Brampton Transit

BUS MAINTENANCE & STORAGE FACILITY

Appendix J

Hydrogeological Study

March 18, 2021

Prepared for

BRAMPTON Flower City
brampton.ca

Prepared by

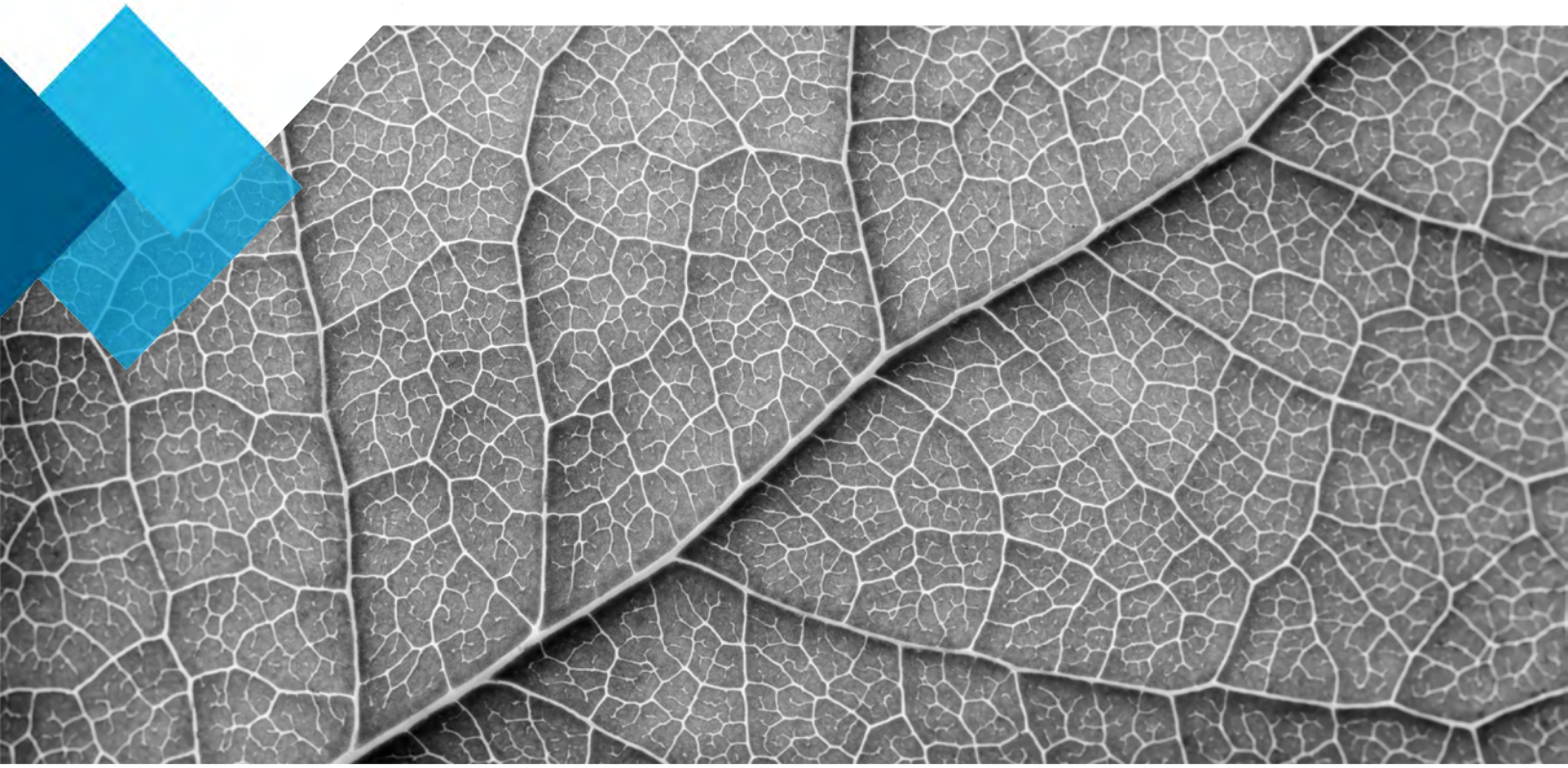
IBI GROUP

SNC·LAVALIN

Hydrogeological Study – Proposed Johnston Transit Facility

10192 Highway 50, Brampton, Ontario

The City of Brampton



Environment & Geoscience

Final – November 23, 2020

Internal Ref: 665125

Notice to Reader

This report has been prepared and the work referred to in this report has been undertaken by the Environment & Geoscience business unit of SNC-Lavalin Inc. (SNC-Lavalin) for the exclusive use of the City of Brampton (the Client), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions, and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions, and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, site conditions change, or applicable standards are amended, modifications to this report may be necessary. The results of this assessment should in no way be construed as a warranty that the subject site is free from any and all contamination.

Any soil and rock descriptions in this report and associated logs have been made with the intent of providing general information on the subsurface conditions of the site. This information should not be used as geotechnical data for any purpose unless specifically addressed in the text of this report. Groundwater conditions described in this report refer only to those observed at the location and time of observation noted in the report.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final versions of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

The contents of this report are confidential and proprietary. Other than by the Client, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of the Client and SNC-Lavalin.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Table of Contents

1 Introduction 1

1.1 Objectives 1
1.2 Site Description 1
1.3 Proposed Development 1
1.4 Scope of Work 2
1.5 Deviation from the Original Scope 2

2 Methodology 4

2.1 Drilling and Well Installation 4
2.2 Groundwater Monitoring 4
2.3 Surface Water Monitoring 5
2.4 Water Quality Sampling 5
2.5 Hydraulic Conductivity Test 6
2.6 Water Balance Analysis 6

3 Regional Geology and Hydrogeology 8

3.1 Physiography 8
3.2 Geology 8
3.3 Hydrogeology 10
3.4 Surface Water Features 11
3.5 Climate 11

4 Site Conditions 13

4.1 Stratigraphy 13
4.2 Groundwater Level 14
4.3 Hydraulic Conductivity 15
4.4 Groundwater Quality 15
4.5 Base-flow Monitoring 16
4.6 Groundwater and Surface Water Interactions 16

5 Dewatering Requirement 17

5.1 Dewatering Assessment 17
5.2 Discharge Plan 18

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

6 Development Impact Assessment 21

6.1 Impact on Local Groundwater Uses 21
6.2 Impact on Surface Water Features 22
6.3 Impact on Water Quality 22
6.4 Water Balance Analysis 23

7 Development Considerations 25

7.1 Groundwater Recharge Management 25
7.2 Potential Contaminants of Concern 25
7.3 Opportunities and Constraints 25
7.4 Mitigation Measures 26
7.5 Monitoring and Sampling Plans 27

8 Conclusions and Recommendations 29

9 References 30

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

List of Figures

1 Site Location Plan
2 Current Site Layout
3 Primary and Secondary Humber River Sub-watersheds
4 Physiographic Regions in the Humber River Watershed
5 Quaternary Geology
6 Estimated Groundwater Recharge Rates
7 Locations of Municipal and PGMN Wells
8 Well Head Protection Areas
9 Highly Vulnerable Aquifers

List of Tables

3.1 Hydro-stratigraphic Units within the Humber River Watershed
4.1 Groundwater Level Measurements – Geotechnical/Environmental Investigation
4.2 Groundwater Level Measurements – Hydrogeological Investigation
4.3 Results of Hydraulic Conductivity Analysis
4.4 Groundwater Analytical Results - City of Brampton Storm Sewer By-Law (90-75)
4.5 Groundwater Analytical Results - Major Ion Chemistry
5.1 Input Parameters for Dewatering Assessment
6.1 Annual Recharge Volumes - Pre- and Post-Development

List of Appendices

A Site Plan Concept
B Borehole Location Plan and Borehole/Well Logs
C Hydraulic Conductivity Analysis
D Groundwater Quality Results
E Dewatering Assessment
F MECP Well Records
G City of Brampton Official Plan - Schedule D
H Water Balance Analysis
I Groundwater Contaminants of Concern

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

1 Introduction

The Environment & Geoscience business unit of SNC-Lavalin Inc. (SNC-Lavalin) was retained by the City of Brampton (the City) to complete a due diligence hydrogeological study, in addition to the geotechnical investigation and environmental site assessment (ESA), prepared under separate cover (SNC-Lavalin, 2019a and 2019b), for the proposed Johnston Transit Facility located at the property with a municipal address of 10192 Highway 50, Brampton, Ontario.

It is understood that the City owns the northeastern portion of the property (identified as “Parcel A1”) and plans to purchase an additional “L”-shape parcel located in the south and west portions of the property (identified as “Parcel A”); as well as a small parcel south of the proposed building footprint and west of Highway 50 (identified as “Parcel B”). Collectively, all these three (3) Parcels, herein, are referred to as the Site (or the Project).

1.1 Objectives

The purpose of the due diligence hydrogeological study is to i) characterize existing Site hydrogeological conditions, ii) determine the needs and options for groundwater control for the foundation and sub-grade structures, iii) assess potential impacts to the local groundwater regime, and iv) determine the need for mitigation measures, if any. This report may also be used to support the registration of Environmental Activity and Sector Registry (EASR) for water taking approval/permit from the Ministry of the Environment, Conservation and Parks (MECP).

1.2 Site Description

The Site is located on the southwest corner of the intersection of Highway 50 and Cadetta Road, in the City of Brampton, Ontario (**Figure 1**). Two (2) residential dwellings, nine (9) barns for storage and/or livestock and five (5) silos are located directly south of the Site.

A metal shed located on Parcel A1 for the storage of farm equipment/machinery is present at the Site, no further structures are present on the Site. It is understood that a portion of Parcel A1 has been re-graded/cleared and backfilled with crushed stone/asphalt and is being used as a satellite yard by the City’s Works Department. The current layout of the Site is shown on **Figure 2**.

The Site is primarily flat with a gentle slope towards the west. The Site is bounded by Cadetta Road and industrial/commercial properties to the north, Highway 50 and a trucking facility to the east, and farm lands to the south and west. The land use at the Site is currently agricultural.

1.3 Proposed Development

The general Project development information was obtained from the Site Plan Concept (draft) provided by the City of Brampton dated March 28, 2019 (**Appendix A**). Based on the information provided to date, the proposed facility includes a main building/structure, four (4) parking lots and one (1) storm management pond and landscaping areas.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

The proposed building is assumed to be supported by spread footings and the bottom of the foundation (typical) is expected to be approximately 3 m below ground surface (bgs). During the construction of the structure/building foundations, open-cut excavations and trenches are expected to be used. The bottom of the open-cut excavations is expected to be approximately 0.5 m below the bottom of the footings to accommodate the placement of the beddings or engineering fill.

1.4 Scope of Work

This report has been prepared in general accordance with the Additional Scope of Work Request (Hydrogeology Study and Report) provided by the City of Brampton, as well as the requirements as described by the Ontario Regulation 63/16 Registrations Under Part II.2 of the Act – Water Taking and Technical Guidance for Hydrogeological Studies in support of Category 3 PTTW applications posted on the MECP Website.

The primary scope of work for the additional hydrogeological study is summarized as follows:

- Drilling and installation of two (2) groundwater monitoring wells (for the purpose of hydrogeological investigation);
- Monitoring groundwater levels in four (4) wells (two newly installed hydrogeological monitoring wells, each paired with an environmental monitoring well);
- Collecting groundwater sampling in three (3) wells: two (2) on Parcel A/A1 and one (1) on Parcel B;
- Conducting in-situ single well response tests in five (5) monitoring wells;
- Conducting private well survey in the Project surrounding areas, mainly involving water supply wells identified through desktop search of the MECP water well database;
- Background review of available published watershed study reports, hydrogeological reports, water well records and geological mapping;
- Review of Site geotechnical investigation report and Phase Two ESA results (including subsurface soil conditions, groundwater level and groundwater quality results);
- Review available historical climate data and performing water balance analysis to assess pre-existing and post-development annual recharge rates at the Site;
- Performing hydraulic conductivity (K) test analysis to determine the K values for different soils or stratigraphic units encountered at the Site;
- Evaluating dewatering needs for the construction of the Project;
- Assessing potential environmental impacts of the Project construction and dewatering activities to surrounding groundwater users and the natural function of the environment;
- Providing recommendations on mitigation measures and monitoring plans; and
- Preparation of a hydrogeological study report documenting the results and findings.

1.5 Deviation from the Original Scope

- Surface water sampling and base-flow/streamflow monitoring of the creek (Rainbow Creek) could not be completed as the creek was dry during the hydrogeological investigation.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

- Sampling of Private water wells was not conducted (or not deemed necessary) as the private water supply wells identified during the desktop search were either decommissioned or replaced by the Region of Peel municipal water supply system, which were verified through the private well (door-to-door well) survey (a few properties did not reply to our request or answer the door).
- Two (2) hydraulic conductivity (K) tests could not be completed using the manual bail-down method as planned due to the fast water recovery in these two (2) wells (attempts were made, but sufficient drawdown could not be achieved by using the manual bail-down). An electrical submersible pump was used during the second round of the K test to achieve the desired groundwater drawdown in these two (2) wells.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

2 Methodology

2.1 Drilling and Well Installation

Two (2) boreholes (BH-02B and BH-51B) for the purposes of hydrogeological investigation were installed in boreholes drilled at the Site by Landshark Drilling Inc. on June 19 and 20, 2019. Drilling was carried out under the supervision of SNC-Lavalin personnel. The borehole/well location plan and selected borehole/well logs are provided in **Appendix B**.

Drilling was conducted using a truck-mounted, CME-75 drill rig. Boreholes BH-02B and BH-51B were drilled using 0.2 m outside diameter (OD) hollow stem augers and were advanced to a depth of approximately 9.6 m and 8.5 m below ground surface (bgs), respectively.

The two (2) boreholes were converted to monitoring wells upon completion of drilling and designated as MW-02B and MW-51B, respectively. The monitoring wells at each of the clusters (MW-02/MW-02B and MW-51/MW-51B) were completed in close proximity to each other (i.e., within 2 m). The two (2) wells were completed at a depth of 9.6 m and 8.5 m bgs, respectively, and were constructed using 5.1 cm diameter PVC piping and with 1.5 m (5 ft) long screens and solid riser extending up to above ground surface. A clean silica sand pack was placed around each screen and isolated with hydrated bentonite to slightly below grade. The wells were completed at surface with above ground protective steel casings set in concrete. The riser pipe was sealed with a j-plug. Borehole and monitoring well construction logs are included in **Appendix B**. The wells were equipped with dedicated sampling equipment including low density polyethylene (LDPE) tubing and inertial foot valves.

The two (2) monitoring wells were developed upon completion of installation by purging approximately three (3) borehole volumes of water (calculated as the volume of standing water plus the volume of water in the sand-pack surrounding the well screen) upon completion of the well installation.

Newly installed monitoring wells were surveyed by SNC-Lavalin personnel on October 21, 2019 to establish the ground surface, well casing and riser elevations. The ground surface elevations at borehole locations were also surveyed. The survey was completed using a Trimble RX 5800 high precision unit (0.01 m horizontal accuracy and 0.01 m vertical accuracy), with elevations relative to geodetic above mean sea level (amsl).

2.2 Groundwater Monitoring

Groundwater levels in monitoring wells MW-02B and MW-51B (along with other environmental monitoring wells) were measured relative to top of riser pipe using a water level meter of Heron Instruments on June 27, 2019 and October 21, 2019.

Monitoring wells MW-02 and MW-51 completed during the geotechnical and environmental investigations were selected for the purposes of hydrogeological assessment. The data from the monitoring well clusters, i.e. MW-02/MW-02B and MW-51/MW-51B, are to be used to assess vertical hydraulic gradients at these locations.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

2.3 Surface Water Monitoring

The base-flow/stream flowing monitoring of the creek (i.e., Rainbow Creek) could not be completed as planned, as the creek was dry during the investigation. The creek crossings at Cadetta Road (up-stream of the Site) and the driveway of the farm land of 10192 Highway 50 were all dry (by visual observation) during the site visits made by SNC-Lavalin personnel in July 2019.

2.4 Water Quality Sampling

Groundwater Sampling

Groundwater sampling was conducted in three (3) selected monitoring wells MW-22, MW-51B and MW-74. The sampling of monitoring wells MW-22 and MW-51B was completed in July 2019, and sampling of monitoring well MW-74 was conducted in October 2019.

The sampling was conducted using dedicated LDPE tubing and plastic foot valves. Prior to sampling, the wells were purged approximately three (3) well volumes of water to remove the standing water in the wells. Samples for total metals analysis were not field filtered, as the sampling results will be compared to Ontario Provincial Water Quality Objectives (PWQO) or City of Brampton Sewer By-Law (90-75) limits. Collected groundwater samples were submitted to Bureau Veritas Laboratories of Mississauga, Ontario for laboratory analyses of those parameters as describe by the City of Brampton Sewer By-Law and major ion chemistry parameters.

Samples were collected directly into laboratory supplied sampling containers.

Surface Water Sampling

Surface water sampling could not be completed as the creek was dry during the investigation.

QA/QC Program

A quality assurance/quality control (QA/QC) program was implemented to minimize and quantify impacts introduced during sample collection, handling, shipping and analysis. As part of the QA/QC program, sampling protocols included minimizing sample handling; submitting field QA/QC samples (field duplicate sample); using dedicated sampling equipment; using sample specific identification and labelling procedures; and using chain of custody records.

Private Well Survey and Sampling

Prior to field work program, a notification letter (discussed further in Section 6) was prepared by SNC-Lavalin (developed in conjunction with the City Brampton) and delivered to each of the properties located within 300 m from the site (west of Highway 50) to confirm their willingness to participate in the water sampling program and obtain consent to access the property to conduct well survey.

The notification letter was hand delivered to the owners/tenants during the site visits and door-to-door well survey. Where the owner of the residence/property was present during the visit, the requirements were discussed in person. When the owner was not at home (on the property), the letter was either provided to the tenant or left in their mail box.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Based on the results of the door-to-door well survey, the private well sampling was deemed not necessary (thus not conducted) as the properties visited were all reported to be connected to and serviced by a municipal drinking water supply system. The identified water supply wells during the desktop survey (within 300 m from the site) were either decommissioned or not in use, confirmed through in-person interviews, telephone conversations or emails.

2.5 Hydraulic Conductivity Test

A total of five (5) in-situ hydraulic conductivity (K) tests (i.e., single well response tests) were completed in July and October 2019. The K tests were completed in three (3) monitoring wells (MW-03, MW-22 and MW-74) using the manual bail-down/rising head method where groundwater recovery is relatively slow and two (2) wells (MW-02B and MW-51B) using an electrical submersible pump to achieve the desired drawdown, as these wells displayed higher recovery rates. Water level transducers (Solinst Level Loggers™) and/or manual measuring were used to record water levels during the K tests. Initial groundwater levels were measured prior to the start of the tests. The water levels were allowed to recover to at least 90% of the original drawdown before ending the tests.

The hydraulic conductivity analysis was completed using the commercial software AquiferTest v.8.0 developed by Schlumberger Water Services. The Bouwer & Rice solution and Theis Solution with Jacob Correction was used to perform the analysis.

2.6 Water Balance Analysis

Thornthwaite Model

The existing conditions of the water balance at the Site was assessed by using a monthly accounting procedure based on the methodology referenced from the U.S. Department of the Interior, U.S. Geological Survey (Gregory J. McCabe and Steven L. Markstrom, 2007). The water-balance model was originally presented by Thornthwaite (Thornth-waite, 1948; Mather, 1978, 1979; McCabe and Wolock, 1999; Wolock and McCabe, 1999). The model is referred to as the Thornthwaite model.

Inputs to the model include mean monthly temperature (T, in degrees Celsius), monthly total precipitation (P, in millimetres), and the latitude (in decimal degrees) of the location of interest. The latitude of the location is used for the calculation of daylight hours, which is needed for the calculation of potential evapotranspiration (PET).

The water-balance model has seven (7) input parameters (runoff factor, direct runoff factor, soil-moisture storage capacity, location latitude, rain temperature threshold, snow temperature threshold, and maximum snow-melt rate of the snow storage) that are modified through the graphical user interface. The range and default values for these parameters are set by the model.

Infiltration

The water balance method developed by Thornthwaite and Mather (1957) determines the potential and actual amounts of evapotranspiration and water surplus (or excess of precipitation over evapotranspiration). Infiltration factors are used to determine the fraction of water surplus that infiltrates into the ground (to recharge groundwater) and the fraction that runs off to nearby streams.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

The Stormwater Planning and Design Manual (MOE, 2003) provides a method to estimate the infiltration amount based on the infiltration factor (i). The factor “I” is applied to the water surplus to estimate the infiltration (groundwater recharge) for a given area with pervious cover.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

3 Regional Geology and Hydrogeology

The project study area (i.e., 500 m radius from the Site boundaries) is located within the Rainbow Creek Subwatershed, which belongs to the Main Humber River Primary Watershed (**Figure 3**). The following regional geological and hydrogeological settings were largely referenced from the Humber River State of the Watershed Report (TRCA, 2008).

3.1 Physiography

The study area lies within a physiographic region known as the South Slope (**Figure 4**). The South Slope physiographic region is defined as the area along the southern slope of the Oak Ridges Moraine (ORM) and extends along the moraine between Durham Region in the east to the Niagara Escarpment in the west. The South Slope is characterized by topography that gently slopes southward towards Lake Ontario and consists of a smooth, faintly drumlinized, clay till plain (TRCA, 2008).

Drainage flows from the highest elevations (approximately 490 m amsl) along the Niagara Escarpment and the ORM to the north shore of Lake Ontario (75 m amsl). The ORM is the prominent ridge of land separating the Lake Ontario drainage basin from the Georgian Bay and Trent River drainage basins.

3.2 Geology

The geology within the Humber River Watershed generally consists of Quaternary sediments infilling a fluvial valley system incised into the bedrock surface. This bedrock valley system drained the upper Great Lakes basin to what is now the St. Lawrence River. This sedimentary package ranges in thickness from zero (bedrock outcrop) to 270 metres within the Laurentian bedrock valley system.

Surficial Geology

The Humber River Watershed has a wide range of surficial geological features. The upper reaches, particularly in the west, are characterized by significant thicknesses of sand and gravel associated with the Oak Ridges Moraine. These areas comprise the key recharge areas in the watershed. In some areas, the sand and gravel is overlain by a thin layer of silt till (Halton Till), but with the hummocky topography (Leney and Kenny, 2003) and thin till, significant infiltration is still possible.

The surficial geology of the remainder of the watershed is dominated by low permeability silt, clay, and silt till of the Halton Till Formation, although there are sands in the lowest reaches associated with the former Lake Iroquois shoreline and some isolated recent fluvial sand deposits along the Humber River.

According to the Ontario Geological Survey (OGS) online maps (http://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth/surficial-geology), the surficial geology in the project study area consists of fine-textured glaciolacustrine deposits of silt and clay, with minor sand and gravel.

Quaternary Geology

Quaternary sediments within the Humber River watershed consist of glacial and interglacial deposits (Eyles, 2002 and Karrow, 1989). **Figure 5** summarizes the Quaternary sediments generally found within the Humber River Watershed.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Only the upper geological units including glaciolacustrine deposits and Halton Till are further discussed here as these deposits are most likely to be encountered during the construction of the project.

The uppermost surficial geologic unit consists of a sequence of glaciolacustrine deposits that form a veneer over the underlying Halton and Newmarket tills. These deposits vary from near shore sands and gravel beach deposits of the Lake Iroquois shoreline located within the southern part of the watershed, to the fine sands, silts and clays of glaciolacustrine deposits (ponding) that occur north of the Lake Iroquois shoreline. These sediments generally form a thin veneer over the underlying deposits, although locally they can be several meters thick.

The Halton Till deposit is typically 3 to 6 m thick, but locally its thickness can be as much as 40 meters. The Halton till generally comprises sandy silt to clayey silt, interbedded with silt, clay, sand and gravel. In some areas it is very clay-rich where the Halton ice has overridden glaciolacustrine deposits. The Halton Till is believed to form the surficial till unit extending southward to the Lake Iroquois shoreline. On the southern flanks of the Oak Ridges Moraine, the Halton Till overrides the granular Oak Ridges Moraine deposits.

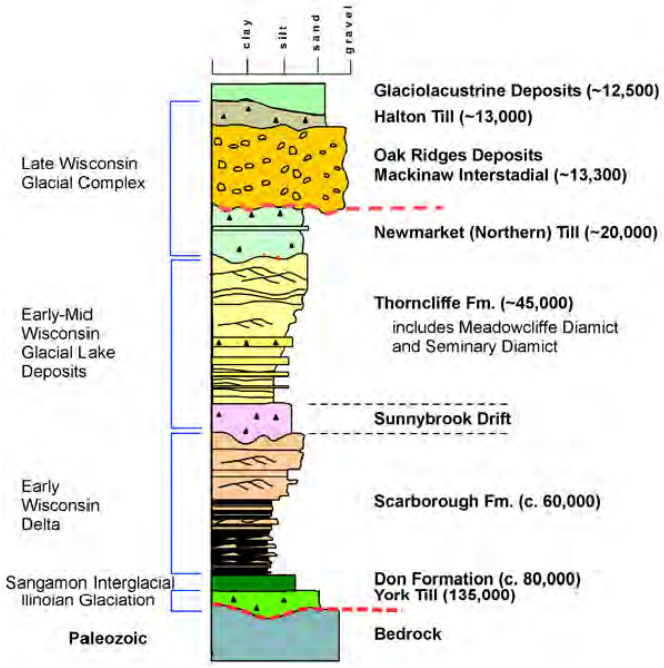


Figure 5: Quaternary Deposits within the Study Area (Eyles, 2002)

Bedrock Geology

In most of the Humber River watershed, the bedrock consists of Georgian Bay Formation (interbedded limestone and shale). These rocks were deposited over the Canadian Shield. The structures of the Paleozoic rock influence the groundwater resources and flow patterns. Glaciofluvial erosion may have enhanced these structures and valleys (Gilbert and Shaw, 1994).

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

3.3 Hydrogeology

Hydro-stratigraphic Units

The hydrogeology within the Humber River Watershed is shaped by the stratigraphic framework (quaternary deposit profile) as shown in **Figure 5**. The regional hydro-stratigraphic units are summarized in **Table 3.1**.

The groundwater system within the watershed consists of three principal aquifers: 1) the upper aquifer system or Oak Ridges Moraine (ORM) aquifer complex occurs within deposits of the ORM and the Mackinaw Interstadial Unit; 2) the intermediate aquifer or Thorncliffe aquifer complex occurs within the Thorncliffe formation; and, 3) the deep aquifer system or Scarborough aquifer complex occurs within the deposit of the Scarborough formation.

The Thorncliffe and Scarborough aquifers are separated from the Oak Ridges Moraine aquifer by layers of Newmarket till. The Newmarket till effectively forms a protective barrier for the deeper aquifers.

Table 3.1: Hydro-stratigraphic Units within the Humber River Watershed

Geological Units	Type	Hydro-Stratigraphic Units
Recent glaciolacustrine deposits		
Halton Till (or Kettleby Till)	Aquitard	Halton Aquitard
Oak Ridges Moraine/Mackinaw Interstadial	Aquifer	Oak Ridges Aquifer Complex
Newmarket Till	Aquitard	Newmarket Aquitard
Thorncliffe Formation	Aquifer	Thorncliffe Aquifer Complex
Sunnybrook Drift	Aquifer	Sunnybrook Aquitard
Scarborough Formation	Aquitard	Scarborough Aquifer Complex
Weathered Bedrock		Limestone and shale

Groundwater Flow

Groundwater flow within the shallow aquifer system is generally from the topographic highs associated with the ORM towards the topographic lows associated with the major stream channels and Lake Ontario. In the shallow groundwater flow system, groundwater flow patterns are influenced by ground surface topography, but are more significantly influenced by the network of local watercourses. Local deflections in flow direction towards tributary streams and their associated valleys can be expected.

Groundwater Recharge

The most significant groundwater recharge areas within the Humber River Watershed are located within the Oak Ridges Moraine. The northern end of the watershed, specifically the southern flank of the Oak Ridges Moraine, is the area with the highest recharge rates due to the sandy soils and hummocky topography.

The closest significant groundwater recharge area (SGRA), where infiltration to surficial sand and gravel deposits exceeds 200 mm/year, is located approximately 2.5 km northeast of the Site (**Figure 6**) (TRCA, 2008).

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Well Head Protection Area

The closest municipal drinking water supply well is Kleinburg #3 (Region of York), which is located approximately 3.5 km northeast of the Site (**Figure 7**). This well was installed in Scarborough Aquifer Complex, with an average daily pumping rate of 761 m^3/day (TRCA, 2008). The Site is located approximately 1.6 km from well head protection area (WHPA)-D, also known as the 25-year time-of-travel zone (**Figure 8**) (MECP, 2020).

Highly Vulnerable Aquifer

The Intrinsic Susceptibility Index (ISI) method was used to map highly vulnerable aquifers in the Source Protection Plan. Vulnerability was measured on a 10-point scale, reflecting how quickly water (and pollutants) moves from the ground surface to the aquifer (TRCA, 2008).

The closest highly vulnerable aquifer is located approximately 2.5 km northeast of the Site, where WHPA-B of municipal well Kleinburg #3 is delineated, with a vulnerability score of 6 (**Figure 9**) (MECP, 2020).

3.4 Surface Water Features

The Main Humber subwatershed drains an area of approximately 357 km^2 that includes Centreville Creek, Cold Creek and Rainbow Creek subwatersheds. The Rainbow Creek Subwatershed covers approximately 48 km^2 and is drained by two (2) watercourses, namely, rainbow Creek and Robinson Creek, which merge north of Highway 7 to form Plunkett Creek. Plunkett Creek joins the Humber River north of Steeles Avenue. Most of the Rainbow Creek Subwatershed is located within the City of Vaughan, with a portion to the Northwest extending into the Town of Caledon and a portion to the west extending into the City of Brampton (TRCA, 2008).

Rainbow Creek is not considered a major contributor to the overall baseflow, inputting less than 1% to the Main Humber subwatershed. Rainbow Creek tributaries were observed to be dry in the headwaters, and sampling was not possible throughout much of these reaches due to site specific conditions. Data from 1996 showed slightly higher baseflow contributions, ranging from 3 to 10 L/s (TRCA, 2008).

3.5 Climate

Within the Humber River watershed area, there are three main zones of relatively contiguous and uniform climate known as the Lake Ontario Shore, the South Slope/Peel Plain, and Oak Ridges Moraine/Horseshoe Moraine zones (named after the physiographic regions). These three zones are largely distinguished by differing precipitation and temperature patterns.

Based on Environment Canada climate stations in or near the watershed with at least 30 years of records, the average annual precipitation for this watershed during the period 1971 to 2000 ranged between 798 millimetres per year (mm/year) in Woodbridge (Station 6159575) in the South Slope/Peel Plain zone. The South Slope/Peel Plain zone has a relatively cooler mean annual temperature of about 7°C (Environment Canada, 2007).

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

The mean annual actual evapotranspiration for the region including the Humber River watershed has previously been estimated to be about 530 to 560 mm/year, reflecting seasonal periods of soil moisture limitations (Brown et al., 1980, Phillips and McCulloch, 1972, Morton, 1983). Through recent application of water budget modelling at the watershed scale, average annual total evapotranspiration is estimated to be 589 mm/year for the South Slope/Peel Plain zone. A value of about 525 mm/year is the average value for the entire watershed (TRCA 2008).

The modelled average annual water surplus (i.e., precipitation minus total evapotranspiration losses) under current conditions is 277 mm/year in the South Slope/Peel Plain. Average water surplus for the entire watershed was estimated at 330 mm/yr. Part of the water surplus will be converted to surface runoff into area watercourses and the balance will infiltrate through the soil profile and eventually recharge the upper portion of the groundwater system.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

4 Site Conditions

Geotechnical investigations and environmental site assessment were completed by SNC-Lavalin in June and October 2019, as part the overall investigation program of the Project.

The field work of the investigations was carried out on Parcel A in June 2019 and then on Parcel B in October 2019. It consisted of drilling seventy-seven (77) boreholes, excluding the two hydrogeological borehole locations, in the footprint of the proposed transit facility and associated structures to maximum depths of 9.8 m. Seventy-three (73) boreholes, namely BH-01 to BH-73 were drilled on Parcel A and four (4) boreholes, namely BH-74 to BH-77 on Parcel B. The depths of boreholes range from 2.9 to 9.8 mbgs. Upon completion of drilling, ten (10) boreholes were converted to environmental monitoring wells (MW-02, MW-03, MW-22, MW-30, MW-33, MW-35, MW-51, MW-70, MW-74 and MW-75).

The locations of the completed environmental monitoring wells are provided in **Appendix B**.

4.1 Stratigraphy

Based on the review of the borehole logs (77 from the geotechnical investigation and 2 from the hydrogeological investigation), the interpreted subsurface soil conditions across the site are summarized as follows:

Fill Materials

- Fill materials consisting predominantly of silty clay (with trace to some sand) was encountered immediately beneath the ground cover in all boreholes, except in BH-20 and BH-30 to BH-33. The fill materials extended to a depth of approximately 2.3 m bgs.

Sandy Silty Clay to Sandy Clayey Silt Till

- A stratum of native soil consisting predominantly of sandy silty clay to sandy clayey silt till was encountered immediately below the fill materials in most of the boreholes at various depths ranging from 0.6 to 2.3 m bgs.

Sandy Silt to Silt Till

- Sandy silt to silt till was encountered at depths ranging from 2.3 to 9.8 m bgs in various boreholes.

Silty Sand to Sand Till

- A silty sand to sand layer (with trace to some clay and trace gravel) was encountered between the depths of 3.6 to 9.1 m bgs in various boreholes. The soils with more gravel content were encountered between approximately 4.0 to 6.1 m bgs in boreholes BH-25, BH-27, BH-30 and BH-34. Some clayey cores were present between 6 to 7 m bgs.

Sandy Gravel

- A layer of sandy gravel was encountered at depths between 6.7 to 9.1 m bgs in borehole BH-02B.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

4.2 Groundwater Level

Groundwater levels were measured in monitoring wells completed during the geotechnical/environmental and hydrogeological investigations in June and October 2019. Measured groundwater levels across the Site are presented in **Table 4.1** and **Table 4.2**.

Table 4.1: Groundwater Level Measurements – Geotechnical/Environmental Investigation

Well ID	Screen Interval (m bgs)	Date	Water Level (m bgs)
MW-02	4.6 to 7.2	2019/06/27 2019/10/21	3.6 4.4
MW-03	3.0 to 6.1	2019/06/27 2019/10/21	2.3 3.1
MW-22	2.1 to 6.7	2019/06/27 2019/10/21	0.3 0.8
MW-30	3.7 to 6.7	2019/06/27 2019/10/21	2.1 3.2
MW-33	3.0 to 6.1	2019/06/27 2019/10/21	2.5 0.9
MW-35	2.4 to 7.0	2019/06/27 2019/10/21	0.6 2.4
MW-51	3.7 to 6.7	2019/06/27 2019/10/21	6.3 2.2
MW-70	3.4 to 6.7	2019/06/27 2019/10/21	1.4 2.3
MW-74	2.6 to 5.6	2019/10/21	2.6
MW-75	2.7 to 5.8	2019/10/21	3.4

Table 4.2: Groundwater Level Measurements – Hydrogeological Investigation

Well ID	Screen Interval (m bgs)	Strata at the Screen Interval	Date	Water Level (m bgs)	Approximate Location
MW02	4.6 to 7.2	Sandy silty clay till	2019/06/27 2019/10/21	3.6 4.4	Northeast (up-gradient)
MW02B	7.9 to 9.4	Sandy gravel	2019/06/27 2019/10/21	3.6 4.5	Northeast (up-gradient)
MW51	3.7 to 6.7	Sandy silt till	2019/06/27 2019/10/21	6.3 2.2	Southwest (down-gradient)
MW51B	7.0 to 8.5	Silty sandy clay	2019/06/27 2019/10/21	2.8 3.8	Southwest (down-gradient)

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Based on the above monitoring results, depths to groundwater in the monitoring wells ranged from approximately 0.8 m to 4.4 m bgs on October 21, 2019. The highest groundwater elevation at the site appears to be centered at monitoring well MW-22, which is located in the northeast portion of the site. The shallow groundwater flow directions were interpreted to be from the northeast portion of the site towards to the boundaries of the Site (**Appendix B**). The inferred horizontal groundwater hydraulic gradients range from 0.01 to 0.05 m/m. The vertical hydraulic gradients were estimated to be 0.004 m/m and 0.62 at MW-02/B and MW-51/B, respectively, and are considered to be downward.

4.3 Hydraulic Conductivity

The hydraulic conductivity analysis results are provided in **Appendix C** and summarized in **Table 4-3**.

Table 4-3: Results of Hydraulic Conductivity Analysis

Well ID	Screen Interval (m bgs)	Strata at the Screen Interval	Hydraulic Conductivity (m/s)
MW-02B	7.9 to 9.4	Sandy gravel	4.3×10^{-4}
MW-03	3.1 to 6.1	Sand till, silty clay seams	1.9×10^{-8}
MW-22	2.1 to 6.7	Sandy silty clay till	7.0×10^{-9}
MW-51B	7.0 to 8.5	Silty sandy clay till	4.3×10^{-6}
MW-74	2.6 to 5.6	Sandy silty clay till, silty sand, sand	8.9×10^{-7}
Maximum value of shallow wells (MW-03, MW-22 and MW-74)			8.9×10^{-7}
Arithmetic mean of shallow wells (MW-03, MW-22 and MW-74)			3.0×10^{-7}

It should be noted that the K test in MW-02B was conducted using a submersible pump set a discharge rate of 0.25 L/s due to the fast water level recovery. As a result, the pumping test was completed within one minute. The K analysis was completed using the Theis Solution (with Jacob Correction) for pumping test. Considering the short duration of the pumping test, the results are qualified in that it represents order of magnitude as would be expected for sand and gravel k values, however, the results may not fully reflect the actual physical characteristics of the aquifer. To obtain more representative site data at this level/layer (sandy gravel), a full scale pumping test is will be required (i.e., 24 to 72-hour continuous constant rate pumping test).

4.4 Groundwater Quality

The results of groundwater sampling for the City of Brampton Storm Sewer By-Law (90-75) and major ion chemistry parameters including analytical tables (**Table 4-4** and **Table 4-5**) and laboratory certificate of analysis are provided in **Appendix D**.

Sewer by-law results

The results indicate that concentration of iron in one well (MW-22) and concentrations of total suspended solids (TSS) in all three (3) wells (MW-22, MW-51B and MW-74) exceeded the City of Brampton Storm Sewer By-Law (90-75) discharge limits.

Major Ion chemistry

The results from the major ion chemistry analysis were compared to PWQO. No parameters were detected above the applicable PWQO.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

4.5 Base-flow Monitoring

Base-flow/streamflow monitoring of the creek (Rainbow Creek) could not be completed as the creek was dry during the hydrogeological investigation.

4.6 Groundwater and Surface Water Interactions

Streams are typically fed/recharged to a varying degree by precipitation, overland runoff and groundwater discharge. Stream flows are dominated by groundwater discharge (often referred to as base-flow) during low flow seasons (i.e., in summer or winter). During wet seasons (i.e., higher water level in spring), streams may be recharging groundwater, particularly along reaches at higher elevations. Stream reaches at lower elevations are typically situated in groundwater discharge zones.

The Site is located in the middle portion of the Rainbow Creek Subwatershed. During dry seasons (i.e., in summer), the creek was dry. It seems that the Site is in a situation where there is limited or no base-flow contribution of groundwater to surface water during dry seasons. During wet seasons (with a higher stream water level), surface water may recharge groundwater.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

5 Dewatering Requirement

5.1 Dewatering Assessment

Assumptions

For the purpose of dewatering assessment, the following assumptions were made based on the available information:

- The open cut method and temporary supporting system will be used to facilitate the construction of the building foundations (i.e., excavation walls will be approximately vertical);
- It is assumed that the longest excavation to be opened at one time for the construction of the foundations is 300 m (i.e., south wall of the proposed building);
- The target groundwater level for dewatering is approximately 1.0 m below the bottom of the excavation;
- The base of the water bearing zone is assumed to be 3 m below the target groundwater level (to account for the depth of sumps/pumps); and
- The water bearing zone is considered to be unconfined.

Input Parameters

Based on the footprint shown on the Site Plan Concept, and the results of groundwater level conditions observed during the geotechnical/environmental and hydrogeological investigations, the input parameters selected/determined for dewatering assessment are summarized in **Tables 5.1**.

Considering the foundation of the building is relatively shallow, conservative values of groundwater water levels and hydraulic conductivities obtained from shallow monitoring wells (excluding MW-02B and MW-51B) were used for the dewatering assessment.

The geometric mean of hydraulic conductivity results obtained (excluding MW-02B and MW-51B) is 1.3×10^{-7} m/s, using a conservative estimation to account for heterogeneity across the site a higher hydraulic conductivity of 1.0×10^{-6} m/s is applied to the dewatering assessment.

Table 5.1: Input Parameters for Dewatering Assessment

	Foundation Excavation	Note
Length of excavation (m)	300	The longest section to be excavated at one time
Width of excavation (m)	6	Assumed
Base of Excavation (m bgs)	3.5	
Initial groundwater level (m bgs)	0.5	Conservative/Higher value
Target groundwater level (m bgs)	4.5	1 m below the bottom of excavation
Groundwater drawdown (m)	4.0	
Hydraulic conductivity (m/s)	1×10^{-6}	Conservative/Higher value

Note: bgs – below ground surface

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Dewatering Rates

Details of the dewatering assessment including input parameters, equations and results are provided in **Appendix E**.

The results indicate that the typical daily dewatering rate was estimated to be 94,300 L/day, under the assumptions listed in Section 5.1, with no additional variations factored into the assessment. To account for seasonal or short-term groundwater level fluctuations, hydraulic conductivity heterogeneity and/or rain/surface water runoff and infiltration into the excavations, especially during the wet weather conditions, a safety factor of 2 was applied to the typical dewatering rates to provide a maximum daily dewatering rate (the worst case), which would be in the order of 188,600 L/day.

The dewatering radius of influence was estimated to be 12 m from the excavation limits.

Water Taking Permits

As the estimated maximum daily dewatering rate will be less than 400,000 L/day (but more than 50,000 L/day), an EASR registration is required for the project based on the worst-case scenario with the available inform provided to date.

5.2 Discharge Plan

In addition to groundwater seepage, rain/surface water may infiltrate and accumulate in open excavations during wet weather conditions. Therefore, water management and control at the Site may include both groundwater and storm water (rain and surface water runoff).

It should be noted that the following discharge plan is a high level plan. More detailed discharge plan should be developed when the detailed design of the building and site development become available. The discharge plan, as well as erosion and sediment control plan, should meet the applicable requirements from the MECP and other local authorities including, but not limited to, Department of Fisheries and Oceans Canada (DFO) and Toronto and Region Conservation Authority (TRCA).

Dewatering Methodology

For dewatering in a relatively small and shallow excavation (i.e., less than 5 m deep), water is typically pumped out using bottom suction submersible pumps installed in sumps constructed inside or immediately outside the excavations, typically installed below the base of the excavation.

To lower the groundwater levels outside the limits of deeper excavations, drilled wells (i.e., well points) may be installed beyond the limits of the excavation (i.e., behind the temporary support system). Groundwater is often pumped out of the wells and directed to header pipes at grade.

The methodology appropriate for each portion of the works should be selected by the contractor following a review of the geotechnical investigation and hydrogeological assessment reports.

During dewatering, daily water taking volumes (and/or cumulative volume) should be recorded by electronic calibrated flow meters or estimated by pump capacity. The detailed design and installation of the dewatering system should be completed by a licensed dewatering company (dewatering subcontractor) prior to construction.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Discharge Locations and Water Quality

Land 30 m away from Water Bodies

Dewatering effluent may be discharged to an undisturbed vegetated area that is located a minimum of 30 m away from all water bodies, wetlands, and drainage features. In this case, at the discharge location, appropriate energy dissipation and settling/filtration measures will be used to prevent erosion and sediment release to water bodies or drainage features. Effluent from the discharge location should be allowed to drain through a well vegetated area to the receiving water body or drainage feature. All discharge water returned to surface water features should meet the PWQO. A separate permit may be required from the local conservation authority (i.e., TRCA).

Land within 30 m of Water Bodies

If water is discharged to land within 30 m of a water body, the discharge criteria and notification are as follows, in addition to meeting the PWQO:

- The turbidity of the discharge shall not exceed 8 Nephelometric Turbidity Units (NTU) above the background level of the nearest water body,
- Background turbidity levels should be measured upstream and out of any influence of the discharge location (if applicable);
- At the discharge location, appropriate energy dissipation and settling/filtration measures will be used for discharge of extracted water to prevent erosion and sediment release to water bodies or drainage features as necessary; and
- The MECP shall be notified of the method prior to the first discharge. A separate permit is required from the local conservation authority (i.e., TRCA).

Surface Water Body

It should be noted that excess water from dewatering is not allowed to discharge directly to a surface water body under EASR registration.

Sewer System – Storm Sewer

If excess water from dewatering is to be discharged to the City of Brampton's storm sewer system, a separate agreement to discharge from the City of Bampton may be required prior to discharge.

The discharge water quantity and quality should meet the requirements as described in the City of Brampton Municipal By-Law 90-75 and/or the approved discharge agreement. The baseline water quality results have been discussed in Section 4.4. In addition, no visible petroleum hydrocarbon film or sheen shall be present in the discharge.

Sewer System – Sanitary and Combined Sewer

If excess water from dewatering is to be discharged to the Region of Peel sanitary and combined sewer, a separate agreement to discharge from the Region of Peel is required prior to discharge.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

The discharge water quantity and quality should meet the requirements as described in the Region of Peel Sanitary Discharge limits (By-Law 53-2010) and/or in the approved discharge permit.

Water Treatment

As the baseline water quality at the Site exceeded the applicable discharge limits (storm sewer discharge limits), the water may need to be treated prior to discharge. The water treatment system should be designed and implemented by the contractor based on the baseline water quality and the results of verification sampling to be conducted by the contractor (if deemed necessary) prior to construction. Water quality should be tested after the treatment system to make sure the applicable criteria or limits are met prior to discharge. In this case, a relevant MECP Environmental Compliance Approval (ECA) may be required and an approval from the local conservation authority (i.e., TRCA) may be required as well.

Notification

In addition, prior to water taking, a written notice about the taking(s) should be given to the local municipalities (i.e., City of Bampton and/or Region of Peel) and the local conservation authority (i.e., TRCA) within whose jurisdiction the proposed water taking is located.

Contingency Measures

Contingency measures should be developed in the event that the discharge water quality does not meet the applicable criteria. In this case, the following contingency measures may be considered for implementation:

- Bring temporary storage tanks to the site to store the water. Stored water may be discharged at a later time (after settling and/or possible treatment system) when the water quality meets the discharge criteria.
- Where practical, hauling water off-site to a licensed receiver may be considered.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

6 Development Impact Assessment

6.1 Impact on Local Groundwater Uses

Groundwater Quantity – Private Water Supply Wells

A desktop well survey was conducted to identify wells registered with the MECP within the study area. The purpose of the desktop well survey was to identify groundwater users in the surrounding areas that could potentially be impacted by the development of the property, including dewatering activities.

The desktop search identified a total of twenty-eight (28) well records within the project study area, as listed and mapped in **Appendix F**. Among them, there are fifteen (15) water supply wells, seven (7) test holes/observation wells, five (5) abandoned wells and one (1) well with an unknown use status.

To verify and confirm the current status of the identified water supply wells (groundwater users) and to assess whether other water supply wells may be present that had not been registered with the MECP, field visits and a water well survey were conducted by SNC-Lavalin technicians in July 2019.

Based on the survey findings, it is inferred that private properties in the project study area are serviced by the municipal water supply system as evidenced from the survey responses and observations of municipal water supply shut-off valves and fire hydrants in the area. During the survey, some property owners/tenants were not present, nor responded to the letter (Notification Letter for Private Well Survey, **Appendix F**) left in their mail box. The status of the remaining water supply wells in the MECP records could not be confirmed, however, based on the presence of municipal water supply it is expected that the wells may no longer be in service.

Considering that dewatering will occur only in the surficial/shallow hydro-stratigraphic units (i.e., less than 5 m bgs) and the identified water supply wells are not expected to be used, plus they are all located beyond the estimated dewatering zone of influence (12 m), minimal impacts to local groundwater users are expected due to the proposed dewatering activities.

Groundwater Quantity – Other Considerations

Activities during construction may include site preparation (i.e., clearing and stripping), dewatering, foundation excavation and soil stockpiling. During the operation phase, the Project activities may mainly involve maintenance and repairs.

Based on the understanding of the Project scope and activities during the construction and operation phases, as well as the baseline (pre-construction) environmental and groundwater conditions, the potential effects on groundwater quantity associated with the Project activities are presented as follows:

- Reduce groundwater recharge due to ground hardening and increase of runoff during site preparation (i.e., clearing and stripping) and development (pavement and structure).
- Lower groundwater levels in the surrounding areas during construction, especially within the dewatering radius of influence, and thus may temporarily reduce groundwater contributions to nearby water supply wells and groundwater features (i.e., streams).

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

- Change local groundwater flow patterns by blocking or redirecting groundwater flows due to new foundations (i.e., concrete spread footings with low permeability).

6.2 Impact on Surface Water Features

According to the City of Brampton Official Plan, Schedule D, Natural Heritage Features and Areas (2015), the Site is not located within, nor adjacent to a well head protection area, intake protection zones, environmentally significant areas, or areas of natural and scientific interest, and it is outside the Oak Ridges Moraine Conservation Plan Area. But the western portion of the Site lies within the Valley Land/Watercourse Corridor and Woodland areas (**Appendix G**).

The proposed dewatering work is near Rainbow Creek. The water taking may temporarily reduce the groundwater base-flow contribution to the stream flow. However, comparing to the annual mean base-flow (0.343 m^3/s or 29,635,200 L/day) of the river based on the historical monitoring data (1965 to 2004) from Stream Gauge 02HC031 (West Humber River @ Highway 7), the estimated maximum water taking rates (188,600 L/day) are considered to be minimal (less than 1% of the annual mean base-flow). Also considering the short-term nature of the construction, no significant impact to the stream flow is expected associated with the proposed dewatering activities.

6.3 Impact on Water Quality

Groundwater Quality

As the groundwater table is relatively shallow in some areas especially near the creek (i.e., Rainbow Creek), potential contaminating activities (i.e., oil and/or hydraulic liquid handling, storage and leaking from equipment and machines, other chemical or hazardous material spills and leaking within the project footprint) during construction or operation may cause potential impacts on shallow groundwater qualities. Other potential impacts on groundwater quality and considerations are as follows:

- Mobilization of contaminated groundwater (i.e., discharge to the environment) due to dewatering.
- Reduction in groundwater quality by increasing the pH value due to concrete curing.
- Reduction in groundwater quality due to excavation and contaminated soil stockpiling.

Surface Water Quality

The potential impacts on surface water quality (i.e., Rainbow Creek) during the construction and operation of the proposed transit facility include the following:

- Reduction in surface water quality (i.e., total suspended solids) due to erosion and overland flow during construction involving ground disturbing, excavation, soil stockpiling and site grading activities.
- Potential impacts on surface water quality associated with contaminating activities (i.e., oil and/or hydraulic liquid handling, storage and leaking from equipment and machines, other chemical or hazardous material spills and leaking within the project footprint) during construction or operation periods through overland flows to the creek.
- Mobilization of contaminated groundwater (i.e., discharge to the environment/creek) due to dewatering.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

6.4 Water Balance Analysis

The inputs used for the water balance calculations are based on the Project information and Environment Canada climate data from the Toronto Lester B. Pearson Int'l A (Toronto INT'L A) meteorological station for the period 1938 to 2012. The Toronto INT'L A station is located approximately 15 km south from the Site. The Soil Moisture Storage capacity of 100 millimeter was used for Clay Loam based on the SWM Planning and Design Manual (MOE 2003).

Based on the analysis of 75 years of climate data (monthly precipitation and temperature), the annual surplus is estimated to be 211 mm/year at the Site. The analysis results are provided in **Attachment H**.

Pre-Development Conditions

The infiltration factors for the pre-development conditions are described as follows:

- Topography on the Site is relatively flat which will have an "i" topo of 0.3.
- Based on the grain size analysis, the surficial soils can be classified as Clay Loam ("i" soil = 0.2).
- Vegetation covering majority of the Site consists predominantly of shallow rooted crops (i.e. manicured lawns) which has an "i" cover of 0.1.

The total pre-development infiltration factor for the Site is calculated at 0.6 and the annual recharge rate to groundwater would be 127 mm/year (211 mm/year multiplied by 0.6). Considering that the entire area of the Site is considered to be pervious before the development, with the total area of the Site being measured at approximately 16.5 hectares (165,000 m^2), the total recharge volume was estimated at 20,900 m^3/year at the Site.

Post-Development Conditions

Under the post-development conditions, the infiltration factors are adjusted to reflect the changes in soil types, vegetation and topography after the land development. As the land after development will have some impervious surfaces that prevent infiltration, such as building footprints, paved road and parking lots, the pervious area available for infiltration will thus be generally reduced.

The infiltration factors for the post-development conditions remain the same (same as pre-development conditions). However, under the post-development conditions, building footprint and parking lots and other paved areas, including drive ways will become impervious. Therefore, the pervious area post-development will be reduced by approximately 60%, which is approximately 99,000 m^2 (9.9 ha). Accordingly, the annual recharge volume is anticipated to be reduced by 12,600 m^3 per year. The annual recharge volume changes under pre- and post-development conditions are summarized in **Table 6-1**.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Table 6.1: Annual Recharge Volumes - Pre- and Post-Development

Parameter	Unit	Pre-Development	Post-Development	Difference
Pervious Area	Square Meters (m^2)	165,000	66,000	-99,000
Impervious Area	Square Meters (m^2)	0	99,000	+99,000
Total area	Square Meters (m^2)	165,000	165,000	0
Annual Surplus	Millimeters	211	211	0
Infiltration Factor (pervious area)	-	0.6	06	0
Recharge Rate (pervious area)	Millimeters/year	127	127	0
Recharge Volume	Cubic Meters (m^3)/year	20,900	8,300	-12,600

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

7 Development Considerations

Based on the current site conditions and the results of the hydrogeological investigation and environmental site assessment, considerations should be given during the site development to address the constraints and reduce the environmental footprint of the Project.

7.1 Groundwater Recharge Management

The main consideration is to minimize the footprints of the buildings and structures, parking lots and other pavement areas including roads and driveways to the extent practicable to reduce the impact of surface hardening on the groundwater recharge.

Other mitigation measures to reduce this impact include, but are not limited to, minimizing ground disturbance areas during construction and implementing low impact development (LID) or green stormwater practices and management systems during the design of the facility.

Dewatering effluent, if meets the PWQO, should be considered first discharging to the natural environment and recharging the groundwater in the shallow water bearing zone.

7.2 Potential Contaminants of Concern

During the Phase II ESA completed by SNC-Lavalin between June and October 2019, groundwater samples collected from ten (10) newly installed monitoring wells were submitted for laboratory analyses of one (1) or more of benzene, toluene, ethylbenzene, xylenes (collectively referred to as BTEX), volatile organic compounds (VOCs), petroleum hydrocarbons (PHC) fractions F1 to F4, herbicides/pesticides, polycyclic aromatic hydrocarbons (PAHs) and metals/inorganics (including Cr6+, Hg, free cyanide and chloride).

The results indicated, concentrations of molybdenum exceeded the MECP Table 8 standards in two (2) monitoring wells (MW-35 and MW-70) during the groundwater sampling event in June 2019. The results from the remaining monitoring wells satisfied the applicable site condition standards (Table 8 Standards).

The identified areas of potential contaminants of concern are provided in **Appendix I.**

7.3 Opportunities and Constraints

Opportunities

The Region of Peel is responsible for the supply and distribution of municipal drinking water throughout the Region including the City of Brampton. For the urban areas in the southern part of Peel Region including Brampton, drinking water is supplied under the South Peel Servicing System. This is accomplished through a system of trunk feeder-mains, storage reservoirs and pumping stations. The new development can obtain water supply via the South Peel Servicing System. The existing watermain trunks pass through the project area along Highway 50. Development which is dependent upon a significant level of water-taking may be subject to the approval of a hydrogeological investigation/study. However, this development is not expected to require a significant amount of water supply. The existing water supply system should be sufficient (have the capacity) to provide enough water for this development.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Sanitary sewer services are the responsibility of the Region of Peel and are implemented in part through agreements with the Province of Ontario. Two (2) major water pollution control plants (wastewater treatment system) are located in the City of Mississauga near Lake Ontario that treat sewage collected from the South Peel Service Area which includes the Cities of Mississauga, Brampton and part of the Town of Caledon. The City of Brampton expects that the Region of Peel will provide appropriate and timely sanitary sewerage facilities to serve the City's development subject to some principles and policies. The existing sanitary trunk sewers pass through the project area along Highway 50.

With the existing infrastructure (utilities and services) in place, the opportunities are, after the development, the Site will be serviced by the Region of Peel municipal drinking water supply system and be connected to the Region of Peel sanitary sewer system. Therefore, there would be no need to consider and assess on-site water supply (wells) and sewage works (septic systems) and associated impacts for this development in terms of water planning and management.

Constraints:

Although opportunities exist, there are some constraints that the development may be facing during the construction and operation phases. The potential constrains are summarized as follows:

- During construction, short-term discharge of water from dewatering may be released to the natural environment or directed to the Region of Peel or the City of Brampton sewer systems. In this case, the discharge water quality needs to meet PWQO or the sewer discharge limits and water treatment may be needed.
- Considering the relatively shallow groundwater table and fine textured soil conditions encountered at the Site, the design of long-term foundation drains (i.e., French drain or soak-away pit, etc.), if needed, should consider the requirements for the minimum groundwater table clearance (at least 1 m below the bottom of the infiltration trench or soak-away pit) and the minimum infiltration rate (should be greater than 15 mm/h).
- If the design opts to use dewatering (pumping) for the long-term foundation drains, detailed dewatering assessment is needed to determine the long-term dewatering rate. In this case, the sewer capacity should be reviewed and analyzed and an approval from the Region of Peel and/or the City Brampton is required for the connection to the existing infrastructure.
- Alternatively, the foundation design may consider water-proof measures to avoid long-term water discharge to the sewers.
- As a portion of the Site is located within the Rainbow Creek flooding areas, additional requirements from TRCA may need to be addressed during the detailed design of the Project.
- A suitable dewatering and groundwater management plan should be developed to address the identified groundwater contamination areas/plumes during the detailed design of the Project.

7.4 Mitigation Measures

Dewatering activities at the site should follow the Ontario Provincial Standard Specifications (OPSS) 517 - Dewatering of Pipeline, Utility, and Associated Structure Excavation and OPSS 518 - Construction Specification for Control of Water from Dewatering Operations.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Erosion and Sediment Control (ESC) measures (e.g. OPSS 805, Construction Specification for Temporary Erosion and Sediment Control Measures) should be incorporated into design and implemented during construction to prevent erosion and soil migration from the site.

Based on the existing infrastructure available near the Site, extracted water from dewatering can be directed to a sediment settling tank first, then through a discharge pipe and filter bag, prior to releasing to the natural environment (i.e., an undisturbed vegetated area located a minimum of 30 m away from all water bodies, wetlands, and drainage features) or discharging to the City of Brampton or Region of Peel sewer systems. The settling tank is expected to serve as a pre-treatment system to dissipate energy, reduce the levels of TSS and some metals in water. Additional water treatment methods may be required if the water quality does not meet the applicable criteria or discharge limits after the settling tank. In this case, an ECA may be required from the MECP for the treatment system.

In addition, appropriate mitigation measures should be implemented to prevent and/or contain leakage from onsite equipment and machines during construction and operation.

7.5 Monitoring and Sampling Plans

Mitigation measures and monitoring plans that may be required as part of the discharge permit issued by the City of Brampton, the Region of Peel and/or local conservation authorities should be implemented. If no such requirements are available, a site-specific water quality monitoring and sampling plan should be developed and implemented. Discharge water quality should be monitored and tested prior to and during construction to ensure that the discharge water quality meets the applicable criteria or discharge limits. The suggested discharge water quality monitoring plan and mitigation measures are as follows:

Water Quality Monitoring Frequency and Location

- One round of water quality sampling and laboratory analysis for each dewatering location, immediately after the dewatering (pumping) system is set up.
- For dewatering effluent pre-treated using a settling tank, the water samples can be taken from the dewatering discharge point and submitted for laboratory analysis.
- Following the discharge effluent directed to an energy dissipation/ sediment filtering measure (e.g. filter bag) in a vegetated discharge location at least 30 m from a watercourse or waterbody, surface sampling should be conducted at predetermined upstream and downstream locations of the release point.
- Water clarity observations and turbidity meter readings (including the presence of any sheen, odour or film) can be conducted on a daily basis during dewatering activities. All inspection and monitoring observations and results will be recorded.
- When contaminants of concern/exceedances are identified, a confirmatory sample shall be taken, and the results will be reviewed by a qualified person.
- If any further treatment/mitigation is to be added, another sample shall be taken to confirm the guidelines are met.
- If no exceedance or issues are identified, then continue to inspect the system and monitor turbidity readings on a daily basis.
- Following the initial laboratory sampling event, the sampling will be conducted once a week within the first month, then monthly thereafter.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Parameters

- General chemistry, nutrients, total metals, TSS, turbidity and identified contaminants of concern.
- If no exceedances identified, continue to observe water clarity/characteristics, and test TSS/Turbidity only.

Triggers for Action

- Exceed the PWQO, or TSS 25 mg/L (or field measuring of turbidity 15 NTU or correlated turbidity value equivalent to TSS 25 mg/L established during the previous sampling events), or City of Brampton or Region of Peel Sewer discharge limits.

Water Treatment Measures

- Pre-treatment including, but not limited to sediment settling, equalization, micron or sand filters, bag filters and/or activated carbon vessels, etc.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

8 Conclusions and Recommendations

- Based on the results of the dewatering assessment, the typical and maximum daily dewatering rates were estimated to be in the order of 94,300 L/day and 188,600 L/day, respectively. As based on the worst-case scenario, the maximum daily dewatering rate will likely be less than 400,000 L/day (but more than 50,000 L/day), an EASR registration is recommended for the Project.
- During construction, short-term discharge of water from dewatering may need to be released to the natural environment or directed to the Region of Peel or the City of Brampton sewer systems. In this case, the discharge water quality needs to meet PWQO or the sewer discharge limits. Water treatment may be needed.
- It appears that private properties in the project study area are being supplied by the municipal drinking water supply system. It is expected that private water supply wells are not being used (most of them were confirmed during the well survey) in the surrounding areas.
- Minimal impacts to local groundwater users and surface water features are expected due to the proposed dewatering activities.
- The water balance analysis indicated that the annual recharge volume to groundwater after the Site development will be reduced by approximately 12,600 m^3 per year, compared to the pre-development recharge volume (without any mitigation measures).
- Appropriate mitigation measures should be implemented to prevent and/or contain any leakage from on-site equipment and machines during construction. Refuelling of pumps and equipment should be conducted away from excavations and dewatering operations.
- Any monitoring and mitigation measures that are required by the authorities should be implemented. If no such sampling requirements are available, the monitoring plan as described in Section 7.5 can be considered. Discharge water quality should be tested and monitored prior to and during construction to ensure that the discharge water quality meets the applicable PWQO or sewer discharge limits.

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

9 References

Cole Engineering Group Ltd., 2014. Rainbow Creek Master Plan Update Study, the City of Vaughan. June 2014

City of Brampton, 2015. Official Plan, Schedule D Natural Heritage Features and Areas, August 10, 2015.

C.W. Fetter, 2001. Applied Hydrogeology. Fourth Edition.

Gregory J. McCabe and Steven L. Markstrom, (U.S. Department of the Interior, U.S. Geological Survey), 2007. A Monthly Water-Balance Model Driven By a Graphical User Interface. 2007.

J. Patrick Powers, Arthur B. Corwin, Paul C. Schmall, Walter E. Kaeck, 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, Third Edition, Chapter 6 Dewatering Design Using Analytical Methods.

Ministry of the Environment, Conservation and Parks, 2020. Source Protection Information Atlas. https://www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/Index.html?site=SourceWaterProtection&viewer=SWPViewer&locale=en-US

SNC-Lavalin Inc., 2019a. Geotechnical Investigation: Proposed Johnston Transit Facility (Transit Bus Garage), 10192 Highway 50, Brampton, Ontario. November 15, 2019.

SNC-Lavalin Inc., 2019b. Phase Two Environmental Site Assessment, 10192 Highway 50, Brampton, Ontario. November 20, 2019.

Toronto and Region Conservation Authority, 2008. Humber River, State of the Watershed Report, Geology and Groundwater Resources, Surface Water Quality. 2008.

SNC-LAVALIN INC.

PROFESSIONAL GEOSCIENTIST
2020.11.23
WUZHOU LIU
PRACTISING MEMBER
1561
ONTARIO

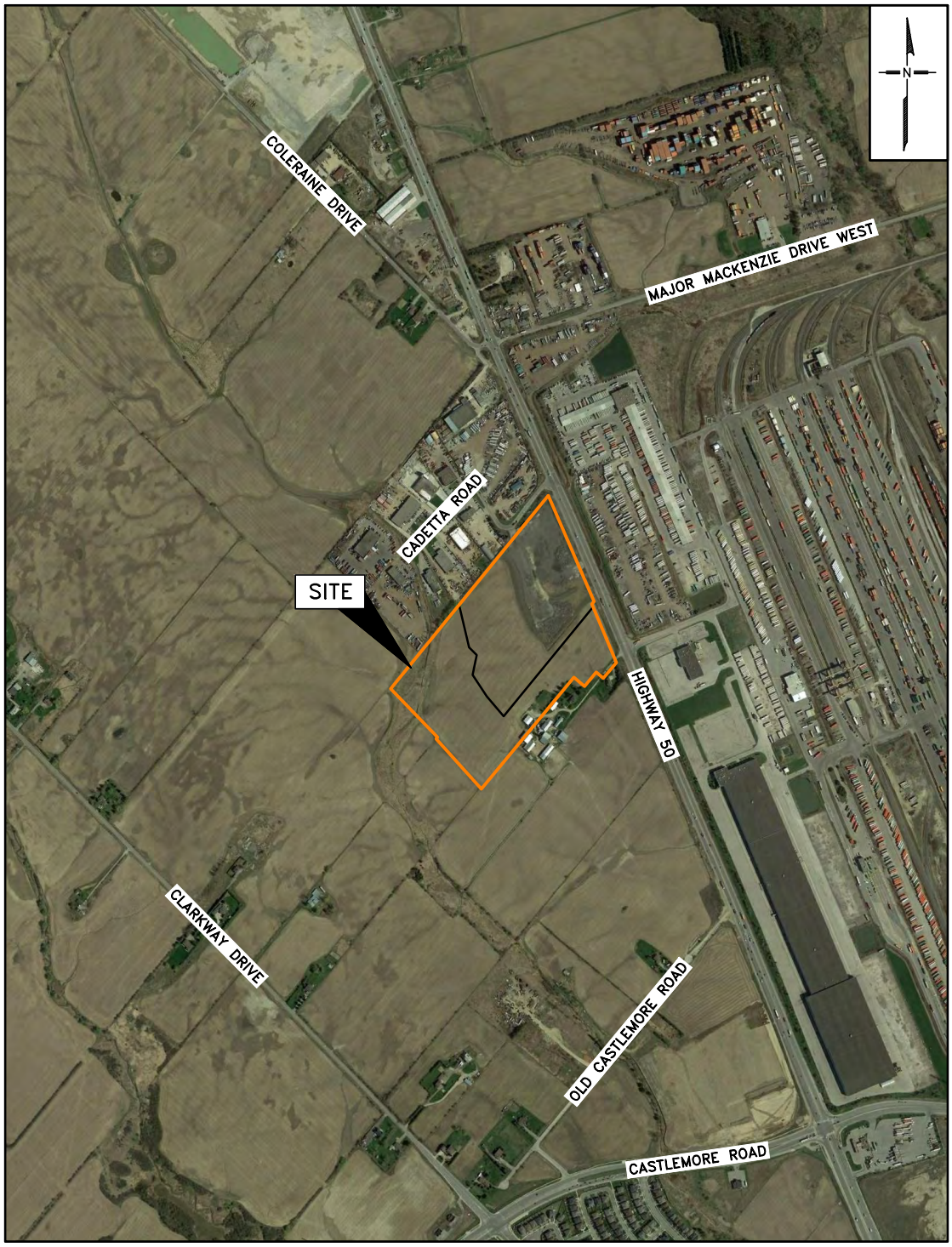
Wuzhou (Wilson) Liu, P. Geo.
Project Hydrogeologist
Environment & Geoscience

PROFESSIONAL GEOSCIENTIST
2020.11.24
LEON BURGER
PRACTISING MEMBER
2713
ONTARIO

Leon Burger, P. Geo.
Senior Project Manager, Hydrogeologist
Environment & Geoscience

© SNC-Lavalin Inc. 2020. All Rights Reserved. Confidential.

Figures



SOURCE(S):
1. GOOGLE EARTH PRO IMAGE, MARCH 7, 2018

SCALE 1:15,000

0 300 600m

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: SITE LOCATION PLAN	
Project No: 665125	Filename: 005F01_665125	Date: NOVEMBER 2019	Dwg No: FIGURE 1
Drawn: AG	Verified: RM	Project Manager: AY	

PAGE FORMAT: 8.5x11

FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\005 (Phase II)\005F01_665125.dwg

DISCUSSION NORTH

TRUE NORTH

RAINBOW CREEK

TRCA FLOODPLAIN

BH3

BH2

RE-GRADED/CLEARED AREA

PIN 14213-0276
(PARCEL A1)

BH1

BH4

HIGHWAY 50

PIN 14213-0300
(PARCEL A)

METAL STORAGE SHED

PIN 14213-0300
(PARCEL B)

LEGEND

- BOREHOLE (TROW, 2008)
- MONITORING WELL (TROW, 2008)
- RE-GRADED/CLEARED AREA
- TORONTO AND REGION CONSERVATION AUTHORITY (TRCA) FLOODPLAIN
- SITE PROPERTY LINE
- PROPERTY LINE
- EXISTING BUILDING

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SCALE 1:2,000

0 40 80m

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: CURRENT SITE LAYOUT	
Project No: 665125	Filename: 005F02_665125	Date: NOVEMBER 2019	Dwg No: FIGURE 2
Drawn: AG	Verified: RM	Project Manager: AY	

PAGE FORMAT: 11x17

FILENAME: \\SLI1025\Projects\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\005 (Phase II)\005F02_665125.dwg

Figure 3: Primary and secondary Humber River Subwatersheds (TRCA, 2008)

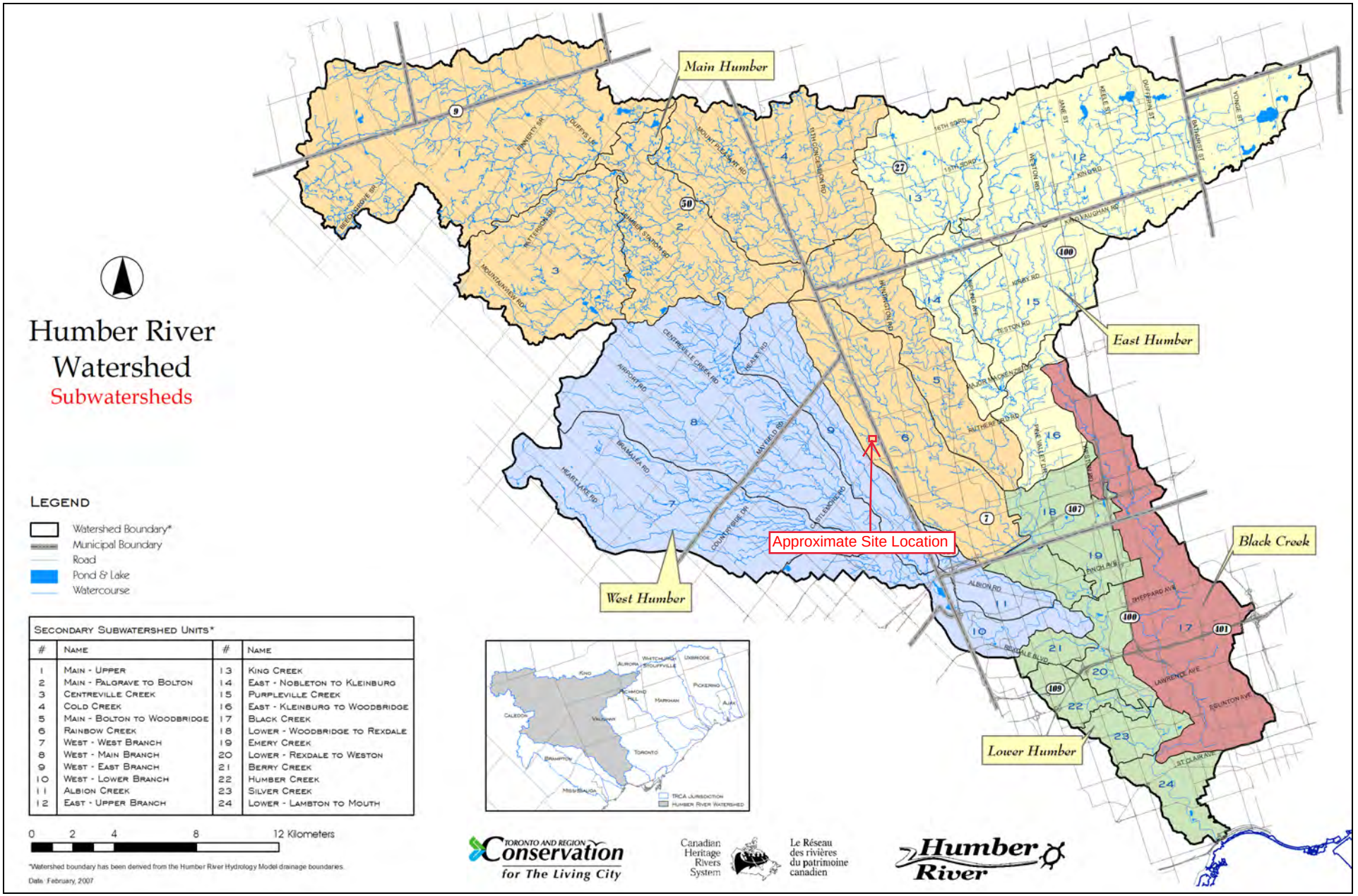


Figure 4: Physiographic Regions in the Humber River Watershed (TRCA, 2008)

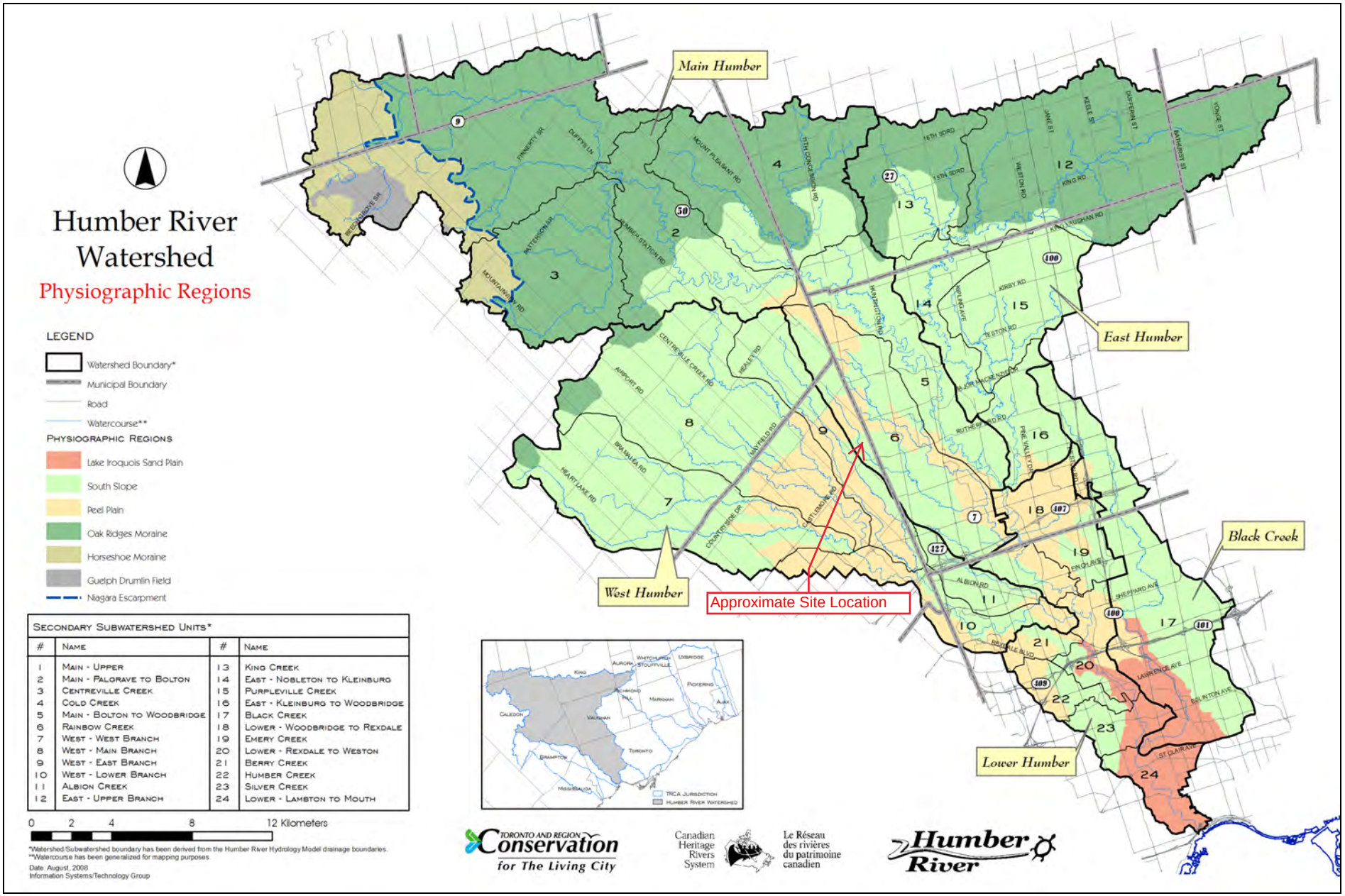


Figure 6: Estimated Groundwater Recharge Rates; mm/year (Earthfx, 2008)

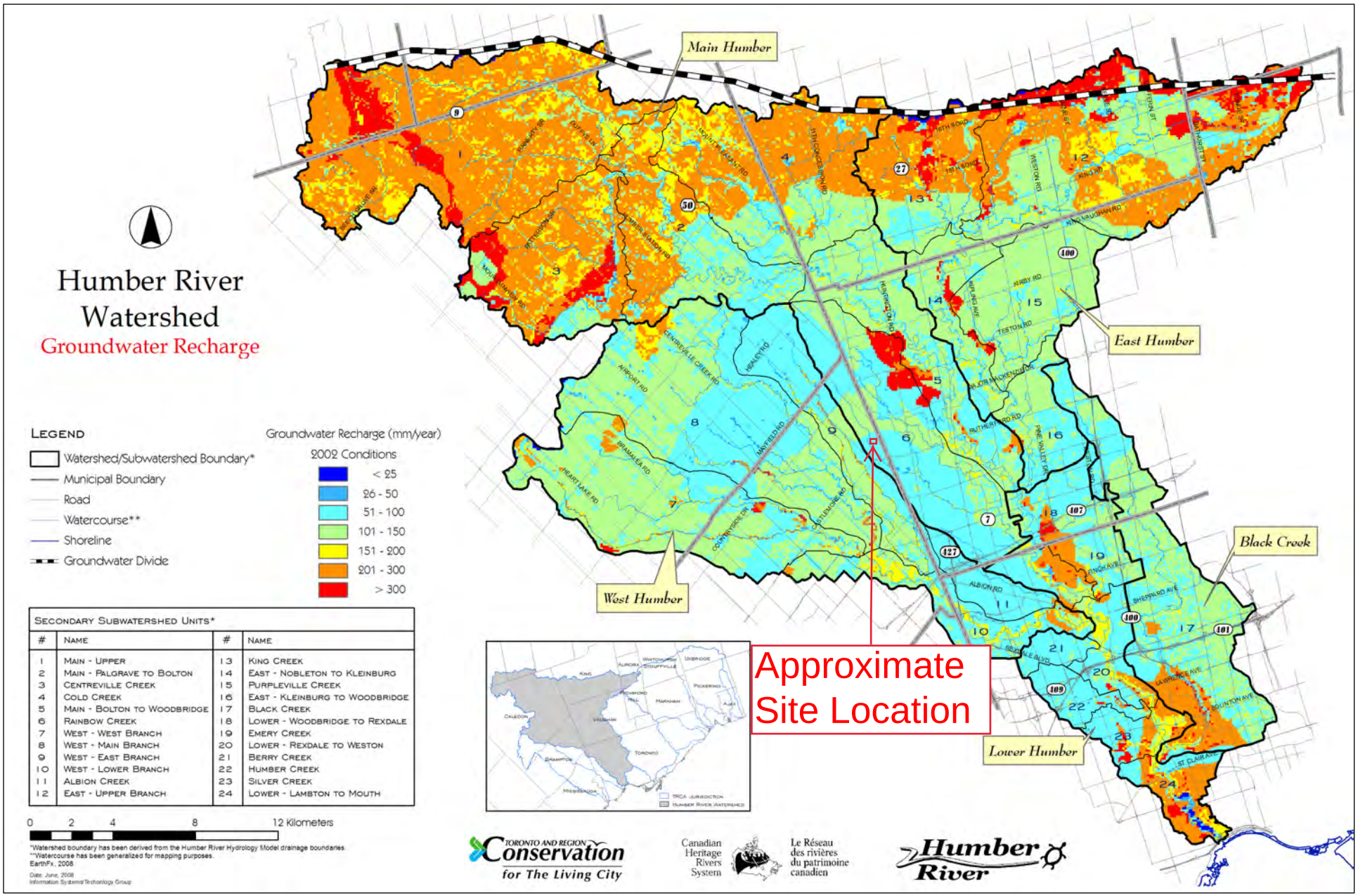


Figure 7: Locations of Municipal and PGMN Wells (TRCA, 2008)

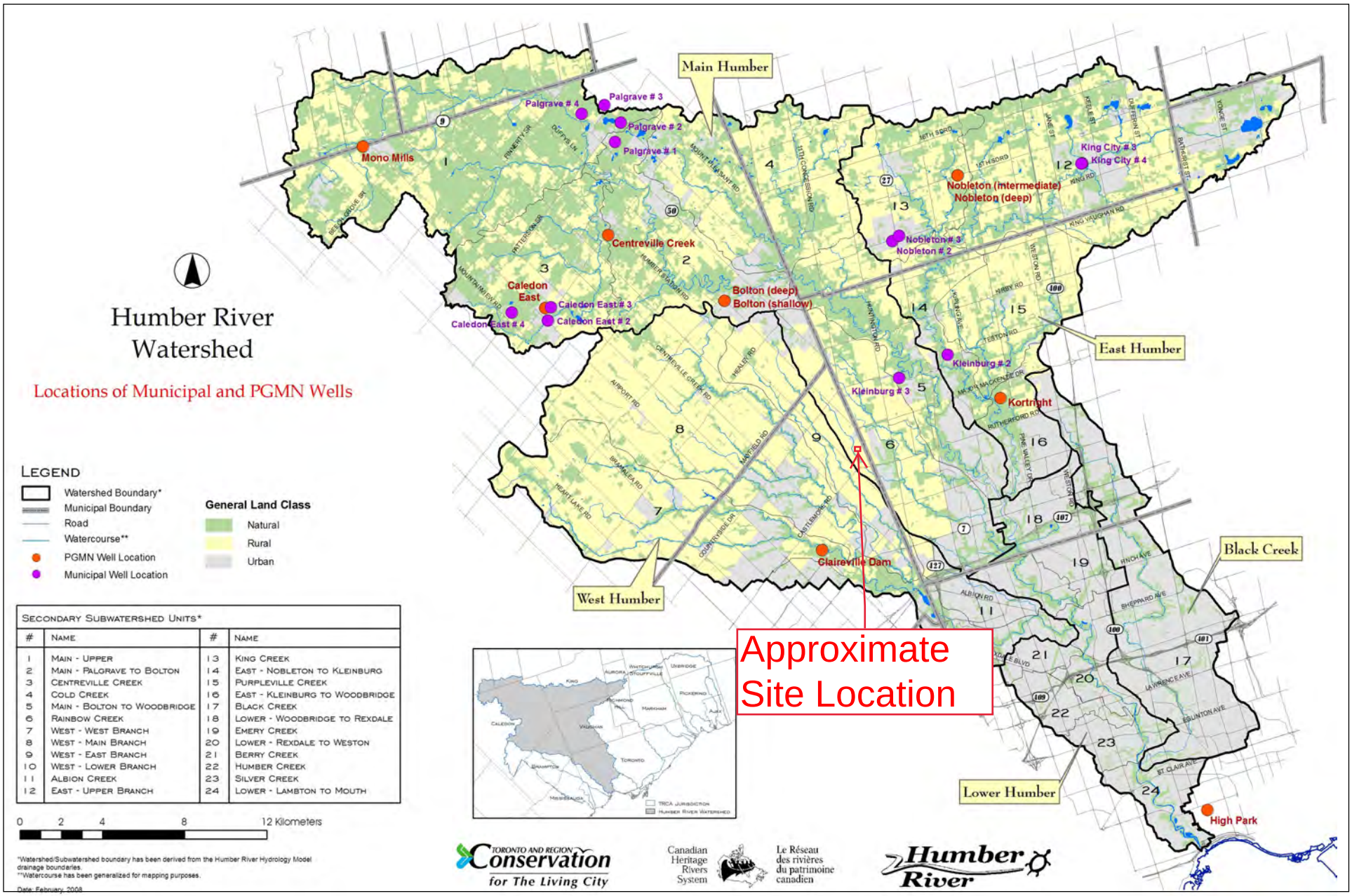


Figure 8: Well Head Protection Areas - MECP Source Protection Plan on-line Maps (MECP, 2020)

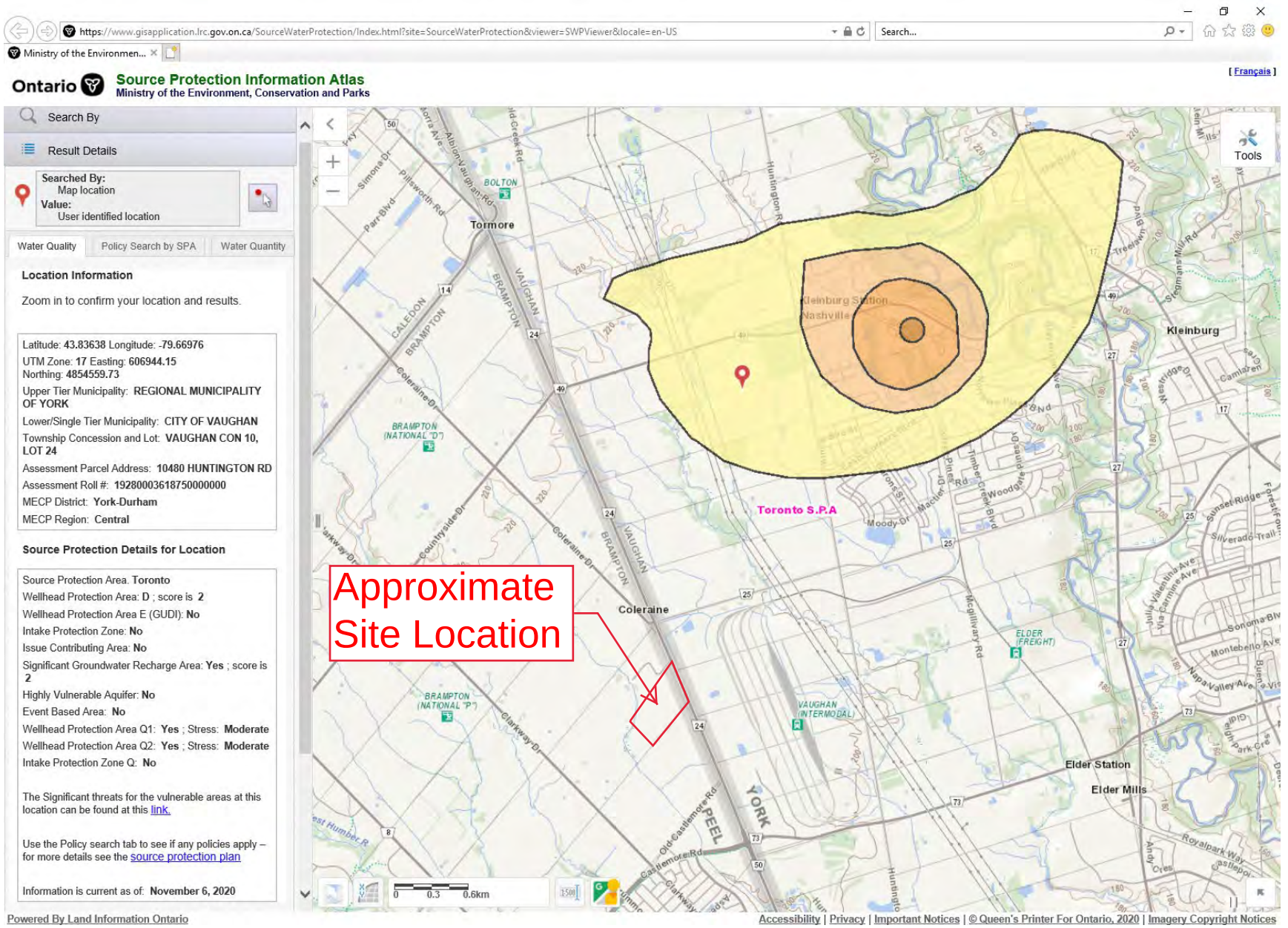
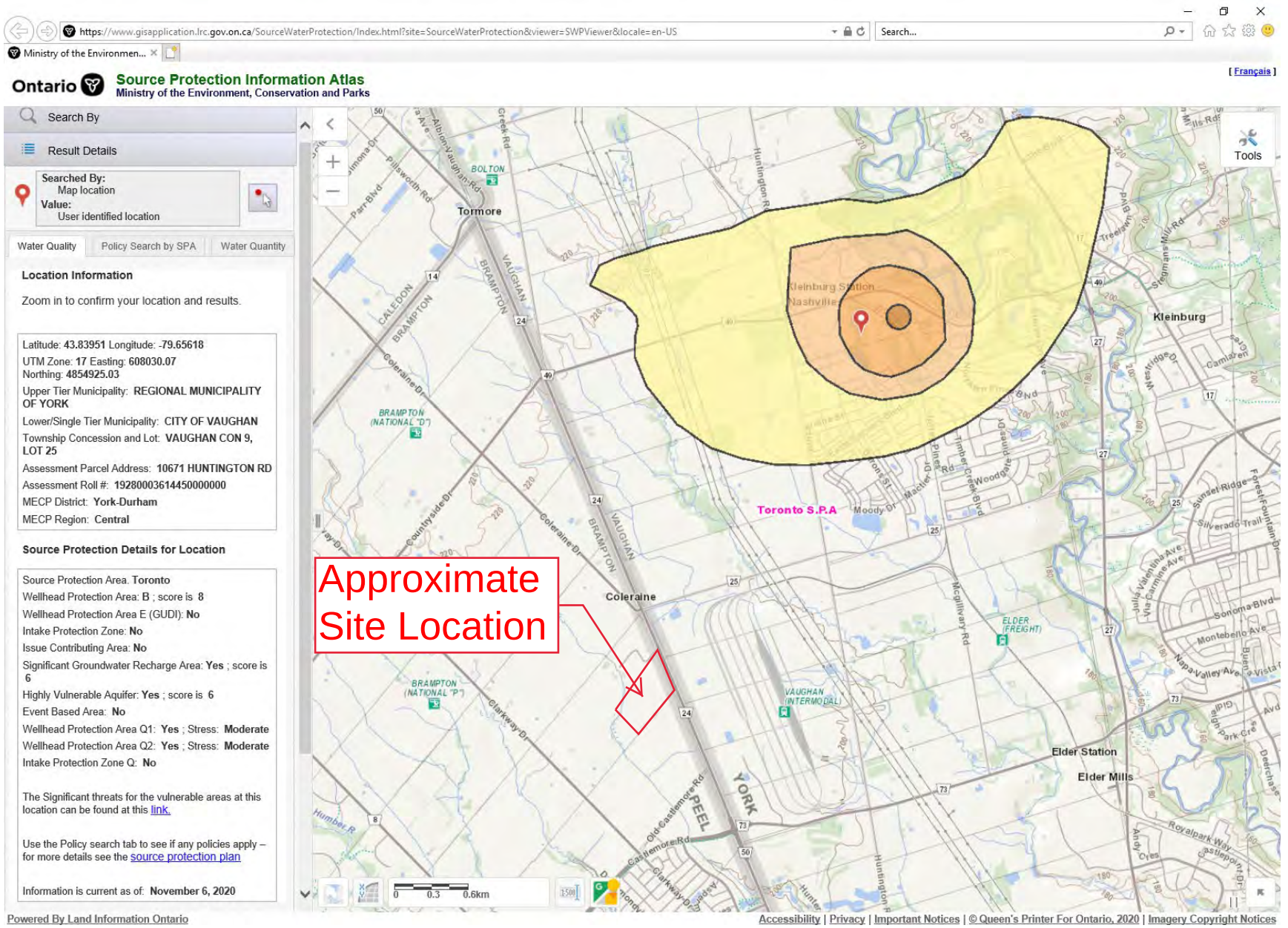


Figure 9: Highly Vulnerable Aquifers - MECP Source Protection Plan on-line Maps (MECP, 2020)



Appendix A

Site Plan Concept


CADETTA RD.
LANDSCAPE BUFFER
PARKING
PARKING
PARKING
LANDSCAPE BUFFER
RAINBOW CREEK
TRCA
FLOODPLAIN
BUILDING
FOOTPRINT
HIGHWAY 50
LANDSCAPE BUFFER
STORM
POND
PARKING
LANDSCAPE BUFFER
POTENTIAL
ACOUSTIC
BARRIER
POTENTIAL
ACOUSTIC
BARRIER
Johnston Transit Facility
Site Plan Concept
March 28, 2019
DRAFT

Appendix B

Borehole Location Plan and Borehole/Well Logs

DISCUSSION NORTH

TRUE NORTH

RAINBOW CREEK

SS-4

BH-35 (MW-35)

SS-1

BH-02B (MW-02B)

BH-02 (MW-02)

BH3

BH2

SS-5

BH-22 (MW-22)

BH1

BH4

BH-03 (MW-03)

HIGHWAY 50

SS-6

BH-33 (MW-33)

SS-2

SS-3

BH-52

BH-18

BH-70 (MW-70)

BH-30 (MW-30)

METAL STORAGE SHED

BH-72

BH-73

BH-51 (MW-51)

BH-51B (MW-51B)

MW-74

MW-75

SS11

SS10

SS7

SS14

SS8

SS12

SS9

BH-72

SS13

SCALE 1:2,000

0 40 80m

LEGEND

- SHALLOW SOIL SAMPLE (SNC-LAVALIN, 2019)
- BOREHOLE (SNC-LAVALIN, 2019)
- BOREHOLE/MONITORING WELL (SNC-LAVALIN, 2019)
- BOREHOLE (TROW, 2008)
- MONITORING WELL (TROW, 2008)
- TORONTO AND REGION CONSERVATION AUTHORITY (TRCA) FLOODPLAIN
- SITE PROPERTY LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- PROPOSED INFRASTRUCTURE

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: PROPOSED SITE LAYOUT AND BOREHOLE/ MONITORING WELL LOCATION PLAN	
Project No: 665125	Filename: 009FB1_665125	Date: NOVEMBER 2019	Dwg No: APPENDIX B1
Drawn: AG	Verified: WL	Project Manager: AY	

PAGE FORMAT: 11x17

FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\009 (Hydrogeological)\009FB1_665125.dwg

RECORD OF BOREHOLE No. BH02/MW02

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 10, 2019 Date Completed: Jun 10, 2019	Revision No.:	0

EASTING: 606377.19
NORTHING: 4852223.96

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 210.12 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (○ SPT ● DCPT); MTO Vane* (△ Intact ▲ Remould); Nilcon Vane* (◇ Intact ◆ Remould); * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL); ✱ Passing 75 um (%); ○ Moisture Content (%); Atterberg Limits W_P 20 40 60 80 W_L	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	Loose crushed stone / asphalt pieces ~460 mm. 209.7	SS	01	75		0	210					Top of Riser Elevation = 211.00 m; Height of Riser =0.90 m
	FILL 0.5 Brown, firm, silty CLAY, trace to some sand, trace gravel, moist.	SS	02	84	4	1	209		22 24			Sample submitted for laboratory analysis: BH02-01 PP = 1.0 kg/ sq-cm Sample submitted for laboratory analysis: BH02-02
	208.6											
	NATIVE TILL 1.5 Brown, very stiff, sandy silty CLAY, trace gravel, wet.	SS	03	100	19	2	208		16			PP = 3.5 kg/ sq-cm
	becomes oxidized, hard	SS	04	100	62				11			PP = 1.5 kg/ sq-cm
	trace broken cobble pieces	SS	05	100	58	3	207		8			PP = 1.5 kg/ sq-cm
						4	206					
		SS	06	33	39	5	205		9			
						6	204					
		SS	07	100	61				12			Sample submitted for laboratory analysis: BH02-07
	202.5					7	203					
	Grey, compact, SAND to silty SAND, trace gravel, wet. 7.6	SS	08	100	22	8	202		12			
						9	201					
	very dense	SS	09	100	94				10			PP = 3.0 kg/ sq-cm
	200.4											
	End of borehole. 9.8 Notes: 1. Borehole was found to be caved-in at 9.14 mbgs with freestanding water at 5.64 mbgl upon completion. 2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019. 3. PP = pocket penetrometer.											

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ Groundwater depth on completion of drilling: 5.64 m

▼ Groundwater depth observed on 21/10/2019 at a depth of: 4.41 m.

◪ Cave in depth recorded on completion of drilling: 9.14 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH02B/MW02B

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	ABK
Client:	City of Brampton	Drilling Method:	200 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Geotechnical Investigation-Johnston Transit Facility	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	Brampton	Date Started:	Jun 19, 2019 Date Completed: Jun 19, 2019	Revision No.:	0

EASTING: 606376.904
NORTHING: 4852222.77

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 210.16 m)		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	FILL Dark black, dense, SAND and GRAVEL, moist.	209.5	SS	01	70	35	0	210	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) ✱ Passing 75 um (%) ○ Moisture Content (%); Atterberg Limits W_P ⊖ W_L 20 40 60 80			Top of Riser Elevation = 210.92 m; Height of Riser = 0.76 m Small roots throughout.
	Reddish brown, loose, silty SAND, trace clay, moist.	0.6 208.9	SS	02	67	8	1	209					
	NATIVE STRATA Reddish brown, stiff, slty CLAY, some sand, moist to wet.	1.2 208.3	SS	03	87	10							
	Redish brown, very dense, silty SAND, some clay, moist.	1.8	SS	04	84	85	2	208					
	becomes light reddish brown		SS	05	100	95							
	NATIVE TILL Dark reddish brown, very dense, silty SAND, some clay, moist to wet.	207.1 3.1	SS	06	67	50 / 150 mm	3	207					Some black granular. Low recovery
			SS	07	100	50 / 150 mm	4	206					
	Light brown to grey, hard, sandy silty CLAY, wet.	205.9 4.3	SS	08	31	50 / 130 mm							Low recovery.
			SS	09	87	57	5	205					
			SS	10	35	61 / 280 mm							Some small rocks. Low recovery.
			SS	11	100	50 / 75 mm	6	204					
	Dark grey, very dense, sandy GRAVEL, wet.	203.4 6.7	SS	12	74	72	7	203					Low recovery.
			SS	13	100	33							
			SS	14	56	56	8	202					Minor outer black and wet staining
			SS	15	0	50 / 125 mm							30 cm grey dense clay some sand. No recovery.
	Grey, hard, silty CLAY, some sand, trace gravel, wet.	201.0 9.1 200.6	SS	16	98	87 / 255 mm	9	201					
	End of borehole.	9.6											

Notes:

1. Borehole was found to be open and no freestanding ground water
2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21,2019.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ No freestanding groundwater measured in open borehole upon completion of drilling.

▼ Groundwater depth observed on 21/10/2019 at a depth of: 4.48 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH03/MW03

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 10, 2019 Date Completed: Jun 10, 2019	Revision No.:	0

EASTING: 606450.93
NORTHING: 4852124.65

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 208.90 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Unit Weight (KN/m3)	COMMENTS
	Loose crushed stone / asphalt pieces~ 460 mm. 208.4	SS	01	75					Top of Riser Elevation = 209.81 m; Height of Riser= 0.92 m
	FILL 0.5 Brown to light brown, stiff, silty CLAY, trace gravel, moist.	SS	02	84	8	1	208		PP = 2.0 kg/ sq-cm Sample submitted for laboratory analysis: BH03-01
	becomes oxidized, some sand. 206.6	SS	03	100	9	2	207		PP = 3.0 kg/ sq-cm Sample submitted for laboratory analysis: BH03-02 PP = 4.0 kg/ sq-cm
	NATIVE TILL 2.3 Brown, hard to very stiff, sandy silty CLAY, trace sand, trace gravel, oxidized, moist.	SS	04	100	40	3	206		PP = 3.0 kg/ sq-cm
	fine sand at bottom. 205.3	SS	05	75	26				PP = 4.5 kg/ sq-cm
	Brown to brownish grey, compact, SAND, 3.6 trace gravel, silty clay seams, moist.	SS	06	75	24	4	205		
	becomes very dense.	SS	07	0	50/ 50 mm	5	204		Sample submitted for laboratory analysis: BH03-07
	becomes compact, wet.	SS	08	75	28	6	203		
	202.2	SS	09	33	17				
	End of borehole. 6.7								Auger refusal.

Notes:

1. Borehole was found to be caved-in at 5.94 mbgs with freestanding water at 4.57 mbgs upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.
3. PP = pocket penetrometer.

FIELD TESTING
Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa) 20 40 60 80

LAB TESTING
★ Rinse pH Values 2 4 6 8 10 12
Soil Vapour Reading △ parts per million (ppm) 100 200 300 400
▲ Lower Explosive Limit (LEL)
✱ Passing 75 um (%)
○ Moisture Content (%)
Atterberg Limits W_P 20 40 60 80 W_L

INSTRUMENTATION INSTALLATION

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

Groundwater depth on completion of drilling: 4.57 m
Cave in depth recorded on completion of drilling: 5.94 m.
Groundwater depth observed on 21/10/2019 at a depth of: 3.13 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

Scale: 1 : 63

RECORD OF BOREHOLE No. BH22/MW22

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 12, 2019 Date Completed: Jun 12, 2019	Revision No.:	0

EASTING: 606347.46
NORTHING: 4852093.13

Lithology Plot	DESCRIPTION Local Ground Surface Elevation: 210.23 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING ★ Rinse pH Values 2 4 6 8 10 12; △ Soil Vapour Reading parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL); ✱ Passing 75 um (%); ○ Moisture Content (%); Atterberg Limits W_P 20 40 60 80 W_L	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	Loose crushed stone / asphalt pieces ~760 mm.	SS	01	67			210					Top of Riser Elevation = 211.08 m; Height of Riser= 0.86 m
	209.5											
	NATIVE TILL 0.8 Brown, stiff, sandy silty CLAY, trace to some gravel, oxidized, moist.	SS	02	75	11	1	209					PP = 3.5 kg/ sq-cm
	becomes hard	SS	03	100	31	2						Sample submitted for laboratory analysis: BH22-03
							208					PP = 4.5 kg/ sq-cm
	trace broken cobbles	SS	04	67	75							
		SS	05	100	60	3	207					PP = 4.5 kg/ sq-cm
	oxidized cores	SS	06	100	44	4	206					PP = 4.5 kg/ sq-cm
	becomes grey, gravelly sand pockets.	SS	07	84	72	5	205					PP = 4.5 kg/ sq-cm
	becomes very stiff.	SS	08	100	29							Sample submitted for laboratory analysis: BH22-08
		SS	09	100	27	6	204					
	203.5											
	End of borehole. 6.7											

Notes:

1. Borehole was found to be open with no freestanding water upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.
3. PP = pocket penetrometer.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ No freestanding groundwater measured in open borehole upon completion of drilling.

▼ Groundwater depth observed on 21/10/2019 at a depth of: 0.76m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH30/MW30

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 11, 2019 Date Completed: Jun 11, 2019	Revision No.:	0

EASTING: 606448.57
NORTHING: 4851932.58

Lithology Plot	DESCRIPTION Local Ground Surface Elevation: 208.46 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Unit Weight (KN/m3)	COMMENTS
	Topsoil ~200 mm.	208.3								Top of Riser Elevation = 209.36 m; Height of Riser=0.88 m
	FILL Brown, firm, silty CLAY, trace gravel, moist.	0.2 207.7	SS	01	84	5				Sample submitted for laboratory analysis: BH30-01
	NATIVE TILL Brown, stiff, sandy silty CLAY, trace to some gravel, some oxidation, moist. GR: 2%; SA: 28%; SI: 49%; & CL: 21%	0.8	SS	02	100	12	1	208		PP = 1.5 kg/ sq-cm PP = 2.0 kg/ sq-cm Sample submitted for laboratory analysis: BH30-02
	becomes hard		SS	03	100	33	2	207		PP = 3.5 kg/ sq-cm
			SS	04	133	50		206		PP = 4.5 kg/ sq-cm
			SS	05	100	44	3	205		PP = 3.5 kg/ sq-cm
			SS	06	100	40	4	204		PP = 4.0 kg/ sq-cm
	becomes brownish grey, very stiff.	203.1	SS	07	100	28	5			PP = 3.5 kg/ sq-cm
	Brown, very dense, gravelly SAND to SAND, wet.	5.3 202.3	SS	08	100	50/ 125 mm		203		Sample submitted for laboratory analysis: BH30-08
	End of borehole.	6.2	SS	09	94	50/ 75 mm	6			

Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa) 20 40 60 80

★ Rinse pH Values 2 4 6 8 10 12
Soil Vapour Reading △ parts per million (ppm) 100 200 300 400
▲ Lower Explosive Limit (LEL)
✱ Passing 75 um (%)
○ Moisture Content (%)
Atterberg Limits W_P 20 40 60 80 W_L

INSTRUMENTATION INSTALLATION

Notes:

1. Borehole was found to caved in at 6.10 mbgs with freestanding water at 5.18 mbgs upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.
3. PP = pocket penetrometer.
4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.

▽ **Groundwater depth on completion of drilling:** 5.18 m
▼ **Groundwater depth observed on** 21/10/2019 **at a depth of:** 3.16 m.
Cave in depth recorded on completion of drilling: 6.1 m.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH33/MW33

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	AB
Client:	City of Brampton	Drilling Method:	200 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 12, 2019 Date Completed: Jun 19, 2019	Revision No.:	0

EASTING: 606355.8
NORTHING: 4852008.7

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 209.83 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80)	LAB TESTING (★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL); ✱ Passing 75 um (%); ○ Moisture Content (%); Atterberg Limits W_P 20 40 60 80 W_L)	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	Loose overbourden asphalt~ 760 mm. 209.2	SS	01	52								Top of Riser Elevation = 210.77 m; Height of Riser =0.92 m
	NATIVE TILL 0.6 Light brown, very stiff, sandy silty CLAY, some silt, moist.	SS	02	64	15	1	209					Sample submitted for laboratory analysis: BH33-02
		SS	03	100	17							Sample submitted for laboratory analysis: BH33-03
	hard	SS	04	100	37	2	208					
		SS	05	100	30		207					
	very stiff	SS	06	85	20	3						
	becomes hard	SS	07	100	58	4	206					Sample submitted for laboratory analysis: BH33-07
		SS	08	72	61							
	some sand pockets	SS	09	31	36	5	205					
		SS	10	100	33	6	204					
	trace to some sand.	SS	11	100	32							
	202.5	SS	12	100	58	7	203					
	End of borehole. 7.3											

Notes:

1. Borehole was found to be open with no freestanding water upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ No freestanding groundwater measured in open borehole upon completion of drilling.

▼ Groundwater depth observed on 21/10/2019 at a depth of: 0.89 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH35/MW35

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 12, 2019 Date Completed: Jun 12, 2019	Revision No.:	0

EASTING: 606263.02
NORTHING: 4852084.8

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 209.24 m)	Elev.	Depth	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	Unit Weight (KN/m3)	COMMENTS
	Topsoil ~150 mm.	209.1	0						Top of Riser Elevation = 210.09m; Height of Riser= 0.90 m
	FILL Brown, soft, silty CLAY, trace gravel, moist.	0.2 / 208.5		SS	01	67	3		PP = 0.5 kg/ sq-cm
	NATIVE TILL Brown, stiff to very stiff, sandy silty CLAY, trace gravel, some oxidation, moist.	0.8	1	SS	02	100	10		PP = 3.0 kg/ sq-cm
				SS	03	100	27		Sample submitted for laboratory analysis: BH35-03 PP = 4.0 kg/ sq-cm
	becomes hard		2	SS	04	100	32		PP = 4.5 kg/ sq-cm
			3	SS	05	100	38		PP = 3.0 kg/ sq-cm
			4	SS	06	0	31		
	becomes brownish grey, stiff.		5	SS	07	100	14		Sample submitted for laboratory analysis: BH35-07
	becomes very stiff.		6	SS	08	0	20		
				SS	09	67	20		PP = 3.5 kg/ sq-cm
		201.6	7						
	Grey, very dense, silty SAND, trace clay broken cobble pieces, moist.	7.6	8	SS	10	67	50/ 150 mm		
			9	SS	11	100	58		PP = 4.5 kg/ sq-cm
		199.5							
	End of borehole.	9.8							

Notes:

1. Borehole was found to be open with no freestanding water upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.

No freestanding groundwater measured in open borehole upon completion of drilling.

Groundwater depth observed on 21/10/2019 at a depth of: 2.39 m.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH51/MW51

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 11, 2019 Date Completed: Jun 11, 2019	Revision No.:	0

EASTING: 606376.62
NORTHING: 4851797.58

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 208.99 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Unit Weight (KN/m3)	COMMENTS
	Top Soil ~150 mm. 208.8								Top of Riser Elevation = 209.94 m; Height of Riser= 1.00 m
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, trace to some sand, rootlets, moist.	SS	01	84	7				PP = 2.0 Kg / sq.cm
		SS	02	100	7	1	208		Sample submitted for laboratory analysis: BH51-02 PP = 2.5 Kg / sq.cm
	207.5								
	NATIVE TILL 1.5 Brown, very stiff, sandy silty CLAY, trace to some gravel, trace sand, oxidised, moist.	SS	03	100	17	2	207		PP = 4.0 Kg / sq.cm
		SS	04	100	17				
	205.9					3	206		
	Brown, dense to very dense, sandy SILT 3.1 trace gravel, trace to some sand, oxidised, moist.	SS	05	100	30				PP = 4.5 Kg / sq. cm
		SS	06	100	50 / 125 mm	4	205		PP = 4.5 Kg / sq. cm
	some gravel	SS	07	33	48	5	204		
	GR: 23%; SA: 26%; SI: 37%; & CL: 14%	SS	08	25	26				Sample submitted for laboratory analysis: BH51-08 PP = 4.5 Kg / sq. cm
						6	203		
		SS	09	100	38				
	202.3								
	End of borehole. 6.7								

Penetration Testing: ○ SPT ● DCPT
MTO Vane*: △ Intact ▲ Remould
Nilcon Vane*: ◇ Intact ◆ Remould
* Undrained Shear Strength (kPa) 20 40 60 80

★ Rinse pH Values 2 4 6 8 10 12
Soil Vapour Reading △ parts per million (ppm) 100 200 300 400
▲ Lower Explosive Limit (LEL) ✱ Passing 75 um (%)
○ Moisture Content (%)
Atterberg Limits W_P 20 40 60 80 W_L

INSTRUMENTATION INSTALLATION

Notes:

1. Borehole was found to be caved in at 3.05 mbgs with freestanding water at 4.72 mbgs upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.
2. PP= Pocket Penetrometer.
4. GR., SA., SI. & CL. denote Gravel, Sand, Silt & Clay respectively.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ **Groundwater depth on completion of drilling: 4.72 m**

▼ **Groundwater depth observed on 21/10/2019 at a depth of: 2.17m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

Scale: 1 : 63

RECORD OF BOREHOLE No. BH51B/MW51B

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	ABK
Client:	City of Brampton	Drilling Method:	200 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Geotechnical Investigation-Johnston Transit Facility	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	Brampton	Date Started:	Jun 20, 2019 Date Completed: Jun 20, 2019	Revision No.:	0

EASTING: 606378.606
NORTHING: 4851801.095

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 209.01 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Unit Weight (KN/m3)	COMMENTS
	Dark brown, loose, SAND, some silt, moist. 208.4	SS	01	66	8				Top of Riser Elevation = 209.67 m; Height of Riser = 0.66 m
	FILL 0.6 Light brown, loose, silty SAND, trace clay, moist. 207.8	SS	02	79	4	1	208		
	NATIVE STRATA 1.2 Light brown, stiff to very stiff, sandy silty CLAY, trace gravel, moist.	SS	03	100	11				
		SS	04	33	20	2	207		
		SS	05	100	20				Brink orange stainning with sand.
		SS	06	100	20	3	206		
	204.7	SS	07	100	35	4	205		Orange sand seam through out.
	NATIVE TILL 4.3 Light brownish grey, dense, sandy SILT, trace clay, moist.	SS	08	100	30				
	becomes grey 203.5	SS	09	100	24	5	204		
	Light grey, very stiff to hard, silty sandy CLAY, moist. 5.5	SS	10	100	27				
		SS	11	100	39	6	203		
	becomes wet.	SS	12	100	25				Some rocks.
		SS	13	100	63	7	202		
	200.5	SS	14	72	78	8	201		Some rocks.
	End of borehole. 8.5								

Notes:

1. Borehole was found to be open and no freestanding ground water
2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21,2019.

No freestanding groundwater measured in open borehole upon completion of drilling. Cave in depth recorded on completion of drilling: 5.64 m.

Groundwater depth observed on 21/10/2019 at a depth of: 3.82 m.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH70/MW70

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	MF
Client:	City of Brampton	Drilling Method:	150 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Phase II Environmental Site Assessment	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	10192 Hwy 50, Brampton, ON	Date Started:	Jun 11, 2019 Date Completed: Jun 11, 2019	Revision No.:	0

EASTING: 606239.26
NORTHING: 4851677.44

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 207.58 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Unit Weight (KN/m3)	COMMENTS
	Top Soil ~150 mm. 207.4								Top of Riser Elevation = 208.47 m; Height of Riser= 0.94 m
	FILL 0.2 Brown, firm, silty CLAY, trace gravel, trace sand, rootlets, moist. 206.8	SS	01	100	5				Sample submitted for laboratory analysis: BH70-01
	NATIVE TILL 0.8 Brown, stiff to very stiff, sandy silty CLAY, some gravel, trace sand, oxidised, moist.	SS	02	16	12	1	207		PP = 2.5 Kg / sq.cm
		SS	03	100	19	2	206		PP = 4.0 Kg / sq.cm
		SS	04	100	25		205		PP = 4.5 Kg / sq. cm
	204.5 Grey, compact, SILT, trace to some clay, some gravel, trace sand, moist. 3.1	SS	05	100	14	3	204		PP = 3.0 Kg / sq.cm
		SS	06	100	14	4			PP = 3.0 Kg / sq.cm
	203.0 Grey, compact, SILT to silty SAND, trace grael, trace clay, moist 4.6	SS	07	8	20	5	203		
		SS	08	8	29		202		
	very dense	SS	09	80	50 / 100 mm	6			
	199.5	SS	10	0	86 / 280 mm	7 8	201 200		
	End of borehole. 8.1								

Notes:

1. Borehole was found to be open with no freestanding water at 4.42 mbgs upon completion.
2. Water table was measured upon completion of drilling inside the hollow stem auger on June 24 and October 21, 2019.
2. PP= Pocket Penetrometer.

No freestanding groundwater measured in open borehole upon completion of drilling.

Groundwater depth observed on 21/10/2019 at a depth of: 2.23 m.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH74/MW74

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	JP
Client:	City of Brampton	Drilling Method:	200 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Geotechnical Investigation-Johnston Transit Facility	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	Brampton	Date Started:	Oct 16, 2019 Date Completed: Oct 16, 2019	Revision No.:	0

EASTING: 606484.167
NORTHING: 4851890.911

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 207.93 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING / LAB TESTING	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	Topsoil ~ 200 mm 207.7										Top of Riser = 208.82 m Height of Riser = 0.89 m
	FILL 0.2 Light brown, loose, silty SAND, some clay, moist. 207.2	SS	01	100	13						Sample submitted for laboratory analysis : BH74-01
	NATIVE TILL 0.8 Light brown, hard, sandy silty CLAY, trace gravel, moist.	SS	02	100	31	1	207				Sample submitted for laboratory analysis : BH74-02
		SS	03	100	38	2	206				
		SS	04	100	55						
		SS	05	100	70	3	205				Some grey clay mottling.
	204.1										
	Brown to light brownish grey, very dense, 3.8 silty SAND, trace clay, moist to wet. 203.4	SS	06	100	70	4	204				Sample submitted for laboratory analysis : BH74-06
	Light greyish brown, very dense, SAND, 4.6 some silt and gravel, wet.	SS	07	8	60	5	203				
	becomes compact. 202.0	SS	08	51	16		202				Borehole cave in at 5.64 mbgl due to wet soil.
	End of Borehole. 5.9										

Notes:

1. Borehole was found to cave at 5.64 mbgs and no freestanding water
2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21,2019.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

No freestanding groundwater measured in open borehole upon completion of drilling.

Groundwater depth observed on 21/10/2019 at a depth of: 2.59 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

RECORD OF BOREHOLE No. BH75/MW75

Project Number:	665125	Drilling Location:	As per borehole location plan	Logged by:	JP
Client:	City of Brampton	Drilling Method:	200 mm Hollow Stem Augering	Compiled by:	NT
Project Name:	Geotechnical Investigation-Johnston Transit Facility	Drilling Machine:	Track Mounted Drill	Reviewed by:	MT
Location:	Brampton	Date Started:	Oct 16, 2019 Date Completed: Oct 16, 2019	Revision No.:	0

EASTING: 606531.454
NORTHING: 4851945.297

Lithology Plot	DESCRIPTION (Local Ground Surface Elevation: 208.09 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80)	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) ✱ Passing 75 um (%) ○ Moisture Content (%); Atterberg Limits W_P 20 40 60 80 W_L	INSTRUMENTATION INSTALLATION	Unit Weight (KN/m3)	COMMENTS
	FILL Light brown, very stiff, silty CLAY, trace gravel, moist. 207.3	SS	01	100	16			○	○ 19			Top of Riser = 208.95 m Height of Riser = 0.86 m. Sample submitted for laboratory analysis : BH75-01
	NATIVE STRATA 0.8 Light brown, very stiff, silty CLAY, trace gravel, trace sand, moist.	SS	02	100	18	1	207	○	○ 18			Sample submitted for laboratory analysis : BH75-02
		SS	03	100	33	2	206	○				
	205.8 NATIVE TILL 2.3 Light brown to brownish grey, hard, sandy silty CLAY, moist.	SS	04	100	89 / 255 mm							Some grey clay mottling.
		SS	05	74	72	3	205	○				
	204.3 Light brownish grey, silty CLAY, some sand, moist. 3.8 203.8	SS	06	100	50 / 125 mm	4	204		○ 11			Sample submitted for laboratory analysis : BH76-06
	End of Borehole. 4.3 Notes: 1. Borehole was found to be open and no freestanding water. 2. Water table was measured upon completion of drilling inside the hollow stem auger and on October 21,2019.											Auger to 4.27 and refusal at 4.27 mbgs.

SNC·LAVALIN
401 Hanlan Rd
Vaughan, Ontario L4L 3T1
Tel: 905-851-0090

▽ **No freestanding groundwater measured in open borehole upon completion of drilling.**

▼ **Groundwater depth observed on 21/10/2019 at a depth of: 3.41 m.**

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned and the accompanying'Notes to Record of Boreholes'.

DISCUSSION NORTH

TRUE NORTH

RAINBOW CREEK

MW–35
206.80

MW–02
205.69

MW–22
209.46

MW–33
208.96

MW–03
205.76

MW–70
205.20

MW–30
205.32

MW–51
206.77

MW–74
205.34

MW–75
204.68

HIGHWAY 50

207

208

209

209

208

207

206

206

205

LEGEND

- MONITORING WELL (SNC–LAVALIN, 2019)
- TORONTO AND REGION CONSERVATION AUTHORITY (TRCA) FLOODPLAIN
- SITE PROPERTY LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- PROPOSED INFRASTRUCTURE
- 206 — INTERPRETED WATER LEVEL ELEVATION CONTOUR (m)
- 206.69 — WATER LEVEL ELEVATION (m) (OCTOBER 21, 2019)
- INTERPRETED SHALLOW HORIZONTAL GROUNDWATER FLOW DIRECTION

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SCALE 1:2,000

0 40 80m

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON 10192 HIGHWAY 50, BRAMPTON, ON		Title: INTERPRETED SHALLOW HORIZONTAL GROUNDWATER FLOW DIRECTION (OCTOBER 21, 2019)	
Project No: 665125	Filename: 009FB2_665125	Date: NOVEMBER 2019	Dwg No: APPENDIX B2
Drawn: AG	Verified: WL	Project Manager: AY	

PAGE FORMAT: 11x17

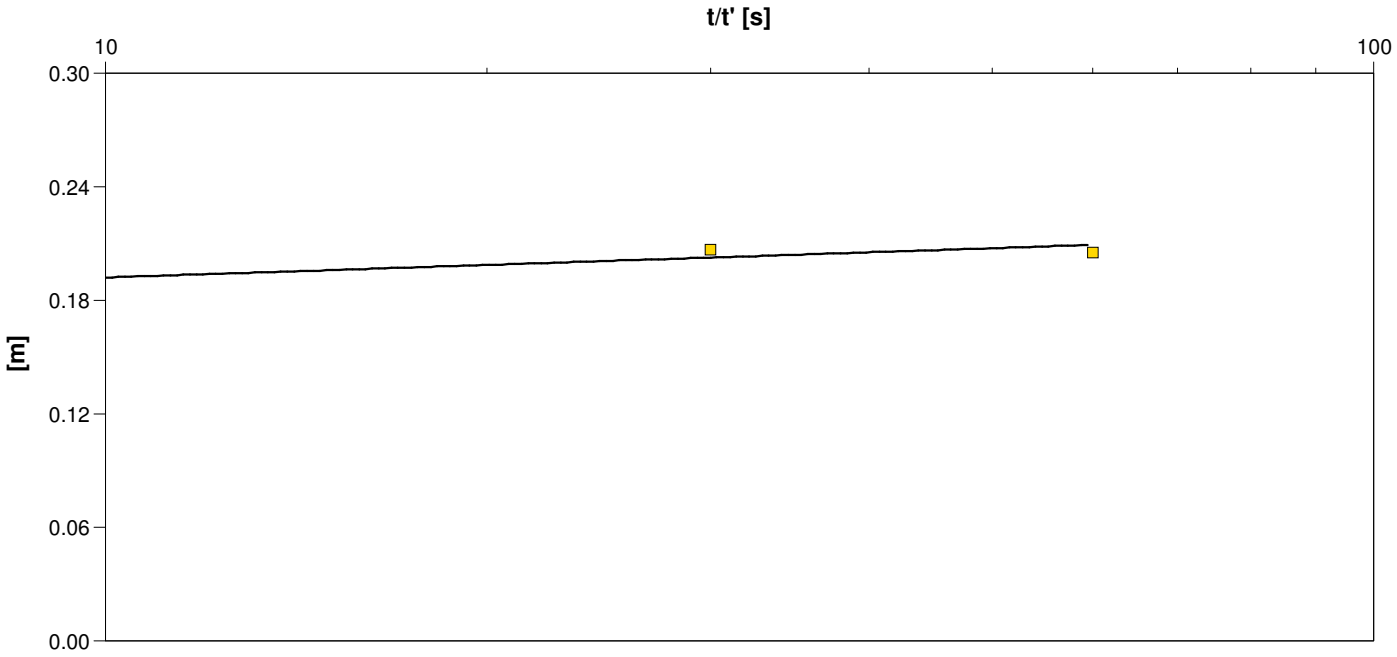
FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\009 (Hydrogeological)\009FB2_665125.dwg

Appendix C

Hydraulic Conductivity Analysis

SNC-Lavalin Inc. 235 Lesmill Road Toronto, Ontario, M3B 2V1	**Pumping Test Analysis Report**
	Project: Johnston Transit Facility
	Number: 665125
	Client: City of Brampton

Location: 10192 Hwy 50, Brampton, ON	Pumping Test: MW-02B	Pumping Well: MW-02B
Test Conducted by: JP		Test Date: 2019/10/21
Analysis Performed by: WL	MW-02B	Analysis Date: 2019/11/22
Aquifer Thickness: 5.00 m	Discharge Rate: 0.00025 [m³/s]	

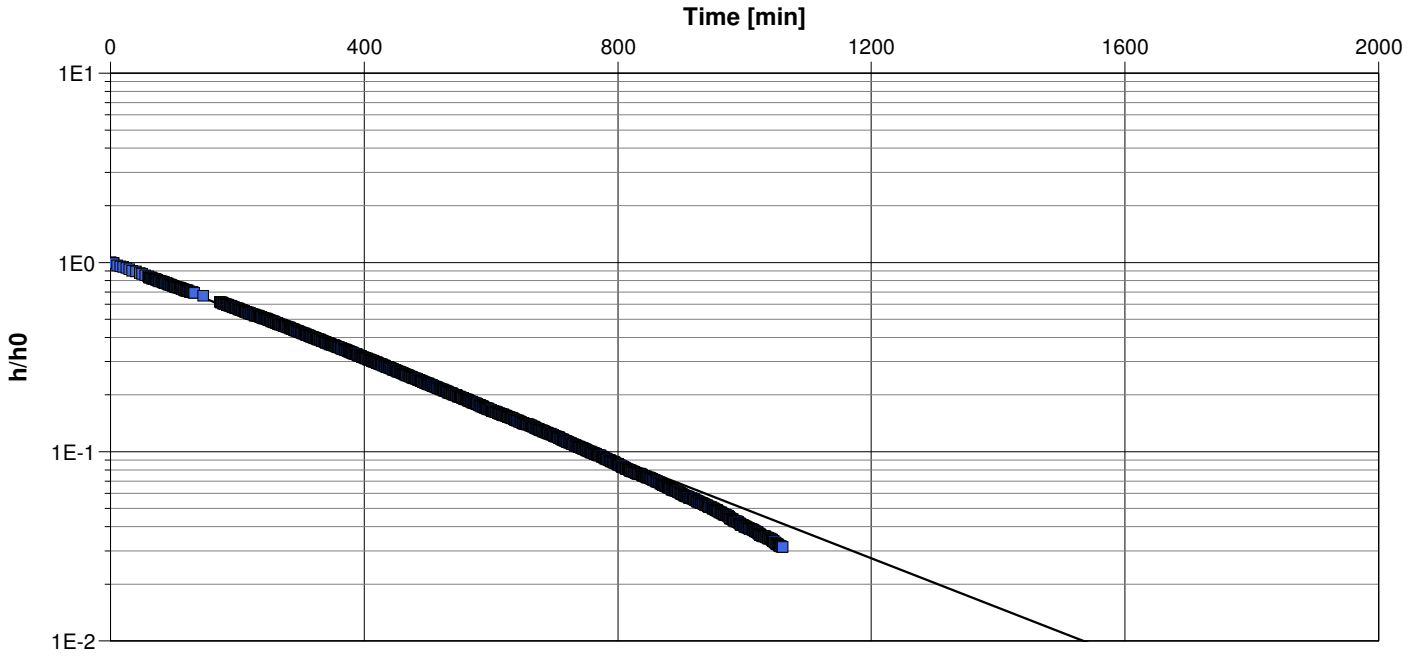


Calculation using Theis with Jacob Correction

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
MW-02B	2.16×10^{-3}	4.32×10^{-4}	0.03	

SNC-Lavalin Inc. 235 Lesmill Road Toronto, Ontario, M3B 2V1	**Slug Test Analysis Report**
	Project: Johnston Transit Facility
	Number: 665125
	Client: City of Brampton

Location: 10192 Hwy 50, Brampton, ON	Slug Test: MW-03	Test Well: MW-03
Test Conducted by: RHH and SA		Test Date: 2019/07/08
Analysis Performed by: RHH	MW-03	Analysis Date: 2019/07/15
Aquifer Thickness: 3.60 m		

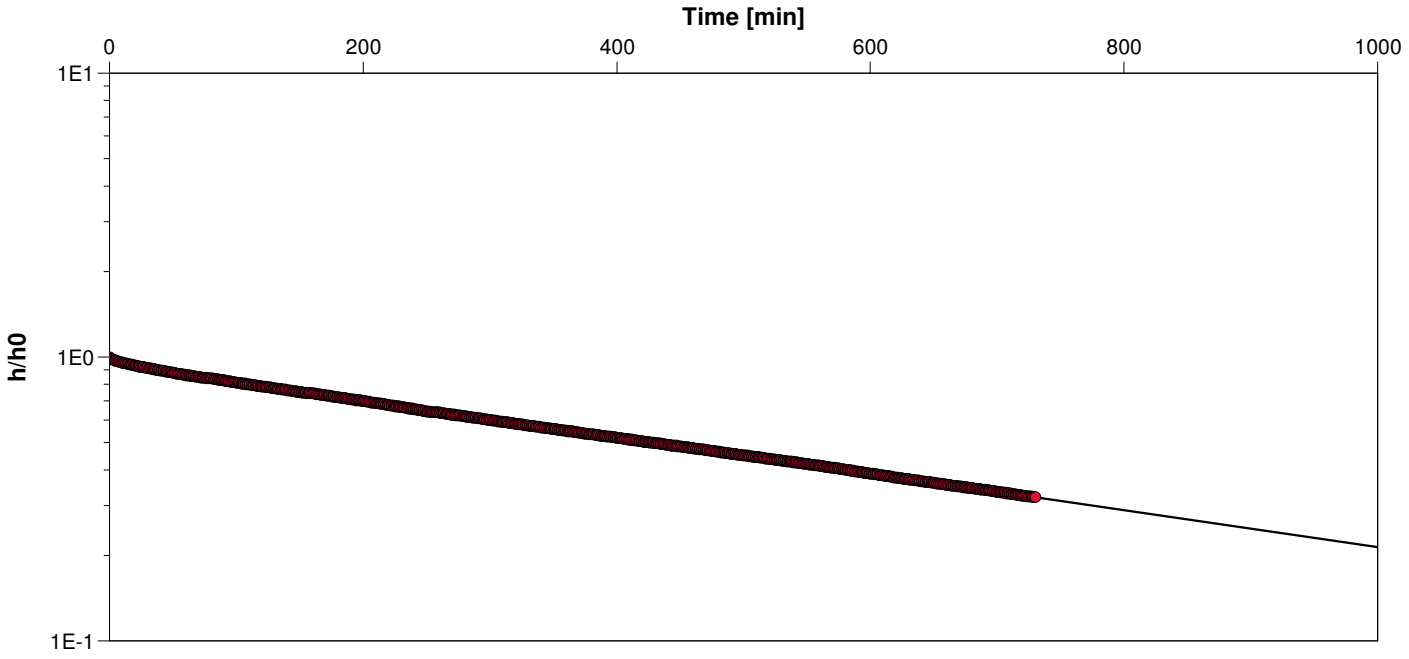


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW-03	1.92×10^{-8}	

SNC-Lavalin Inc. 235 Lesmill Road Toronto, Ontario, M3B 2V1	**Slug Test Analysis Report**
	Project: Johnston Transit Facility
	Number: 665125
	Client: City of Brampton

Location: 10192 Hwy 50, Brampton, ON	Slug Test: MW-22	Test Well: MW-22
Test Conducted by: RHH and SA		Test Date: 2019/07/15
Analysis Performed by: RHH	MW-22	Analysis Date: 2019/07/15
Aquifer Thickness: 6.10 m		

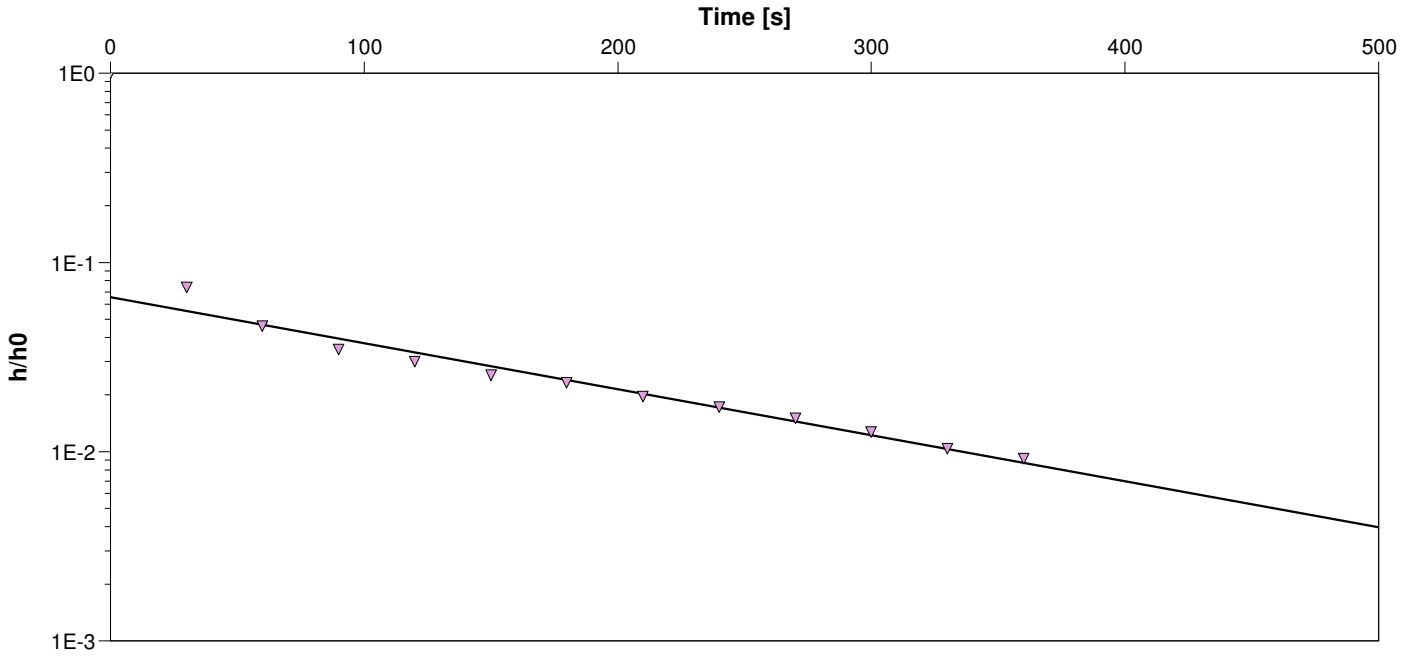


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW-22	7.03×10^{-9}	

SNC-Lavalin Inc. 235 Lesmill Road Toronto, Ontario, M3B 2V1	**Slug Test Analysis Report**
	Project: Johnston Transit Facility
	Number: 665125
	Client: City of Brampton

Location: 10192 Hwy 50, Brampton, ON	Slug Test: MW-51B	Test Well: MW-51B
Test Conducted by: JP		Test Date: 2019/10/21
Analysis Performed by: WL	MW-51B	Analysis Date: 2019/11/22
Aquifer Thickness: 4.80 m		

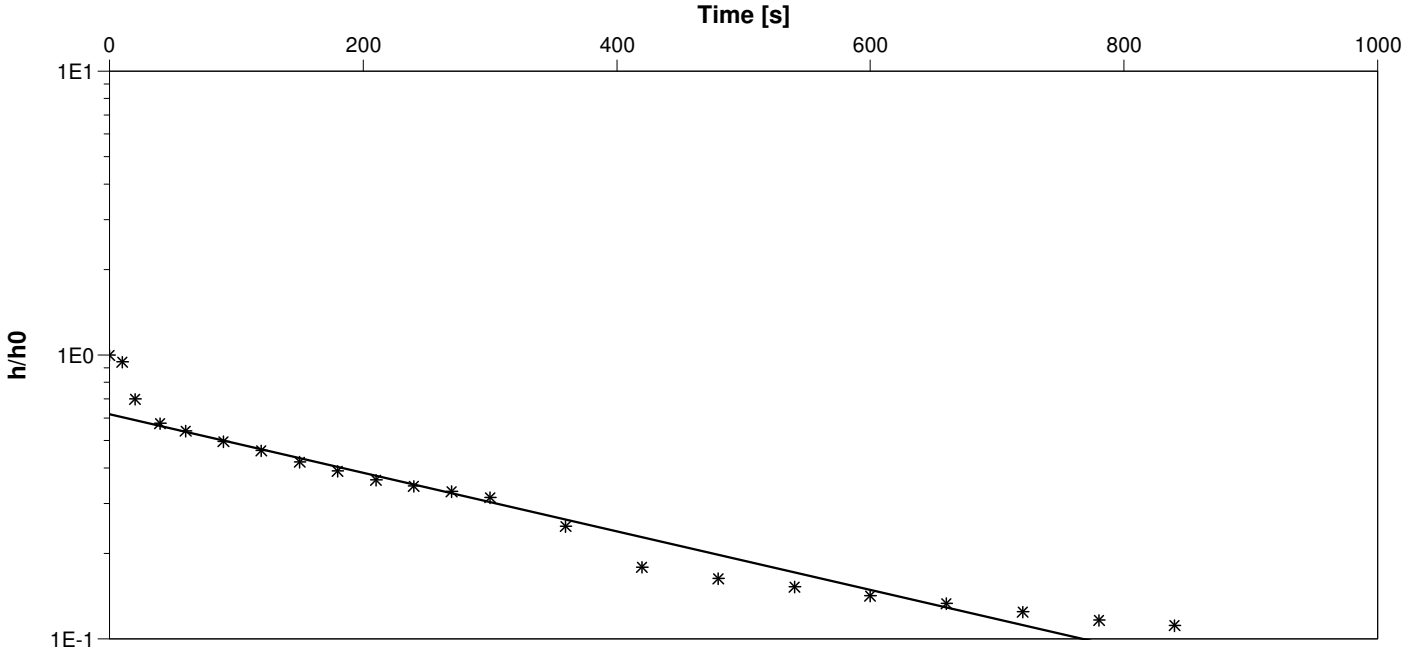


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW-51B	4.32×10^{-6}	

SNC-Lavalin Inc. 235 Lesmill Road Toronto, Ontario, M3B 2V1	**Slug Test Analysis Report**
	Project: Johnston Transit Facility
	Number: 665125
	Client: City of Brampton

Location: 10192 Hwy 50, Brampton, ON	Slug Test: MW-74	Test Well: MW-74
Test Conducted by: JP		Test Date: 2019/10/21
Analysis Performed by: WL	MW-74	Analysis Date: 2019/11/22
Aquifer Thickness: 3.10 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW-74	8.87×10^{-7}	

Appendix D

Groundwater Quality Results

TABLE 4-5: Groundwater Analytical Results - Major Ion Chemistry
10192 Highway 50, Brampton, ON

	Sample Location			**MW-22**	**MW-51B**
	Laboratory Sample ID			KFE482	KFO559
	SNC-Lavalin Sample ID		**PWQO[1]**	MW22	MW51B
	Sampling Date (yyyy/mm/dd)			2019/07/08	2019/07/10
Parameter	**RDL**	**Units**			
General Chemistry					
Alkalinity, Bicarbonate (as CaCO3)	1.0	mg/L	na[2]	460	430
Chloride	1.0	mg/L	na	22	20
Electrical Conductivity	1	µS/cm	na	1,150	880
pH	-	pH	(6.5 - 8.5)	7.27	7.86
Sulphate	1.0	mg/L	na	250	67
Total Anion	-	meq/L	na	14.9	10.7
Total Cations	-	meq/L	na	14.7	11.0
Dissolved Metals					
Calcium	50	µg/L	na	110,000	46,000
Magnesium	50	µg/L	na	94,000	86,000
Potassium	1,000	µg/L	na	11,000	5,000
Sodium	500	µg/L	na	29,000	35,000

Footnotes:

Additional terms may be defined within the body of SNC-Lavalin's report.
RDL - Reportable Detection Limit, unless otherwise noted
< - Denotes concentration less than indicated detection limit
"-" - Not analyzed
na - Not applicable
µg/L – micrograms per litre
µS/cm - microSiemens per centimetre
mg/L - milligrams per litre

BOLD Concentration greater than PWQO

[1] Provincial Water Quality Objectives (MOEE, 1994, reprinted 1999 version)
[2] Alkalinity should not be decreased by more than 25% of the natural concentration

TABLE 4-4: Groundwater Analytical Results - City of Brampton Storm Sewer By-Law (90-75)
10192 Highway 50, Brampton, ON

			Sample Location	City of Brampton Storm Discharge Limits[1]	MW-22	MW-51B	MW-74
			Laboratory Sample ID		KFE482	KFO559	LCI312
			SNC-Lavalin Sample ID		MW22	MW51B	MW-74
			Sampling Date (yyyy/mm/dd)		2019/07/08	2019/07/10	2019/10/22
Parameter	**RDL**	**Units**					
Oil and Grease							
Total Oil and Grease	0.50	mg/L		15	7.9	< 0.50	< 0.50
General Chemistry							
Alkalinity, Bicarbonate (as CaCO3)	1.0	mg/L		na	460	430	-
Alkalinity, Carbonate (as CaCO3)	1.0	mg/L		na	< 1.0	2.9	-
Biochemical oxygen demand	2	mg/L		15	< 2	< 2	< 2
Chloride	1.0	mg/L		1,500	22	20	40
Cyanide	0.0050	mg/L		0.1	< 0.0050	< 0.0050	< 0.0050
Electrical Conductivity	1	µS/cm		na	1,150	880	-
pH	-	pH		(5.5 - 9.5)	7.27	7.86	7.42
Sulphate	1.0	mg/L		1,500	250	67	73
Total Alkalinity	1.0	mg/L		na	460	440	-
Total Anion	-	meq/L		na	14.9	10.7	-
Total Cations	-	meq/L		na	14.7	11.0	-
Total Phenols	0.0010	mg/L		0.020	< 0.0010	0.0010	< 0.0010
Total Suspended Solids	10	mg/L		15	**4,100**	**460**	**17**
Microbiological Tests							
Background	10	CFU/100mL		na	60	3,500	2,700
Total Coliforms	10	CFU/100mL		2,400	< 10	10	30
Total Metals							
Cadmium	5	µg/L		1,000	< 5	< 5	< 5
Chromium (total)	10	µg/L		1,000	160	10	< 10
Copper	20	µg/L		1,000	130	< 20	< 20
Iron	20	µg/L		17,000	**100,000**	14,000	590
Nickel	50	µg/L		1,000	100	< 50	< 50
Zinc	10	µg/L		1,000	200	30	< 10

Footnotes:

Additional terms may be defined within the body of SNC-Lavalin's report.
RDL - Reportable Detection Limit, unless otherwise noted
< - Denotes concentration less than indicated detection limit
"-" - Not analyzed
na - Not applicable
µg/L – micrograms per litre
µS/cm - microSiemens per centimetre
mg/L - milligrams per litre

BOLD Concentration greater than City of Brampton Storm Discharge Limits

[1] City of Brampton Discharge of Sewage By-law 90-75

Your P.O. #: 11876
Your Project #: 665125
Site Location: BRAMPTON STORM
Your C.O.C. #: 726374-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/07/16
Report #: R5799250
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I7351
Received: 2019/07/09, 10:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2019/07/11	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2019/07/11	CAM SOP-00102	APHA 4500-CO2 D
Biochemical Oxygen Demand (BOD)	1	2019/07/10	2019/07/15	CAM SOP-00427	SM 23 5210B m
Chloride by Automated Colourimetry	1	N/A	2019/07/10	CAM SOP-00463	SM 4500-Cl E m
Conductivity	1	N/A	2019/07/11	CAM SOP-00414	SM 23 2510 m
Total Cyanide	1	2019/07/10	2019/07/10	CAM SOP-00457	OMOE E3015 5 m
Lab Filtered Metals Analysis by ICP	1	2019/07/11	2019/07/15	CAM SOP-00408	EPA 6010D m
Total Metals Analysis by ICP	1	2019/07/10	2019/07/10	CAM SOP-00408	EPA 6010D m
Anion and Cation Sum	1	N/A	2019/07/15		
Total Coliforms, (CFU/100mL)	1	N/A	2019/07/09	CAM SOP-00552	MOE LSB E3371
Total Oil and Grease	1	2019/07/12	2019/07/12	CAM SOP-00326	EPA1664B m,SM5520A m
pH	1	2019/07/09	2019/07/10	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2019/07/10	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2019/07/10	CAM SOP-00464	EPA 375.4 m
Total Suspended Solids	1	2019/07/10	2019/07/11	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Your P.O. #: 11876
Your Project #: 665125
Site Location: BRAMPTON STORM
Your C.O.C. #: 726374-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/07/16
Report #: R5799250
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I7351
Received: 2019/07/09, 10:50

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: Ema.Gitej@bvlabs.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

BRAMPTON STORM SEWER BYLAW (90-75)

BV Labs ID		KFE482			KFE482		
Sampling Date		2019/07/08 12:00			2019/07/08 12:00		
COC Number		726374-01-01			726374-01-01		
	UNITS	MW22	RDL	QC Batch	MW22 Lab-Dup	RDL	QC Batch
Inorganics							
Total BOD	mg/L	<2	2	6220507			
pH	pH	7.27		6219443			
Phenols-4AAP	mg/L	<0.0010	0.0010	6220158			
Total Suspended Solids	mg/L	4100	100	6220410			
Dissolved Sulphate (SO4)	mg/L	250	1.0	6218810			
Total Cyanide (CN)	mg/L	<0.0050	0.0050	6220584	<0.0050	0.0050	6220584
Dissolved Chloride (Cl-)	mg/L	22	1.0	6218804			
Petroleum Hydrocarbons							
Total Oil & Grease	mg/L	7.9	0.50	6224621			
Metals							
Total Cadmium (Cd)	mg/L	<0.005	0.005	6220285			
Total Chromium (Cr)	mg/L	0.16	0.01	6220285			
Total Copper (Cu)	mg/L	0.13	0.02	6220285			
Total Iron (Fe)	mg/L	100	0.02	6220285			
Total Nickel (Ni)	mg/L	0.10	0.05	6220285			
Total Zinc (Zn)	mg/L	0.20	0.01	6220285			
Microbiological							
Background	CFU/100mL	60	10	6219412			
Total Coliforms	CFU/100mL	<10	10	6219412			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

RESULTS OF ANALYSES OF WATER

BV Labs ID		KFE482		
Sampling Date		2019/07/08 12:00		
COC Number		726374-01-01		
	UNITS	MW22	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	14.9	N/A	6222640
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	460	1.0	6222638
Carb. Alkalinity (calc. as CaCO3)	mg/L	<1.0	1.0	6222638
Cation Sum	me/L	14.7	N/A	6222640
Inorganics				
Conductivity	mS/cm	1.15	0.001	6222829
Alkalinity (Total as CaCO3)	mg/L	460	1.0	6222830

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		KFE482		
Sampling Date		2019/07/08 12:00		
COC Number		726374-01-01		
	UNITS	MW22	RDL	QC Batch
Metals				
Dissolved Calcium (Ca)	mg/L	110	0.05	6223541
Dissolved Magnesium (Mg)	mg/L	94	0.05	6223541
Dissolved Potassium (K)	mg/L	11	1	6223541
Dissolved Sodium (Na)	mg/L	29	0.5	6223541

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

TEST SUMMARY

BV Labs ID: KFE482
Sample ID: MW22
Matrix: Water

Collected: 2019/07/08
Shipped:
Received: 2019/07/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6222830	N/A	2019/07/11	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6222638	N/A	2019/07/11	Automated Statchk
Biochemical Oxygen Demand (BOD)	DO	6220507	2019/07/10	2019/07/15	Nusrat Naz
Chloride by Automated Colourimetry	KONE	6218804	N/A	2019/07/10	Deonarine Ramnarine
Conductivity	AT	6222829	N/A	2019/07/11	Surinder Rai
Total Cyanide	SKAL/CN	6220584	2019/07/10	2019/07/10	Louise Harding
Lab Filtered Metals Analysis by ICP	ICP	6223541	2019/07/11	2019/07/15	Azita Fazaeli
Total Metals Analysis by ICP	ICP	6220285	2019/07/10	2019/07/10	Azita Fazaeli
Anion and Cation Sum	CALC	6222640	N/A	2019/07/15	Automated Statchk
Total Coliforms, (CFU/100mL)	PL	6219412	N/A	2019/07/09	Farhana Rahman
Total Oil and Grease	BAL	6224621	2019/07/12	2019/07/12	Francis Afonso
pH	AT	6219443	2019/07/09	2019/07/10	Surinder Rai
Phenols (4AAP)	TECH/PHEN	6220158	N/A	2019/07/10	Bramdeo Motiram
Sulphate by Automated Colourimetry	KONE	6218810	N/A	2019/07/10	Alina Dobreanu
Total Suspended Solids	BAL	6220410	2019/07/10	2019/07/11	Mandeep Kaur

BV Labs ID: KFE482 Dup
Sample ID: MW22
Matrix: Water

Collected: 2019/07/08
Shipped:
Received: 2019/07/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Cyanide	SKAL/CN	6220584	2019/07/10	2019/07/10	Louise Harding

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C

Sample KFE482 [MW22] : Sample has been analyzed for Alkalinity, Bicarbonate, Sodium, Calcium, Magnesium Potassium, and Conductivity as per client request.

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6218804	DRM	Matrix Spike	Dissolved Chloride (Cl-)	2019/07/10		NC	%	80 - 120
6218804	DRM	Spiked Blank	Dissolved Chloride (Cl-)	2019/07/10		104	%	80 - 120
6218804	DRM	Method Blank	Dissolved Chloride (Cl-)	2019/07/10	<1.0		mg/L	
6218804	DRM	RPD	Dissolved Chloride (Cl-)	2019/07/10	2.8		%	20
6218810	ADB	Matrix Spike	Dissolved Sulphate (SO4)	2019/07/10		NC	%	75 - 125
6218810	ADB	Spiked Blank	Dissolved Sulphate (SO4)	2019/07/10		105	%	80 - 120
6218810	ADB	Method Blank	Dissolved Sulphate (SO4)	2019/07/10	<1.0		mg/L	
6218810	ADB	RPD	Dissolved Sulphate (SO4)	2019/07/10	0.63		%	20
6219443	SAU	Spiked Blank	pH	2019/07/10		102	%	98 - 103
6219443	SAU	RPD	pH	2019/07/10	0.62		%	N/A
6220158	BMO	Matrix Spike	Phenols-4AAP	2019/07/10		NC	%	80 - 120
6220158	BMO	Spiked Blank	Phenols-4AAP	2019/07/10		103	%	80 - 120
6220158	BMO	Method Blank	Phenols-4AAP	2019/07/10	<0.0010		mg/L	
6220158	BMO	RPD	Phenols-4AAP	2019/07/10	0.68		%	20
6220285	AFZ	Matrix Spike	Total Cadmium (Cd)	2019/07/10		98	%	80 - 120
			Total Chromium (Cr)	2019/07/10		97	%	80 - 120
			Total Copper (Cu)	2019/07/10		98	%	80 - 120
			Total Iron (Fe)	2019/07/10		101	%	80 - 120
			Total Nickel (Ni)	2019/07/10		97	%	80 - 120
			Total Zinc (Zn)	2019/07/10		100	%	80 - 120
6220285	AFZ	Spiked Blank	Total Cadmium (Cd)	2019/07/10		98	%	80 - 120
			Total Chromium (Cr)	2019/07/10		99	%	80 - 120
			Total Copper (Cu)	2019/07/10		99	%	80 - 120
			Total Iron (Fe)	2019/07/10		98	%	80 - 120
			Total Nickel (Ni)	2019/07/10		98	%	80 - 120
			Total Zinc (Zn)	2019/07/10		103	%	80 - 120
6220285	AFZ	Method Blank	Total Cadmium (Cd)	2019/07/11	<0.005		mg/L	
			Total Chromium (Cr)	2019/07/11	<0.01		mg/L	
			Total Copper (Cu)	2019/07/11	<0.02		mg/L	
			Total Iron (Fe)	2019/07/11	<0.02		mg/L	
			Total Nickel (Ni)	2019/07/11	<0.05		mg/L	
			Total Zinc (Zn)	2019/07/11	<0.01		mg/L	
6220285	AFZ	RPD	Total Chromium (Cr)	2019/07/10	1.2		%	25
			Total Copper (Cu)	2019/07/10	1.6		%	25
			Total Nickel (Ni)	2019/07/10	2.3		%	25
			Total Zinc (Zn)	2019/07/10	3.2		%	25
6220410	MKX	QC Standard	Total Suspended Solids	2019/07/11		96	%	85 - 115
6220410	MKX	Method Blank	Total Suspended Solids	2019/07/11	<10		mg/L	
6220410	MKX	RPD	Total Suspended Solids	2019/07/11	2.7		%	25
6220507	NNA	QC Standard	Total BOD	2019/07/15		100	%	80 - 120
6220507	NNA	Method Blank	Total BOD	2019/07/15	<2		mg/L	
6220507	NNA	RPD	Total BOD	2019/07/15	NC		%	30
6220584	LHA	Matrix Spike [KFE482-06]	Total Cyanide (CN)	2019/07/10		102	%	80 - 120
6220584	LHA	Spiked Blank	Total Cyanide (CN)	2019/07/10		94	%	80 - 120
6220584	LHA	Method Blank	Total Cyanide (CN)	2019/07/10	<0.0050		mg/L	
6220584	LHA	RPD [KFE482-06]	Total Cyanide (CN)	2019/07/10	NC		%	20
6222829	SAU	Spiked Blank	Conductivity	2019/07/11		102	%	85 - 115
6222829	SAU	Method Blank	Conductivity	2019/07/11	<0.001		mS/cm	
6222829	SAU	RPD	Conductivity	2019/07/12	1.8		%	25
6222830	SAU	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/11		95	%	85 - 115
6222830	SAU	Method Blank	Alkalinity (Total as CaCO3)	2019/07/11	<1.0		mg/L	
6222830	SAU	RPD	Alkalinity (Total as CaCO3)	2019/07/12	0.20		%	20

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6223541	AFZ	Matrix Spike	Dissolved Calcium (Ca)	2019/07/15		NC	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		NC	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		106	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		NC	%	80 - 120
6223541	AFZ	Spiked Blank	Dissolved Calcium (Ca)	2019/07/15		97	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		97	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		100	%	80 - 120
6223541	AFZ	Method Blank	Dissolved Calcium (Ca)	2019/07/15	<0.05		mg/L	
			Dissolved Magnesium (Mg)	2019/07/15	<0.05		mg/L	
			Dissolved Potassium (K)	2019/07/15	<1		mg/L	
			Dissolved Sodium (Na)	2019/07/15	<0.5		mg/L	
6223541	AFZ	RPD	Dissolved Calcium (Ca)	2019/07/15	2.7		%	25
			Dissolved Magnesium (Mg)	2019/07/15	2.2		%	25
			Dissolved Potassium (K)	2019/07/15	2.8		%	25
			Dissolved Sodium (Na)	2019/07/15	1.7		%	25
6224621	FA	Spiked Blank	Total Oil & Grease	2019/07/12		97	%	85 - 115
6224621	FA	RPD	Total Oil & Grease	2019/07/12	3.3		%	25
6224621	FA	Method Blank	Total Oil & Grease	2019/07/12	<0.50		mg/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I7351
Report Date: 2019/07/16

SNC-Lavalin Inc
Client Project #: 665125
Site Location: BRAMPTON STORM
Your P.O. #: 11876
Sampler Initials: RHH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Farhana Rahman

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free 800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

MICRO

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#2432 SNC-Lavalin Inc	Company Name:	#13733 SNC-Lavalin Inc	Quotation #:	B90721	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Wilson Liu	P.O. #:			726374
Address:	455 René-Lévesque Blvd. West	Address:	235 Lesmill Road	Project:	665125	COC #:	Project Manager:
	Montreal QC H2Z 1Z3		Toronto ON M3B 2V1	Project Name:		C#726374-01-01	Ema Gitej
Tel:	(519) 393-1000 Fax: (514) 866-0795	Tel:	(416) 635-5882 Fax:	Site #:	Brampton Storm		
Email:	Payables@snclavalin.com	Email:	Wilson.Liu@snclavalin.com, ON_LabData@snclavalin.c	Sampled By:	RHH & SA		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)

☐ Table 1 ☐ Res/Park ☐ Medium/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ For RSC
☐ Table ___

Other Regulations

☐ CCME ☐ Sanitary Sewer Bylaw
☐ Reg 558 ☒ Storm Sewer Bylaw
☐ MISA Municipality Brampton
☐ PWQO
☐ Other

Special Instructions

✓

Include Criteria on Certificate of Analysis (Y/N)? N

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: X
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests..
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: _____ ☐
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Brampton Storm Sewer Bylaw (90-75)									# of Bottles	Comments
1		MW22	July 8/19	12:00	GW	N	X									8	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

09-Jul-19 10:50
Ema Gitej
B9I7351
GK1 ENV-1236

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Rochelle Hum-Horan	19/07/08	16:00		19/07/09	10:50	0

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	11 20	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Your P.O. #: 11876
Your Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your C.O.C. #: 726383-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/07/17
Report #: R5800701
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I9006
Received: 2019/07/10, 13:00

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2019/07/11	CAM SOP-00448	SM 23 2320 B m
Alkalinity	1	N/A	2019/07/12	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	2	N/A	2019/07/12	CAM SOP-00102	APHA 4500-CO2 D
Biochemical Oxygen Demand (BOD)	1	2019/07/11	2019/07/16	CAM SOP-00427	SM 23 5210B m
Chloride by Automated Colourimetry	2	N/A	2019/07/12	CAM SOP-00463	SM 4500-Cl E m
Conductivity	1	N/A	2019/07/11	CAM SOP-00414	SM 23 2510 m
Conductivity	1	N/A	2019/07/12	CAM SOP-00414	SM 23 2510 m
Total Cyanide	1	2019/07/11	2019/07/11	CAM SOP-00457	OMOE E3015 5 m
Lab Filtered Metals Analysis by ICP	2	2019/07/11	2019/07/15	CAM SOP-00408	EPA 6010D m
Total Metals Analysis by ICP	1	2019/07/11	2019/07/12	CAM SOP-00408	EPA 6010D m
Anion and Cation Sum	2	N/A	2019/07/15		
Total Coliforms, (CFU/100mL)	1	N/A	2019/07/10	CAM SOP-00552	MOE LSB E3371
Total Oil and Grease	1	2019/07/13	2019/07/13	CAM SOP-00326	EPA1664B m,SM5520A m
pH	1	2019/07/11	2019/07/11	CAM SOP-00413	SM 4500H+ B m
pH	1	2019/07/11	2019/07/12	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2019/07/11	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	2	N/A	2019/07/12	CAM SOP-00464	EPA 375.4 m
Total Suspended Solids	1	2019/07/11	2019/07/12	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your P.O. #: 11876
Your Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your C.O.C. #: 726383-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/07/17
Report #: R5800701
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9I9006
Received: 2019/07/10, 13:00

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: Ema.Gitej@bvlabs.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

BRAMPTON STORM SEWER BYLAW (90-75)

BV Labs ID		KFO559		
Sampling Date		2019/07/10 10:30		
COC Number		726383-01-01		
	UNITS	**MW51B**	**RDL**	**QC Batch**
Inorganics				
Total BOD	mg/L	<2	2	6222661
pH	pH	7.86		6222836
Phenols-4AAP	mg/L	0.0010	0.0010	6222826
Total Suspended Solids	mg/L	460	10	6222923
Dissolved Sulphate (SO4)	mg/L	67	1.0	6223639
Total Cyanide (CN)	mg/L	<0.0050	0.0050	6223497
Dissolved Chloride (Cl-)	mg/L	20	1.0	6223635
Petroleum Hydrocarbons				
Total Oil & Grease	mg/L	<0.50	0.50	6226807
Metals				
Total Cadmium (Cd)	mg/L	<0.005	0.005	6222604
Total Chromium (Cr)	mg/L	0.01	0.01	6222604
Total Copper (Cu)	mg/L	<0.02	0.02	6222604
Total Iron (Fe)	mg/L	14	0.02	6222604
Total Nickel (Ni)	mg/L	<0.05	0.05	6222604
Total Zinc (Zn)	mg/L	0.03	0.01	6222604
Microbiological				
Background	CFU/100mL	3500	10	6221476
Total Coliforms	CFU/100mL	10	10	6221476

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

RESULTS OF ANALYSES OF WATER

BV Labs ID		KFO559			KFO560			KFO560		
Sampling Date		2019/07/10 10:30			2019/07/10 10:30			2019/07/10 10:30		
COC Number		726383-01-01			726383-01-01			726383-01-01		
	UNITS	MW51B	RDL	QC Batch	MW511B	RDL	QC Batch	MW511B Lab-Dup	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	10.7	N/A	6220746	10.8	N/A	6220746			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	430	1.0	6220743	440	1.0	6220743			
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.9	1.0	6220743	3.5	1.0	6220743			
Cation Sum	me/L	11.0	N/A	6220746	11.2	N/A	6220746			
Inorganics										
Conductivity	mS/cm	0.880	0.001	6222829	0.893	0.001	6222829	0.877	0.001	6222829
pH	pH				7.93		6222836	7.95		6222836
Dissolved Sulphate (SO4)	mg/L				68	1.0	6223639			
Alkalinity (Total as CaCO3)	mg/L	440	1.0	6222830	440	1.0	6222830	440	1.0	6222830
Dissolved Chloride (Cl-)	mg/L				20	1.0	6223635			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		KFO559	KFO560	KFO560		
Sampling Date		2019/07/10 10:30	2019/07/10 10:30	2019/07/10 10:30		
COC Number		726383-01-01	726383-01-01	726383-01-01		
	UNITS	MW51B	MW511B	MW511B Lab-Dup	RDL	QC Batch
Metals						
Dissolved Calcium (Ca)	mg/L	46	47	46	0.05	6223541
Dissolved Magnesium (Mg)	mg/L	86	87	86	0.05	6223541
Dissolved Potassium (K)	mg/L	5	4	4	1	6223541
Dissolved Sodium (Na)	mg/L	35	35	34	0.5	6223541

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

TEST SUMMARY

BV Labs ID: KFO559
Sample ID: MW51B
Matrix: Water

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6222830	N/A	2019/07/11	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6220743	N/A	2019/07/12	Automated Statchk
Biochemical Oxygen Demand (BOD)	DO	6222661	2019/07/11	2019/07/16	Nusrat Naz
Chloride by Automated Colourimetry	KONE	6223635	N/A	2019/07/12	Deonarine Ramnarine
Conductivity	AT	6222829	N/A	2019/07/11	Surinder Rai
Total Cyanide	SKAL/CN	6223497	2019/07/11	2019/07/11	Gnana Thomas
Lab Filtered Metals Analysis by ICP	ICP	6223541	2019/07/11	2019/07/15	Azita Fazaeli
Total Metals Analysis by ICP	ICP	6222604	2019/07/11	2019/07/12	Suban Kanapathippllai
Anion and Cation Sum	CALC	6220746	N/A	2019/07/15	Automated Statchk
Total Coliforms, (CFU/100mL)	PL	6221476	N/A	2019/07/10	Sirimathie Aluthwala
Total Oil and Grease	BAL	6226807	2019/07/13	2019/07/13	Sukhhardey Pal Singh Khangura
pH	AT	6222836	2019/07/11	2019/07/11	Surinder Rai
Phenols (4AAP)	TECH/PHEN	6222826	N/A	2019/07/11	Louise Harding
Sulphate by Automated Colourimetry	KONE	6223639	N/A	2019/07/12	Deonarine Ramnarine
Total Suspended Solids	BAL	6222923	2019/07/11	2019/07/12	Xinyue (Sarah) Hou

BV Labs ID: KFO560
Sample ID: MW511B
Matrix: Water

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6222830	N/A	2019/07/12	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6220743	N/A	2019/07/12	Automated Statchk
Chloride by Automated Colourimetry	KONE	6223635	N/A	2019/07/12	Deonarine Ramnarine
Conductivity	AT	6222829	N/A	2019/07/12	Surinder Rai
Lab Filtered Metals Analysis by ICP	ICP	6223541	2019/07/11	2019/07/15	Azita Fazaeli
Anion and Cation Sum	CALC	6220746	N/A	2019/07/15	Automated Statchk
pH	AT	6222836	2019/07/11	2019/07/12	Surinder Rai
Sulphate by Automated Colourimetry	KONE	6223639	N/A	2019/07/12	Deonarine Ramnarine

BV Labs ID: KFO560 Dup
Sample ID: MW511B
Matrix: Water

Collected: 2019/07/10
Shipped:
Received: 2019/07/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6222830	N/A	2019/07/12	Surinder Rai
Conductivity	AT	6222829	N/A	2019/07/12	Surinder Rai
Lab Filtered Metals Analysis by ICP	ICP	6223541	2019/07/11	2019/07/15	Azita Fazaeli
pH	AT	6222836	2019/07/11	2019/07/12	Surinder Rai

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.0°C

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6222604	SUK	Matrix Spike	Total Cadmium (Cd)	2019/07/12		99	%	80 - 120
			Total Chromium (Cr)	2019/07/12		99	%	80 - 120
			Total Copper (Cu)	2019/07/12		98	%	80 - 120
			Total Iron (Fe)	2019/07/12		99	%	80 - 120
			Total Nickel (Ni)	2019/07/12		98	%	80 - 120
			Total Zinc (Zn)	2019/07/12		98	%	80 - 120
6222604	SUK	Spiked Blank	Total Cadmium (Cd)	2019/07/12		100	%	80 - 120
			Total Chromium (Cr)	2019/07/12		99	%	80 - 120
			Total Copper (Cu)	2019/07/12		98	%	80 - 120
			Total Iron (Fe)	2019/07/12		101	%	80 - 120
			Total Nickel (Ni)	2019/07/12		105	%	80 - 120
			Total Zinc (Zn)	2019/07/12		109	%	80 - 120
6222604	SUK	Method Blank	Total Cadmium (Cd)	2019/07/12	<0.005		mg/L	
			Total Chromium (Cr)	2019/07/12	<0.01		mg/L	
			Total Copper (Cu)	2019/07/12	<0.02		mg/L	
			Total Iron (Fe)	2019/07/12	<0.02		mg/L	
			Total Nickel (Ni)	2019/07/12	<0.05		mg/L	
			Total Zinc (Zn)	2019/07/12	<0.01		mg/L	
6222604	SUK	RPD	Total Zinc (Zn)	2019/07/12	1.0		%	25
6222661	NNA	QC Standard	Total BOD	2019/07/16		102	%	80 - 120
6222661	NNA	Method Blank	Total BOD	2019/07/16	<2		mg/L	
6222661	NNA	RPD	Total BOD	2019/07/16	NC		%	30
6222826	LHA	Matrix Spike	Phenols-4AAP	2019/07/11		98	%	80 - 120
6222826	LHA	Spiked Blank	Phenols-4AAP	2019/07/11		97	%	80 - 120
6222826	LHA	Method Blank	Phenols-4AAP	2019/07/11	<0.0010		mg/L	
6222826	LHA	RPD	Phenols-4AAP	2019/07/11	NC		%	20
6222829	SAU	Spiked Blank	Conductivity	2019/07/11		102	%	85 - 115
6222829	SAU	Method Blank	Conductivity	2019/07/11	<0.001		mS/cm	
6222829	SAU	RPD [KFO560-01]	Conductivity	2019/07/12	1.8		%	25
6222830	SAU	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/11		95	%	85 - 115
6222830	SAU	Method Blank	Alkalinity (Total as CaCO3)	2019/07/11	<1.0		mg/L	
6222830	SAU	RPD [KFO560-01]	Alkalinity (Total as CaCO3)	2019/07/12	0.20		%	20
6222836	SAU	Spiked Blank	pH	2019/07/11		102	%	98 - 103
6222836	SAU	RPD [KFO560-01]	pH	2019/07/12	0.23		%	N/A
6222923	XH1	QC Standard	Total Suspended Solids	2019/07/12		95	%	85 - 115
6222923	XH1	Method Blank	Total Suspended Solids	2019/07/12	<10		mg/L	
6222923	XH1	RPD	Total Suspended Solids	2019/07/12	NC		%	25
6223497	GTO	Matrix Spike	Total Cyanide (CN)	2019/07/11		101	%	80 - 120
6223497	GTO	Spiked Blank	Total Cyanide (CN)	2019/07/11		100	%	80 - 120
6223497	GTO	Method Blank	Total Cyanide (CN)	2019/07/11	<0.0050		mg/L	
6223497	GTO	RPD	Total Cyanide (CN)	2019/07/11	0.66		%	20
6223541	AFZ	Matrix Spike [KFO560-01]	Dissolved Calcium (Ca)	2019/07/15		NC	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		NC	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		106	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		NC	%	80 - 120
6223541	AFZ	Spiked Blank	Dissolved Calcium (Ca)	2019/07/15		97	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/15		97	%	80 - 120
			Dissolved Potassium (K)	2019/07/15		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/15		100	%	80 - 120
6223541	AFZ	Method Blank	Dissolved Calcium (Ca)	2019/07/15	<0.05		mg/L	
			Dissolved Magnesium (Mg)	2019/07/15	<0.05		mg/L	
			Dissolved Potassium (K)	2019/07/15	<1		mg/L	

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sodium (Na)	2019/07/15	<0.5		mg/L	
6223541	AFZ	RPD [KFO560-01]	Dissolved Calcium (Ca)	2019/07/15	2.7		%	25
			Dissolved Magnesium (Mg)	2019/07/15	2.2		%	25
			Dissolved Potassium (K)	2019/07/15	2.8		%	25
			Dissolved Sodium (Na)	2019/07/15	1.7		%	25
6223635	DRM	Matrix Spike	Dissolved Chloride (Cl-)	2019/07/12		118	%	80 - 120
6223635	DRM	Spiked Blank	Dissolved Chloride (Cl-)	2019/07/12		102	%	80 - 120
6223635	DRM	Method Blank	Dissolved Chloride (Cl-)	2019/07/12	<1.0		mg/L	
6223635	DRM	RPD	Dissolved Chloride (Cl-)	2019/07/12	2.6		%	20
6223639	DRM	Matrix Spike	Dissolved Sulphate (SO4)	2019/07/12		112	%	75 - 125
6223639	DRM	Spiked Blank	Dissolved Sulphate (SO4)	2019/07/12		101	%	80 - 120
6223639	DRM	Method Blank	Dissolved Sulphate (SO4)	2019/07/12	<1.0		mg/L	
6223639	DRM	RPD	Dissolved Sulphate (SO4)	2019/07/12	0.85		%	20
6226807	SPK	Spiked Blank	Total Oil & Grease	2019/07/13		100	%	85 - 115
6226807	SPK	RPD	Total Oil & Grease	2019/07/13	3.1		%	25
6226807	SPK	Method Blank	Total Oil & Grease	2019/07/13	<0.50		mg/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: B9I9006
Report Date: 2019/07/17

SNC-Lavalin Inc
Client Project #: 665125
Site Location: 10192 HWY50, BRAMPTON, ON
Your P.O. #: 11876
Sampler Initials: SA

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Sirimathie Aluthwala, Campobello Micro

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

MICRO

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvlabs.com

STANTEC

10-Jul-19 13:00
Ema Gitej
B9I9006

HGL ENV-1251

INVOICE INFORMATION:		REPORT INFORMATION(if differs from invoice):		PROJECT INFORMATION:		
Company Name:	#2432 SNC-Lavalin Inc	Company Name:	#13733 SNC-Lavalin Inc	Quotation #:	B93355	Bottle Order #: 726383
Contact Name:	Accounts Payable	Contact Name:	Wilson Liu	Task #:		
Address:	455 René-Lévesque Blvd. West	Address:	235 Lesmill Road	Project #:	665125	
	Montreal QC H2Z 1Z3		Toronto ON M3B 2V1	Profit Centre:		COC #: C#726383-01-01 / Project Manager: Ema Gitej
Phone:	(519) 393-1000 Fax: (514) 866-0795	Phone:	(416) 635-5882 Fax:	Site #:	10192 Hwy50, Brampton, ON	
Email:	Payables@snclavalin.com	Email:	Wilson.Liu@snclavalin.com, ON_LabData@snclavalin.c	Sampled By:	Sara Akib / Renee Hsai	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☐ Sanitary Sewer Bylaw
- ☐ Reg 558 ☒ Storm Sewer Bylaw
- ☐ MISA Municipality Brampton
- ☐ PWQO
- ☐ Other

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ____

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ____ Time Required: ____ ☐
Rush Confirmation Number: ____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	PHCs F1-F4	VOCs	PAHs	Total Metals Analysis by ICPMS	Conductivity, SAR, pH	Alkalinity, Bicarbonate, Carbonate	Chloride, Sulphate, Nitrate, Nitrite, Ortho-Phosphate	Lab Filtered Ca, Mg, K and Na	Storm/Sanitary Sewer SA Major Ions Chemistry Brampton Storm Sewer bylaw		# of Bottles	Comments
1	MW-51B	MW-51B	July 10/19	10:30am	GW										✓	✓	8	Trace of sediments
2	MW-511B	MW-51B	July 10/19	10:30am	GW										✓		2	trace of sediments
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Rece	Custody Seal Present	Yes	No
Sara Akib	July 10/19	13:00		2019/07/10	13:00	0		10/11/9	Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

On ice

Bureau Veritas Canada (2019) Inc.

Your P.O. #: 11876
Your Project #: 665125
Site Location: CITY OF BRAMPTON
Your C.O.C. #: 743070-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/10/28
Report #: R5941689
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9T6639
Received: 2019/10/22, 16:03

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Biochemical Oxygen Demand (BOD)	1	2019/10/23	2019/10/28	CAM SOP-00427	SM 23 5210B m
Chloride by Automated Colourimetry	1	N/A	2019/10/24	CAM SOP-00463	SM 23 4500-Cl E m
Total Cyanide	1	2019/10/24	2019/10/24	CAM SOP-00457	OMOE E3015 5 m
Total Metals Analysis by ICP	1	2019/10/23	2019/10/24	CAM SOP-00408	EPA 6010D m
Total Coliforms, (CFU/100mL)	1	N/A	2019/10/22	CAM SOP-00552	MOE LSB E3371
Total Oil and Grease	1	2019/10/28	2019/10/28	CAM SOP-00326	EPA1664B m,SM5520A m
pH	1	2019/10/23	2019/10/23	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2019/10/24	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2019/10/24	CAM SOP-00464	EPA 375.4 m
Total Suspended Solids	1	2019/10/23	2019/10/24	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your P.O. #: 11876
Your Project #: 665125
Site Location: CITY OF BRAMPTON
Your C.O.C. #: 743070-01-01

Attention: Wilson Liu

SNC-Lavalin Inc
235 Lesmill Road
Toronto, ON
CANADA M3B 2V1

Report Date: 2019/10/28
Report #: R5941689
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9T6639
Received: 2019/10/22, 16:03

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: Ema.Gitej@bvlabs.com
Phone# (905)817-5829
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

BRAMPTON STORM SEWER BYLAW (90-75)

BV Labs ID		LCI312		
Sampling Date		2019/10/22 12:15		
COC Number		743070-01-01		
	UNITS	MW-74	RDL	QC Batch
Inorganics				
Total BOD	mg/L	<2	2	6401388
pH	pH	7.42		6402072
Phenols-4AAP	mg/L	<0.0010	0.0010	6403865
Total Suspended Solids	mg/L	17	10	6402237
Dissolved Sulphate (SO4)	mg/L	73	1.0	6402215
Total Cyanide (CN)	mg/L	<0.0050	0.0050	6404196
Dissolved Chloride (Cl-)	mg/L	40	1.0	6402207
Petroleum Hydrocarbons				
Total Oil & Grease	mg/L	<0.50	0.50	6409890
Metals				
Total Cadmium (Cd)	mg/L	<0.005	0.005	6402377
Total Chromium (Cr)	mg/L	<0.01	0.01	6402377
Total Copper (Cu)	mg/L	<0.02	0.02	6402377
Total Iron (Fe)	mg/L	0.59	0.02	6402377
Total Nickel (Ni)	mg/L	<0.05	0.05	6402377
Total Zinc (Zn)	mg/L	<0.01	0.01	6402377
Microbiological				
Background	CFU/100mL	2700	10	6400460
Total Coliforms	CFU/100mL	30	10	6400460

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

TEST SUMMARY

BV Labs ID: LCI312
Sample ID: MW-74
Matrix: Water

Collected: 2019/10/22
Shipped:
Received: 2019/10/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Biochemical Oxygen Demand (BOD)	DO	6401388	2019/10/23	2019/10/28	Nusrat Naz
Chloride by Automated Colourimetry	KONE	6402207	N/A	2019/10/24	Deonarine Ramnarine
Total Cyanide	SKAL/CN	6404196	2019/10/24	2019/10/24	Gnana Thomas
Total Metals Analysis by ICP	ICP	6402377	2019/10/23	2019/10/24	Suban Kanapathippllai
Total Coliforms, (CFU/100mL)	PL	6400460	N/A	2019/10/22	Farhana Rahman
Total Oil and Grease	BAL	6409890	2019/10/28	2019/10/28	Gurseerat singh gill
pH	AT	6402072	2019/10/23	2019/10/23	Kazzandra Adeva
Phenols (4AAP)	TECH/PHEN	6403865	N/A	2019/10/24	Bramdeo Motiram
Sulphate by Automated Colourimetry	KONE	6402215	N/A	2019/10/24	Deonarine Ramnarine
Total Suspended Solids	BAL	6402237	2019/10/23	2019/10/24	Massarat Jan

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.7°C

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6401388	NNA	QC Standard	Total BOD	2019/10/28		89	%	80 - 120
6401388	NNA	Method Blank	Total BOD	2019/10/28	<2		mg/L	
6401388	NNA	RPD	Total BOD	2019/10/28	NC		%	30
6402072	KAD	Spiked Blank	pH	2019/10/23		102	%	98 - 103
6402072	KAD	RPD	pH	2019/10/23	0.20		%	N/A
6402207	DRM	Matrix Spike	Dissolved Chloride (Cl-)	2019/10/24		NC	%	80 - 120
6402207	DRM	Spiked Blank	Dissolved Chloride (Cl-)	2019/10/24		105	%	80 - 120
6402207	DRM	Method Blank	Dissolved Chloride (Cl-)	2019/10/24	<1.0		mg/L	
6402207	DRM	RPD	Dissolved Chloride (Cl-)	2019/10/24	2.6		%	20
6402215	DRM	Matrix Spike	Dissolved Sulphate (SO4)	2019/10/24		NC	%	75 - 125
6402215	DRM	Spiked Blank	Dissolved Sulphate (SO4)	2019/10/24		104	%	80 - 120
6402215	DRM	Method Blank	Dissolved Sulphate (SO4)	2019/10/24	<1.0		mg/L	
6402215	DRM	RPD	Dissolved Sulphate (SO4)	2019/10/24	2.2		%	20
6402237	MJ1	QC Standard	Total Suspended Solids	2019/10/24		100	%	85 - 115
6402237	MJ1	Method Blank	Total Suspended Solids	2019/10/24	<10		mg/L	
6402237	MJ1	RPD	Total Suspended Solids	2019/10/24	NC		%	25
6402377	SUK	Matrix Spike	Total Cadmium (Cd)	2019/10/24		106	%	80 - 120
			Total Chromium (Cr)	2019/10/24		97	%	80 - 120
			Total Copper (Cu)	2019/10/24		104	%	80 - 120
			Total Iron (Fe)	2019/10/24		96	%	80 - 120
			Total Nickel (Ni)	2019/10/24		99	%	80 - 120
			Total Zinc (Zn)	2019/10/24		98	%	80 - 120
6402377	SUK	Spiked Blank	Total Cadmium (Cd)	2019/10/24		104	%	80 - 120
			Total Chromium (Cr)	2019/10/24		96	%	80 - 120
			Total Copper (Cu)	2019/10/24		103	%	80 - 120
			Total Iron (Fe)	2019/10/24		100	%	80 - 120
			Total Nickel (Ni)	2019/10/24		100	%	80 - 120
			Total Zinc (Zn)	2019/10/24		100	%	80 - 120
6402377	SUK	Method Blank	Total Cadmium (Cd)	2019/10/24	<0.005		mg/L	
			Total Chromium (Cr)	2019/10/24	<0.01		mg/L	
			Total Copper (Cu)	2019/10/24	<0.02		mg/L	
			Total Iron (Fe)	2019/10/24	<0.02		mg/L	
			Total Nickel (Ni)	2019/10/24	<0.05		mg/L	
			Total Zinc (Zn)	2019/10/24	<0.01		mg/L	
6402377	SUK	RPD	Total Iron (Fe)	2019/10/24	8.2		%	25
6403865	BMO	Matrix Spike	Phenols-4AAP	2019/10/24		101	%	80 - 120
6403865	BMO	Spiked Blank	Phenols-4AAP	2019/10/24		99	%	80 - 120
6403865	BMO	Method Blank	Phenols-4AAP	2019/10/24	<0.0010		mg/L	
6403865	BMO	RPD	Phenols-4AAP	2019/10/24	9.5		%	20
6404196	GTO	Matrix Spike	Total Cyanide (CN)	2019/10/24		98	%	80 - 120
6404196	GTO	Spiked Blank	Total Cyanide (CN)	2019/10/24		98	%	80 - 120
6404196	GTO	Method Blank	Total Cyanide (CN)	2019/10/24	<0.0050		mg/L	
6404196	GTO	RPD	Total Cyanide (CN)	2019/10/24	4.5		%	20
6409890	GSG	Spiked Blank	Total Oil & Grease	2019/10/28		99	%	85 - 115
6409890	GSG	RPD	Total Oil & Grease	2019/10/28	2.0		%	25

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6409890	GSG	Method Blank	Total Oil & Grease	2019/10/28	<0.50		mg/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: B9T6639
Report Date: 2019/10/28

SNC-Lavalin Inc
Client Project #: 665125
Site Location: CITY OF BRAMPTON
Your P.O. #: 11876
Sampler Initials: JP

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

Farhana Rahman

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

MICRO

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario, Canada L5N 2L8 Tel: (905) 817-5700 Toll-free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

22-Oct-19 16:03
Ema Gitej
B9T6639
J_L ENV-667

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#2432 SNC-Lavalin Inc	Company Name:	#13733 SNC-Lavalin Inc	Quotation #:	B93355
Attention:	Accounts Payable	Attention:	Wilson Liu	P.O. #:	
Address:	455 René-Lévesque Blvd. West	Address:	235 Lesmill Road	Project:	665125
	Montreal QC H2Z 1Z3		Toronto ON M3B 2V1	Project Name:	City of Brampton
Tel:	(519) 393-1000 Fax: (514) 866-0795	Tel:	(416) 635-5882 Fax:	Site #:	10192 HWY50, BRAMPTON
Email:	Payables@snclavalin.com	Email:	Wilson.Liu@snclavalin.com, ON_LabData@snclavalin.c	Sampled By:	Joey Preston

Bottle Order #: 743070
COC #: C#743070-01-01
Project Manager: Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☒ Sanitary Sewer Bylaw ☐ Reg 558 ☒ Storm Sewer Bylaw ☐ MISA Municipality: Brampton ☐ PWQO ☐ Other

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ____

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ____ Time Required: ____ ☐
Rush Confirmation Number: ____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle) Metals / Hg / Cr VI	Brampton Storm (incl. Micro)									# of Bottles	Comments
1		MW-14	Oct 22/19	12:15	GW		X									8	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Joseph Preston	19/10/22	11:30	[illegible]	2019/10/22	1603	

Laboratory Use Only
Time Sensitive
Temperature (°C) on Recei: 6 | 1.5 | SICE
Custody Seal Present / Intact: Yes ☒ No ☐

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Appendix E

Dewatering Assessment

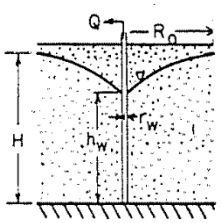
Flow to Trench Excavations in Unconfined Conditions
Building Foundation (Spread Footing) - Johnston Transit Facility, Brampton

Parameters/Formulas	Units	Symbol	Value
Initial Water Head	m	**H**	7.0
Groundwater Drawdown	m	**$H-h_w$**	4.0
Target Water Head	m	**h_w**	3.0
Water Head at the Base of the Water Bearing Zone (assumed 3 m below the target water head)	m	**h_0**	0
Hydraulic Conductivity	m/s	**K**	1.0E-06
Length of the Trench Excavation	m	**a**	300
Width of the Trench Excavation	m	**b**	6
Length of the Line Source	m	**X**	300
Distance to the Line Source	m	**L**	12
Effective Radius of Influence (R_0)			
$R_0 = 3000*(H-h_w)*sqrt(K)$	m	**R_0**	12
Equivalent Radius (r_s)			
$r_s=b/2$	m	**r_s**	3

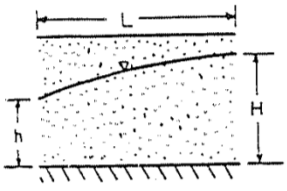
Radial Flow to a Well in a Water Table Aquifer			
$Q1=[Pi*K*(H^2-h_w^2)]/ln(R_0/r_s)$	m^3/day	**Q1**	7.9
	L/day	**Q1**	7,900

Flow to a Drainage Trench from a Line Source			
$Q2= 2*(X*K*(H^2-h_w^2)/2L)$	m^3/day	**Q2**	86.4
	L/day	**Q2**	86,400

Total Flow to the Trench Excavation (Q1+Q2)	L/day	**Q**	94,300
Apply a Safety Factor of 2	L/day	**Q**	188,600
	L/min	**Q**	131



Radial Flow, Water Table Aquifer



Water Table Flow From a Line Source to a Drainage Trench

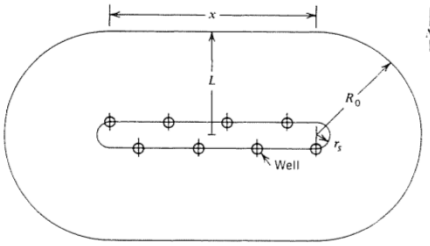


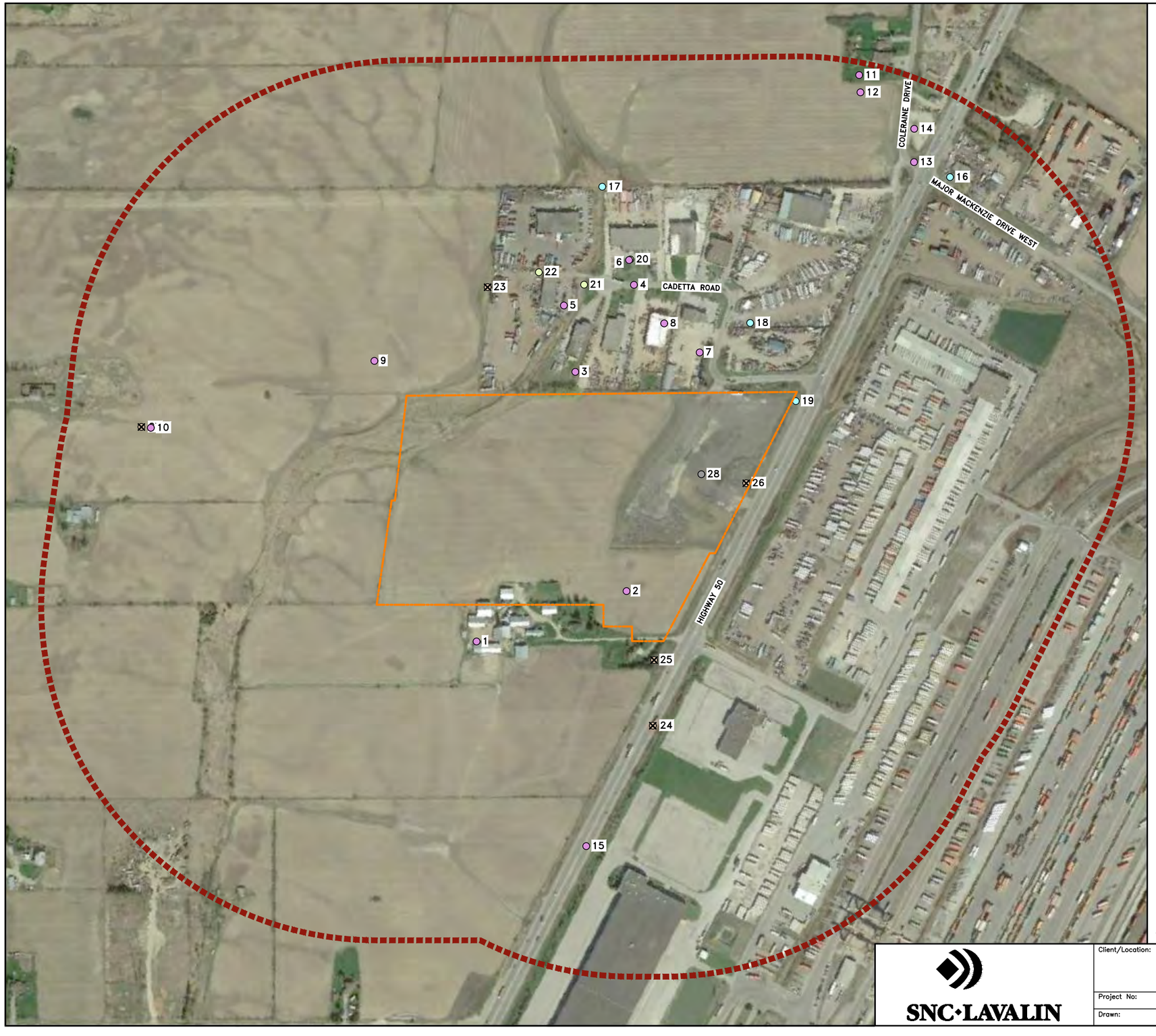
Figure 6.8 *Approximate analysis of long narrow systems*

Reference

J. Patrick Powers, Arthur B. Corwin, Paul C. Schmall, Walter E. Kaeck, 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, Third Edition, Chapter 6 Dewatering Design Using Analytical Methods.

Appendix F

MECP Well Records



DISCUSSION NORTH

TRUE NORTH

WELL LOCATION	WELL NUMBER	ADDRESS	DATE RECEIVED	USE
1	4902862	-	17-Jan-67	Water Supply
2	4905218	-	16-Nov-77	Water Supply
3	4905247	-	07-Dec-77	Water Supply
4	4905769	-	10-Apr-81	Water Supply
5	4905812	-	03-Nov-81	Water Supply
6	4905813	-	03-Nov-81	Water Supply
7	4906179	-	18-May-84	Water Supply
8	4906478	-	08-Aug-86	Water Supply
9	4908701	-	07-Feb-01	Water Supply
10	4902865	-	17-Jan-67	Water Supply
11	4904154	-	29-Aug-73	Water Supply
12	4904215	-	27-Nov-73	Water Supply
13	4904866	-	10-May-76	Water Supply
14	4905674	-	05-Aug-80	Water Supply
15	6907184	-	-	Water Supply
16	4909717	10021 HWY 50	-	Observation Wells
17	7116410	10514 COLERAINE DR.	-	Observation Wells
18	7241945	4 CORDETTA RD	28-May-15	Observation Wells
19	7282340	HWY 50 SOUTHBOUND LANE SOUTH OF CADETTA RD	28-Feb-17	Observation Wells
20	7166972	12 CADETTA RD	09-Aug-11	Test Hole
21	7178624	16 CADETLA ROAD	29-Mar-12	Test Hole
22	4905768	-	10-Apr-81	Test Hole
23	7225368	16 CADETTA RD.	12-Aug-14	Abandoned-Supply
24	7249972	HWY 50 ASTLEMORE ROAD-COLERAINE DR.	14-Oct-15	Abandoned-Other
25	7249973	HWY 50 CASTLEMORE RD. & COLERAINE DR.	14-Oct-15	Abandoned-Other
26	7249974	HWY 50 CASTLEMORE RD. & COLERAINE DR.	14-Oct-15	Abandoned-Other
27	4902864	-	17-Jan-67	Abandoned-Quality
28	7279718	-	26-Jan-17	Unknown

LEGEND

- 1 — WATER WELL NUMBER
- WATER WELL
- OBSERVATION WELL
- TEST HOLE
- ABANDONED WELL
- UNKNOWN WELL
- PHASE ONE PROPERTY LIMIT
- 500m RADIUS FROM SITE

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SOURCE(S):
1. GOOGLE EARTH PRO IMAGE, MARCH 7, 2018
2. MINISTRY OF THE ENVIRONMENT CONSERVATION AND PARKS, WATER WELL DATA SYSTEM AS OF JUNE 2019

SCALE 1:6,000

0 120 240m

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON, 10192 HIGHWAY 50, BRAMPTON, ON

Title: WATER WELL RECORDS

Project No:	Filename:	Date:	Dwg No:
665125	009FF1_665125	NOVEMBER 2019	APPENDIX F
Drawn: AG	Verified: WL	Project Manager: AY	

PAGE FORMAT: 11x17

FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\009 (Hydrogeological)\009FF1_665125.dwg

Environment & Geoscience
235 Lesmill Road
Toronto, Ontario, Canada M3B 2V1
416-635-5882

July 3, 2019

Private Water Wells Sampling
Due diligence work for potential acquisition of the property known as
10192 Highway 50, Brampton, Ontario

Dear Property Owner,

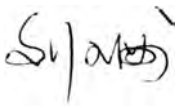
The City of Brampton (City) is completing a due diligence work for potential acquisition of the property located at 10192 Highway 50, Brampton, Ontario.

At the request of the City, SNC-Lavalin will be conducting a water well survey and sampling program in the project area to gather information on private water wells including well construction details and historical use. We are requesting permission to access your property and private wells prior to and during construction. Participation is not mandatory. However, we recommend your volunteering participation.

Upon receiving your consent, staff from SNC-Lavalin will be visiting your property and collecting water samples from your well(s) for drinking water standards analysis. A cover letter along with water quality results will be provided to you once they become available.

If you would like to participate in this program, please contact Wilson Liu at (416) 635-5882 ext. 55806 or via email wilson.liu@snclavalin.com, and we request that you provide your confirmation by no later than Friday July 12, 2019. We appreciate your time and cooperation in this matter.

Yours Truly,



Wilson Liu, P. Geo.
Project Hydrogeologist
Environment & Geoscience
SNC-LAVALIN INC.
Wilson.Liu@snclavalin.com

Appendix G

City of Brampton Official Plan – Schedule D

Brampton

The Natural Heritage Features and Areas within the identified area may not be fully accurate. Further review and verification of these Natural Heritage Features and Areas will be undertaken as part of future planning processes or comprehensive environmental studies.

TOWN OF CALEDON

TOWN OF HALTON HILLS

CITY OF VAUGHAN

CITY OF TORONTO

CITY OF MISSISSAUGA

APPEALED TO THE OMB

Approximate Site Location

The Natural Heritage Features and Areas within the identified area may not be fully accurate. Further review and verification of these Natural Heritage Features and Areas will be undertaken as part of future planning processes or comprehensive environmental studies.

1:70000

0 1 2 3 4 5 Kilometres

LEGEND

- VALLEYLAND / WATERCOURSE CORRIDOR
- WOODLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LAKES AND PONDS
- OTHER WETLAND
- SPECIAL POLICY AREA
- ENVIRONMENTALLY SENSITIVE / SIGNIFICANT AREA
- PROVINCIAL GREENBELT / PROTECTED COUNTRYSIDE
- AREAS OF NATURAL AND SCIENTIFIC INTEREST - LIFE SCIENCE
- AREAS OF NATURAL AND SCIENTIFIC INTEREST - EARTH SCIENCE

Last Amended Date
Aug 10th, 2015

NOTES: WATERCOURSES AND TRIBUTARIES ARE SHOWN FOR CONTEXT PURPOSES

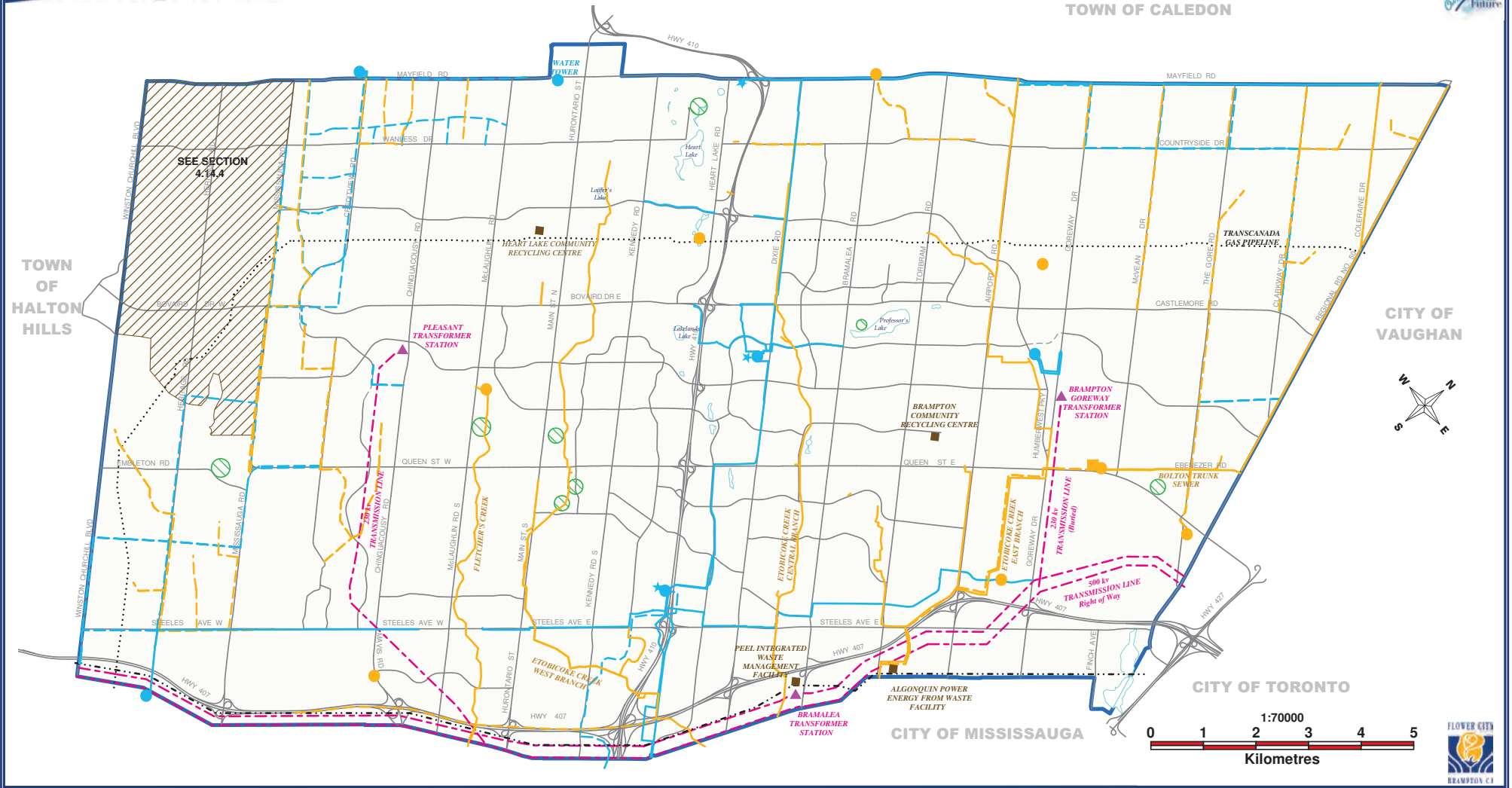
The boundaries and alignments of designations on this Schedule are approximate and are not to be scaled. This map forms part of the Official Plan of The City of Brampton and must be read in conjunction with the text,other Schedules and Secondary Plans. Mapping to support the implementation of the "Development, Interference with Wetlands, and Alterations to Shorelines and Watercourses Regulation" is not specifically reflected in this Schedule. Please refer to Appendix C to determine if a property may be affected by this Regulation. The Toronto and Region Conservation Authority and Credit Valley Conservation should be contacted for details regarding their respective requirements for the areas regulated under the said Regulation.

City of Brampton 2006 Official Plan September 2015 Office Consolidation.

Schedule D

NATURAL HERITAGE FEATURES AND AREAS

Brampton



LEGEND

- EXISTING WATERMAIN TRUNKS
- PROPOSED WATERMAIN TRUNK
- RESERVOIR
- TREATMENT PLANT
- EXISTING SANITARY TRUNK SEWER
- PROPOSED SANITARY TRUNK SEWER
- PUMPING STATIONS
- TREATMENT PLANT SANITARY
- WASTE WATER MANAGEMENT
- TRANSFORMER STATION
- HYDRO TRANSMISSION LINE
- FUTURE UTILITY CORRIDOR
- TRANSCANADA GAS PIPELINE
- FORMER WASTE DISPOSAL SITE
- NORTH WEST BRAMPTON POLICY AREA

Last Amended Date
Nov 1st, 2013

NOTES: This map forms part of the Official Plan of the City of Brampton and must be read in conjunction with the text, other schedules and secondary plans. The boundaries and alignments of designations on this schedule are approximate and are not intended to be scaled.
Information regarding existing or former waste disposal sites has been compiled based on information from the Ministry of Environment or the Region of Peel. Please contact the Ministry of Environment or the Region of Peel directly for further information and / or clarification regarding the status of these sites.

City of Brampton 2006 Official Plan September 2015 Office Consolidation.

Schedule F

Infrastructure, Utilities and Resources

Appendix H

Water Balance Analysis

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jan-38	8.1	40.4	-8.1	137.9	12.1	-4	40.4	0	12.7
Feb-38	11.4	76.5	-11.4	122.2	15.7	-4.3	116.9	0	6.4
Mar-38	22.2	41.7	75.8	100	22.2	0	58.4	98	54.3
Apr-38	40.3	33.3	20.5	100	40.3	0	29.2	20.5	38
May-38	66.1	72.4	17.3	100	66.1	0	14.6	17.3	30.5
Jun-38	96.4	42.2	-49	51	96.4	0	7.3	0	15.5
Jul-38	126.4	63.2	-59	20.9	97.4	28.9	0	0	9.9
Aug-38	114.2	37.1	-78.9	4.4	51.7	62.4	0	0	5.2
Sep-38	51.9	102.1	45.1	49.5	51.9	0	0	0	6.8
Oct-38	31.8	7.1	-25.1	37.1	19.1	12.7	0	0	1.2
Nov-38	15.8	33	15.6	52.7	15.8	0	0	0	2.1
Dec-38	10	27.4	-10	47.4	5.3	4.7	27.4	0	0.2
Jan-39	8.3	48.3	-8.3	43.4	4	4.4	75.7	0	0.1
Feb-39	10	88.1	-10	39.1	4.3	5.7	163.8	0	0.1
Mar-39	16.3	80.5	-16.3	32.7	6.4	9.9	244.3	0	0
Apr-39	32.5	90.2	175.4	100	32.5	0	122.1	108.1	58.6
May-39	73.9	26.4	12.3	100	73.9	0	61.1	12.3	34.5
Jun-39	100.7	51.8	-21	79	100.7	0	30.5	0	19.2
Jul-39	119.5	39.4	-66.8	26.2	105.5	14	15.3	0	10.3
Aug-39	107.3	51.6	-50.7	12.9	69.9	37.4	7.6	0	6.7
Jan-40	7.1	48.3	-7.1	12	0.9	6.1	55.9	0	2.1
Feb-40	9.8	34	-9.8	10.9	1.2	8.6	89.9	0	1
Mar-40	14.8	48.3	-14.8	9.3	1.6	13.2	138.2	0	0.5
Apr-40	32.5	50.8	84.9	94.2	32.5	0	69.1	0	2.8
May-40	64.4	123.4	87.4	100	64.4	0	34.6	81.5	47.1
Jun-40	92.3	86.1	6.7	100	92.3	0	17.3	6.7	28.1
Jul-40	116.6	70.9	-40.6	59.4	116.6	0	8.6	0	15.4
Aug-40	93	84.1	-4.5	56.7	91.2	1.8	0	0	10.2
Sep-40	54.9	102.4	42.4	99.1	54.9	0	0	0	8.1
Oct-40	27.2	45.5	16	100	27.2	0	0	15.1	11.3
Nov-40	14.8	114.3	93.8	100	14.8	0	0	93.8	57.1
Dec-40	9.4	82.6	-9.4	90.6	9.4	0	82.6	0	25.7
Jan-41	8.2	71.1	-8.2	83.2	7.5	0.8	153.7	0	12.9
Feb-41	9.8	31	-9.8	75.1	8.1	1.6	184.7	0	6.4
Mar-41	16.1	36.8	-16.1	63	12.1	4	221.5	0	3.2
Apr-41	44.5	45	109	100	44.5	0	110.8	71.9	39.8
May-41	73.9	53.8	32.6	100	73.9	0	55.4	32.6	37.8
Jun-41	109.2	75.7	-9.6	90.4	109.2	0	27.7	0	21.3
Jul-41	124	68.1	-45.5	49.3	119.7	4.4	13.8	0	12.2
Aug-41	93.6	39.4	-49.3	25	68.6	25	6.9	0	6.4
Sep-41	61	25.1	-30.2	17.4	38.3	22.7	0	0	3.4
Oct-41	32	89.2	52.7	70.2	32	0	0	0	5.6
Nov-41	17.3	52.6	32.7	100	17.3	0	0	2.8	4.6
Dec-41	10.7	41.1	-10.7	89.3	10.7	0	41.1	0	1
Jan-42	9	37.1	-9	81.3	8	1	78.2	0	0.5
Feb-42	8.9	41.1	-8.9	74.1	7.2	1.7	119.3	0	0.2
Mar-42	22.2	117.1	148.7	100	22.2	0	59.7	122.7	67.3
Apr-42	43.7	43.4	27.3	100	43.7	0	29.8	27.3	46.6
May-42	69.4	208.5	143.6	100	69.4	0	14.9	143.6	104.4
Jun-42	99.5	32.8	-60.9	39.1	99.5	0	7.5	0	48.6

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jul-42	114.4	110	-2.5	38.2	112.9	1.5	0	0	29
Aug-42	94.8	28.7	-67.5	12.4	53	41.7	0	0	13.2
Sep-42	54.9	99.8	39.9	52.3	54.9	0	0	0	10.9
Oct-42	31	56.4	22.5	74.9	31	0	0	0	5.8
Nov-42	15.4	78	58.7	100	15.4	0	0	33.6	22.2
Dec-42	8.3	110	-8.3	91.7	8.3	0	110	0	9.1
Jan-43	7.2	70.9	-7.2	85.1	6.6	0.6	180.9	0	4.6
Feb-43	10.4	48.8	-10.4	76.3	8.8	1.5	229.7	0	2.3
Mar-43	16.8	85.3	-16.8	63.5	12.8	4	315	0	1.1
Apr-43	30	56.6	181.3	100	30	0	157.5	144.8	75.8
May-43	66.1	104.4	111.9	100	66.1	0	78.8	111.9	97.6
Jun-43	114.7	45.2	-32.4	67.6	114.7	0	39.4	0	48.5
Jul-43	120.2	86.6	-18.3	55.2	114.3	5.9	19.7	0	27.4
Aug-43	96	49.3	-39.3	33.5	78.4	17.6	9.8	0	14
Sep-43	52.9	35.1	-9.7	30.3	46.4	6.4	0	0	7.5
Oct-43	28.8	73.4	40.9	71.2	28.8	0	0	0	6.6
Nov-43	14.5	40.6	24	95.2	14.5	0	0	0	3.5
Dec-43	8.7	15.5	-8.7	87	8.3	0.4	15.5	0	0.7
Jan-44	10.7	20.1	-10.7	77.6	9.3	1.4	35.6	0	0.4
Feb-44	9.9	63.2	-9.9	70	7.7	2.2	98.8	0	0.2
Mar-44	16.3	81.5	-16.3	58.6	11.4	4.9	180.3	0	0.1
Apr-44	32.9	82.8	135.9	100	32.9	0	90.2	94.5	51.4
May-44	80.1	137.9	96	100	80.1	0	45.1	96	78.6
Jun-44	104.5	102.4	15.3	100	104.5	0	22.5	15.3	48.6
Jul-44	120.2	90.2	-23.3	76.7	120.2	0	11.3	0	26.2
Aug-44	104.7	54.9	-46.9	40.7	93.8	10.9	5.6	0	13.6
Sep-44	57.3	64	9.1	49.9	57.3	0	0	0	8.6
Oct-44	29.9	17.5	-13.3	43.2	23.2	6.7	0	0	3.6
Nov-44	15.9	42.7	24.7	67.9	15.9	0	0	0	3.5
Dec-44	8.2	70.6	-8.2	62.4	5.6	2.6	70.6	0	0.7
Jan-45	6	40.1	-6	58.6	3.8	2.3	110.7	0	0.3
Feb-45	9.9	47.8	-9.9	52.8	5.8	4.1	158.5	0	0.2
Mar-45	28	114	159.6	100	28	0	79.2	112.4	62
Apr-45	40.6	83.1	78	100	40.6	0	39.6	78	71.3
May-45	55.9	145	101.7	100	55.9	0	19.8	101.7	91.7
Jun-45	92.9	81.3	-5.8	94.2	92.9	0	9.9	0	46.3
Jul-45	110.9	118.1	11.2	100	110.9	0	0	5.4	29.7
Aug-45	96	49	-49.4	50.6	96	0	0	0	14.4
Sep-45	57.7	128.8	64.7	100	57.7	0	0	15.3	20
Oct-45	29	57.2	25.4	100	29	0	0	25.4	22.3
Nov-45	15.9	54.6	36	100	15.9	0	0	36	30.5
Dec-45	8	41.7	-8	92	8	0	41.7	0	13.9
Jan-46	9.1	97.5	-9.1	83.6	8.4	0.7	139.2	0	6.9
Feb-46	9.3	57.9	-9.3	75.8	7.8	1.5	197.1	0	3.5
Mar-46	28.1	28.4	97.4	100	28.1	0	98.6	73.2	39.7
Apr-46	36.5	17	28.9	100	36.5	0	49.3	28.9	34.5
May-46	64	95.5	51.3	100	64	0	24.6	51.3	47.2
Jun-46	95.3	43.7	-41.4	58.6	95.3	0	12.3	0	23.4
Jul-46	115.8	79.2	-34.4	38.4	101.6	14.3	6.2	0	14.6
Aug-46	86.4	37.8	-44.3	21.4	59.1	27.3	0	0	7.2

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Sep-46	59.1	73.7	10.9	32.3	59.1	0	0	0	6.3
Oct-46	35.6	81	41.4	73.6	35.6	0	0	0	5.4
Nov-46	17.3	44.5	25	98.6	17.3	0	0	0	2.9
Dec-46	10	50.3	-10	88.8	9.8	0.1	50.3	0	0.3
Jan-47	9.5	98.3	-9.5	80.4	8.4	1.1	148.6	0	0.2
Feb-47	9.2	27.2	-9.2	73	7.4	1.8	175.8	0	0.1
Mar-47	17.8	46.7	-17.8	60	13	4.8	222.5	0	0
Apr-47	34.5	74.9	147.9	100	34.5	0	111.2	107.9	57.7
May-47	60.6	84.8	75.6	100	60.6	0	55.6	75.6	69
Jun-47	97	117.1	42	100	97	0	27.8	42	59.3
Jul-47	115.1	103.1	-3.3	96.7	115.1	0	13.9	0	31.9
Aug-47	112.8	61	-47.9	50.4	111.2	1.6	7	0	16.4
Sep-47	59.5	37.6	-16.8	41.9	51.2	8.3	0	0	8.6
Oct-47	39.8	34.3	-7.2	38.9	35.6	4.2	0	0	5.1
Nov-47	14.7	29.7	13.5	52.4	14.7	0	0	0	3.2
Dec-47	8.8	44.2	-8.8	47.8	4.6	4.2	44.2	0	0.8
Jan-48	6.9	40.1	-6.9	44.5	3.3	3.6	84.3	0	0.4
Feb-48	8.8	67.1	-8.8	40.6	3.9	4.9	151.4	0	0.2
Mar-48	17.9	57.9	-17.9	33.3	7.3	10.6	209.3	0	0.1
Apr-48	40.3	52.6	114.3	100	40.3	0	104.6	47.6	26.5
May-48	62.5	62.7	49.4	100	62.5	0	52.3	49.4	39.8
Jun-48	100.1	80.5	2.5	100	100.1	0	26.2	2.5	23.6
Jul-48	120.2	51.3	-58.4	41.6	120.2	0	13.1	0	12.4
Aug-48	102.1	48.5	-49.5	21	73.2	28.9	6.5	0	7.3
Sep-48	65.3	154.4	87.9	100	65.3	0	0	8.9	14.6
Oct-48	29	58.4	26.5	100	29	0	0	26.5	19.6
Nov-48	19.1	81	57.8	100	19.1	0	0	57.8	41.3
Dec-48	10.5	47.8	-10.5	89.5	10.5	0	47.8	0	18.6
Jan-49	10.6	69.3	-10.6	80	9.5	1.1	117.1	0	9.3
Feb-49	11.5	75.9	-11.5	70.9	9.2	2.3	193	0	4.7
Mar-49	18.3	63	-18.3	57.9	13	5.3	256	0	2.3
Apr-49	38.2	31.2	119.5	100	38.2	0	128	77.3	41.4
May-49	73.9	9.4	-0.9	99.1	73.9	0	64	0	20.4
Jun-49	126.7	4.1	-90.8	9.1	125.8	0.8	32	0	10.2
Jul-49	132.8	61.5	-58.4	3.8	79.7	53	16	0	8.1
Aug-49	109.3	133.9	25.9	29.7	109.3	0	8	0	9.2
Sep-49	52.2	90.2	41.5	71.1	52.2	0	0	0	5.8
Oct-49	35.8	67.8	28.6	99.8	35.8	0	0	0	4
Nov-49	14.2	48	31.4	100	14.2	0	0	31.2	18.3
Dec-49	10.7	84.8	-10.7	89.3	10.7	0	84.8	0	7.9
Jan-50	11.3	96.5	-11.3	79.2	10.1	1.2	181.3	0	4
Feb-50	9.5	72.1	-9.5	71.7	7.5	2	253.4	0	2
Mar-50	15.7	63.2	-15.7	60.4	11.3	4.4	316.6	0	1
Apr-50	31.1	61.7	185.8	100	31.1	0	158.3	146.3	76.7
May-50	66.9	20.1	31.4	100	66.9	0	79.2	31.4	53.5
Jun-50	98.9	64	1.5	100	98.9	0	39.6	1.5	30.2
Jul-50	112.3	116.3	18	100	112.3	0	19.8	18	28.3
Aug-50	91.9	85.1	-1.2	98.8	91.9	0	9.9	0	15.5
Sep-50	51.9	22.1	-21	78.1	51.7	0.2	0	0	6.7
Oct-50	34.3	78	39.8	100	34.3	0	0	17.9	15.7

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Nov-50	14.8	90.4	71.1	100	14.8	0	0	71.1	45.9
Dec-50	9.4	27.7	-9.4	90.6	9.4	0	27.7	0	20.7
Jan-51	9.7	60.5	-9.7	81.8	8.8	0.9	88.2	0	10.4
Feb-51	10.9	44.2	-10.9	72.9	8.9	2	132.4	0	5.2
Mar-51	20.8	97.5	138.1	100	20.8	0	66.2	110.9	62.9
Apr-51	37.2	108.7	99.1	100	37.2	0	33.1	99.1	84
May-51	72.9	36.8	-21.4	78.6	72.9	0	16.6	0	41.1
Jun-51	98.9	88.4	-6.6	73.4	97.4	1.4	8.3	0	24.1
Jul-51	120.2	90.4	-26.1	54.2	113.3	6.9	0	0	14.3
Aug-51	93.6	52.3	-43.9	30.4	73.5	20.1	0	0	7.5
Sep-51	56.3	41.7	-16.7	25.3	44.7	11.6	0	0	4.5
Oct-51	31.8	60.5	25.7	51	31.8	0	0	0	4.3
Nov-51	13.1	70.6	54	100	13.1	0	0	5	6.6
Dec-51	9.4	99.6	-9.4	90.6	9.4	0	99.6	0	1.6
Jan-52	9.5	67.3	-9.5	82	8.6	0.9	166.9	0	0.8
Feb-52	11.4	40.9	-11.4	72.7	9.3	2	207.8	0	0.4
Mar-52	19	66.5	-19	58.8	13.8	5.2	274.3	0	0.2
Apr-52	42.4	58.4	150.2	100	42.4	0	137.1	109.1	57.6
May-52	63.6	72.6	73.9	100	63.6	0	68.6	73.9	67.9
Jun-52	107.8	29	-46	54	107.8	0	34.3	0	33.6
Jul-52	134.4	68.8	-51.9	26	110.6	23.9	17.1	0	19.5
Aug-52	95.4	61	-28.9	18.5	74	21.4	8.6	0	11.1
Sep-52	62.1	60.2	3.6	22.1	62.1	0	0	0	7
Oct-52	26.4	17.3	-10	19.9	18.6	7.8	0	0	2.9
Nov-52	17.2	90.7	69	88.9	17.2	0	0	0	5.5
Dec-52	11.6	40.1	-11.6	78.6	10.3	1.3	40.1	0	0.5
Jan-53	10.6	43.2	-10.6	70.3	8.3	2.3	83.3	0	0.3
Feb-53	12.3	36.1	-12.3	61.6	8.7	3.7	119.4	0	0.1
Mar-53	22	67.1	101.5	100	22	0	59.7	63.1	35
Apr-53	35.9	62	52.9	100	35.9	0	29.8	52.9	45.4
May-53	69.8	136.1	74.4	100	69.8	0	14.9	74.4	65.1
Jun-53	103.9	69.6	-30.3	69.7	103.9	0	7.5	0	32.6
Jul-53	121.7	71.9	-46	37.7	107.8	13.9	0	0	18.2
Aug-53	100.2	102.9	-2.5	36.7	98.7	1.5	0	0	12.4
Sep-53	58	72.9	11.2	47.9	58	0	0	0	7.3
Oct-53	33	19.3	-14.7	40.9	25.4	7.6	0	0	2.8
Nov-53	18.1	41.9	21.7	62.6	18.1	0	0	0	3
Dec-53	11.3	47.5	-11.3	55.6	7.1	4.2	47.5	0	0.5
Jan-54	7.7	52.3	-7.7	51.3	4.3	3.4	99.8	0	0.2
Feb-54	12.7	59.9	-12.7	44.8	6.5	6.2	159.7	0	0.1
Mar-54	18.9	77	-18.9	36.3	8.5	10.5	236.7	0	0.1
Apr-54	38.9	91.4	166.3	100	38.9	0	118.4	102.6	55.9
May-54	62.9	19.3	14.7	100	62.9	0	59.2	14.7	34
Jun-54	109.2	116.1	30.7	100	109.2	0	29.6	30.7	37.7
Jul-54	113.7	18.3	-81.5	18.5	113.7	0	14.8	0	16.8
Aug-54	91.9	91.2	2.1	20.6	91.9	0	7.4	0	12.5
Sep-54	56.3	80.5	27.6	48.2	56.3	0	0	0	8
Oct-54	34.1	213.9	169.1	100	34.1	0	0	117.3	71.4
Nov-54	16.6	37.3	18.9	100	16.6	0	0	18.9	41.6
Dec-54	9.5	57.2	-9.5	90.5	9.5	0	57.2	0	19.9

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jan-55	8.8	37.1	-8.8	82.5	8	0.8	94.3	0	9.9
Feb-55	10.3	38.6	-10.3	74	8.5	1.8	132.9	0	5
Mar-55	19	70.6	-19	59.9	14.1	4.9	203.5	0	2.5
Apr-55	45.4	63.2	116.4	100	45.4	0	101.8	76.3	42.6
May-55	77.1	59.7	30.5	100	77.1	0	50.9	30.5	37.9
Jun-55	107.2	24.6	-58.4	41.6	107.2	0	25.4	0	18.7
Jul-55	146.6	34.8	-100.8	0	87.4	59.2	12.7	0	10.5
Aug-55	116.3	104.4	-10.8	0	105.5	10.8	6.4	0	9.6
Sep-55	57.3	30.7	-21.8	0	35.5	21.8	0	0	3.7
Oct-55	34.1	77	39.1	39.1	34.1	0	0	0	4.9
Nov-55	15	52.1	34.5	73.6	15	0	0	0	3.2
Dec-55	8.3	53.3	-8.3	67.5	6.1	2.2	53.3	0	0.3
Jan-56	8.9	42.9	-8.9	61.5	6	2.9	96.2	0	0.1
Feb-56	10.8	46.5	-10.8	54.8	6.7	4.2	142.7	0	0.1
Mar-56	17.5	76.7	-17.5	45.2	9.6	7.9	219.4	0	0
Apr-56	33.1	69.3	142.5	100	33.1	0	109.7	87.7	47.3
May-56	58.4	114	104.8	100	58.4	0	54.8	104.8	80
Jun-56	102	38.9	-37.6	62.4	102	0	27.4	0	39.1
Jul-56	108.9	108	7.4	69.8	108.9	0	13.7	0	24
Aug-56	93.6	124.7	31.7	100	93.6	0	6.9	1.5	16.3
Sep-56	48.5	40.1	-3.5	96.5	48.5	0	0	0	7
Oct-56	33	22.9	-11.3	85.6	32.6	0.4	0	0	3.7
Nov-56	16.5	27.4	9.6	95.2	16.5	0	0	0	2.6
Dec-56	10.9	66.5	-10.9	84.8	10.3	0.5	66.5	0	0.6
Jan-57	7.5	55.9	-7.5	78.5	6.3	1.1	122.4	0	0.3
Feb-57	11.2	58.2	-11.2	69.7	8.8	2.4	180.6	0	0.2
Mar-57	21.4	27.9	95.4	100	21.4	0	90.3	65.1	34
Apr-57	40.6	86.9	87.1	100	40.6	0	45.2	87.1	64.2
May-57	64.8	72.1	26.2	100	64.8	0	22.6	26.2	46.7
Jun-57	108.5	91.9	-9.9	90.1	108.5	0	11.3	0	26.1
Jul-57	121	11.4	-104.5	0	106.6	14.4	5.6	0	11.3
Aug-57	91.9	61	-28.3	0	63.6	28.3	0	0	8.4
Sep-57	57.7	96.8	34.3	34.3	57.7	0	0	0	7.5
Oct-57	29.9	44.7	12.6	46.8	29.9	0	0	0	3.6
Nov-57	16.7	46	27	73.9	16.7	0	0	0	3
Dec-57	11.6	68.8	-11.6	65.3	8.5	3	68.8	0	0.3
Jan-58	9.2	25.1	-9.2	59.3	6	3.2	93.9	0	0.2
Feb-58	8.9	36.8	-8.9	54	5.3	3.6	130.7	0	0.1
Mar-58	22.2	24.9	66.8	100	22.2	0	65.4	20.8	11.7
Apr-58	41.6	35.8	25.1	100	41.6	0	32.7	25.1	19.6
May-58	65.6	23.9	-26.6	73.4	65.6	0	16.3	0	10.1
Jun-58	89.5	26.7	-56	32.3	74.6	14.9	8.2	0	5.8
Jul-58	121.7	58.4	-58.1	13.5	82.4	39.3	0	0	5.1
Aug-58	97.8	69.1	-32.1	9.2	70	27.8	0	0	4.6
Sep-58	60.2	78.5	14.3	23.5	60.2	0	0	0	4.5
Oct-58	31.4	31.2	-1.8	23.1	30.1	1.4	0	0	1.8
Nov-58	16.7	71.1	50.9	74	16.7	0	0	0	3.7
Dec-58	7.6	25.4	-7.6	68.4	5.6	2	25.4	0	0.1
Jan-59	8.1	65.5	-8.1	62.8	5.5	2.6	90.9	0	0
Feb-59	8.9	74.2	-8.9	57.2	5.6	3.3	165.1	0	0

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Mar-59	18	59.9	-18	46.9	10.3	7.7	225	0	0
Apr-59	39.1	61	131.3	100	39.1	0	112.5	78.3	42.2
May-59	75.2	41.4	20.3	100	75.2	0	56.3	20.3	31.8
Jun-59	113.3	22.4	-63.9	36.1	113.3	0	28.1	0	16
Jul-59	130.3	27.7	-90	3.6	72.8	57.5	14.1	0	8.8
Aug-59	122.2	38.6	-78.5	0.8	46.5	75.7	7	0	5.6
Sep-59	68.6	69.3	4.2	5	68.6	0	0	0	5.3
Oct-59	31.4	79.5	44.1	49.1	31.4	0	0	0	4.9
Nov-59	14.7	56.1	38.6	87.7	14.7	0	0	0	3.3
Dec-59	10.7	80.5	-10.7	78.3	9.4	1.3	80.5	0	0.2
Jan-60	9.2	68.1	-9.2	71.1	7.2	2	148.6	0	0.1
Feb-60	10.9	64.8	-10.9	63.3	7.7	3.2	213.4	0	0.1
Mar-60	14.1	38.9	-14.1	54.4	8.9	5.2	252.3	0	0
Apr-60	40.1	64.5	147.3	100	40.1	0	126.1	101.8	54.1
May-60	72.5	116.8	101.5	100	72.5	0	63.1	101.5	82.1
Jun-60	102	55.6	-17.6	82.4	102	0	31.5	0	40.9
Jul-60	115.1	103.9	-0.7	81.8	115	0.1	15.8	0	24.2
Aug-60	99	39.6	-53.5	38.1	89.3	9.7	7.9	0	11.5
Sep-60	64.1	6.4	-50.1	19	33	31.1	0	0	5.1
Oct-60	31.8	57.9	23.2	42.2	31.8	0	0	0	5.3
Nov-60	18.2	57.2	36.2	78.3	18.2	0	0	0	4.1
Dec-60	8.4	17	-8.4	71.8	6.6	1.8	17	0	0.6
Jan-61	7.7	10.9	-7.7	66.3	5.5	2.2	27.9	0	0.3
Feb-61	11.9	59.2	-11.9	58.4	7.9	4	87.1	0	0.1
Mar-61	20.5	77	96.2	100	20.5	0	43.6	54.6	31.2
Apr-61	33.5	98.3	81.7	100	33.5	0	21.8	81.7	59.4
May-61	64.4	64	7.3	100	64.4	0	10.9	7.3	34.1
Jun-61	100.7	82.8	-16.6	83.4	100.7	0	5.4	0	19.6
Jul-61	121	80.5	-39.1	50.8	114.5	6.5	0	0	11.7
Aug-61	100.2	56.1	-46.9	27	77.1	23.1	0	0	6.7
Sep-61	71.2	42.4	-30.9	18.6	48.6	22.6	0	0	4.1
Oct-61	36.2	14.7	-22.3	14.5	18.1	18.1	0	0	1.7
Nov-61	15.8	51.6	33.3	47.7	15.8	0	0	0	3.1
Dec-61	10	46.2	-10	42.9	4.8	5.2	46.2	0	0.2
Jan-62	8	67.6	-8	39.5	3.5	4.6	113.8	0	0.1
Feb-62	8.7	86.1	-8.7	36.1	3.4	5.2	199.9	0	0.1
Mar-62	19.9	11.9	-19.9	28.9	7.2	12.7	211.8	0	0
Apr-62	38.6	34.5	100	100	38.6	0	105.9	28.9	16.2
May-62	83.6	11.7	-19.5	80.5	83.6	0	52.9	0	7.8
Jun-62	105.2	65.3	-16.7	67	101.9	3.3	26.5	0	6.9
Jul-62	111.6	90.7	-12.2	58.9	107.6	4	13.2	0	6.3
Aug-62	99.6	76.2	-20.6	46.7	91.1	8.5	6.6	0	4.7
Sep-62	52.9	131.8	78.9	100	52.9	0	0	25.7	19.9
Oct-62	32.6	98	60.5	100	32.6	0	0	60.5	41.8
Nov-62	15	96.8	77	100	15	0	0	77	61.8
Dec-62	8.8	59.9	-8.8	91.2	8.8	0	59.9	0	28.5
Jan-63	7.4	25.9	-7.4	84.4	6.8	0.7	85.8	0	14.2
Feb-63	8	13.5	-8	77.6	6.7	1.2	99.3	0	7.1
Mar-63	21.4	59.7	84.9	100	21.4	0	49.6	62.6	37.8
Apr-63	38.6	54.1	37.6	100	38.6	0	24.8	37.6	38.9

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
May-63	65.6	72.6	15.7	100	65.6	0	12.4	15.7	29.6
Jun-63	108.5	42.7	-61.7	38.3	108.5	0	6.2	0	15.1
Jul-63	123.3	73.7	-47	20.3	94.2	29	0	0	10.2
Aug-63	90.2	57.7	-35.4	13.1	62	28.2	0	0	6.1
Sep-63	51.3	48	-5.7	12.4	46.3	4.9	0	0	4
Oct-63	40	9.1	-31.4	8.5	12.5	27.5	0	0	1.3
Nov-63	19	65.5	43.2	51.7	19	0	0	0	3.7
Dec-63	7.3	42.9	-7.3	47.9	3.8	3.5	42.9	0	0.2
Jan-64	9.9	58.7	-9.9	43.2	4.7	5.1	101.6	0	0.1
Feb-64	9.8	28.7	-9.8	38.9	4.2	5.6	130.3	0	0.1
Mar-64	19.4	87.1	-19.4	31.4	7.6	11.8	217.4	0	0
Apr-64	36.1	73.9	142.8	100	36.1	0	108.7	74.2	40.8
May-64	73.4	41.4	20.3	100	73.4	0	54.3	20.3	30.8
Jun-64	92.9	38.1	-29.5	70.5	92.9	0	27.2	0	16.3
Jul-64	121	101.6	-10.9	62.8	117.8	3.2	13.6	0	12.3
Aug-64	79.2	147.6	67.8	100	79.2	0	6.8	30.6	26.3
Sep-64	51.9	14	-31.8	68.2	51.9	0	0	0	10.1
Oct-64	27.6	46.2	16.3	84.5	27.6	0	0	0	7
Nov-64	16.4	32.8	14.8	99.3	16.4	0	0	0	4
Dec-64	9.5	52.6	-9.5	89.8	9.5	0.1	52.6	0	1.2
Jan-65	8.2	70.1	-8.2	82.4	7.4	0.8	122.7	0	0.6
Feb-65	9.9	107.2	-9.9	74.2	8.2	1.7	229.9	0	0.3
Mar-65	16.4	45	-16.4	62	12.2	4.2	274.9	0	0.1
Apr-65	31.1	75.2	177.8	100	31.1	0	137.4	139.8	73.8
May-65	71.2	46.5	41.7	100	71.2	0	68.7	41.7	58.2
Jun-65	91.8	40.1	-19.3	80.7	91.8	0	34.4	0	29.9
Jul-65	95.6	63.5	-18.1	66.1	92.1	3.5	17.2	0	17.1
Aug-65	85.8	74.9	-6.1	62.1	83.8	2.1	8.6	0	10.7
Sep-65	55.2	66.5	16.5	78.6	55.2	0	0	0	6.8
Oct-65	27.1	104.6	72.3	100	27.1	0	0	50.9	32.4
Nov-65	15.3	81	61.7	100	15.3	0	0	61.7	48.5
Dec-65	11.2	63.8	-11.2	88.8	11.2	0	63.8	0	22.2
Jan-66	7.6	60.7	-7.6	82	6.8	0.9	124.5	0	11.1
Feb-66	10.3	30.5	-10.3	73.6	8.5	1.9	155	0	5.6
Mar-66	21.3	55.6	109	100	21.3	0	77.5	82.6	46.9
Apr-66	33.5	52.8	55.4	100	33.5	0	38.8	55.4	52.4
May-66	55.9	47.2	8.3	100	55.9	0	19.4	8.3	31.4
Jun-66	99.5	72.6	-20.8	79.2	99.5	0	9.7	0	18.2
Jul-66	122.5	15	-98.6	1.1	102	20.5	0	0	8
Aug-66	93	70.4	-26.2	0.8	67.2	25.9	0	0	7.2
Sep-66	51.3	55.1	1.1	1.9	51.3	0	0	0	4.6
Oct-66	28.8	24.4	-5.6	1.8	23.3	5.5	0	0	2.1
Nov-66	16.5	142.7	119.1	100	16.5	0	0	20.9	18
Dec-66	9.6	84.8	-9.6	90.4	9.6	0	84.8	0	5.5
Jan-67	10.2	55.4	-10.2	81.2	9.2	1	140.2	0	2.7
Feb-67	8.4	42.4	-8.4	74.4	6.8	1.6	182.6	0	1.4
Mar-67	17.5	21.1	-17.5	61.4	13	4.5	203.7	0	0.7
Apr-67	36.8	99.1	159.2	100	36.8	0	101.8	120.7	65.6
May-67	52.8	49	44.6	100	52.8	0	50.9	44.6	55.1
Jun-67	109.2	150.9	59.6	100	109.2	0	25.5	59.6	63.7

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jul-67	105.6	65	-31.1	68.9	105.6	0	12.7	0	31.3
Aug-67	84.8	45.7	-35	44.8	73.9	10.9	6.4	0	16.3
Sep-67	51.9	68.1	19.1	63.9	51.9	0	0	0	10.4
Oct-67	29.7	75.2	41.7	100	29.7	0	0	5.7	10.1
Nov-67	14	39.4	23.4	100	14	0	0	23.4	16.8
Dec-67	10.4	69.6	-10.4	89.6	10.4	0	69.6	0	7.4
Jan-68	7.3	82	-7.3	83	6.6	0.8	151.6	0	3.7
Feb-68	8.9	37.8	-8.9	75.6	7.4	1.5	189.4	0	1.9
Mar-68	20.8	57.4	128.5	100	20.8	0	94.7	104.1	55.8
Apr-68	40.3	30.2	35.7	100	40.3	0	47.3	35.7	45.8
May-68	56.9	101.3	63	100	56.9	0	23.7	63	58.7
Jun-68	91.2	57.9	-24.4	75.6	91.2	0	11.8	0	29.7
Jul-68	109.6	58.2	-48.4	39.1	97.8	11.8	5.9	0	16.3
Aug-68	89.1	163.6	72.2	100	89.1	0	0	11.3	20.5
Sep-68	60.2	88.1	23.5	100	60.2	0	0	23.5	22.3
Oct-68	32.2	41.1	6.8	100	32.2	0	0	6.8	14.4
Nov-68	15.2	93.2	73.3	100	15.2	0	0	73.3	47.5
Dec-68	8.7	80	-8.7	91.3	8.7	0	80	0	21.4
Jan-69	8.5	50.3	-8.5	83.6	7.7	0.7	130.3	0	10.7
Feb-69	10.4	15.7	-10.4	74.9	8.7	1.7	146	0	5.4
Mar-69	18.2	35.6	-18.2	61.2	13.7	4.6	181.6	0	2.7
Apr-69	38.4	89.9	137.8	100	38.4	0	90.8	99	55.4
May-69	62.5	75.4	54.6	100	62.5	0	45.4	54.6	56.5
Jun-69	88.4	38.9	-28.8	71.2	88.4	0	22.7	0	28.3
Jul-69	113.7	107.4	-0.3	71	113.6	0.1	11.4	0	18.5
Aug-69	102.1	56.6	-42.7	40.7	89.7	12.4	5.7	0	9.4
Sep-69	56.6	15	-36.7	25.8	34.9	21.8	0	0	4
Oct-69	28.8	49	17.7	43.5	28.8	0	0	0	4.1
Nov-69	15.9	71.1	51.7	95.2	15.9	0	0	0	4.4
Dec-69	7.9	61.2	-7.9	87.7	7.5	0.4	61.2	0	0.4
Jan-70	6.4	25.7	-6.4	82	5.6	0.8	86.9	0	0.2
Feb-70	9.5	29.7	-9.5	74.2	7.8	1.7	116.6	0	0.1
Mar-70	17.7	43.7	-17.7	61.1	13.1	4.6	160.3	0	0.1
Apr-70	37.9	81.3	119.5	100	37.9	0	80.2	80.6	44.4
May-70	65.6	56.6	28.2	100	65.6	0	40.1	28.2	37.1
Jun-70	95.3	38.1	-39	61	95.3	0	20	0	19
Jul-70	117.3	113.5	0.6	61.5	117.3	0	10	0	14.2
Aug-70	94.8	113.3	17.9	79.4	94.8	0	5	0	9.9
Sep-70	55.9	61.7	7.7	87.1	55.9	0	0	0	5.2
Oct-70	32.2	63.8	28.4	100	32.2	0	0	15.5	12
Nov-70	16.7	45	26.1	100	16.7	0	0	26.1	19.7
Dec-70	8.5	80.5	-8.5	91.5	8.5	0	80.5	0	8.7
Jan-71	7.1	29.2	-7.1	85	6.5	0.6	109.7	0	4.4
Feb-71	10.4	71.1	-10.4	76.2	8.8	1.6	180.8	0	2.2
Mar-71	16.4	33.5	-16.4	63.7	12.5	3.9	214.3	0	1.1
Apr-71	33.5	24.9	97.3	100	33.5	0	107.2	61	32.3
May-71	64	34.8	22.6	100	64	0	53.6	22.6	28.6
Jun-71	100.1	77	-0.2	99.8	100.1	0	26.8	0	17.3
Jul-71	106.2	78.5	-18.2	81.6	106.2	0	13.4	0	10.6
Aug-71	89.6	126	36.8	100	89.6	0	6.7	18.4	18.8

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Sep-71	61.4	32.5	-23.8	76.2	61.4	0	0	0	7.9
Oct-71	37.6	37.6	-1.9	74.8	37.2	0.5	0	0	5
Nov-71	15.2	35.1	18.2	92.9	15.2	0	0	0	3.3
Dec-71	10.8	92.7	-10.8	82.9	10	0.8	92.7	0	0.8
Jan-72	8.7	37.8	-8.7	75.7	7.2	1.5	130.5	0	0.4
Feb-72	8.7	59.7	-8.7	69.1	6.6	2.1	190.2	0	0.2
Mar-72	15.6	96.8	-15.6	58.3	10.8	4.8	287	0	0.1
Apr-72	30	52.8	163.7	100	30	0	143.5	122	63.7
May-72	69.8	35.3	35.4	100	69.8	0	71.8	35.4	50
Jun-72	86.8	113	56.4	100	86.8	0	35.9	56.4	58
Jul-72	111.6	34.5	-60.9	39.1	111.6	0	17.9	0	27.9
Aug-72	88	74.9	-7.9	36	83.2	4.8	9	0	16.8
Sep-72	55.9	84.1	32.9	69	55.9	0	0	0	10.7
Oct-72	25.5	98.8	68.4	100	25.5	0	0	37.4	26.9
Nov-72	13.8	72.1	54.7	100	13.8	0	0	54.7	42
Dec-72	9.7	95	-9.7	90.3	9.7	0	95	0	19.2
Jan-73	9.7	34.3	-9.7	81.6	8.8	0.9	129.3	0	9.6
Feb-73	8.9	36.3	-8.9	74.3	7.3	1.6	165.6	0	4.8
Mar-73	24.9	121.2	173.1	100	24.9	0	82.8	147.4	82.1
Apr-73	37.7	62.2	62.8	100	37.7	0	41.4	62.8	72.6
May-73	61.3	87.9	42.9	100	61.3	0	20.7	42.9	60.6
Jun-73	103.2	67.8	-28.5	71.5	103.2	0	10.4	0	31.5
Jul-73	118.8	62.5	-54.2	32.7	103.3	15.4	5.2	0	17.2
Aug-73	108.6	29.2	-75.7	7.9	57.7	50.9	0	0	8.5
Sep-73	57	53.3	-6.3	7.4	51.1	5.8	0	0	6.2
Oct-73	33.4	124.7	85	92.5	33.4	0	0	0	8
Nov-73	16.2	93	72.2	100	16.2	0	0	64.7	37.9
Dec-73	8.8	76.5	-8.8	91.2	8.8	0	76.5	0	16.6
Jan-74	8.8	66.8	-8.8	83.2	8	0.8	143.3	0	8.3
Feb-74	8.7	45.2	-8.7	75.9	7.3	1.5	188.5	0	4.2
Mar-74	19.2	56.9	-19.2	61.4	14.5	4.6	245.4	0	2.1
Apr-74	38.9	92.2	171.4	100	38.9	0	122.7	132.8	72
May-74	57.6	140	136.7	100	57.6	0	61.4	136.7	109.1
Jun-74	92.3	127.3	59.3	100	92.3	0	30.7	59.3	87
Jul-74	115.1	58.7	-44	56	115.1	0	15.3	0	43.3
Aug-74	94.8	14.5	-73.3	14.9	62.5	32.3	7.7	0	20.9
Sep-74	51	46.5	0.9	15.8	51	0	0	0	12.4
Oct-74	26.7	24.1	-3.8	15.2	23.5	3.2	0	0	6.2
Nov-74	15.7	74.7	55.3	70.5	15.7	0	0	0	6.3
Dec-74	10.8	45.5	-10.8	62.9	7.6	3.2	45.5	0	1.3
Jan-75	10.2	51.6	-10.2	56.4	6.4	3.8	97.1	0	0.6
Feb-75	11.2	72.4	-11.2	50.1	6.3	4.9	169.5	0	0.3
Mar-75	17.5	63.8	-17.5	41.3	8.7	8.7	233.3	0	0.2
Apr-75	30	69.6	152.8	100	30	0	116.6	94.2	50.6
May-75	81.6	64.3	37.9	100	81.6	0	58.3	37.9	45.7
Jun-75	101.3	62.5	-12.8	87.2	101.3	0	29.2	0	24.4
Jul-75	124.8	51.3	-61.5	33.6	116.9	7.9	14.6	0	13.2
Aug-75	96	109	14.9	48.5	96	0	7.3	0	10.8
Sep-75	48.5	65.3	20.8	69.3	48.5	0	0	0	5.9
Oct-75	30.8	54.9	21.3	90.6	30.8	0	0	0	4.1

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Nov-75	19.2	54.9	32.9	100	19.2	0	0	23.5	15.2
Dec-75	8.6	69.9	-8.6	91.4	8.6	0	69.9	0	6.2
Jan-76	6.8	52.3	-6.8	85.2	6.2	0.6	122.2	0	3.1
Feb-76	12	59.2	-12	74.9	10.3	1.8	181.4	0	1.6
Mar-76	20.6	116.3	180.5	100	20.6	0	90.7	155.5	84.3
Apr-76	40.6	72.1	73.3	100	40.6	0	45.4	73.3	79.5
May-76	60.2	114.6	71.4	100	60.2	0	22.7	71.4	79.4
Jun-76	104.5	83.3	-14.1	85.9	104.5	0	11.3	0	41
Jul-76	103.6	81.8	-20.2	68.5	100.8	2.8	5.7	0	22.5
Aug-76	88.5	64.8	-21.3	53.9	81.8	6.7	0	0	12.4
Sep-76	52.6	69.9	13.8	67.8	52.6	0	0	0	8.1
Oct-76	25.1	64.5	36.1	100	25.1	0	0	3.9	7.5
Nov-76	13.1	11.7	-2	98	13.1	0	0	0	2.7
Dec-76	7.3	36.1	-7.3	90.8	7.2	0.1	36.1	0	1.1
Jan-77	6.1	36.9	-6.1	85.3	5.6	0.6	73	0	0.5
Feb-77	9.9	26.3	-9.9	76.8	8.4	1.5	99.3	0	0.3
Mar-77	23.4	71.9	94.6	100	23.4	0	49.6	71.4	39.4
Apr-77	39.8	70.3	51.8	100	39.8	0	24.8	51.8	47.3
May-77	76.7	28.3	-37.4	62.6	76.7	0	12.4	0	23.3
Jun-77	92.9	104	12.1	74.7	92.9	0	6.2	0	16.2
Jul-77	116.6	118.5	2.2	76.9	116.6	0	0	0	11.4
Aug-77	85.3	103.3	12.8	89.8	85.3	0	0	0	7.9
Sep-77	54.9	154.2	91.6	100	54.9	0	0	81.4	49.8
Oct-77	28.3	69.4	37.7	100	28.3	0	0	37.7	43.3
Nov-77	16.6	85.9	65	100	16.6	0	0	65	56.7
Dec-77	8.8	102.3	-8.8	91.2	8.8	0	102.3	0	26.2
Jan-78	7.4	69.2	-7.4	84.4	6.8	0.7	171.5	0	13.1
Feb-78	7.8	9.1	-7.8	77.8	6.5	1.2	180.6	0	6.6
Mar-78	16	39.8	-16	65.4	12.5	3.5	220.4	0	3.3
Apr-78	32.3	63.9	138.6	100	32.3	0	110.2	104	56.8
May-78	70.7	68.2	49.2	100	70.7	0	55.1	49.2	54.8
Jun-78	92.9	25.2	-41.4	58.6	92.9	0	27.5	0	27
Jul-78	115.8	42.5	-61.7	22.4	90.3	25.6	13.8	0	15
Aug-78	94.8	63.6	-27.5	16.3	73.5	21.3	6.9	0	9.6
Sep-78	53.2	134.3	81.3	97.5	53.2	0	0	0	9.9
Oct-78	28.6	56.2	24.8	100	28.6	0	0	22.3	15.6
Nov-78	15.6	52.9	34.7	100	15.6	0	0	34.7	26.4
Dec-78	9.8	61.1	-9.8	90.2	9.8	0	61.1	0	11.9
Jan-79	7.8	69.6	-7.8	83.1	7.1	0.8	130.7	0	5.9
Feb-79	7.3	33.5	-7.3	77	6.1	1.2	164.2	0	3
Mar-79	22.5	48.1	105.3	100	22.5	0	82.1	82.3	45
Apr-79	35	88.6	90.2	100	35	0	41	90.2	70.9
May-79	63.2	99.2	51.5	100	63.2	0	20.5	51.5	63.9
Jun-79	95.8	71.8	-17.4	82.6	95.8	0	10.3	0	33.1
Jul-79	116.6	68	-46.8	43.9	108.4	8.1	5.1	0	18.1
Aug-79	88.5	74.2	-12.9	38.3	81.3	7.2	0	0	11.1
Sep-79	54.2	44.5	-11.9	33.7	46.8	7.4	0	0	5.9
Oct-79	29.2	84.2	50.8	84.5	29.2	0	0	0	6.1
Nov-79	16.3	96.5	75.4	100	16.3	0	0	59.9	35.7
Dec-79	10.9	101	-10.9	89.1	10.9	0	101	0	15.4

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jan-80	9.2	37.8	-9.2	80.9	8.2	1	138.8	0	7.7
Feb-80	8.8	16.1	-8.8	73.7	7.1	1.7	154.9	0	3.9
Mar-80	18	82.8	-18	60.4	13.3	4.7	237.7	0	1.9
Apr-80	37	111.9	188.2	100	37	0	118.8	148.6	80.9
May-80	73.4	48.7	32.3	100	73.4	0	59.4	32.3	56.2
Jun-80	84.7	89.2	29.8	100	84.7	0	29.7	29.8	46.2
Jul-80	115.8	182.3	72.2	100	115.8	0	14.9	72.2	66.1
Aug-80	104.7	37.3	-61.8	38.2	104.7	0	7.4	0	30.4
Sep-80	54.6	53.1	3.3	41.5	54.6	0	0	0	16.9
Oct-80	26.6	88.7	57.7	99.2	26.6	0	0	0	11.6
Nov-80	14.7	35.3	18.8	100	14.7	0	0	18	14.3
Dec-80	7.8	64.7	-7.8	92.2	7.8	0	64.7	0	6.3
Jan-81	6.7	11.9	-6.7	86	6.2	0.5	76.6	0	3.1
Feb-81	12.6	66.2	-12.6	75.2	10.8	1.8	142.8	0	1.6
Mar-81	20.4	17.8	-3.5	72.6	19.5	0.9	142.8	0	1.7
Apr-81	40.3	49.7	78.3	100	40.3	0	71.4	50.9	28.3
May-81	64.8	58.1	26.1	100	64.8	0	35.7	26.1	28.8
Jun-81	96.4	61.5	-20.2	79.8	96.4	0	17.8	0	16
Jul-81	117.3	66.6	-45.1	43.8	108.2	9.1	8.9	0	9.8
Aug-81	93	128.5	38	81.8	93	0	0	0	9.7
Sep-81	52.2	103.3	45.9	100	52.2	0	0	27.7	20.6
Oct-81	25.8	134.9	102.4	100	25.8	0	0	102.4	65.7
Nov-81	16	57.8	38.9	100	16	0	0	38.9	51.8
Dec-81	9.8	34	-9.8	90.2	9.8	0	34	0	24.5
Jan-82	6.8	54.3	-6.8	84.1	6.1	0.7	88.3	0	12.2
Feb-82	8.9	28.3	-8.9	76.6	7.5	1.4	116.6	0	6.1
Mar-82	18	64.8	-18	62.8	13.8	4.2	181.4	0	3.1
Apr-82	33.7	43.1	97.9	100	33.7	0	90.7	60.8	34.1
May-82	75.7	45.1	12.5	100	75.7	0	45.3	12.5	24.5
Jun-82	84.7	112.5	44.9	100	84.7	0	22.7	44.9	39.2
Jul-82	119.5	31.1	-78.6	21.4	119.5	0	11.3	0	18.3
Aug-82	81.7	120.1	38.1	59.5	81.7	0	5.7	0	14.4
Sep-82	53.9	128.9	74.2	100	53.9	0	0	33.7	27.5
Oct-82	31.4	43.5	9.9	100	31.4	0	0	9.9	17.6
Nov-82	16.5	94.8	73.6	100	16.5	0	0	73.6	49.3
Dec-82	12.2	80.9	64.6	100	12.2	0	0	64.6	58.6
Jan-83	9.8	33.7	-9.8	90.2	9.8	0	33.7	0	27.3
Feb-83	11.8	40.6	-11.8	79.5	10.7	1.2	74.3	0	13.6
Mar-83	21.2	77.3	89.4	100	21.2	0	37.2	69	45.2
Apr-83	35.4	83.2	62.2	100	35.4	0	18.6	62.2	55.9
May-83	58.4	99.5	45.5	100	58.4	0	9.3	45.5	53.6
Jun-83	102.6	33	-62	38	102.6	0	0	0	26
Jul-83	130.3	18.3	-112.9	0	55.4	74.9	0	0	13.1
Aug-83	103.4	112.2	3.2	3.2	103.4	0	0	0	11.7
Sep-83	60.6	54.9	-8.5	2.9	52.4	8.2	0	0	5.8
Oct-83	29.9	71.8	38.3	41.2	29.9	0	0	0	5.1
Nov-83	15.9	89.1	68.8	100	15.9	0	0	10	10.2
Dec-83	7.9	82	-7.9	92.1	7.9	0	82	0	2.9
Jan-84	6.9	30.2	-6.9	85.7	6.4	0.5	112.2	0	1.4
Feb-84	13.1	59	-13.1	74.6	11.2	1.9	171.2	0	0.7

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Mar-84	15.3	59.5	-15.3	63.1	11.4	3.9	230.7	0	0.4
Apr-84	39.4	58.7	131.8	100	39.4	0	115.4	94.9	50.6
May-84	59.1	102.8	96.3	100	59.1	0	57.7	96.3	77.1
Jun-84	102	48.1	-27.4	72.6	102	0	28.8	0	38.4
Jul-84	111.6	63.3	-37.1	45.7	101.4	10.2	14.4	0	21.2
Aug-84	103.4	63.8	-35.6	29.4	84.1	19.3	7.2	0	12.2
Sep-84	51	74.7	27.2	56.6	51	0	0	0	8.2
Oct-84	32.6	26.1	-7.8	52.2	29.2	3.4	0	0	3.6
Nov-84	15.3	69.9	51.1	100	15.3	0	0	3.3	6.3
Dec-84	11.6	61.3	-11.6	88.4	11.6	0	61.3	0	1.4
Jan-85	7.5	76.6	-7.5	81.8	6.6	0.9	137.9	0	0.7
Feb-85	10	83.1	-10	73.6	8.2	1.8	221	0	0.3
Mar-85	20.8	78.6	164.4	100	20.8	0	110.5	138	73.1
Apr-85	39.6	33.1	47.1	100	39.6	0	55.2	47.1	59.8
May-85	70.3	75.9	29.4	100	70.3	0	27.6	29.4	47.6
Jun-85	87.3	37.3	-38.1	61.9	87.3	0	13.8	0	23.8
Jul-85	110.2	91.5	-16.4	51.8	104	6.3	6.9	0	15.5
Aug-85	93	152.5	58.7	100	93	0	0	10.5	18.3
Sep-85	61.8	57.6	-7	93	61.8	0	0	0	8.2
Oct-85	30.8	52.3	18.8	100	30.8	0	0	11.8	11.2
Nov-85	16	161.8	137.7	100	16	0	0	137.7	81.3
Dec-85	8.8	35.9	-8.8	91.2	8.8	0	35.9	0	36.6
Jan-86	8.9	26.5	-8.9	83.1	8.2	0.8	62.4	0	18.3
Feb-86	9.8	32	-9.8	74.9	8.1	1.7	94.4	0	9.1
Mar-86	21.2	48.8	72.4	100	21.2	0	47.2	47.3	30.7
Apr-86	40.3	54	34.6	100	40.3	0	23.6	34.6	34.1
May-86	75.7	75.2	7.5	100	75.7	0	11.8	7.5	23.2
Jun-86	91.2	67.4	-21.3	78.7	91.2	0	5.9	0	13.1
Jul-86	120.2	122.3	1.8	80.6	120.2	0	0	0	11
Aug-86	87.5	146.2	51.4	100	87.5	0	0	32	25.7
Sep-86	53.6	212.3	148.1	100	53.6	0	0	148.1	93.9
Oct-86	29.5	54.8	22.5	100	29.5	0	0	22.5	55.6
Nov-86	14.3	44.4	27.9	100	14.3	0	0	27.9	42.6
Dec-86	10.9	67.3	-10.9	89.1	10.9	0	67.3	0	20.2
Jan-87	9.5	56.6	-9.5	80.7	8.5	1	123.9	0	10.1
Feb-87	10	14.8	-10	72.6	8.1	1.9	138.7	0	5.1
Mar-87	22.8	44.2	88.5	100	22.8	0	69.4	61.1	35.3
Apr-87	43.5	49.8	38.5	100	43.5	0	34.7	38.5	38.3
May-87	77.6	29.6	-32.2	67.8	77.6	0	17.3	0	19.4
Jun-87	111.2	68.3	-37.7	42.3	99.1	12.1	8.7	0	12.4
Jul-87	132	108.1	-20.6	33.6	120.1	11.9	0	0	9.9
Aug-87	94.2	52.3	-44.5	18.6	64.6	29.6	0	0	4.9
Sep-87	56.3	108	46.3	65	56.3	0	0	0	6.5
Oct-87	26.6	48.1	19.1	84.1	26.6	0	0	0	3
Nov-87	16	83.4	63.3	100	16	0	0	47.3	28.1
Dec-87	11.5	47.4	-11.5	88.5	11.5	0	47.4	0	12
Jan-88	9.6	21.5	-9.6	80	8.5	1.1	68.9	0	6
Feb-88	9.4	64.6	-9.4	72.5	7.5	1.9	133.5	0	3
Mar-88	19.4	23.6	-19.4	58.5	14.1	5.3	157.1	0	1.5
Apr-88	36.3	55.2	94.7	100	36.3	0	78.6	53.1	30.1

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
May-88	73.9	39.6	3	100	73.9	0	39.3	3	17.2
Jun-88	98.9	25	-55.5	44.5	98.9	0	19.6	0	8.8
Jul-88	135.3	109.7	-21.2	35.1	123.5	11.8	9.8	0	9.3
Aug-88	105.3	37.2	-60.2	14	66.3	39.1	0	0	3.8
Sep-88	56.3	70.6	10.8	24.8	56.3	0	0	0	4.5
Oct-88	26.9	67.4	37.1	61.9	26.9	0	0	0	3.8
Nov-88	17.1	58.1	38.1	100	17.1	0	0	0	3.1
Dec-88	9.8	31.5	-9.8	90.2	9.8	0	31.5	0	0.1
Jan-89	11	25.9	-11	80.2	9.9	1.1	57.4	0	0.1
Feb-89	9.6	19	-9.6	72.5	7.7	1.9	76.4	0	0
Mar-89	17.9	37.1	-17.9	59.6	13	4.9	113.5	0	0
Apr-89	34.5	41.1	61.2	100	34.5	0	56.8	20.8	12.5
May-89	69.8	79.2	33.8	100	69.8	0	28.4	33.8	26
Jun-89	103.2	94.7	0.9	100	103.2	0	14.2	0.9	16.2
Jul-89	124	70.4	-50.1	49.9	124	0	7.1	0	9.3
Aug-89	94.8	39.6	-50.1	24.9	69.7	25.1	0	0	4.9
Sep-89	57	44.1	-15.1	21.2	45.7	11.3	0	0	3.6
Oct-89	31.6	76.2	40.8	61.9	31.6	0	0	0	4.5
Nov-89	14.5	78.5	60	100	14.5	0	0	22	15.3
Dec-89	6.3	23.8	-6.3	93.7	6.3	0	23.8	0	5.7
Jan-90	12	36.7	-12	82.5	11.3	0.8	60.5	0	2.8
Feb-90	11.5	76.9	-11.5	73	9.5	2	137.4	0	1.4
Mar-90	21.3	28.7	74.7	100	21.3	0	68.7	47.6	26
Apr-90	42.1	53	42.6	100	42.1	0	34.4	42.6	36.2
May-90	64	86.6	35.4	100	64	0	17.2	35.4	38.8
Jun-90	105.2	69.4	-30.7	69.3	105.2	0	8.6	0	20.7
Jul-90	119.5	68.4	-45.9	37.5	105.4	14.1	0	0	12
Aug-90	98.4	112.6	8.6	46.1	98.4	0	0	0	9.9
Sep-90	55.6	42.8	-14.9	39.2	47.5	8	0	0	4.3
Oct-90	31	87.8	52.4	91.6	31	0	0	0	5.5
Nov-90	17.2	39.6	20.4	100	17.2	0	0	12	8.5
Dec-90	11	112.8	-11	89	11	0	112.8	0	3.3
Jan-91	8.9	33.6	-8.9	81.1	7.9	1	146.4	0	1.6
Feb-91	12.3	23.5	-12.3	71.1	10	2.3	169.9	0	0.8
Mar-91	22.5	98.1	155.6	100	22.5	0	85	126.7	68.7
Apr-91	43.2	115.4	108.9	100	43.2	0	42.5	108.9	92.1
May-91	85.7	83.6	15	100	85.7	0	21.2	15	54.8
Jun-91	114	24.4	-80.2	19.8	114	0	10.6	0	26.5
Jul-91	125.6	91	-33.8	13.1	98.4	27.1	5.3	0	17.2
Aug-91	103.4	91.4	-11.2	11.6	93.6	9.8	0	0	10.9
Sep-91	54.2	52.1	-4.7	11.1	50	4.2	0	0	5.8
Oct-91	32.8	46.3	11.2	22.2	32.8	0	0	0	3.9
Nov-91	15	56.3	38.5	60.7	15	0	0	0	3.6
Dec-91	10.1	44.7	-10.1	54.6	6.1	4	44.7	0	0.4
Jan-92	9.7	37.2	-9.7	49.3	5.3	4.4	81.9	0	0.2
Feb-92	11.2	35	-11.2	43.7	5.5	5.7	116.9	0	0.1
Mar-92	19	21.7	-19	35.4	8.3	10.7	138.6	0	0
Apr-92	35.6	133.8	160.8	100	35.6	0	69.3	96.2	54.8
May-92	66.9	69.7	34	100	66.9	0	34.6	34	44.5
Jun-92	91.2	37.2	-38.5	61.5	91.2	0	17.3	0	22.4

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jul-92	99.8	134.5	36.6	98.1	99.8	0	8.7	0	17
Aug-92	84.8	154.4	70.6	100	84.8	0	0	68.6	47.2
Sep-92	53.6	98.4	39.9	100	53.6	0	0	39.9	44.6
Oct-92	27.2	66	35.5	100	27.2	0	0	35.5	40.9
Nov-92	15.4	107.2	86.5	100	15.4	0	0	86.5	67.4
Dec-92	10.6	56.3	-10.6	89.4	10.6	0	56.3	0	31
Jan-93	9.9	70.6	-9.9	80.6	8.8	1	126.9	0	15.5
Feb-93	8.5	26.6	-8.5	73.7	6.9	1.7	153.5	0	7.8
Mar-93	18	31	-18	60.4	13.3	4.7	184.5	0	3.9
Apr-93	37.9	85.4	135.5	100	37.9	0	92.2	95.9	54.2
May-93	66.1	51.6	29.1	100	66.1	0	46.1	29.1	42.1
Jun-93	95.3	133.8	54.9	100	95.3	0	23.1	54.9	53.9
Jul-93	125.6	87.7	-30.7	69.3	125.6	0	11.5	0	28
Aug-93	103.4	39.9	-59.7	27.9	85	18.3	5.8	0	13.8
Sep-93	50	59.2	12	39.9	50	0	0	0	8.9
Oct-93	28.1	71	39.3	79.2	28.1	0	0	0	6.5
Nov-93	15.7	65.2	46.3	100	15.7	0	0	25.5	17.5
Dec-93	9.9	28.8	-9.9	90.1	9.9	0	28.8	0	7.1
Jan-94	5.9	61	-5.9	84.8	5.3	0.6	89.8	0	3.6
Feb-94	8.6	20.2	-8.6	77.6	7.3	1.3	110	0	1.8
Mar-94	19.4	51.2	-19.4	62.5	15	4.4	161.2	0	0.9
Apr-94	39.6	96	132.2	100	39.6	0	80.6	94.7	52.6
May-94	64.8	78.8	50.3	100	64.8	0	40.3	50.3	53
Jun-94	107.8	54.4	-36	64	107.8	0	20.2	0	27.3
Jul-94	124	83	-35.1	41.5	111.4	12.6	10.1	0	16.4
Aug-94	89.1	60.1	-27	30.3	73.3	15.8	5	0	9.1
Sep-94	57.7	51.4	-3.8	29.2	55	2.7	0	0	5.6
Oct-94	32	27.4	-6	27.4	27.8	4.2	0	0	2.9
Nov-94	18.1	84.9	62.6	90	18.1	0	0	0	5
Dec-94	11.6	51.4	-11.6	79.6	10.5	1.2	51.4	0	0.4
Jan-95	10.4	133.3	-10.4	71.3	8.3	2.1	184.7	0	0.2
Feb-95	9.1	20.8	-9.1	64.8	6.5	2.6	205.5	0	0.1
Mar-95	22.9	50.8	128.1	100	22.9	0	102.8	92.8	49
Apr-95	32.5	76.6	91.7	100	32.5	0	51.4	91.7	72.9
May-95	71.2	87	37.2	100	71.2	0	25.7	37.2	57.5
Jun-95	113.3	52.1	-51	49	113.3	0	12.8	0	29.2
Jul-95	127.1	55.4	-68.1	15.6	92.4	34.7	6.4	0	16.1
Aug-95	108	135.4	27.1	42.7	108	0	0	0	13.4
Sep-95	51.3	27.5	-25.2	32	36.9	14.4	0	0	4.7
Oct-95	34.1	131.8	91.2	100	34.1	0	0	23.1	19.8
Nov-95	13.8	121.6	101.8	100	13.8	0	0	101.8	63.6
Dec-95	8.5	35.8	-8.5	91.5	8.5	0	35.8	0	28.7
Jan-96	8.3	72.6	-8.3	83.8	7.6	0.7	108.4	0	14.4
Feb-96	10	38.2	-10	75.5	8.4	1.6	146.6	0	7.2
Mar-96	17.1	36.2	-17.1	62.5	12.9	4.2	182.8	0	3.6
Apr-96	33.1	101.6	154.8	100	33.1	0	91.4	117.4	65.6
May-96	64	90.6	67.7	100	64	0	45.7	67.7	68.6
Jun-96	104.5	118	30.4	100	104.5	0	22.8	30.4	53.2
Jul-96	110.2	97.4	-6.3	93.7	110.2	0	11.4	0	28.5
Aug-96	100.9	48.2	-49.4	47.5	97.8	3.1	5.7	0	14.2

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Sep-96	59.9	166.2	103.7	100	59.9	0	0	51.2	39.8
Oct-96	30.5	75.8	41.5	100	30.5	0	0	41.5	40.3
Nov-96	13.7	29.8	14.6	100	13.7	0	0	14.6	27.1
Dec-96	11.4	95.2	-11.4	88.6	11.4	0	95.2	0	12.8
Jan-97	8.5	64.6	-8.5	81.1	7.5	1	159.8	0	6.4
Feb-97	11.7	78.6	-11.7	71.5	9.5	2.2	238.4	0	3.2
Mar-97	18.7	69.8	-18.7	58.2	13.4	5.3	308.2	0	1.6
Apr-97	36.1	29.2	145.8	100	36.1	0	154.1	103.9	54.2
May-97	56.6	65.4	82.6	100	56.6	0	77	82.6	71
Jun-97	112.6	50.8	-25.8	74.2	112.6	0	38.5	0	36.4
Jul-97	119.5	30	-71.7	21	101	18.5	19.3	0	18.4
Aug-97	90.8	71.8	-12.9	18.3	80.6	10.2	9.6	0	12.1
Sep-97	56.3	48	-1	18.1	55.4	0.9	0	0	6.6
Oct-97	31	35.2	2.4	20.5	31	0	0	0	3.9
Nov-97	15.1	55	37.2	57.6	15.1	0	0	0	3.8
Dec-97	11.1	30.2	-11.1	51.3	6.4	4.7	30.2	0	0.5
Jan-98	11	97.2	-11	45.6	5.7	5.4	127.4	0	0.3
Feb-98	14.1	45.8	-14.1	39.2	6.4	7.6	173.2	0	0.1
Mar-98	23.2	98.4	156.9	100	23.2	0	86.6	96	53
Apr-98	42.9	57.2	54.7	100	42.9	0	43.3	54.7	54.3
May-98	89.5	71.8	0.4	100	89.5	0	21.6	0.4	29.5
Jun-98	106.5	80.5	-19.2	80.8	106.5	0	10.8	0	17
Jul-98	121.7	45.4	-73.2	21.7	107.7	14.1	5.4	0	8.7
Aug-98	107.3	26.8	-76.4	5.1	47.4	59.9	0	0	4.6
Sep-98	66.5	38.4	-30	3.6	38	28.5	0	0	3.5
Oct-98	33.6	24	-10.8	3.2	23.2	10.5	0	0	2
Nov-98	17.5	33.6	14.4	17.6	17.5	0	0	0	2.1
Dec-98	12.2	63	47.6	65.2	12.2	0	0	0	3.4
Jan-99	8.6	107	-8.6	59.6	5.6	3	107	0	0.1
Feb-99	13	27.4	-13	51.9	7.7	5.2	134.4	0	0.1
Mar-99	20.6	23.4	68.8	100	20.6	0	67.2	20.7	11.5
Apr-99	41.6	48.9	38.4	100	41.6	0	33.6	38.4	26.8
May-99	81.6	39	-27.7	72.3	81.6	0	16.8	0	14.2
Jun-99	116.9	66.2	-45.6	39.3	104.2	12.6	8.4	0	9.4
Jul-99	147.5	44.4	-97	1.2	88.7	58.8	0	0	5.3
Aug-99	98.4	59	-42.3	0.7	56.6	41.8	0	0	4.5
Sep-99	65.7	80	10.3	11	65.7	0	0	0	4.8
Oct-99	30.8	61.8	27.9	38.8	30.8	0	0	0	3.5
Nov-99	18.5	78.2	55.8	94.6	18.5	0	0	0	4.1
Dec-99	11.2	26.5	-11.2	84	10.6	0.6	26.5	0	0.1
Jan-00	8.8	29.2	-8.8	76.6	7.4	1.4	55.7	0	0
Feb-00	11.8	48.4	-11.8	67.5	9.1	2.8	104.1	0	0
Mar-00	26.9	18.8	43	100	26.9	0	52	10.5	6.2
Apr-00	38.2	79.3	63.2	100	38.2	0	26	63.2	38.2
May-00	75.7	124.4	55.5	100	75.7	0	13	55.5	51.1
Jun-00	102	169.2	65.3	100	102	0	6.5	65.3	63.5
Jul-00	113.7	33.8	-75.1	24.9	113.7	0	0	0	29.2
Aug-00	100.2	38	-64.1	8.9	52.1	48.2	0	0	15.7
Sep-00	57.7	70	8.8	17.7	57.7	0	0	0	10.4
Oct-00	34.5	17.6	-17.8	14.6	19.9	14.6	0	0	4.3

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Nov-00	16.2	55.6	36.7	51.3	16.2	0	0	0	4.5
Dec-00	7.5	71.4	-7.5	47.4	3.8	3.6	71.4	0	0.9
Jan-01	9.8	31.2	-9.8	42.8	4.7	5.2	102.6	0	0.4
Feb-01	11.9	94	-11.9	37.7	5.1	6.8	196.6	0	0.2
Mar-01	20	31.4	-20	30.1	7.5	12.5	228	0	0.1
Apr-01	42.1	36.4	106.5	100	42.1	0	114	36.6	20.2
May-01	78.1	92.2	66.5	100	78.1	0	57	66.5	47
Jun-01	111.9	61.8	-24.7	75.3	111.9	0	28.5	0	24.3
Jul-01	120.2	34	-73.7	19.8	102	18.2	14.3	0	12.3
Aug-01	117.8	34.6	-77.8	4.4	55.4	62.4	7.1	0	7
Sep-01	60.6	50.4	-5.6	4.2	55.3	5.4	0	0	5.2
Oct-01	33.2	108.8	70.1	74.3	33.2	0	0	0	6.8
Nov-01	20.1	75	51.2	100	20.1	0	0	25.5	17.1
Dec-01	13	40.6	25.6	100	13	0	0	25.6	21.5
Jan-02	12.3	46.2	-12.3	87.7	12.3	0	46.2	0	9.7
Feb-02	13.2	38.4	-13.2	76.1	11.6	1.6	84.6	0	4.9
Mar-02	20.9	61.3	79.6	100	20.9	0	42.3	55.8	33.4
Apr-02	39.6	103.2	79.6	100	39.6	0	21.2	79.6	60.1
May-02	61.3	80.7	25.9	100	61.3	0	10.6	25.9	44.5
Jun-02	107.8	59.6	-45.9	54.1	107.8	0	5.3	0	23.2
Jul-02	146.6	59	-85.3	8	107.5	39.2	0	0	13.1
Aug-02	113.5	11.6	-102.4	0	19	94.5	0	0	5.6
Sep-02	75.3	59.2	-19.1	0	56.2	19.1	0	0	5.5
Oct-02	29.9	43	10.9	10.9	29.9	0	0	0	3.4
Nov-02	15.8	67.2	48.1	59	15.8	0	0	0	4
Dec-02	10.3	32.5	-10.3	52.9	6.1	4.2	32.5	0	0.3
Jan-03	7.6	35.4	-7.6	48.9	4	3.6	67.9	0	0.2
Feb-03	9.3	46.8	-9.3	44.4	4.5	4.7	114.7	0	0.1
Mar-03	19.5	50	-19.5	35.7	8.7	10.9	164.7	0	0
Apr-03	35.9	60.8	104.3	100	35.9	0	82.4	40	23
May-03	66.9	152.8	119.5	100	66.9	0	41.2	119.5	77.4
Jun-03	102.6	63.8	-21.4	78.6	102.6	0	20.6	0	38.1
Jul-03	126.4	66.2	-53.2	36.8	115	11.4	10.3	0	20.7
Aug-03	110	53.4	-54.1	16.9	75.8	34.2	5.1	0	11.4
Sep-03	61.8	114.2	51.9	68.8	61.8	0	0	0	10.1
Oct-03	30.3	49.4	16.7	85.4	30.3	0	0	0	4.6
Nov-03	17.3	141.2	116.8	100	17.3	0	0	102.3	59.3
Dec-03	11.6	61.6	-11.6	88.4	11.6	0	61.6	0	26.1
Jan-04	7.1	49.6	-7.1	82.1	6.2	0.8	111.2	0	13.1
Feb-04	11.3	20.8	-11.3	72.8	9.3	2	132	0	6.5
Mar-04	23.5	63.4	102.7	100	23.5	0	66	75.6	44.2
Apr-04	38.9	64.2	55.1	100	38.9	0	33	55.1	51.3
May-04	70.7	98.8	39.6	100	70.7	0	16.5	39.6	48.8
Jun-04	98.3	62.8	-30.3	69.7	98.3	0	8.2	0	25.1
Jul-04	118	119.8	4	73.7	118	0	0	0	17
Aug-04	93.6	60	-36.6	46.7	84	9.6	0	0	8.5
Sep-04	67.4	25.2	-43.4	26.4	44.2	23.1	0	0	4
Oct-04	33.4	35.2	0	26.4	33.4	0	0	0	3.1
Nov-04	18.1	64.8	43.5	69.9	18.1	0	0	0	3.9
Dec-04	9.8	90.4	-9.8	63.1	6.9	3	90.4	0	0.3

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Jan-05	8.3	70.4	-8.3	57.8	5.2	3.1	160.8	0	0.2
Feb-05	11.2	75.6	-11.2	51.4	6.5	4.7	236.4	0	0.1
Mar-05	18.5	32.8	-18.5	41.9	9.5	9	269.2	0	0
Apr-05	40.8	97.6	186.5	100	40.8	0	134.6	128.4	69.1
May-05	65.2	14.4	15.7	100	65.2	0	67.3	15.7	40.7
Jun-05	134	31.8	-70.1	29.9	134	0	33.6	0	21.6
Jul-05	145.7	20.4	-109.5	0	66.1	79.6	16.8	0	11
Aug-05	112.8	135.6	24.5	24.5	112.8	0	8.4	0	11.8
Sep-05	69.9	79.6	14.1	38.6	69.9	0	0	0	6.5
Oct-05	34.3	47.4	10.8	49.4	34.3	0	0	0	3.6
Nov-05	17.7	102.2	79.4	100	17.7	0	0	28.7	20.1
Dec-05	9.4	58.9	-9.4	90.6	9.4	0	58.9	0	7.5
Jan-06	12.8	74.6	87.5	100	12.8	0	29.4	78.1	46.5
Feb-06	11.5	74.8	-11.5	88.5	11.5	0	104.2	0	21.4
Mar-06	22.1	48.8	76.4	100	22.1	0	52.1	64.9	45.6
Apr-06	41.9	62.4	43.5	100	41.9	0	26.1	43.5	46.4
May-06	76.2	82	14.8	100	76.2	0	13	14.8	33.1
Jun-06	112.6	45.4	-63	37	112.6	0	6.5	0	16.8
Jul-06	139.5	105.2	-33.1	24.8	118.7	20.8	0	0	12.5
Aug-06	103.4	40.2	-65.2	8.6	54.4	49	0	0	5.6
Sep-06	57	77.6	16.7	25.4	57	0	0	0	5.7
Oct-06	29.5	120.6	85	100	29.5	0	0	10.4	12.1
Nov-06	18	71.7	50.2	100	18	0	0	50.2	31.7
Dec-06	13.2	62.4	46.1	100	13.2	0	0	46.1	40.2
Jan-07	10.6	38.6	-10.6	89.4	10.6	0	38.6	0	18.6
Feb-07	8.5	24.6	-8.5	81.8	7.6	0.9	63.2	0	9.3
Mar-07	20.9	33.4	42.4	100	20.9	0	31.6	24.3	18.4
Apr-07	36.8	60.8	36.8	100	36.8	0	15.8	36.8	29.8
May-07	75.7	73.6	2.1	100	75.7	0	7.9	2.1	18.1
Jun-07	119.8	43.2	-70.9	29.1	119.8	0	0	0	9.4
Jul-07	122.5	47.4	-77.5	6.6	67.6	54.9	0	0	6
Aug-07	112.1	20.8	-92.3	0.5	25.8	86.2	0	0	2.8
Sep-07	67.4	28.6	-40.2	0.3	27.4	40	0	0	2.3
Oct-07	41.5	41.2	-2.4	0.3	39.1	2.4	0	0	2.5
Nov-07	15.2	87.8	68.2	68.5	15.2	0	0	0	4.6
Dec-07	10.1	92.7	-10.1	61.6	6.9	3.2	92.7	0	0.1
Jan-08	11.1	58.2	-11.1	54.7	6.8	4.3	150.9	0	0.1
Feb-08	10.3	107.6	-10.3	49.1	5.6	4.7	258.5	0	0
Mar-08	18.3	61.6	-18.3	40.1	9	9.3	320.1	0	0
Apr-08	45.4	54.6	166.5	100	45.4	0	160	106.6	56
May-08	64.8	68.8	80.5	100	64.8	0	80	80.5	70.4
Jun-08	111.2	110.4	33.7	100	111.2	0	40	33.7	55.8
Jul-08	124	193.2	79.5	100	124	0	20	79.5	74.6
Aug-08	94.8	92.6	3.2	100	94.8	0	10	3.2	38.7
Sep-08	61.4	83.4	22.9	100	61.4	0	5	22.9	32.6
Oct-08	30.1	39.6	12.5	100	30.1	0	0	12.5	22.5
Nov-08	15.5	79.8	60.3	100	15.5	0	0	60.3	44.4
Dec-08	9.7	99.8	-9.7	90.3	9.7	0	99.8	0	20.2
Jan-09	7.3	44.4	-7.3	83.7	6.6	0.7	144.2	0	10.1
Feb-09	11.4	73.6	-11.4	74.2	9.5	1.9	217.8	0	5.1

				Soil			snow		
Date	PET	P	P-PET	Moisture	AET	PET-AET	Storage	Surplus	ROtotal
Mar-09	21.4	68.8	152.8	100	21.4	0	108.9	127	69.5
Apr-09	40.8	133.6	140.5	100	40.8	0	54.4	140.5	110
May-09	70.3	60.8	14.7	100	70.3	0	27.2	14.7	62
Jun-09	97.6	70.2	-17.3	82.7	97.6	0	13.6	0	33
Jul-09	107.5	84.8	-20.2	66	104	3.5	6.8	0	19
Aug-09	100.2	144	43.4	100	100.2	0	0	9.4	19.3
Sep-09	61.4	40.2	-23.2	76.8	61.4	0	0	0	8
Oct-09	29.5	71	37.9	100	29.5	0	0	14.7	13.9
Nov-09	18.8	32.2	11.8	100	18.8	0	0	11.8	12.7
Dec-09	10.1	80.4	-10.1	89.9	10.1	0	80.4	0	5.6
Jan-10	9.2	24.4	-9.2	81.7	8.2	0.9	104.8	0	2.8
Feb-10	11.6	24.8	-11.6	72.2	9.5	2.1	129.6	0	1.4
Mar-10	26.8	62.6	97.5	100	26.8	0	64.8	69.7	38.7
Apr-10	48.3	36.2	18.5	100	48.3	0	32.4	18.5	28.8
May-10	84.1	51	-19.5	80.5	84.1	0	16.2	0	16.1
Jun-10	108.5	191.6	81.6	100	108.5	0	8.1	62.1	47.4
Jul-10	138.7	89.6	-45.4	54.6	138.7	0	0	0	23.4
Aug-10	112.1	58.6	-56.4	23.8	86.4	25.6	0	0	12.4
Sep-10	59.5	88.2	24.3	48.1	59.5	0	0	0	9.1
Oct-10	32.4	57.2	21.9	70	32.4	0	0	0	5.2
Nov-10	17.1	66.2	45.8	100	17.1	0	0	15.8	12.4
Dec-10	9.2	36.8	-9.2	90.8	9.2	0	36.8	0	4.5
Jan-11	8.2	42	-8.2	83.3	7.4	0.8	78.8	0	2.3
Feb-11	10.2	47	-10.2	74.8	8.5	1.7	125.8	0	1.1
Mar-11	19.8	91.4	-19.8	60	14.8	5	217.2	0	0.6
Apr-11	38.6	96.6	161.7	100	38.6	0	108.6	121.7	66
May-11	74.8	142	114.4	100	74.8	0	54.3	114.4	94.9
Jun-11	107.8	59	-24.6	75.4	107.8	0	27.2	0	46.8
Jul-11	148.5	32.4	-104.1	0	119.7	28.7	13.6	0	23.6
Aug-11	108.6	72.2	-33.3	0	75.4	33.3	6.8	0	14.6
Sep-11	64.5	85	23	23	64.5	0	0	0	9.7
Oct-11	33	119.2	80.2	100	33	0	0	3.3	10.3
Nov-11	19.5	98	73.6	100	19.5	0	0	73.6	43.9
Dec-11	12.3	52	37.1	100	12.3	0	0	37.1	40.7
Jan-12	11.4	54.2	-11.4	88.6	11.4	0	54.2	0	19
Feb-12	14.1	26.6	-14.1	76.2	12.5	1.6	80.8	0	9.5
Mar-12	30.9	18	26.6	100	30.9	0	40.4	2.8	7
Apr-12	39.6	43.6	22	100	39.6	0	20.2	22	16.3
May-12	87.3	44.4	-35	65	87.3	0	10.1	0	9.3
Jun-12	118.3	76.4	-40.7	38.5	104.1	14.3	5.1	0	7.3
Jul-12	147.5	100	-47.5	20.2	118.3	29.2	0	0	6.8
Aug-12	106.6	52.4	-56.9	8.7	61.3	45.4	0	0	3.5
Sep-12	59.5	121	55.4	64.2	59.5	0	0	0	6.5
Oct-12	32.4	126.4	87.7	100	32.4	0	0	51.8	32.5
Nov-12	16.1	10.2	-6.4	93.6	16.1	0	0	0	13.6
Dec-12	12.3	58.4	43.2	100	12.3	0	0	36.8	27.9

Appendix I

Groundwater Contaminants of Concern

DISCUSSION NORTH

TRUE NORTH

RAINBOW CREEK

HIGHWAY 50

MW-35	
SAMPLE DATE	Mo
2019 06 24	73.2

MW-02	
SAMPLE DATE	Mo
2019 06 24	7.0

MW-22	
SAMPLE DATE	Mo
2019 06 25	15.7

MW-03	
SAMPLE DATE	Mo
2019 06 25	14.9

MW-33	
SAMPLE DATE	Mo
2019 06 27	18.3

MW-30	
SAMPLE DATE	Mo
2019 06 24	6.9

MW-51	
SAMPLE DATE	Mo
2019 06 27	43.7

MW-70	
SAMPLE DATE	Mo
2019 06 24	120

MW-74	
SAMPLE DATE	Mo
2019 10 22	2.5

LEGEND

- MONITORING WELL (SNC–LAVALIN, 2019)
- LOCATION WHERE MOST RECENT GROUNDWATER SAMPLE MET STANDARDS FOR ALL PARAMETERS THAT WERE ANALYSED, SHOWN IN GREEN
- LOCATION WHERE MOST RECENT GROUNDWATER SAMPLE EXCEEDED STANDARDS FOR AT LEAST ONE PARAMETER THAT WAS ANALYSED, SHOWN IN RED
- GREEN — GREEN COLOURED CONCENTRATION MET THE MOE STANDARD
- RED — RED COLOURED AND UNDERLINED CONCENTRATION EXCEEDED THE MOE STANDARD
- INFERRED LIMITS OF CONTAMINATION
- TORONTO AND REGION CONSERVATION AUTHORITY (TRCA) FLOODPLAIN
- SITE PROPERTY LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- PROPOSED INFRASTRUCTURE

PARAMETERS	ABBREVIATION	UNITS	STANDARDS
MOLYBDENUM	Mo	µg/L	70

STANDARDS:
- TABLE 8 GENERIC SITE CONDITION STANDARDS FOR USE WITHIN 30m OF A WATER BODY IN A POTABLE GROUNDWATER CONDITION FOR ALL TYPES OF PROPERTY USE (MOE, 2011)

GENERAL NOTES:
1. 'm' : METERS

NOTE(S):
1. SCALE AND SITE INFRASTRUCTURE LOCATIONS ARE APPROXIMATE
2. INFORMATION ON THIS FIGURE MAY BE LOST IF IT IS PRINTED, PHOTOCOPIED OR FAXED IN OTHER THAN ITS ORIGINAL SIZE AND COLOURS
3. 'm' : METRES

SCALE 1:2,000

0 40 80m

SNC·LAVALIN

Client/Location: CITY OF BRAMPTON, 10192 HIGHWAY 50, BRAMPTON, ON

Title: GROUNDWATER ANALYTICAL RESULTS

Project No: 665125 | Filename: 008FI1_665125 | Date: NOVEMBER 2019 | Dwg No: APPENDIX I

Drawn: AG | Verified: WL | Project Manager: AY

PAGE FORMAT: 11x17

FILENAME: P:\City of Brampton\Johnston Transit Facility\665125\40_Execution\47_Wrkg_Vers\CAD_GIS\009 (Hydrogeological)\008FI1_665125.dwg

SNC·LAVALIN

195 The West Mall
Toronto, Ontario, Canada M9C 5K1
416-252-5311
www.snclavalin.com