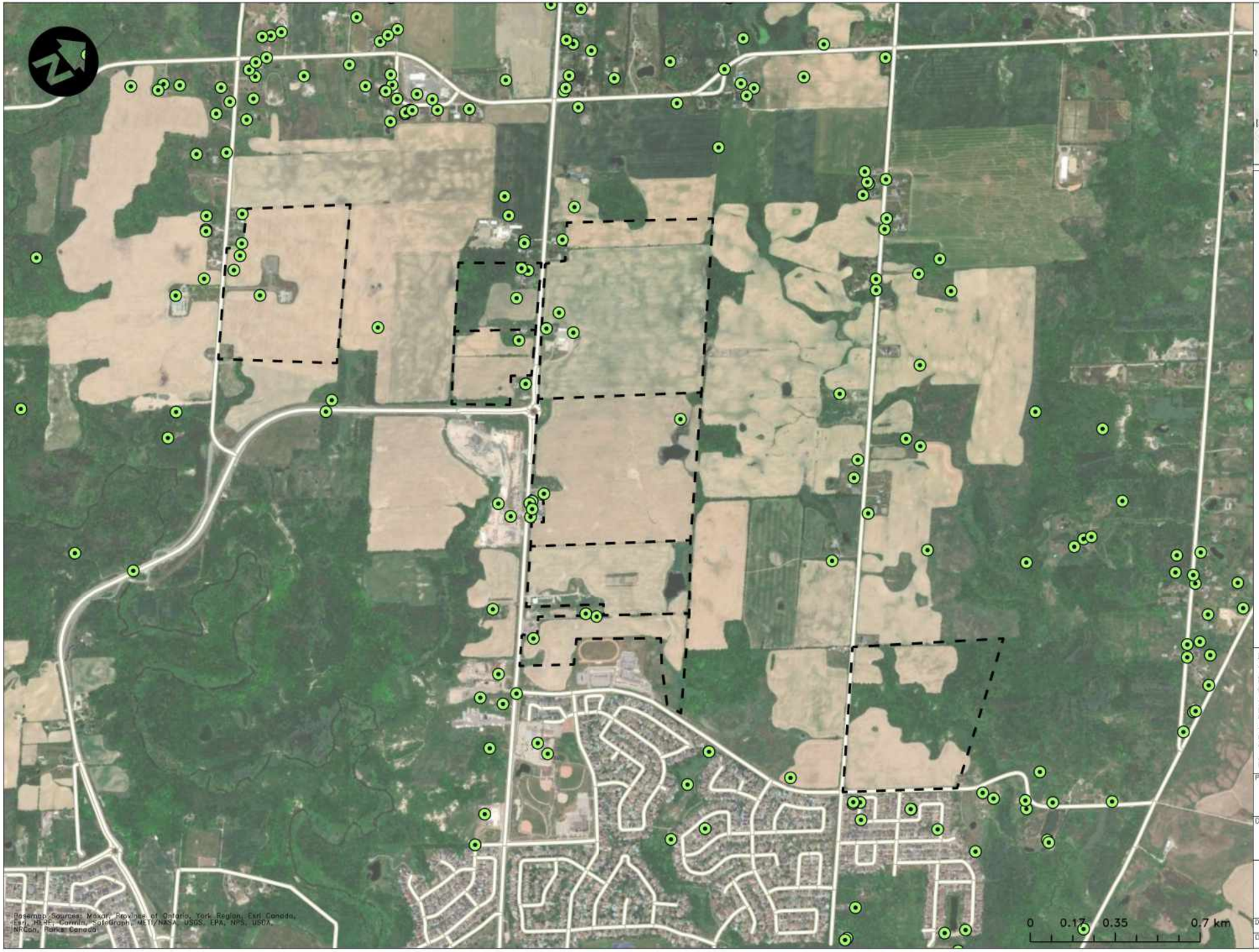

LEGEND

- MECP Wells
- Roads
- Accessible Lands

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MECP WELLS

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Dwg. FIG. 7

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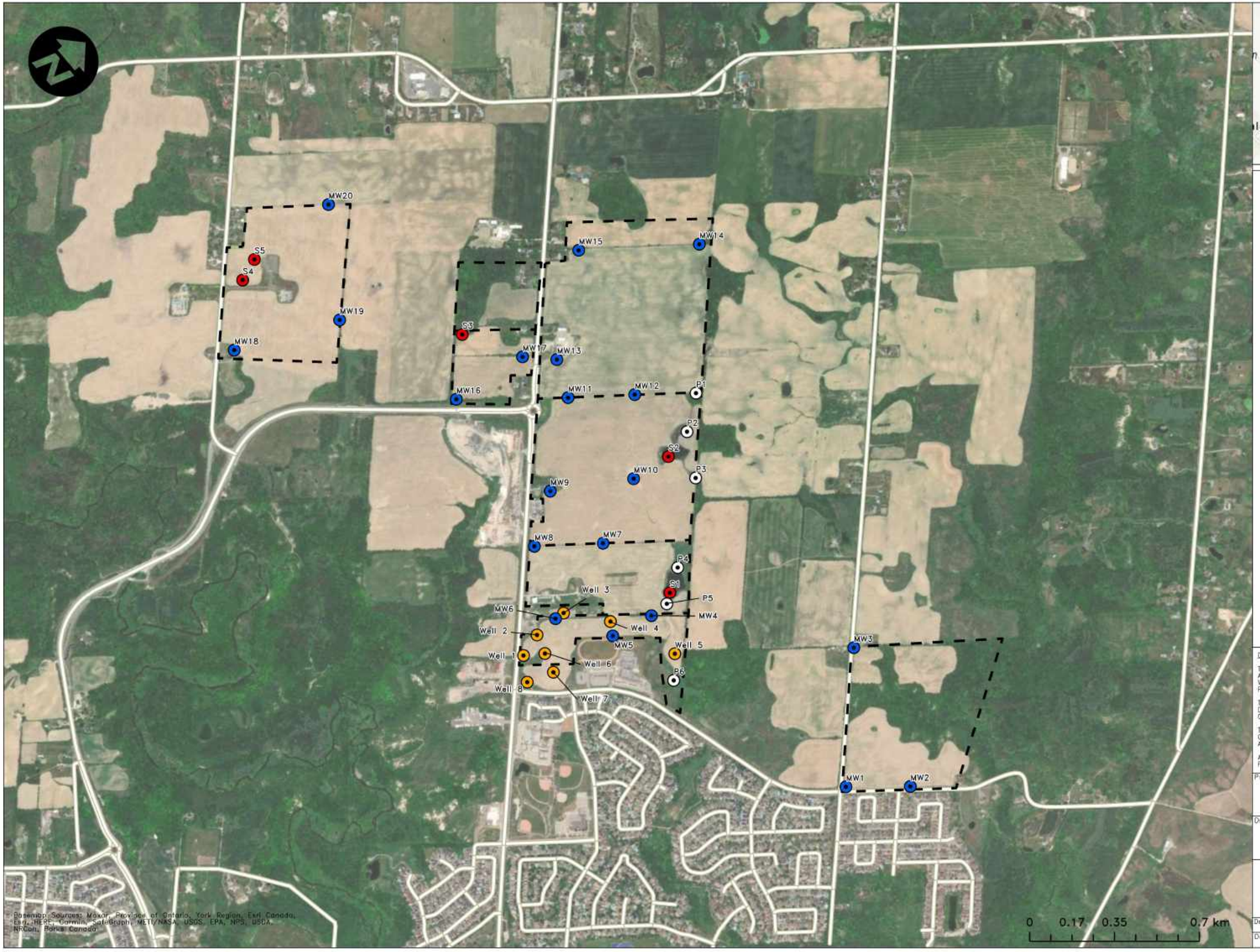

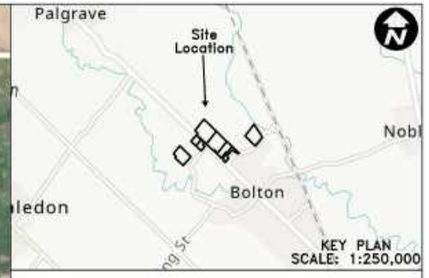

LEGEND

- MW1 Monitoring Location
- Piezometer
- Staff Gauge
- Monitoring Well
- Old Wells
- Accessible Lands
- Roads

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ON SITE WELLS

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Dwg. FIG. 8

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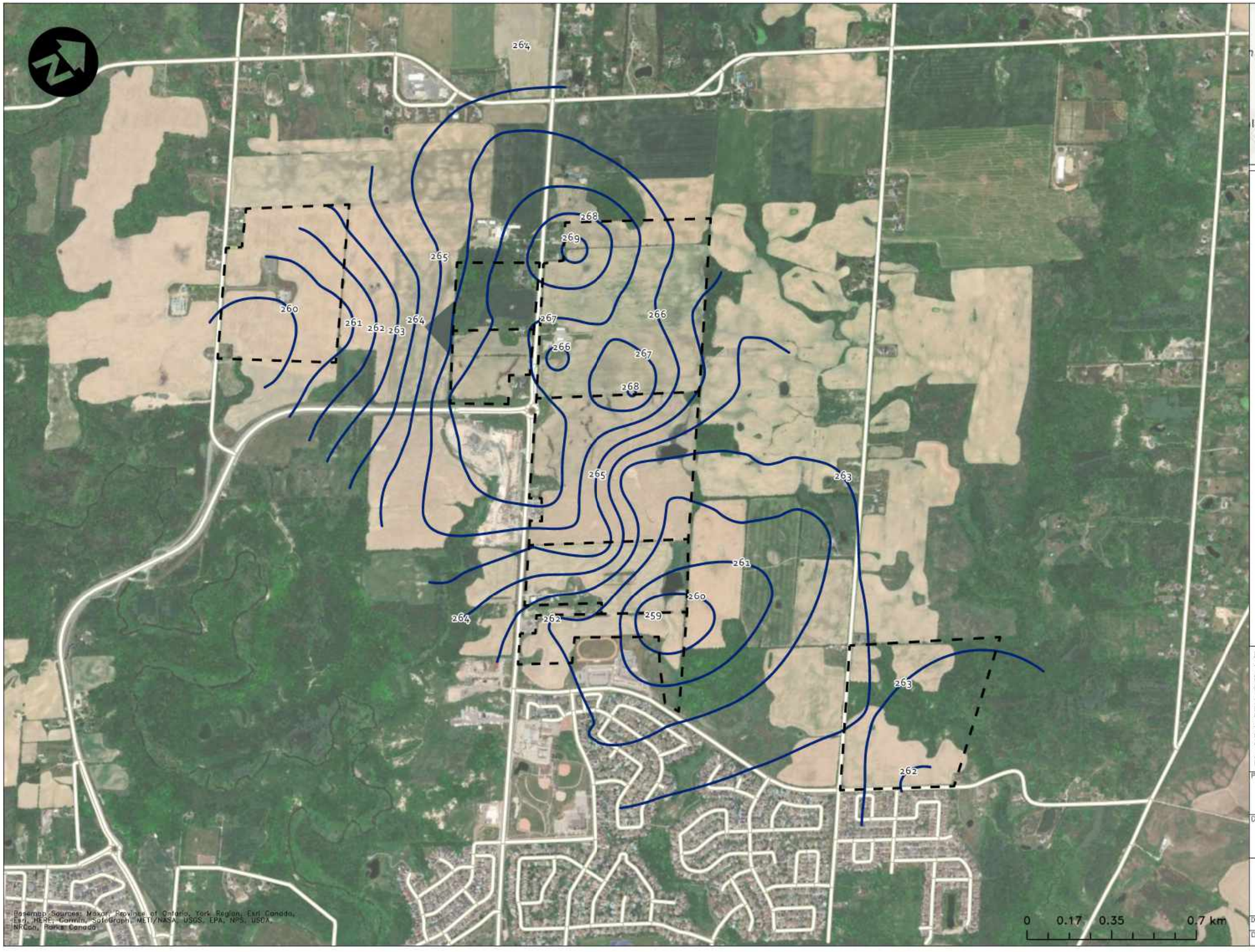

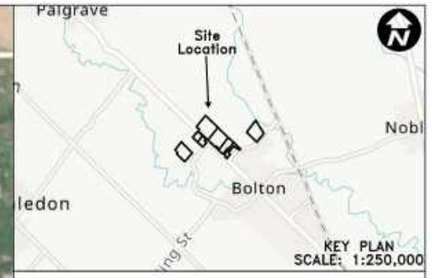

LEGEND

- Roads
- Accessible Lands
- Groundwater Contour

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ESTIMATED GROUNDWATER FLOW DIRECTION

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Dwg. FIG. 9

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