LANDTEK LIMITED
*Consulting Engineers*
205 Nebo Road, Unit 3
Hamilton, Ontario
Canada
L8W 2E1
Phone: 905-383-3733
Fax: 905-383-8433
engineering@landteklimited.com
www.landteklimited.com

# Hydrogeological Investigation
# Proposed Development
# Phase 3 – Lot C
# 747 & 761 Brant Street (Phase 3)
# Burlington, Ontario

Prepared for:

**Brant Street Joint Venture**
**c/o Molinaro Group**
472 Brock Avenue, Unit 103
Burlington, Ontario
L7S 1N1

Landtek File: 20255-C
May 17, 2022

■ FOUNDATION INVESTIGATIONS ■ ENVIRONMENTAL SITE ASSESSMENTS AND CLEANUP ■ GROUNDWATER STUDIES ■ SLOPE STABILITY STUDIES
■ ASPHALT TECHNOLOGY ■ ASPHALT MIX DESIGNS ■ PAVEMENT PERFORMANCE ANALYSIS ■ CONSTRUCTION MATERIALS TESTING & INSPECTION
■ ANALYSIS OF SOIL CORROSION POTENTIAL ■ PAVEMENT REHABILITATION & TENDER SPECIFICATIONS ■ CONCRETE QUALITY ASSURANCE TESTING
■ ROOF INSPECTIONS ■ INFRASTRUCTURE NEEDS STUDIES ■ FAILURE ANALYSIS AND EXPERT WITNESS SERVICES ■ AGGREGATE EVALUATION

# EXECUTIVE SUMMARY

## SCOPE OF SERVICES

| | |
|---|---|
| **Proposed Development** | Brant Street Joint Venture is intending to develop the site identified as civic addresses 747 and 761 Brant Street in Burlington, Ontario for a primarily residential and limited commercial use. Based on the Proposed Site Plan provided to Landtek, as developed by Graziani + Corazza Architects Inc., the proposed structure is to comprise of an 8-storey tower with a surrounding three to seven storey podium. The structure will include a maximum of two levels of basement parking. The footprint of the proposed structure is to cover the full site area. |
| **Report Deliverables** | The Hydrogeological Investigation is required to assess the current site groundwater conditions, determine potential development/post development effects of the proposed development; and provide monitoring and mitigation plans for the development. |

## SITE DETAILS AND SETTING

| | | | |
|---|---|---|---|
| **Coordinates** | 596634, 4798498 | **Site Area (approx.)** | 3,831 $m^2$ (0.95 acres) |
| **Site Description** | The site is situated in a developed predominantly mixed commercial and residential area and is bounded by Ghent Avenue to the northwest and Brant Street to the southwest. Residential and commercial premises bound the site to the northeast and southeast respectively. The site consists of a three-storey apartment brick building and a two-storey building. The remainder of the site is covered by an asphalt paved parking lot and access route and maintained landscaped areas. | | |
| **Geology** | Topsoil and asphalt were encountered at the ground level. Underlying the surface material is fill material. The fill extends to depths of approximately 3.0 m below existing ground level. Underlying the fill is clayey silt till and red shale. Red shale bedrock was encountered underlying the till. | | |
| **Groundwater** | Depths to groundwater in all monitoring wells were obtained manually from September 2020 to August 2021. It was determined that that depth to groundwater ranged from 1.00 to 3.15 metres below ground surface. | | |

## DEWATERING CONSIDERATIONS

| | |
|---|---|
| **Short Term** | Dewatering rate will range from 6,044 (0.07 L/s) to 70,016 L/day (0.81 L/s) outside periods of active precipitation; while Dewatering during Spring/active precipitation period: is estimated to be approximately 70,016 L/day (radial flow into excavation) + 383,100 L/day (direct precipitation) = 453,116 L/day (5.24 L/s). Normal condition is considered to be weather conditions that should be expected during the operation of the construction dewatering but excludes extreme weather events. |
| **Long Term** | The basement parking will be waterproofed to prevent inflow of groundwater into the subsurface parking structures and foundation, post construction. As a result, long term dewatering will not be required at the Site. |
| **Monitoring and Mitigation Plans** | Monitoring and mitigation plans are provided. These include dewatering abstraction and settlement monitoring and responses; and limiting adverse dewatering related settlement and adverse effects on surface water bodies. |

## PERMIT CONSIDERATIONS

| | |
|---|---|
| **PTTW** | Construction dewatering will be required only during the construction phase of the project, as it is proposed that the underground parking be waterproofed to prevent inflow of groundwater into the subsurface parking structures and foundation, post construction. This consideration is based on a 100 year-storm event for the City of Burlington. As a result, the maximum dewatering rate of groundwater for the proposed excavation is estimated to be approximately 453,116 L/day or ~5.24 L/s(radial inflow and direct precipitation). A permit to take water (PTTW) is required for this volume of water taking, as the estimated water taking is more than 400,000 L/day. |

## WATER BALANCE

| | |
|---|---|
| **Maintenance of Groundwater Recharge** | The site is considered to have low groundwater recharge due to the relatively low impermeable soils encountered at surface at the site. In addition, there no natural area for infiltration is proposed for the development. As a result, infiltration value is expected to decrease from 147 to 68 $m^3$/year based on the water balance calculations. This decrease in infiltration indicates that approximately 4% of the roof runoff from the proposed buildings must be re-directed towards overland flow or infiltration facilities to match the pre-development infiltration rates. |

## Table of Contents

1.0 INTRODUCTION ..... 1
1.1 Background ..... 1
1.2 Work Scope and Report Organization ..... 1
2.0 METHODOLOGY ..... 3
2.1 Desktop Study ..... 3
2.2 Site Inspection to Assess Hydrogeologic Features ..... 3
2.3 Field Investigation ..... 3
2.3.1 Drilling and Well Installation ..... 3
2.3.2 Hydraulic Conductivity Tests ..... 4
3.0 FINDINGS ..... 5
3.1 Site Topography, Drainage and Hydrology ..... 5
3.2 Physiography ..... 5
3.3 Climate ..... 5
3.4 Regional Geology ..... 5
3.5 Regional Hydrogeology ..... 6
3.6 Groundwater Resources/Well Survey ..... 6
3.7 Local Geology and Hydrogeology ..... 7
3.8 Groundwater Monitoring ..... 8
3.9 Hydraulic Gradients and Flow ..... 9
3.10 Estimated Hydraulic Conductivity ..... 9
3.10.1 Hydraulic Conductivity Tests ..... 9
3.11 Groundwater Quality ..... 10
3.12 Site Inspection to Assess Hydrogeologic Features ..... 11
4.0 WATER TAKING EVALUATION & IMPACT ASSESSMENT ..... 12
4.1 Estimating Construction Dewatering Rate ..... 12
4.2 Dewatering Considerations ..... 13
4.2.1 Estimating Dewatering Volume ..... 13
4.2.2 Short Term Dewatering Volume ..... 13
4.2.3 Long Term Groundwater Control (Post Construction) ..... 14
4.2.4 Permit to Take Water ..... 14
4.2.5 Dewatering Volume Plan for Construction ..... 14
4.2.6 Dewatering Procedure ..... 14
4.2.7 Water Management and Discharge Plan ..... 15
4.3 Assessment of Potential Impacts and Water Management ..... 15
4.3.1 Impact to Existing Groundwater Users ..... 15
4.3.2 Impact to Surface Water and Natural Functions of the Ecosystem ..... 15
4.3.3 Contaminants Impacts ..... 15
4.3.4 Geotechnical Impacts ..... 15
5.0 MONITORING PLAN ..... 17
5.1 Construction Monitoring ..... 17
5.2 Management of Dewatering Abstraction ..... 17
5.2.1 Monitoring, Trigger Levels and Management Responses ..... 17
5.2.2 Contingency Responses ..... 17
5.2.3 Settlement Monitoring ..... 18
6.0 MITIGATION PLAN ..... 20
7.0 SITE DEVELOPMENT, HYDROGEOLOGY and WATER BALANCE ..... 21
7.1 Site Development Concept ..... 21
7.2 Principal Hydrogeologic Features and Functions ..... 21
7.3 Water Balance ..... 22
7.4 Mitigating Measures to Maintain Hydrogeological Functions ..... 23
7.4.1 Maintenance of Groundwater Recharge ..... 23

7.4.2 Maintenance of Groundwater Transmission Pathways ....23
8.0 SUMMARY AND CONCLUSIONS ....24
9.0 RECOMMENDATIONS ....25
10.0 CLOSURE ....26
11.0 REFERENCES ....27
12.0 LIMITATIONS ....28

Appendices:

Appendix A – Figures
Appendix B – Boreholes & Monitoring Wells Logs
Appendix C – Summary of MOE Well Records
Appendix D – Hydraulic Conductivity Testing Analysis Results
Appendix E – Summary of Hydraulic Conductivity Results from Previous Investigations
Appendix F – Laboratory Certificate of Analysis
Appendix G – Dewatering Assumptions and Calculations – Basements Levels
Appendix H – Water Balance

# 1.0 INTRODUCTION

## 1.1 Background

Landtek Limited (Landtek) was retained by Molinaro Group to complete a Hydrogeological Investigation for the proposed development at 747 & 761 Brant Street (Phase 3) in Burlington, Ontario (the 'site' or 'development property').

The Site is rectangular in shape and comprises an area of approximately 3,833 $m^2$ (0.95 acres) of developed land located to the east corner area of the intersection of the Brant Street and Ghent Avenue in Burlington, north of Brant Street. The Site is bound by Brant Street to the south, Ghent Avenue to the West, and developed properties to the North and East.

It is understood that the proposed development is to consist of three, five, six, seven and eight-storey buildings, with two-level of basement parking across the full site area.

A site location plan showing the Study Area for this investigation is presented on Figure 1 in Appendix A. The proposed Siteplan is shown on Figure 2 in Appendix A.

The purpose of the Hydrogeological Investigation is to evaluate the current conditions of the Site, delineate possible development/post-development effects, and suggest mitigation measures to minimize the effects to the shallow groundwater system post-development. Specifically, the report provides the following:

- A description of the hydrogeologic setting of the property and a summary of the existing soil and groundwater conditions at the Site.
- Identification of hydrogeologic features such as zones of significant groundwater recharge and discharge.
- Assessment of the requirement for groundwater control during construction, if any.
- A detailed water budget for the Site based on the current and proposed Site development plans and recommendations for mitigation measures in order to maintain groundwater infiltration and aquifer recharge in the area.

## 1.2 Work Scope and Report Organization

The scope of work for this investigation includes the following:

- *Review of available background information.* A review of published works was done of available geologic and hydrogeologic information for the site including topographic and geologic maps. Meteorological data was reviewed to assess the local climate and to use the information for water balance calculations.
- *Site Assessment.* A detailed visual inspection of the site and surrounding area was completed to identify and document local topography, surface water drainage features, and the potential presence of significant hydrogeologic features such as closed depressions (areas of ground water recharge), seeps, springs, or the presence of phreatophytic vegetation.

- *A subsurface investigation.* Boreholes were drilled at the site and completed as monitoring wells. The subsurface investigation of the property was done to characterize the overburden stratigraphy at the property as well as assess the site-specific groundwater conditions.

- *Water Balance.* A water balance of pre and post-development scenarios for the site was completed, including suggestions for mitigation measures that could be implemented in order to maintain shallow groundwater recharge conditions.

- *Hydraulic Conductivity Tests.* In-situ rising head tests were completed in all monitoring wells to assess overburden permeability.

- *Groundwater Monitoring.* Groundwater level monitoring was conducted in all installed monitoring wells in order to assess the depth in groundwater levels across the site.

The report is organized as follows:

**Section 1** contains a brief introduction to the project and the scope of work undertaken by Landtek.

**Section 2** outlines the methodologies followed during completion of the desktop study and the field investigation.

**Section 3** summarizes the findings of the investigation. It includes:
- a description of the physical setting
- the results of the field investigation

**Section 4** provides Water Taking Evaluation and Impact Assessment

**Section 5** provides Monitoring Plan.

**Section 6** provides Mitigation Plan.

**Section 7** provides Site Development, Hydrogeology and Water Balance.

**Section 8** provides Summary and Conclusions.

**Section 9** provides Recommendations.

**Section 10** provides Closure.

**Section 11** provides References.

**Section 12** provides Limitations.

## 2.0 METHODOLOGY

### 2.1 Desktop Study

A review of published works, existing site reports and available geologic and hydrogeological information for the site including topographic and geologic maps was completed.

Climate data for the period of 1981 to 2010 was obtained from Environment Canada publications and from the Hamilton A station (Hamilton Airport) to assess the local climate and to use the information for water balance calculations.

The MECP water well database for the local area was also accessed and the individual well records were obtained for wells that are located in the Study Area. The Study Area is defined, as an area extending 500 m outward from the edge of the excavation for the proposed basement parking levels.

### 2.2 Site Inspection to Assess Hydrogeologic Features

A detailed site inspection was conducted on August 24, 2020 to assess the presence of features which may be of Hydrogeologic significance. In particular, the site was inspected to assess the following:

- The presence of closed drainage features, depressions, or sandy areas which may allow for ponding and significant or enhanced infiltration of water.
- Assessment of the presence of phreatophytic vegetation which may indicate seasonally high groundwater levels and/or groundwater discharge and seepage.
- Identification of any zones of visible seepage or groundwater discharge.

### 2.3 Field Investigation

#### 2.3.1 Drilling and Well Installation

**Drilling:** Landtek's investigation involved the advancement of a total of eleven (11) boreholes at the site project area on August 31 to September 2, 2020; three at the Site, four at the west adjacent property across Ghent Avenue (769-789 Brant Street & 2023-2031 Ghent Avenue); and two at the property located at the west corner area of the intersection of Brant Street and Ghent Avenue (774-782 Brant Street). All three properties are concomitantly connected hydrogeologically. The boreholes were drilled to log the stratigraphy and collect samples for laboratory testing. Six (6) of the boreholes BH1, BH4, BH5, BH8, BH9, and BH11 were completed as a monitoring wells MW1, MW4, MW5, MW8, MW9, and MW11, respectively to depths ranging from 9.1 to 18.4 meter below ground surface (mbgs). The boreholes were advanced by Pontil Drilling. and were drilled using a CME 75 track-mounted drill rig, with hollow stem augers [150 mm outer diameter (OD) and 100 mm inner diameter (ID)]. Representative soil samples were retained for logging purposes and for subsequent grain-size composition analysis.

The drilling was supervised by an experienced Landtek soil technician, who also prepared borehole logs. The borehole logs are included in Appendix B of this report.

The monitoring wells installed in MW1, MW4, MW5, MW8, MW9, and MW11 were constructed with 50 mm inner diameter, Schedule 40 machine slotted PVC screens equipped with a bottom cap, and machine threaded riser pipe. The screen length and slot size are 3.0 m, and 0.10-inch, respectively.

The annular space between the PVC riser pipes and each borehole wall was backfilled to at least 0.3 m above the top of the screen with silica sand (No. 2). A bentonite seal was placed immediately above the sand pack to a height just below grade. Each monitoring well was finished with a protective steel casing, which was cemented in-place.

The boreholes and monitoring well locations are shown on Figure 3 in Appendix A, and well construction details are provided below in Table 1.

Table 1. Well Construction Details

| Well ID | Ground Surface Elevation [masl*] | Well Diameter [mm] | Well Depth [mbgs] | Well UTMs** | | Bentonite Seal Depth [masl] | | Well Screen Depth [masl] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Easting | Northing | Top | Bottom | Top | Bottom |
| BH/MW1 | 92.80 | 50 | 18.4 | 596475.6 | 4798472.4 | 92.25 | 77.70 | 77.40 | 74.40 |
| BH/MW4 | 91.53 | 50 | 18.4 | 596530.5 | 4798499.0 | 91.23 | 76.43 | 76.13 | 73.13 |
| BH/MW5 | 91.77 | 50 | 12.1 | 596534.0 | 4798599.9 | 91.47 | 82.97 | 82.67 | 79.67 |
| BH/MW8 | 91.74 | 50 | 12.1 | 596692.2 | 4798628.5 | 91.44 | 82.94 | 82.64 | 79.64 |
| BH/MW9 | 91.44 | 50 | 9.1 | 596633.3 | 4798530.9 | 91.14 | 85.64 | 85.34 | 82.34 |
| BH/MW11 | 91.13 | 50 | 9.3 | 596662.9 | 4798494.0 | 90.83 | 85.13 | 84.83 | 81.83 |

masl* = meters above sea level based on Topographical Survey completed by A.T. McLaren Limited for the site.
mm = millimetre
mbgs = metre below ground surface
UTMs**: +/- 4.0 m Error.

**Well Development:** All monitoring wells were developed to remove any sediment that may have been introduced during drilling/installation and to improve the hydraulic properties of the formation against which the wells were screened. This work was completed by Landtek staff on September 17, 2020. Development employed an electric well pump and/or Waterra Tubing with Foot Valve. Each well was pumped until a visible decrease in turbidity was observed.

**Groundwater Sampling:** On September 22, 2020, ground water samples were collected from monitoring wells MW9 and MW11 and submitted to ALS laboratories in Mississauga, Ontario for the City of Burlington Storm Water Discharge Parameters Limits analysis and e-coli.

### 2.3.2 Hydraulic Conductivity Tests

**Hydraulic Conductivity Testing:** Five (5) installed monitoring wells (MW1, MW4, MW5, MW8 and MW11) in the project area were tested to provide estimates of the hydraulic conductivity for the zones against which the screens for the wells were set. Rising head tests were conducted by Landtek on September 24, 2020. The tests involved the extraction of a known volume to displace the water level. A datalogger programed at 2 seconds intervals was used to record the water level response during the tests.

**Data Analysis:** The rising head test data were analyzed using AqteSolve Professional Version 4.5 software package developed by Glenn M. Duffield of HydroSOLVE Inc. applying the Hvorslev analysis solutions, depending on hydrogeology.

## 3.0 FINDINGS

### 3.1 Site Topography, Drainage and Hydrology

The Site is developed and flat-lying at approximately 91 to 92 masl. Rambo Creek is located approximately 77 m east of the Site while Lake Ontario is located approximately 1.4 km southeast of the site. It is expected that the direction of groundwater flow at the site is southeast towards Lake Ontario.

### 3.2 Physiography

The Site is located in the Iroquois Plains physiographic region, as defined by Chapman and Putnam (1984). The Iroquois Plains extends 305 km along the western part of Lake Ontario, with varying conditions from the Niagara River to the Trent River. In more detail, Chapman and Putnam (1984) subdivided the Iroquois Plains into smaller areas to account for the varying conditions along this region. The Site and its surrounding area are described as being situated in a former gravel bar (extending between Hamilton and Toronto), with the nearby shoreline consisting of distinct bluff cuts into the red shale of the Queenston Formation.

### 3.3 Climate

The climate in the study area is largely influenced by Lake Ontario. The general climate data presented below in Table 2 was obtained from Environment Canada publications and from the Environment Canada online database. Average climate data was taken from Hamilton A station Airport (Hamilton Airport) for the period of 1981 to 2010.

Table 2. 1981 to 2010 Climate Normals for Hamilton A Station (as averages)

| | Daily Average Temperature (°C) | Average Rainfall (mm) | Average Snowfall (cm) | Average Precipitation (mm) |
|---|---|---|---|---|
| January | -5.5 | 29.7 | 40.8 | 64.0 |
| February | -4.6 | 28.2 | 35.1 | 57.8 |
| March | -0.1 | 42.6 | 26.5 | 68.4 |
| April | 6.7 | 71.3 | 8.4 | 79.1 |
| May | 12.8 | 78.7 | 0.5 | 79.4 |
| June | 18.3 | 84.9 | 0.0 | 84.9 |
| July | 20.9 | 100.7 | 0.0 | 100.7 |
| August | 20.0 | 79.2 | 0.0 | 79.2 |
| September | 15.8 | 81.9 | 0.0 | 81.9 |
| October | 9.3 | 76.5 | 0.7 | 77.4 |
| November | 3.7 | 74.4 | 11.0 | 84.3 |
| December | -2.3 | 43.8 | 33.5 | 73.0 |
| Year | 7.9 | 791.7 | 156.5 | 929.8 |

### 3.4 Regional Geology

The surficial geology of the Site and the surrounding area is mapped as sand and is shown on Figure 2. Ministry of Natural Resources mapping (accessed via Ontario Geological Survey (OGS) OGS Earth published by the Ontario Ministry of Natural Development, Mines and Forestry), indicates the regional surficial geology on the Site is comprised of coarse-textured glacio-lacustrine deposits of sand, gravel, minor silt and clay.

According to bedrock mapping provided by the OGS Earth website, bedrock in the area of the Site and the Study Area is identified as the Queenston Formation consisting of shale, limestone, dolostone, and siltstone.

The Site is generally flat with a slight slope from the northwest to southeast. Based on groundwater levels measured at the Site, the inferred shallow groundwater flow direction is southeasterly.

### 3.5 Regional Hydrogeology

The Halton Till unit, underlying the Site and its vicinity, is generally regarded as an aquitard. The range of indicated hydraulic conductivity values for the Halton Till is from 7 x 10-10 m/s (Gartner Lee, 1983) to 4.8 x 10-5 m/s (Ostry, 1979). Ostry (1979) also calculated hydraulic conductivities for Peel Plain sediments as ranging from 4.0 x 10-5 m/s to 5.0 x 10-6 m/s as far as to east and middle areas of the Town of Oakville. As such, the shallow overburden materials (Halton Till and Peel Plain sediments) are considered aquitards.

The underlying Queenston Formation shale bedrock, particularly the upper, weathered portion, is regarded as a poor aquifer, however the upper 3 to 6 m of weathered bedrock typically provides sufficient water supplies to meet domestic requirements (Ostry, 1979). The bedrock porosity is low as a result of the compaction and consolidation of these fine-grained rocks since their deposition. Groundwater does, however, flow within joints, fractures, cleavage planes and faults within the shale bedrock (which generally become tighter and fewer with increasing depth). Well yields from the Queenston Formation shale bedrock in Halton Region are generally low. Very few wells yield 276,480 L/day (3.2 L/s) or more, and a yield of approximately 13,824 L/day (0.16 L/s) is generally expected (Gore & Storrie et al., 1995).

A regional summary of hydraulic conductivity values derived from consulting work conducted throughout Halton Region, by Holysh, April 1997 are presented. The indicated hydraulic conductivity values for the Halton Till range from 7 x 10-10 (Gartner Lee, 1983) to 4.8 x 10-5 m/s (Ostry, 1979). The range of indicated values for the Queenston Formation is from 1 x 10-8 m/s (Gartner Lee, 1983) to 3.2 x 10-5 m/s (Ostry, 1979).

### 3.6 Groundwater Resources/Well Survey

The site is located in the Halton Region Source Protection Area and is classified as a Highly Vulnerable Aquifer area with score of 6 and an Intake Protection Zone 2 with a score of 5.6. The source water protection details for the site were referenced from the Ministry of the Environment, Conservation and Park (MECP) website on Source Water Protection for the Province of Ontario (MECP, 2020). Observed evidence of karstification was not observed due to the character of bedrock, lack of outcrop and/or relative thickness of overburden.

Well records were downloaded from the MECP water well database for a radius of approximately 500 m from the proposed development. A total of 42 well records were identified within the search radius.

The well records were reviewed to assess the general nature and use of the groundwater resource in the area and to characterize local hydrogeologic conditions; and determine the type of well. A summary of the data obtained from this review is presented on the following page.

**Well Construction**

- Wells terminated in bedrock .....9
- Wells terminated in overburden .....28
- No information (assumed to be overburden).....5
- **Total.....42**

**Well Uses**

- Domestic .....0
- Observation Wells .....16
- Test Holes/Monitoring Wells .....20
- Abandoned.....4
- No Information.....2
- **Total.....42**

**Well Depth**

- Less than 15 m .....35
- 15 to 30 m .....3
- Abandoned.....4
- **Total.....42**

The locations of all the MECP wells are plotted on Figure 4 in Appendix A, and the Well Records are included in Appendix C.

Based on the well records, it was determined that there are no water wells within 500 m of the site.

### 3.7 Local Geology and Hydrogeology

Based on the results of the Geotechnical and Hydrogeological Investigations carried out at the Site, a brief description of the general surficial geology of the Site, in order of depth is summarized in the following sections. Boreholes BH9, BH10 and BH11 were completed at the Site and sampled as part of the investigation on the Site and completed at depths ranging from approximately 7.6 to 18.4 mbgs (Appendix B).

The borehole information is generally consistent with the geological data. The lithologies encountered by the boreholes are discussed further in the following sections.

**Fill**

A layer of fill of 3.0 m in thickness was encountered in all the boreholes at the ground surface overlying clayey silt in BH9, and bedrock in BH10 and BH11.

**Clayey Silt**

A layer of fill of 0.5 m in thickness was encountered below the fill in BH9, overlying shale bedrock.

**Bedrock**

Shale bedrock was encountered below the clayey silt in BH1; and fill in BH10 and BH11 at depths ranging from 3.0 to 3.5 mbgs. The boreholes were terminated in bedrock at the maximum depth of approximately 9.3 mbgs.

### 3.8 Groundwater Monitoring

Depths to groundwater in all monitoring wells were obtained manually by Landtek staff on September 21 and 24, 2020, January 14, February 23, March 17, April 12 and April 22, 2021. The readings are presented below in Table 3.

Table 3. Monitoring Well Details

| Monitoring Well ID | Ground Surface Elevation (masl)* | Date | Stick-up | Water Strike Depth (mbgs) | Water Level (mbgs) | Water Level Elevation (masl) | Screened Material |
|---|---|---|---|---|---|---|---|
| MW1 | 92.80 | 21-Sep-20 | 0.85 | 1.50 | 3.02 | 89.78 | Bedrock |
| | | 24-Sep-20 | | | 2.99 | 89.81 | |
| | | 14-Jan-21 | | | 2.78 | 90.02 | |
| | | 23-Feb-21 | | | 2.85 | 89.95 | |
| | | 17-Mar-21 | | | 2.81 | 89.99 | |
| | | 12-Apr-21 | | | 2.76 | 90.04 | |
| | | 10-May-21 | | | 2.77 | 90.03 | |
| | | 10-Jun-21 | | | 2.80 | 90.00 | |
| | | 19-Jul-21 | | | 2.82 | 89.98 | |
| | | 31-Aug-21 | | | 2.80 | 90.00 | |
| MW4 | 91.53 | 21-Sep-20 | 0.91 | 3.50 | 2.61 | 88.92 | Bedrock |
| | | 24-Sep-20 | | | 2.57 | 88.96 | |
| | | 14-Jan-21 | | | 2.43 | 89.10 | |
| | | 23-Feb-21 | | | 2.56 | 88.97 | |
| | | 17-Mar-21 | | | 2.49 | 89.04 | |
| | | 12-Apr-21 | | | 2.50 | 89.03 | |
| | | 10-May-21 | | | 2.54 | 88.99 | |
| | | 10-Jun-21 | | | 2.64 | 88.89 | |
| | | 19-Jul-21 | | | 2.64 | 88.89 | |
| | | 31-Aug-21 | | | 2.75 | 88.78 | |
| MW5 | 91.77 | 21-Sep-20 | Flush mount | 7.60 | 2.33 | 89.44 | Bedrock |
| | | 24-Sep-20 | | | 2.20 | 89.57 | |
| | | 14-Jan-21 | | | 2.11 | 89.66 | |
| | | 23-Feb-21 | | | 2.20 | 89.57 | |
| | | 17-Mar-21 | | | 2.13 | 89.64 | |
| | | 12-Apr-21 | | | 2.07 | 89.70 | |
| | | 22-Apr-21 | | | 2.09 | 89.68 | |
| | | 10-May-21 | | | 2.06 | 89.71 | |
| | | 10-Jun-21 | | | 1.98 | 89.79 | |
| | | 19-Jul-21 | | | 2.16 | 89.61 | |
| | | 31-Aug-21 | | | 2.16 | 89.61 | |
| MW8 | 91.74 | 21-Sep-20 | Flush mount | 1.5 | 2.34 | 89.40 | Bedrock |
| | | 24-Sep-20 | | | 1.85 | 89.89 | |
| | | 14-Jan-21 | | | 1.72 | 90.02 | |
| | | 23-Feb-21 | | | 1.82 | 89.92 | |
| | | 17-Mar-21 | | | 1.68 | 90.06 | |
| | | 12-Apr-21 | | | UW** | NA** | |
| | | 22-Apr-21 | | | 1.63 | 90.11 | |
| | | 10-May-21 | | | 1.65 | 90.09 | |
| | | 10-Jun-21 | | | 1.98 | 89.76 | |
| | | 19-Jul-21 | | | 1.66 | 90.08 | |
| | | 31-Aug-21 | | | Dest*** | NA | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MW9 | 91.30 | 21-Sep-20 | Flush mount | None | 3.13 | 88.17 | Bedrock |
| | | 24-Sep-20 | | | 3.15 | 88.15 | |
| | | 14-Jan-21 | | | 2.83 | 88.47 | |
| | | 23-Feb-21 | | | 2.92 | 88.38 | |
| | | 17-Mar-21 | | | 2.54 | 88.76 | |
| | | 12-Apr-21 | | | 2.56 | 88.74 | |
| | | 10-May-21 | | | 2.53 | 88.77 | |
| | | 10-Jun-21 | | | 2.76 | 88.54 | |
| | | 19-Jul-21 | | | 2.72 | 88.58 | |
| | | 31-Aug-21 | | | 2.85 | 88.80 | |
| MW11 | 91.13 | 21-Sep-20 | Flush mount | None | 2.00 | 89.13 | Bedrock |
| | | 24-Sep-20 | | | 1.95 | 89.18 | |
| | | 14-Jan-21 | | | 1.29 | 89.84 | |
| | | 23-Feb-21 | | | 1.35 | 89.78 | |
| | | 17-Mar-21 | | | 1.19 | 89.94 | |
| | | 12-Apr-21 | | | 1.00 | 90.13 | |
| | | 10-May-21 | | | 1.36 | 89.77 | |
| | | 10-Jun-21 | | | 1.52 | 88.61 | |
| | | 19-Jul-21 | | | 1.43 | 89.70 | |
| | | 31-Aug-21 | | | 1.36 | 89.77 | |

**Notes:**
masl* = meters above sea level based on Topographical Survey completed by A.T. McLaren Limited for the site.
mbgs = meters below ground surface
mbtoc = meters below top of casing
[**] = under water/flooded

### 3.9 Hydraulic Gradients and Flow

Groundwater typically follows the general path of the surface water courses and flows to low lying and major surface water features from areas of higher gradients to areas of relative lower gradients.

The groundwater flow regime for the Site was determined by using the groundwater elevations recorded in monitoring wells MW8, MW9, and MW11. The water table contours lines were completed by using triangulation with linear interpolation. The arrow, perpendicular to the contours, indicates the direction of groundwater flow was southeast on December 3, 2018 as shown on Figure 5 in Appendix A. The horizontal hydraulic gradient across the Site was approximately 0.043 m/m southwest toward Lake Ontario.

### 3.10 Estimated Hydraulic Conductivity

#### 3.10.1 Hydraulic Conductivity Tests

The estimated hydraulic conductivity values are provided below in Table 4, and normalized head vs. time curves for each hydraulic conductivity test is provided in Appendix D.

It should be noted that the tested monitoring wells are enough to characterize the hydraulic conductivity of the Site, as a result MW9 was not tested.

Table 4. Estimated Hydraulic Conductivity

| Monitoring Well | Hydraulic Conductivity (m/s) | Well Screened Material |
|---|---|---|
| MW1 | $1.847 \times 10^{-5}$ | Bedrock |
| MW4 | $8.12 \times 10^{-8}$ | Bedrock |
| MW5 | $1.871 \times 10^{-5}$ | Bedrock |
| MW8 | $8.538 \times 10^{-8}$ | Bedrock |

| | | |
|---|---|---|
| MW11 | 1.597 x $10^{-7}$ | Bedrock |

Note:
[1] A regional summary of hydraulic conductivity values derived from consulting work conducted throughout Halton Region, by Holysh, April 1997 is presented in Appendix E. The indicated hydraulic conductivity values for the Queenston Formation range from 1 x $10^{-8}$ m/s (Gartner Lee, 1983) to 3.2 $10^{-5}$ m/s (Ostry, 1979).

[2] Based on the hydraulic conductivity values in Table 4 above, the geometric mean of the hydraulic conductivity values was determined to be 8.252 x $10^{-7}$ m/s. As a result, the value of 8.252 x $10^{-7}$ m/s was adopted in estimating the potential dewatering requirement at the Site.

### 3.11 Groundwater Quality

Copies of the laboratory Certificates of Analysis are provided in Appendix F.

Sewer Discharge Analysis

The laboratory results for the analyzed groundwater samples collected from monitoring wells MW9 and MW11 were compared to the City of Burlington Municipal Storm Sewer Discharge Limits Guidelines. The parameters that exceeded the Limits Guidelines are highlighted on the table presented below.

Sample Date: October 22, 2020

| Parameter | G/S (mg/L) | MW9 | MW11 |
|---|---|---|---|
| | | Lab Result (mg/L) | Lab Result (mg/L) |
| pH | 6.5-8.5* | 7.76 | 7.72 |
| BOD | 15 | <2 | <2 |
| Total Cyanide | 0.02 | <0.002 | <0.002 |
| Phenols | 0.008 | <0.002 | 0.005 |
| Total Phosphorus | 0.4 | 0.10 | **2.75** |
| Total Suspended Solids | 15 | **39** | **202** |
| Total Arsenic | 0.02 | <0.015 | <0.030 |
| Total Cadmium | 0.008 | <0.005 | <0.010 |
| Total Chromium | 0.08 | <0.020 | **0.086** |
| Chromium VI | 0.04 | <0.005 | <0.005 |
| Total Copper | 0.04 | <0.020 | **0.068** |
| Total Lead | 0.12 | <0.020 | <0.040 |
| Total Manganese | 0.05 | **0.164** | **3.45** |
| Total Mercury | 0.0004 | <0.0002 | <0.0002 |
| Total Nickel | 0.08 | <0.030 | **0.115** |
| Total Selenium | 0.02 | <0.020 | <0.040 |
| Total Silver | 0.12 | <0.020 | <0.040 |
| Total Zinc | 0.04 | <0.020 | **0.238** |
| E. Coli | 200** | ND | ND |
| Methylene Chloride | 0.0052 | <0.0003 | <0.0003 |

| | | | |
|---|---|---|---|
| trans-1,3-Dichloropropylene | 0.0056 | <0.0003 | <0.0003 |
| cis-1,2-Dichloroetylene | 0.0056 | <0.0002 | <0.0002 |
| Chloroform | 0.002 | <0.0002 | <0.0002 |
| Benzene | 0.002 | <0.0002 | 0.0002 |
| Trichloroethylene | 0.0076 | 0.0002 | 0.0002 |
| Toluene | 0.002 | <0.0002 | <0.0002 |
| Tetrachloroethylene | 0.0044 | <0.0001 | <0.0001 |
| Ethylbenzene | 0.002 | <0.0002 | <0.0002 |
| 1,1,2,2-Tetrachloroethane | 0.017 | <0.0002 | <0.0002 |
| 1,2-Dichlorobenzene | 0.0056 | <0.0002 | <0.0002 |
| 1,4-Dichlorobenzene | 0.0068 | <0.0002 | <0.0002 |
| Total Xylenes | 0.0044 | <0.0002 | <0.0002 |
| PCBs | 0.0004 | <0.0002 | <0.0002 |
| Pentachlorophenol | 0.002 | <0.0005 | <0.0005 |
| Di-n-butyl phthalate | 0.015 | <0.0005 | <0.0005 |
| 3,3'-dichlorobenzidine | 0.0008 | <0.0001 | <0.0001 |
| Bis(2-Ethylhexyl)phthalate | 0.0088 | <0.0005 | <0.0005 |
| Total PAHs | 0.002 | <0.0003 | <0.0003 |
| Total Nonylphenol | 0.001 | <0.001 | <0.001 |
| NP1E0 | None | <0.001 | <0.001 |
| NP2E0 | None | <0.0003 | <0.0003 |
| Total Nonylphenol Ethoxylates | 0.01 | <0.001 | <0.001 |

[*] pH Units
[**] CFU/100ml
[*] Exceedance
[ND] – Not Detected

An application for a proposed groundwater dewatering discharge into the City of Burlington Storm Water System should be submitted for approval. The application should include a dewatering plan by dewatering contractor specifying a treatment system for identified exceedances proposed by the retained dewatering contractor.

According to AGAT Laboratories, Temperature is more of a field parameter that is determined on a case-by-case basis during period of dewatering before discharge. Temperature analysis is not included in AGAT Laboratory package for the City of Burlington Storm Discharge. The temperature value of underground water is usually ambient, and the dewatering contractor should incorporate a system to have the temperature of discharge groundwater <30$^{o}$ C before discharge

### 3.12 Site Inspection to Assess Hydrogeologic Features

Significant hydrogeologic features were not identified at the site during the inspection.

## 4.0 WATER TAKING EVALUATION & IMPACT ASSESSMENT

The Molinaro Group proposes to develop the property to comprise of an 8-storey tower with a surrounding three to seven storey podium. The structure will include a maximum of two levels of basement parking. The footprint of the proposed structure is to cover the full site area.

### 4.1 Estimating Construction Dewatering Rate

It is assumed that the underground levels will be installed in a supported open excavation. The excavation area estimated from the Site Plan provided by Graziani + Corazza Architects Inc. is approximated to be: ~ 75.1 m x 51.0 m = ~3831 $m^2$.

There will be two levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 7.1 mbgs (Level 1 = 4.1 m, and Level 2 = 3.0 m). An elevator shaft extension is assumed to be 1.5 m. Therefore, a total excavation depth of 8.6 mbgs is required for the construction. A dewatering depth of approximately 0.5 m below the excavation bottom (9.1 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.

Basement Excavation

The potential groundwater flow rate to the underground parking excavation was estimated using the dewatering equation for a fully penetrated well of confined aquifer fed by circular source:

$$Q = 2\pi kD\,(H-h_w)/(\ln R_o/r_e)$$

Where: Q = pumping rate [$m^3/s$]
k = hydraulic conductivity [m/s]
D = aquifer thickness [m]
H = height of piezometer level above base of aquifer before dewatering [m]
$h_w$ = height of water after dewatering [m]
$R_o$. = radius of influence [m]
$r_e$ = equivalent radius [m]

The radius of cone of depression R can be estimated using:

$$R_o = Ch*Sqrt(K)$$

Where: C = is a factor equal to 3000 for radial flow to a pumping well

h = H- $h_w$ = required drawdown [m]
K = hydraulic conductivity [m/s]

Dewatering of a rectangular area can be accomplished by using an equivalent radius ($r_e$) to assess drawdown where $r_e$ is given by the following equation:

$r_e$ = Sqrt (length*width/π) (applies when a/b>1.5 and $R_o << r_e$)
$r_e$ = (length + width)/π (applies when a/b,1.5 and $R_o >> r_e$)

Static Water Levels

Depths to groundwater in all monitoring wells were obtained manually by Landtek staff on September 21 and 24, 2020, January 14, February 23, March 17, and April 12, 2021. The readings are presented in Table 3. Based on the groundwater levels recorded in monitoring MW9 and MW11 located at the Site, it was determined that depth to groundwater ranged from 1.00 mbgs to 3.15 mbgs. The highest ground water level was determined to be 1.00 mbgs. The data were recorded in September, and it should be noted that depths groundwater vary seasonally, and the water table is typically elevated during spring and periods of active precipitation.

Radial Flow into Excavation

The total amount of groundwater required to be pumped for dewatering the excavation associated with the underground level construction assuming there is no rainfall and applying a factor of safety of 1.5 will be ~70,016 L/day (0.81 L/s). These calculations and associated assumptions are provided in Table 1, Appendix G.

## 4.2 Dewatering Considerations

### 4.2.1 Estimating Dewatering Volume

The dewatering rate for the proposed excavation must also consider management of direct precipitation input. As a result, dewatering volume is estimated from the following two contributions:

- Radial flow into an excavation under a water table condition (Section 4.1).
- Direct precipitation

**Direct Precipitation**

**Note:** Radial flow into an excavation under a water table condition estimate does not take into account storm water management from rainfall events. Additional volume generated from a 100 year-storm event for the City of Burlington of 100 mm (from Extreme Rainfall Intensity-Duration-Frequency [IDF] Curve for the City of Burlington) rainfall event is estimated as follows:

**Direct Precipitation into the proposed excavation** = A ($m^2$) *rainfall (m) = (3,831)*0.100 m = 383.1 $m^3$/day = 383,100 L/day

Contingencies should be made by the dewatering contractor to handle the estimated volume during active of active precipitation.

### 4.2.2 Short Term Dewatering Volume

- Dewatering rate outside periods of active precipitation: ~70,016 L/day (~0.81 L/s)
- Dewatering during Spring/active precipitation period: ~~70,016 L/day (radial flow into excavation) + 383,100 L/day (direct precipitation) = 453,116 L/day or ~5.2 L/s.

Normal condition is considered to be weather conditions that should be expected during the operation of the construction dewatering. Normal operation does not include extreme weather events. Dewatering requirements less precipitation is estimated to be approximately 60,680 L/day = ~61 $m^3$/day.

### 4.2.3 Long Term Groundwater Control (Post Construction)

Long term dewatering is not required at the Site as the proposed underground parking levels and structures will be designed to be fully waterproofed in accordance regulatory requirements.

### 4.2.4 Permit to Take Water

The maximum dewatering rate of groundwater for the proposed excavation is estimated to be approximately 453,116 or ~5.2 L/s (radial inflow and direct precipitation). A permit to take water (PTTW) is required for this volume of water taking, as the estimated water taking is more than 400,000 L/day.

### 4.2.5 Dewatering Volume Plan for Construction

A regional summary of hydraulic conductivity values derived from consulting work conducted throughout Halton Region, by Holysh, April 1997 is presented in Appendix E. The indicated hydraulic conductivity values for the Queenston Formation range from $1 \times 10^{-8}$ m/s to $1 \times 10^{-6}$ m/s (Gartner Lee, 1983).

The excavation dewatering volume was also estimated based on the low-end value of hydraulic conductivity for the Burlington Shale of $1 \times 10^{-8}$ m/s above; and was determined to be approximately 6,044 L/day withr a factor of safety of 1.5. These calculations and associated assumptions are provided in Table 2, Appendix G.

Based on the above, it is recommended that the Dewatering Volume Plan should provide for dewatering volumes ranging from 6,044 L/day or 0.07 l/s (determined using the low-end value of hydraulic conductivity value for Burlington shale) to 453,116 L/day or ~5.2 L/s (radial inflow [determined with the geometric mean of the field determined hydraulic conductivity values] + direct precipitation).

### 4.2.6 Dewatering Procedure

Based on the results of the hydraulic conductivity tests, seepage through the overburden/bedrock beneath the Site should be feasible to be handled by a sump and/or well point dewatering system. The type of dewatering system to be used should be discussed with a dewatering contractor and be evaluated based on anticipated low and high volumes estimates.

The following general construction practices can be implemented to minimize the volume of water to be extracted:

- Schedule construction outside the spring period when the water table is typically elevated and avoid constructing during period of active precipitation.
- It is recommended that any excavations should be staged or constructed in such a manner to be able to manage dewatering volume conveniently.
- Reduce the length of time during which the open cut remains open.

### 4.2.7 Water Management and Discharge Plan

The City of Burlington is currently reviewing the Municipal Storm Sewer Discharge By-Law. The City advises that the requirements of the by-law in place should be adhered to at the time of excavation.

## 4.3 Assessment of Potential Impacts and Water Management

### 4.3.1 Impact to Existing Groundwater Users

A search of the Ontario Ministry of the Environment Water Well Records for an area extending about 500 m outward from the edge of the excavation was completed, identifying no Water wells in the database. As a result, it is not anticipated that there will be any impact to the existing water wells.

### 4.3.2 Impact to Surface Water and Natural Functions of the Ecosystem

Rambo Creek is located approximately 77 m east of the Site, Lake Ontario is located approximately 1.4 km southeast of the site. The groundwater dewatering activities will result in localized depression of the groundwater table, and it is anticipated that there will be impact within the radius of influence of approximately 22 m calculated in Table 1, Appendix G.

### 4.3.3 Contaminants Impacts

This occurs when pre-existing ground or groundwater contamination is mobilised and transported where transmission pathways are created.

Based on the environmental site assessments completed by Landtek, there are no known sources of contamination in groundwater at the Site. As a result, there is no potential for mobilization of contaminants or creation of transmission pathways during the planned groundwater dewatering activities.

### 4.3.4 Geotechnical Impacts

Geotechnical impacts occur where the geotechnical properties or state of the ground are changed by groundwater control activities. The most common type of impact in this category is ground settlement, with the corresponding risk of distortion and damage to structures, services and other sensitive infrastructure.

Ground settlement can be caused by two principal mechanisms:

- Increases in effective stress as a result of lowering of groundwater levels, resulting in compression and consolidation of the ground. Such settlements are an unavoidable consequence of lowering of groundwater levels.
- Removal of fine particles from the ground (loss of fines) which can occur when poorly controlled sump pumping draws out soil particles with the pumped water. With good design and implementation, loss of fines (and the associated settlement risk) can be avoided.

The Site is located to the east corner area of the intersection of the Brant Street and Ghent Avenue in Burlington, east of Ghent Avenue. The Site is bound by Brant Street to the south, Ghent Avenue to the West, and developed properties to the North and East. It is anticipated that there will be impact within the radius of influence of approximately 22 m calculated in Table 1, Appendix G.

Dewatering could be handled by pumping from a sump/well point dewatering system. The well sump/point system used for lowering the water table within the excavation must be properly screened and installed to ensure that pumping will not remove sediment from the low permeability overburden aquifer. Removal of significant fines may result in the formation of voids and the loss of ground.

Based on the above, potential geotechnical impacts are anticipated during dewatering at the Site. Surrounding buildings and roads should be monitored by geotechnical instrumentation to determine impact, if any.

The proposed monitoring and mitigation plans are presented in Sections 5 and 6, respectively.

# 5.0 MONITORING PLAN

## 5.1 Construction Monitoring

Once construction dewatering is initiated it will be difficult to stop pumping or significantly reduce the rate of pumping without disrupting construction activities. It will however be possible to monitor the drawdown response at the construction site and to adjust the pumping rate to optimize drawdown and the associated pumping rate.

## 5.2 Management of Dewatering Abstraction

### 5.2.1 Monitoring, Trigger Levels and Management Responses

Abstraction management is critical to ensure target water levels within the construction zone are met, but that over-pumping does not occur.

Target groundwater levels in- and outside excavations will be set individually for each dewatering monitoring well based on location, aquifer and construction requirements, in-line with stated dewatering aims above.

Trigger levels for wells will typically be set 0.5 m above the dewatering target and 1.0 m below the dewatering target to give a 1.5 m target operational zone. These targets may be reviewed and adjusted to decrease size of the operational target zone and increase the factor of safety.

If monitoring indicates that dewatering zone groundwater levels exceed the upper trigger levels (i.e. required drawdown is not being achieved or maintained) management actions are available (in order of preference):

- Adjust automatic pump start and stop water levels.
- Increase pumping rates within the constraints of the system; and/or
- Install additional abstraction capacity (well points, spears or sump pumps).

If monitoring indicates that excavation zone groundwater levels are below the lower trigger levels (i.e. excessive drawdown) management actions available are (in order of preference):

- Adjust automatic pump start and stop water levels; and/or
- Decrease pumping rates; and/or
- Reduce the number of pumps operating.

### 5.2.2 Contingency Responses

If management responses prove to be insufficient to achieve and maintain the target levels, excavations may be slowed or suspended to enable contingencies to be implemented. Available contingency measures that will be assessed include (in order of preference):

- Construction of additional dewatering wells, spears or sumps.
- Construction of additional drains or groundwater control structures.

Excavation would resume when the required drawdown is able to be reliably obtained.

### 5.2.3 Settlement Monitoring

Ground settlement can be caused by two principal mechanisms:

- Increases in effective stress as a result of lowering of groundwater levels, resulting in compression and consolidation of the ground. Such settlements are the unavoidable consequence of lowering of groundwater level
- Removal of fine particles from the ground (loss of fines) which can occur when poorly controlled sump pumping draws out soil particles with the pumped water. With good design and implementation, loss of fines (and the associated settlement risk) can be avoided.

Implementation of a settlement monitoring plan should be completed within an approximate radius of influence of 22.0 m of the Site, the estimated radius of influence from dewatering. Prior to commencing dewatering, condition surveys of adjacent properties that could potentially be affected by dewatering, considering anticipated effects and specific dewatering design, should be completed.

Temporary access permit should be obtained from properties and utilities owners with the estimated radius of influence of the Site on a case-by-case basis prior to construction

The following monitoring measures are recommended to be carried out before and during the temporary dewatering:

- Complete a pre-excavation condition survey and install settlement monitoring monuments and or markers at the existing buildings and roadways within the estimated zone of influence. This should be done to document existing ground elevations and building/structure conditions. In addition, buried infrastructure and utilities should be identified and surveyed by ground penetrating radar.

- The settlement monitoring monuments (markers) should be surveyed prior to the dewatering to establish a baseline and surveyed on a daily basis during the dewatering.

- A typical settlement monitoring system should comprise a series of settlement markers sited at various distances beyond and at the site, within the zone of influence of groundwater drawdown. Monitoring points should be surveyed to an accuracy of +/-2 mm. Note that the reference benchmark must be located beyond the extent of the anticipated influence of groundwater drawdown. For very high-risk projects, incorporation of piezometer standpipes will allow confirmation of the field groundwater drawdown and will enable calibration of field settlement observation with theoretical assessments.

- Condition of buried infrastructure and utilities should be monitored on regular basis.

- Alert and Action settlement thresholds should be set, selected through theoretical assessment of anticipated settlements and review of sensitivity of adjacent structures and infrastructures. It is prudent to implement staged groundwater drawdown, providing holding points to allow adequate time to enable observation of the delayed settlement response of the ground.

- The monitoring program will include review and alert levels. If instrument readings exceed “review” levels, the Proponent and its Contractor will jointly assess the necessity of altering the method, rate, or sequence of construction.
- The survey results should be provided to the project geotechnical engineer for evaluation. The estimated potential and actual settlements should also be reviewed by a structural engineer to assess the potential damage to the existing structures.

## 6.0 MITIGATION PLAN

The groundwater dewatering activities will result in localized depression of the groundwater table, and it is not anticipated that there will impact beyond the radius of influence of 22.0 m.

Mitigation would involve the reduction or elimination of the impacts induced by construction dewatering. As noted above, the potential exists for dewatering to cause ground settlement, with the corresponding risk of distortion and damage to structures, services and other sensitive infrastructure.

Methods to limit adverse dewatering settlement should include the following:

- Settlement associated with loss of fines should be mitigated through appropriate design of the dewatering system to control flow velocity and provide screens and/or filters matched to the grading of the in-situ soils. Entrainment of fines must be monitored during construction; actions could include analysis of TSS in discharge water and/or monitoring of accumulation of sediment in sedimentation tanks.

- Drawdown-induced ground settlement should be mitigated though pre-construction estimation of groundwater drawdown and settlement coefficients to identify risk prior to drawing the groundwater down, and water level monitoring in monitoring wells to check that larger drawdown than anticipated at distance from the excavation are not occurring.

- Differential settlement is most problematic. This should be reduced by managing the rate of drawdown and understanding where clear changes in soil type occur. Should potentially damaging settlement be indicated, these can be mitigated by installing groundwater cut-offs to stem or restrict groundwater flow and limit drawdown beyond the site.

- Sufficient temporary support should be provided for excavations to maintain stability, where seeps might otherwise induce progressive collapse of the sides of the excavation.

- During dewatering, staged drawdowns (where appropriate) should be implemented and field settlement and water level changes beyond the immediate site monitored, comparing against theoretical settlements and water levels to allow warning of potential dewatering settlement issues.

At “alert” levels during monitoring, the dewatering should be reduced to a lower rate or ceased temporarily, and alternative measures considered for the excavation, which should be approved by the project geotechnical engineer and project team.

If the settlement monitoring indicates an undesirable deformation, the project manager should order construction operations to cease until the necessary mitigation measures are undertaken.

In the event that a property or infrastructure owner submits a claim for damages, the Developer should conduct further investigations and, if appropriate, negotiate a settlement.

## 7.0 SITE DEVELOPMENT, HYDROGEOLOGY and WATER BALANCE

The following discussion and recommendations are based on the data gathered for the study and are presented for site planning purposes.

### 7.1 Site Development Concept

It is understood that the proposed development is to comprise of an 8-storey tower with a surrounding three to seven storey podium. The structure will include a maximum of two levels of basement parking. The footprint of the proposed structure is to cover the full site area.

The following summarizes the proposed approximate land coverage areas for the development:

- Building roof area ..... 0.229 ha
- Parking Areas, Roadways, and other impervious Areas..... 0.087 ha
- Green space, SWMP, natural areas..... 0.068 ha
- **Total Area ..... 0.383 ha**

### 7.2 Principal Hydrogeologic Features and Functions

The results of the study indicate that the site hydrogeologic characteristics can be summarized as follows:

- Generally, the site stratigraphy consists of fill/clayey silt to depths varying from 3.0-3.5 mbgs, over bedrock. Drilling was terminated at a maximum depth of approximately 9.3 mbgs in bedrock.
- The water table recorded at the site ranges from 1.95 mbgs to 3.15 mbgs.
- There will be two levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 7.1 mbgs (Level 1 = 4.1 m, Level 2 = 3.0 m). An elevator shaft extension is assumed to be 1.5 m. Therefore, a total excavation depth of mbgs is required for the construction. A dewatering depth of approximately 0.5 m below the excavation bottom (9.1 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.
- The Site is generally flat with a slight slope from the northeast to southwest. Based on groundwater levels measured at the Site, the inferred shallow groundwater flow direction is southwesterly.

The above noted hydrogeological characteristics should be considered in conjunction with the requirement for site development plans and in particular storm water management practices at the site. Further information regarding water balance at the site is presented in the following section.

Based on the above information, the following considerations should be made with respect to maintenance of hydrogeologic functions and hydrogeologic conditions at the site:

- The site consists of fill/clayey silt overlying shale bedrock and would not be well suited to groundwater recharge due to the relatively high hydraulic conductivity of the subsurface strata. Engineered infiltration methods, other Best Management Practices and low impact development methods should be implemented accordingly.

### 7.3 Water Balance

The proposed site development plan will result in the construction of buildings, parking areas, and roadways. Without mitigation, this will lead to a decrease in infiltration and groundwater recharge.

The surface soils at the site will provide relatively high water recharge into the shallow groundwater system. This is a result of the relatively high permeable silty sand/sandy silt soil encountered below ground surface across the site. Based on the subsurface investigation completed for the site, no enhanced zones of groundwater flow or transmission were identified across the site.

Notwithstanding the above, one of the objectives during development should be to ensure that the overall volume of groundwater recharge is not significantly impacted. A water balance for the site was prepared to assess the distribution of precipitation, evapotranspiration, infiltration and runoff for existing (pre-development) conditions as well as post-development conditions. The water balance calculations are detailed in Appendix H.

Evapotranspiration represents the transport of water from the earth back to the atmosphere and is an important component to a water balance calculation. The Thornthwaite method was used to calculate potential evapotranspiration typical for the region. By using equations 8, 9, and 10 in Thornthwaite (1948), the potential evapotranspiration for the region was found to be 609 mm/year. The calculation is included in Appendix H.

As was presented in Table 2, the annual total precipitation was taken from the Hamilton Airport climate station for the period of 1981 to 2010. Total annual precipitation for the area is 930 mm/year and mean daily temperature is 7.9 °C.

In summary, the total shallow groundwater recharge rate for the site is estimated to be 175 mm/year. This recharge was referenced from the MOE Table 2 and Table 3 approach in the Technical Information Requirements for Land Development Applications (MOE, 1995). The post-development water budget was calculated and is presented in Appendix H. A recharge rate of 100 mm/year was assumed for the silty sand/sandy silt beneath the site.

The water balance (pre- and post-development) is summarized in Table 5 from Appendix H.

Table 5. Comparison of Pre- and Post-Development Water Balance

| Development | Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Infiltration ($m^3$) | Run-Off ($m^3$) |
|---|---|---|---|---|
| Pre-Development | 3,563 | 897 | 147 | 2,518 |
| Post-Development | 3,565 | 413 | 68 | 3,084 |

The increase in run-off from 2,518 $m^3$ to 3,084 $m^3$ is the result of developing and installing hard surfaced or impermeable areas across the site. The post-development impermeable areas also result in the decrease of evapotranspiration and infiltration across the site.

The above-noted values and associated calculations found in Appendix H are considered to be conservative and are based on the following assumptions:

- No infiltration will occur beneath the internal roads, walkways, buildings or driveways.
- No evapotranspiration will occur from the internal roads, walkways, buildings or parking areas.

## 7.4 Mitigating Measures to Maintain Hydrogeological Functions

### 7.4.1 Maintenance of Groundwater Recharge

The site is considered to have significant amounts of groundwater recharge due to the relatively high permeable soils encountered at surface at the site. There is no natural area for infiltration proposed for the development. However, infiltration value is expected to decrease from 147 to 68 $m^3$/year based on the water balance calculations outlined in Appendix H. This decrease in infiltration indicates that approximately 4% of the roof runoff from the proposed buildings must be re-directed towards overland flow or infiltration facilities in order to match the pre-development infiltration rates.

It is recommended that development planners collaborate with storm water specialists or engineers to be able to maintain pre-development water balance and recharge at the site through storm water management design techniques. Perhaps Low Impact Development techniques would be applicable for this site.

### 7.4.2 Maintenance of Groundwater Transmission Pathways

As referenced from the Graziani & Corazza Architects Inc. drawings provided by Molinaro Group, it is understood that the earthworks and servicing will be completed within the clayey silt and bedrock beneath the Site. The overall continuity of the groundwater flow at the site should be maintained, where practical. Generally, any groundwater transmission pathways encountered can be maintained through the following means:

- The excavation of any underground services or utilities across more permeable layers may interrupt the groundwater flow. As good practice, it is recommended that trench backfilling operations be carried out with materials that are similar to the materials that have been excavated. In particular, if any more permeable sand zones are encountered, they must not be truncated by backfilling of the excavation or trench using lower permeability materials (such as the silty sand/sandy silt identified at the subject site).

## 8.0 SUMMARY AND CONCLUSIONS

The following summarizes the results of the investigation:

- Generally, the site stratigraphy consists of fill/clayey silt to depths varying from 3.0-3.5 mbgs, which overlies bedrock. Drilling was terminated at a maximum depth of approximately 9.3 mbgs in bedrock.
- Lake Ontario is located approximately 1.4 km southeast of the site. The direction of groundwater flow at the site is southwest towards.
- Groundwater contour plot from groundwater monitoring levels recorded on September 24, 2020 indicates the direction of groundwater flow was southwest. The horizontal hydraulic gradient across the Site, was approximately 0.043 m/m southwest.
- The water table present within the shale bedrock at the site ranges from 1.0 meters mbgs to 3.15 mbgs.
- There will be two levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 7.1 mbgs (Level 1 = 4.1 m, and Level 2 = 3.0 m). A dewatering depth of approximately 0.5 m below the excavation bottom (7.6 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.
- The maximum short term dewatering rate of groundwater for the proposed excavation under normal operation which does not include extreme weather events is estimated to be approximately 70,016 L/day = ~0.81 L/s.
- Long term dewatering is not required at the Site as the proposed underground parking levels and structures will be designed to be fully waterproofed in accordance regulatory requirements.
- The maximum dewatering rate of groundwater for the proposed excavation is estimated to be approximately 453,116 L/day or ~5.2 L/s (radial inflow and direct precipitation).
- A permit to take water (PTTW) is required for above volume of water taking, as the estimated water taking is more than 400,000 L/day.
- A Dewatering Volume Plan for construction should provide for dewatering volumes ranging from 6,044 L/day or 0.07 L/s (determined using the low-end value of hydraulic conductivity value for Burlington shale) to 453,116 or ~5.2 L/s (radial inflow [determined with the geometric mean of the field determined hydraulic conductivity values] + direct precipitation).
- Water extracted during construction dewatering is required to be discharged into an approved combined storm sewer near the Site.
- As per the Sewers ByLaw, in order to issue a discharge approval, information relating to the quality and quantity of the discharge must be provided to City of Burlington. It is strongly recommended that the applicant provide this information eight to twelve weeks prior to the proposed start of discharge.
- Geotechnical and surface water impacts are anticipated during groundwater dewatering within a radius of approximately 22 m outside the Site boundaries.

## 9.0 RECOMMENDATIONS

The following general construction practices are recommended to minimize the volume of water to be extracted:

- Schedule construction outside the spring period when the water table is typically elevated and avoid constructing during period of active precipitation.
- Reduce the length of time during which the open cut remains open.
- Install valves on the individual well point to allow for the flow adjustment.

The City of Burlington is currently reviewing the Municipal Storm Sewer Discharge By-Law. The City advises that at the time of excavation the requirements of the by-law in place should be adhered to.

An application for a Permit to Take Water (PTTW) should be completed for the potential groundwater dewatering requirement at the Site.

## 10.0 CLOSURE

We trust this report is satisfactory for you purposes. If you have any questions regarding our submission, please do not hesitate to contact this office.

Yours truly,

Landtek Limited




Henry Erebor, M.Sc., P.Geo.,

## 11.0 REFERENCES

Armstrong, D.K., and Dodge, J.E.P. 2007. Paleozoic Geology Map of Southern Ontario. OntarioGeological Survey, Miscellaneous Release – Data 219.

Chapman, L.J., Putnam, D.F. 1984. Physiography of Southern Ontario. Ontario Geological Survey Map P.2715. https://brocku.ca/maplibrary/maps/geology/Ontario/P2715_Physiography_of_Southern_Ontario.pdf

Chapman, L.J., and Putnam, D.F. 2007. The Physiography of Southern Ontario. Ontario Geological Survey, Miscellaneous Release – Data 228.

Johnson, M.D., Armstrong, D.K., Sanford, B.V., Telford, P.G., and Rutka, M.A. 1992. Paleozoic and Mesozoic geology of Ontario: in Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, p.907-1010.

Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario.

Ontario Geological Survey. 2016. Quaternary Geology of Ontario, 1:100,000. OGS Earth Application.

Ministry of the Environment and Climate Change. 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995. Ontario Ministry of Environment and Energy.

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

Ontario Geological Survey, OGS Earth. Quaternary Geology of Ontario

Ontario Geological Survey, OGS Earth. Bedrock Geology of Ontario.

## 12.0 LIMITATIONS

The conclusions and recommendations given in this report are based on information determined at the borehole locations. Subsurface and ground water conditions between and beyond the boreholes may be different from those encountered at the borehole locations, and conditions may become apparent during construction that could not be detected or anticipated at the time of the geotechnical investigation. It is recommended practice that Landtek be retained during construction to confirm that the subsurface conditions throughout the site are consistent with the conditions encountered in the boreholes.

The comments made in this report on potential construction problems and possible remedial methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may influence construction methods and costs. For example, the thickness and quality of surficial topsoil or fill layers may vary markedly and unpredictably. Contractors bidding on the project, or undertaking construction on the site should make their own interpretation of the factual borehole information, and establish their own conclusions as to how the subsurface conditions may affect their work.

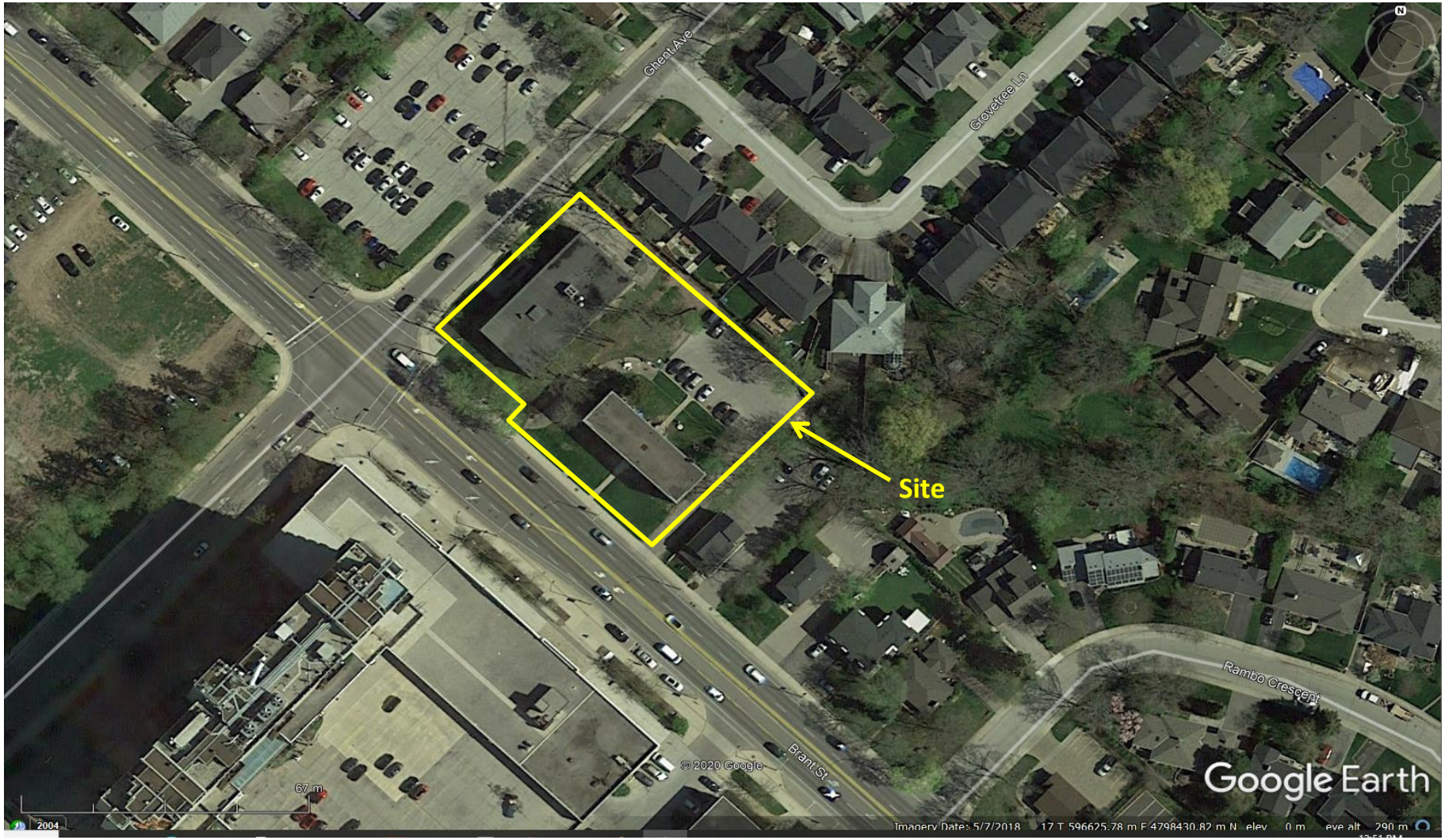
The survey elevations in the report were obtained by Landtek or others, and are strictly for use by Landtek in the preparation of the geotechnical report. The elevations should not be used by any other parties for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Landtek accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

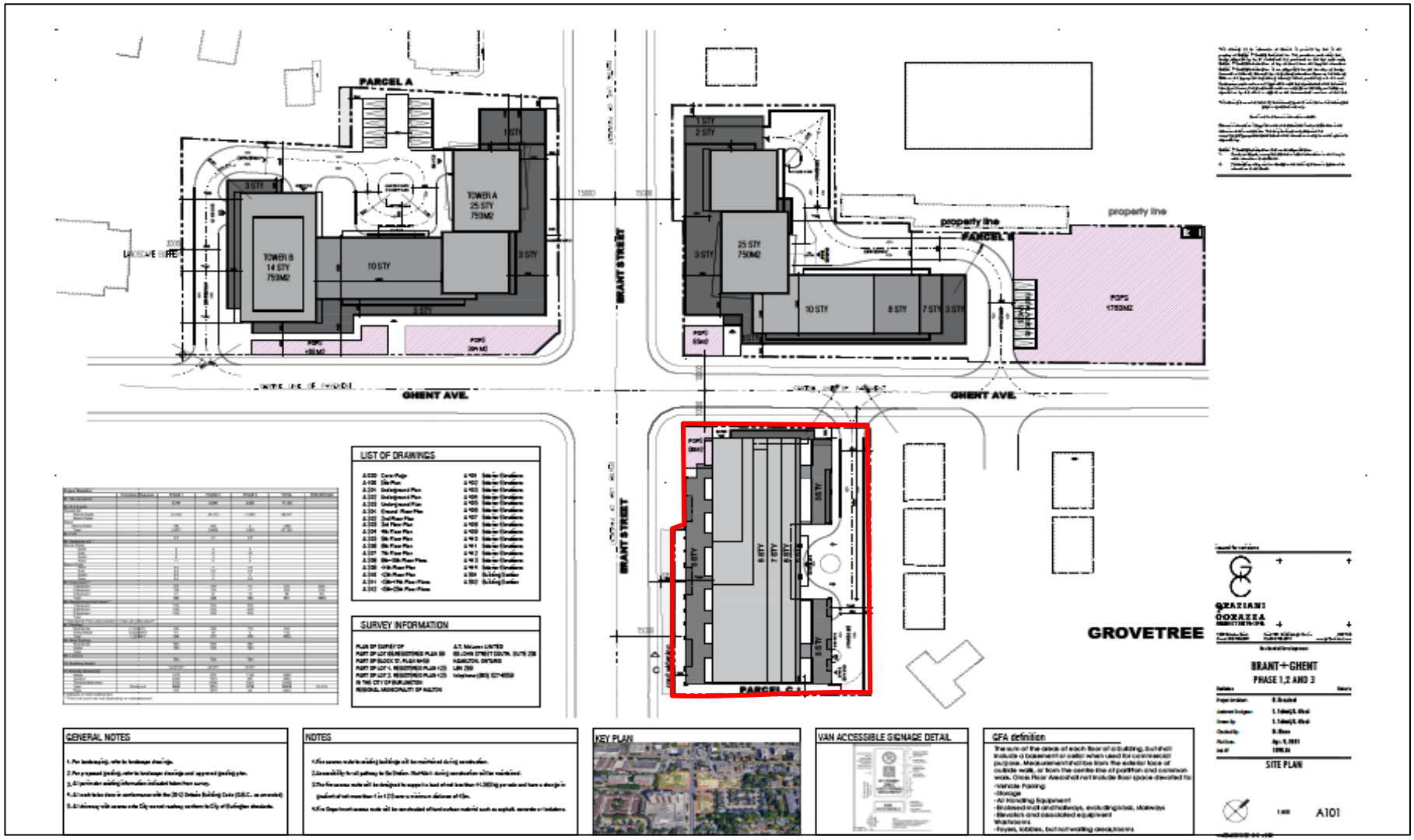
This report does not reflect environmental issues or concerns related to the property unless otherwise stated in the report. The design recommendations given in the report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, it is recommended that Landtek be retained during the final design stage to verify that the design is consistent with the report recommendations, and that the assumptions made in the report are still valid.

# APPENDIX A

# FIGURES

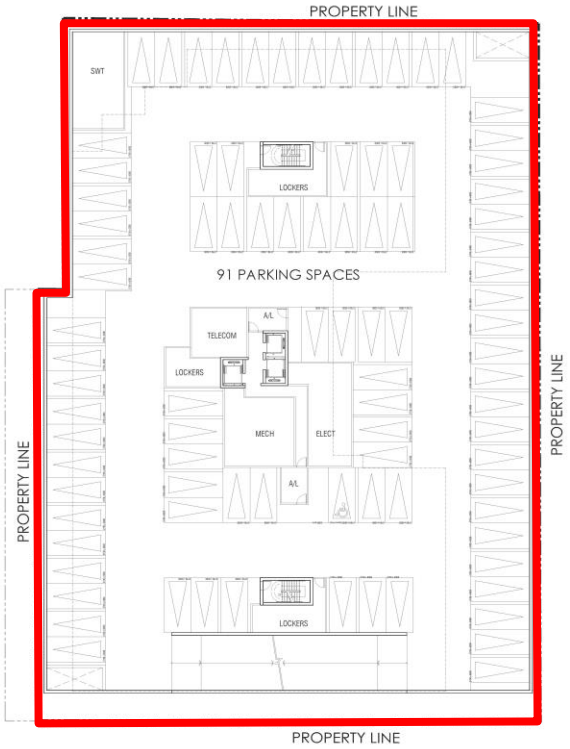



| | |
|---|---|
| **LANDTEK LIMITED**<br>***CONSULTING ENGINEERS***<br>**205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1** | |
| Scale: See Map | Date: September 2020 |
| **Project:** | Hydrogeological Investigation<br>747 and 761 Brant Street<br>Burlington, Ontario |
| **Title:** | Figure 1: Site Location |
| **Project No.** | 20255C |




Site

| | |
|---|---|
| | **LANDTEK LIMITED**<br>***CONSULTING ENGINEERS***<br>**205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1** |
| Scale: On Plan | Date: May 2021 |
| **Project:** | Hydrogeological Investigation<br>774-782 Brant Street<br>Burlington, Ontario |
| **Title:** | Figure 2: Site Plan |
| **Project No.** | 20255A |

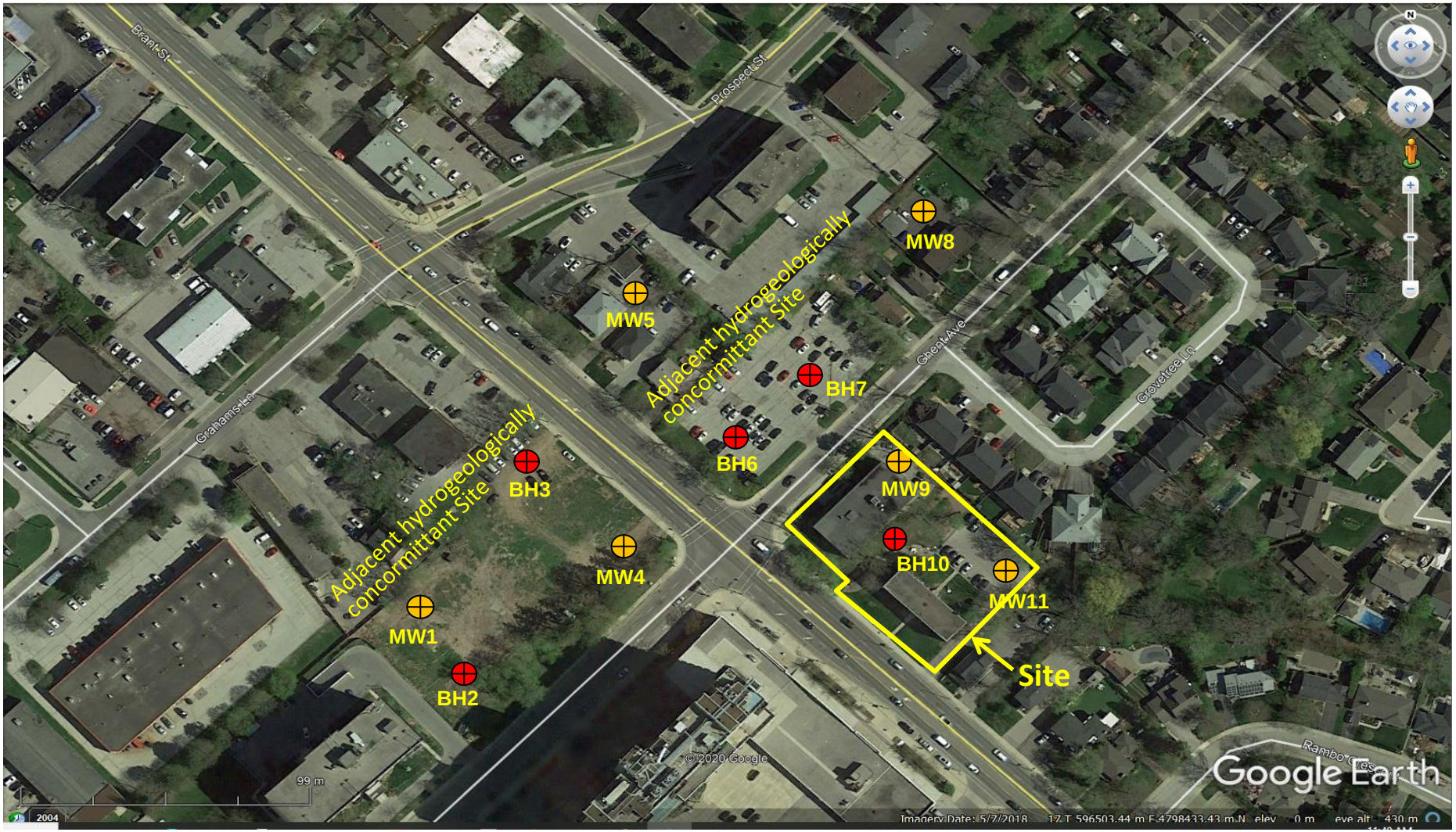








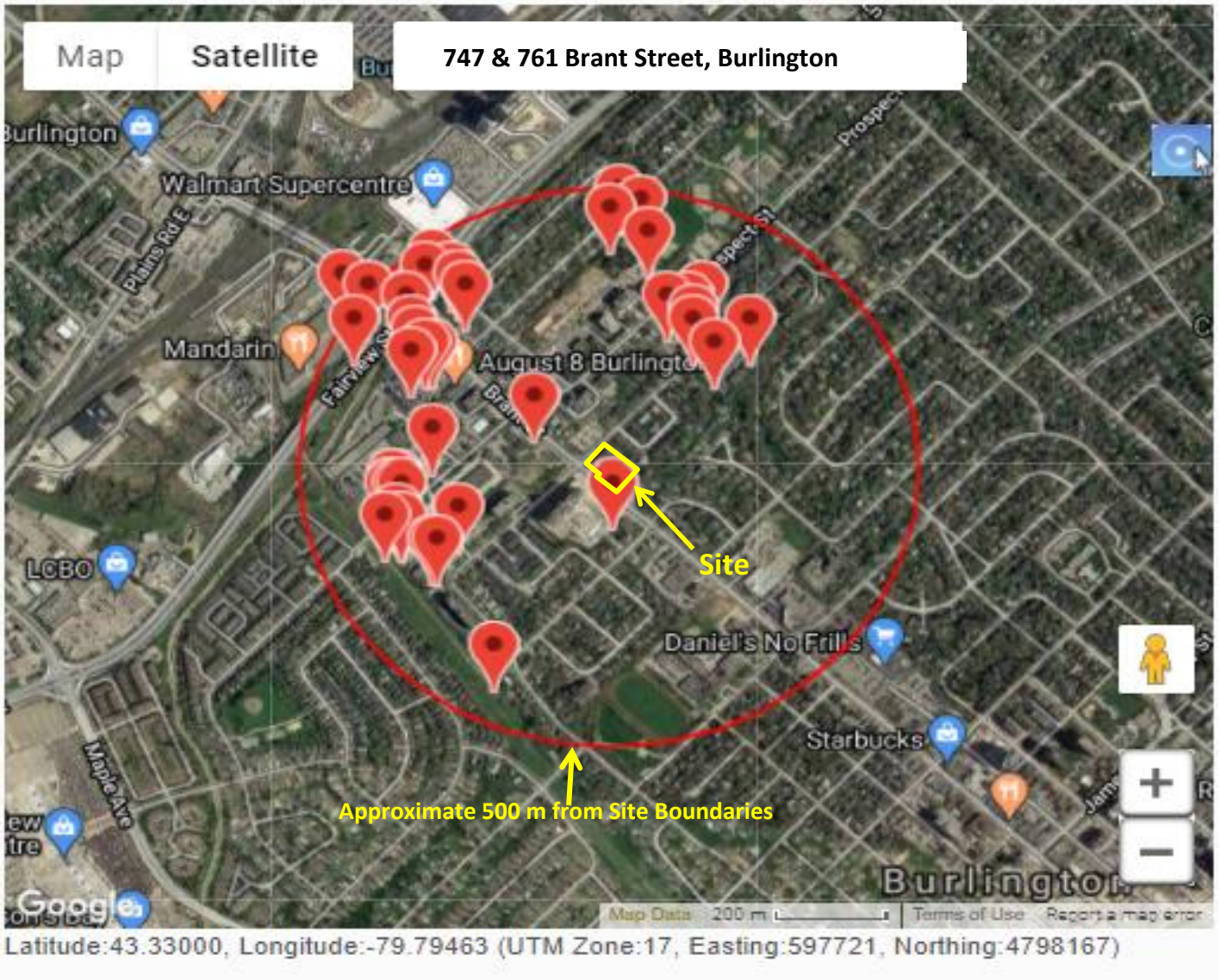
| | |
|---|---|
| | **LANDTEK LIMITED**<br>***CONSULTING ENGINEERS***<br>**205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1** |
| Scale: On Plan | Date: May 2022 |
| **Project:** | Hydrogeological Investigation<br>Hydrogeological Investigation<br>774-782 Brant Street |
| **Title:** | Figure 3: Underground Parking Plan |
| **Project No.** | 20255C |




Monitoring Well Location

Borehole Location

| | |
|---|---|
| LANDTEK LIMITED<br>*CONSULTING ENGINEERS*<br>205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1 | |
| Scale: See Map | Date: September 2020 |
| **Project:** | Hydrogeological Investigation<br>747 and 761 Brant Street<br>Burlington, Ontario |
| **Title:** | Figure 4: Boreholes and Monitoring Wells Locations |
| **Project No.** | 20255C |



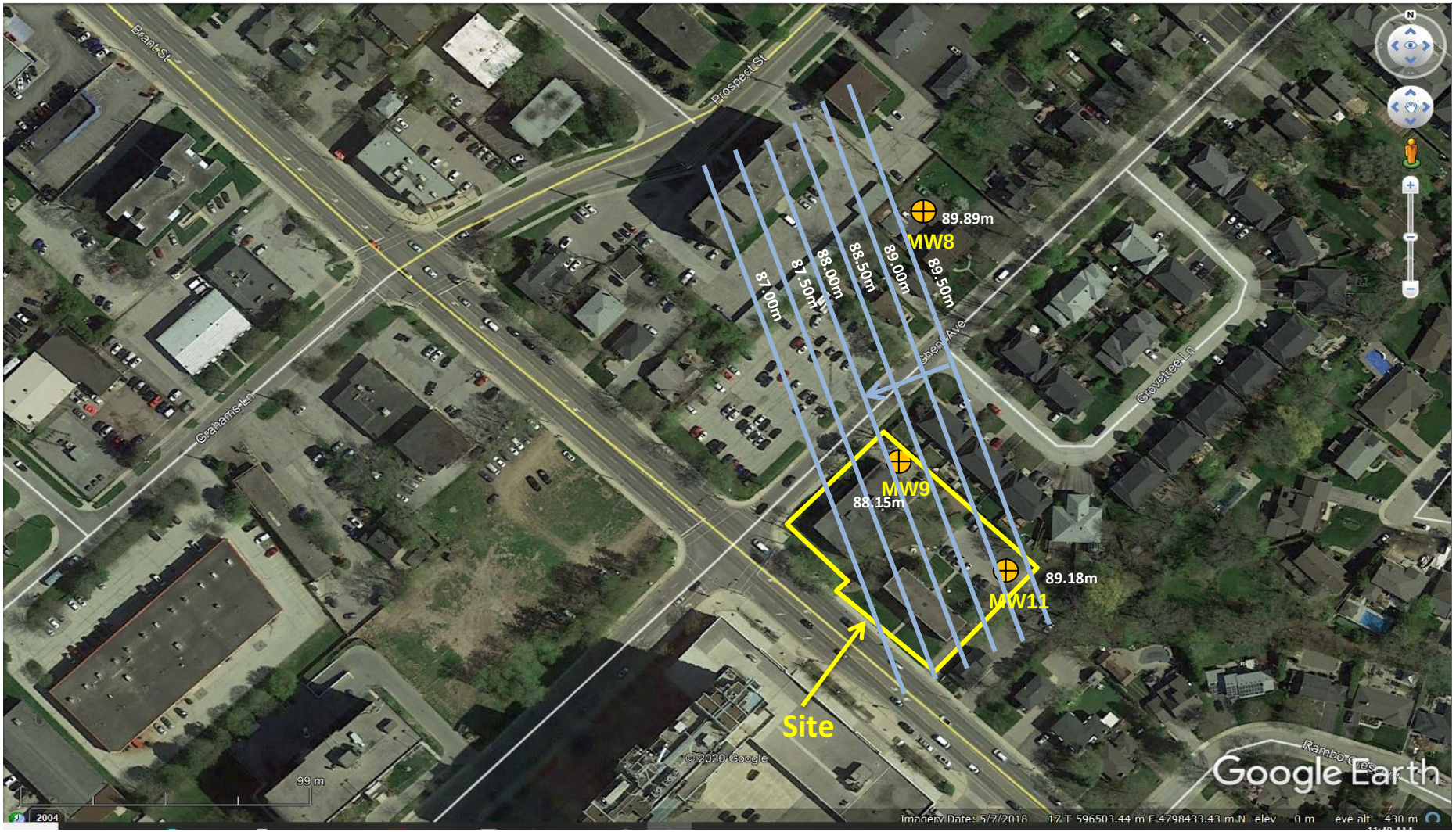

MECP Wells Locations

**LANDTEK LIMITED**

*CONSULTING ENGINEERS*

**205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1**

| | | |
|---|---|---|
| | Scale: See Map | Date: September 2020 |
| **Project:** | Hydrogeological Investigation<br>747 and 761 Brant Street<br>Burlington, Ontario | |
| **Title:** | Figure 5: MECP Wells Locations | |
| **Project No.** | 20255 | |




**LEGEND**

- Borehole/Monitoring Well
- Groundwater Flow Direction
- 90.00 m — Groundwater Level Contour

| | |
|---|---|
| | **LANDTEK LIMITED**<br>*CONSULTING ENGINEERS*<br>**205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1** |
| Scale: See Map | Date: September 2020 |
| **Project:** | Hydrogeological Investigation<br>747 and 761 Brant Street<br>Burlington, Ontario |
| **Title:** | Figure 6: Monitoring Wells Locations |
| **Project No.** | 20255C |

# APPENDIX B

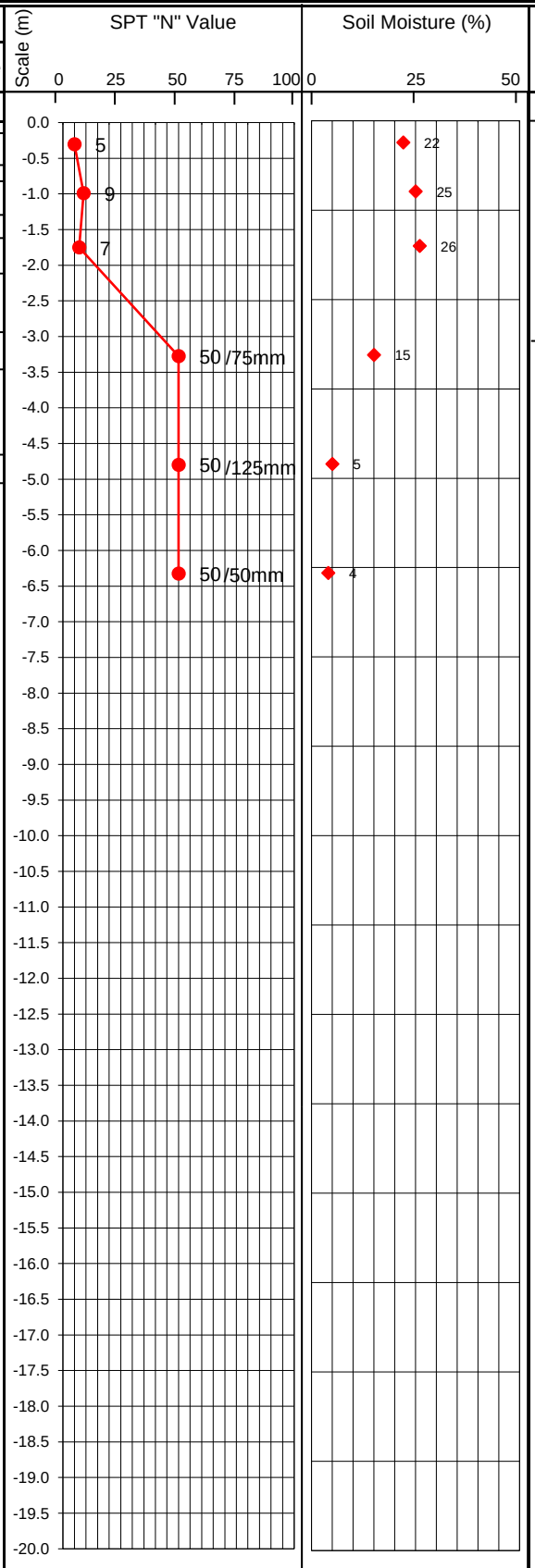
## BOREHOLES & MONITORING WELLS LOGS

# Landtek Limited

**BH 9**

| | | | |
|---|---|---|---|
| Project No.: | 20255C | Drill Date: | August 31, 2020 |
| Project: | Hydrogeological Investigation | Drill Method: | [ ] solid stem [ x ] hollow stem [ ] Coring |
| Location: | Brant Street and Ghent Avenue, Burlington, Ontario | Datum: | Geodetic (Approximate) |

| Material Description | Elev. Depth | Samples No. | Type | Test Data |
|---|---|---|---|---|
| Ground Surface | 91.3 | | | Flush mount |
| ±50 mm of asphalt | 0.0 | 1 | SS | |
| ± 200 mm of crushed limestone | | | | |
| **FILL:** clayey silt, trace gravel, dark brown, firm, moist | | 2 | SS | |
| | | 3 | SS | |
| | 88.3 | | | |
| **CLAYEY SILT TILL**: trace gravel, trace shale, brownish grey, very stiff, moist | 3.0 | 4 | SS | |
| | 3.5 | | | |
| **SHALE BEDROCK** (Queenston Formation) very weak to weak, highly weathered, red, moist | | 5 | SS | |
| | 82.2 | | | |
| | 9.1 | | | |
| **AUGER REFUSAL** **BOREHOLE TERMINATED** | | | | |




**Notes:**
1. Groundwater not encountered during drilling
2. Water level reading: 3.15 m on September 24, 2020

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

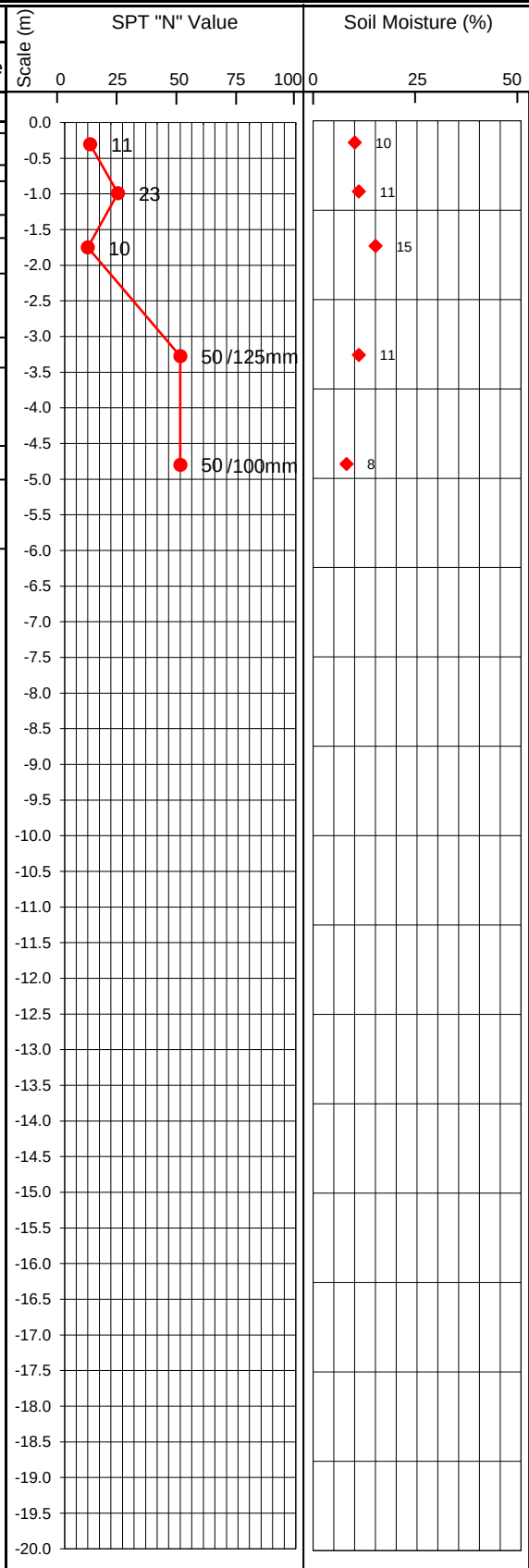

Landtek Limited
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

# Landtek Limited

**BH 10**

| | | | |
|---|---|---|---|
| Project No.: | 20255C | Drill Date: | August 31, 2020 |
| Project: | Hydrogeological Investigation | Drill Method: | [ ] solid stem [ x ] hollow stem [ ] Coring |
| Location: | Brant Street and Ghent Avenue, Burlington, Ontario | Datum: | Geodetic (Approximate) |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Test Data |
|---|---|---|---|---|---|
| Ground Surface | | 91.3 | | | |
| ±50 mm of Topsoil | | 0.0 | | | |
| **FILL:** clayey silt, trace gravel, trace iron staining, stiff to very stiff, moist | | | 1 | SS | |
| | | | 2 | SS | |
| | | | 3 | SS | |
| **SHALE BEDROCK** (Queenston Formation) very weak to weak, highly weathered, red, moist | | 3.0 | 4 | SS | |
| | | | 5 | SS | |
| **AUGER REFUSAL** **BOREHOLE TERMINATED** | | 6.0 | | | |




GWL | Monitor Details | Test Data

**Notes:** 1. Groundwater not encountered during drilling

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity


Landtek Limited
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

# Landtek Limited

**BH/MW 11**

| | | | |
|---|---|---|---|
| Project No.: | 20255C | Drill Date: | August 31, 2020 |
| Project: | Hydrogeological Investigation | Drill Method: | [ ] solid stem [ x ] hollow stem [ x ] Coring |
| Location: | Brant Street and Ghent Avenue, Burlington, Ontario | Datum: | Geodetic (Approximate) |

| Material Description | Symbol | Elev. Depth | Samples No. | Samples Type | Scale (m) |
|---|---|---|---|---|---|
| Ground Surface | | 91.1 | | | |
| ±50 mm of asphalt<br>± 100 mm of crushed limestone<br>**FILL:** clayey silt, trace gravel, trace iron staining, soft to stiff, very moist to wet | | 0.0 | 1<br>2<br>3 | SS<br>SS<br>SS | |
| | | 88.1 | | | |
| **SHALE BEDROCK** (Queenston Formation) very weak to weak, highly weathered, red, moist<br>7.6 m to 9.3 m: slightly weathered to fresh, medium strong | | 3.0<br>83.5 | 4<br>5 | SS<br>SS | 63 mm Dia. Core |
| Recovery = 100 %; RQD = 83 %<br>∂ = 25.7 kN/m³; UCS strength = 27.3 MPa | | 7.6 | RUN #1 | | |
| Recovery = 100 %; RQD = 100 %<br>∂ = 25.7 kN/m³; UCS strength = 39.5 MPa | | 8.5<br>81.8 | RUN #2 | | |
| **BOREHOLE TERMINATED** | | 9.3 | | | |

SPT "N" Value: 9, 8, 3, 50/125 mm, 50/75 mm

Soil Moisture (%): 27, 22, 22, 19, 5

GWL: WL = 1.95 m Sept. 24, 2020

Monitor Details: Flush mount; bentonite backfill to 0.3 m below existing pavement surface; sand backfill to 6.0 m; 6.3 m; 3.0 m of slotted 50 mm dia. PVC pipe; 9.3 m

**Notes:**
1. Groundwater not encountered during drilling
2. Water level reading: 1.95 m on September 24, 2020

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

Landtek Limited
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

# APPENDIX C

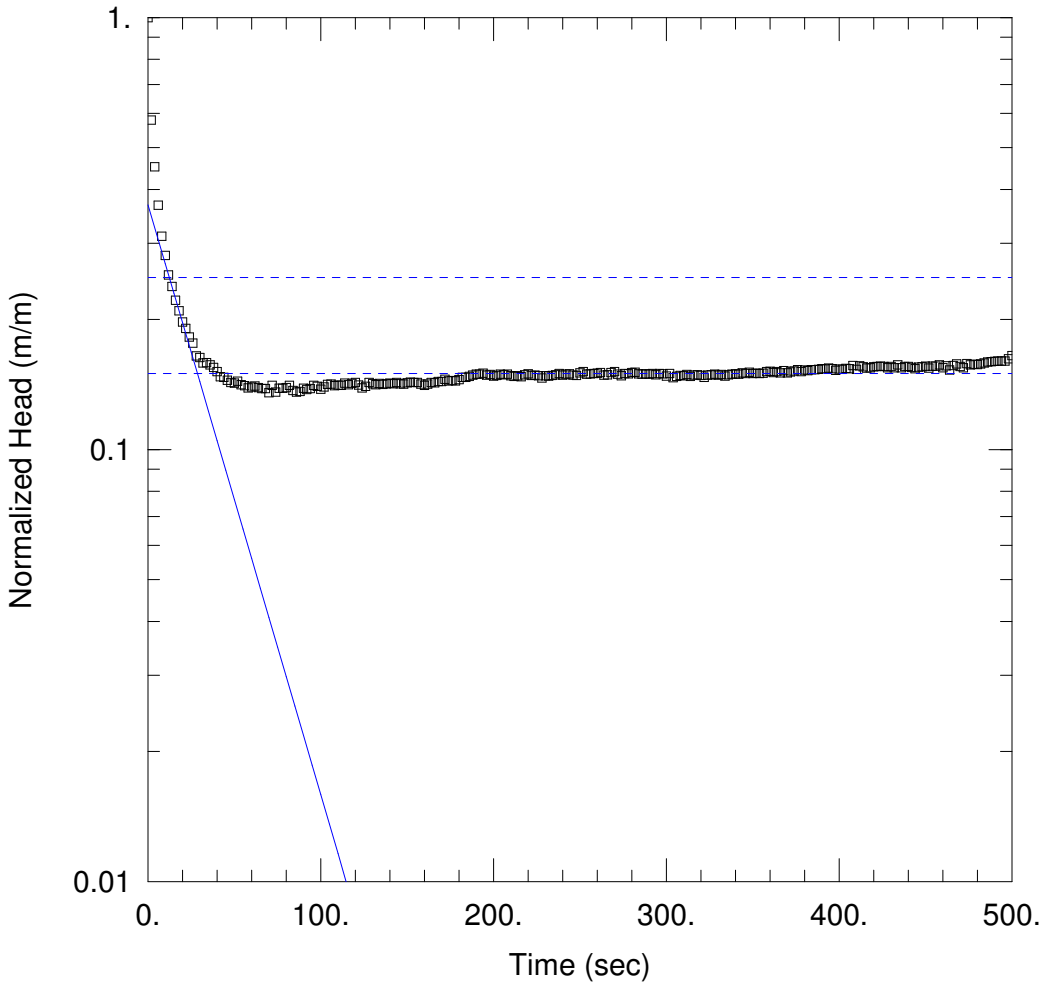
## SUMMARY OF MECP WELL RECORDS

**906 Main Street West, Hamilton**

| Well # | WELL_ID | DATE_COMPLETED | DATE_RECEIVED | EAST83 | NORTH83 | WATER_FOUND_ DEPTH (FT) | Static Water Level (ft) | KIND | FINAL_STATUS | USE_1ST | DEPTH_TO (ft) | DEPTH_TO (m) | Well Construction | STREET | CITY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2810171 | 09-Feb-05 | 10-Mar-05 | 596252 | 4798292 | 11.5 | NA | Fresh | Observation Well | Observation Well | 14.8 | 4.51 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 2 | 2810214 | 21-Mar-05 | 26-Apr-05 | 596212 | 4798276 | 6.6 | NA | NA | Observation Well | NA | 14.8 | 4.51 | Overburden | NA | BURLINGTON |
| 3 | 2810308 | 16-May-05 | 03-Aug-05 | 596240 | 4798302 | 8.2 | NA | Fresh | Observation Well | Observation Well | 15.1 | 4.60 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 4 | 7042731 | 03-Apr-07 | 17-Apr-07 | 596361 | 4798305 | NA | NA | NA | Observation Well | Monitoring Well | 13.1 | 3.99 | Overburden | 802 Hager Avenue | BURLINGTON |
| 5 | 7128794 | 09-Jan-08 | 01-Sep-09 | 596186 | 4798748 | NA | NA | NA | Abandoned | Monitoring Well | 22.3 | 6.80 | Overburden | 2075 Fairview Street | BURLINGTON |
| 6 | 7179514 | 09-Jan-12 | 17-Apr-12 | 596238 | 4798370 | NA | NA | NA | Monitoring and Test hole | Monitoring and Test hole | 16.73 | 5.10 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 7 | 7179515 | 19-Jan-12 | 17-Apr-12 | 596232 | 4798362 | NA | NA | NA | Monitoring and Test hole | Monitoring and Test hole | 16.73 | 5.10 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 8 | 7179516 | 19-Jan-12 | 17-Apr-12 | 596245 | 4798354 | NA | NA | NA | Monitoring and Test hole | Monitoring and Test hole | 16.73 | 5.10 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 9 | 7179605 | 19-Jan-12 | 17-Apr-12 | 596248 | 4798355 | NA | NA | NA | Monitoring and Test hole | Monitoring and Test hole | 18 | 5.49 | Overburden | 1380 Grahams Lane | BURLINGTON |
| 10 | 7187211 | NA | 17-Sep-12 | 596799 | 4798762 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Bedrock | 2096 Hent Avenue | BURLINGTON |
| 11 | 7187212 | NA | 17-Sep-12 | 596775 | 4798734 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Bedrock | 2084 Ghgnt Avenue | BURLINGTON |
| 12 | 7220604 | 21-Apr-14 | 20-May-14 | 596782 | 4798703 | NA | NA | NA | Monitoring Well | Monitoring Well | 17 | 5.18 | Bedrock | 2702 Ghent Avenue | BURLINGTON |
| 13 | 7220605 | 21-Apr-14 | 20-May-14 | 596782 | 4798703 | NA | NA | NA | Abandoned | NA | 20 | 6.10 | NA | 2702 Ghent Avenue | BURLINGTON |
| 14 | 7244979 | 03-Jun-15 | 21-Jul-15 | 596883 | 4798686 | 7 | NA | NA | Abandoned | NA | NA | NA | NA | 2086 Grant Avenue | BURLINGTON |
| 15 | 7244980 | 03-Jun-15 | 21-Jul-15 | 596883 | 4798686 | NA | NA | NA | Observation Well | Monitoring Well | 18 | 5.5 | Bedrock | 2086 Grant Avenue | BURLINGTON |
| 16 | 7244981 | 03-Jun-15 | 21-Jul-15 | 596883 | 4798686 | NA | NA | NA | Observation Well | NA | 18 | 5.49 | Bedrock | 2086 Grant Avenue | BURLINGTON |
| 17 | 7244982 | 03-Jun-15 | 21-Jul-15 | 596825 | 4798636 | NA | NA | NA | Abandoned | NA | NA | NA | NA | 2086 Grant Avenue | BURLINGTON |
| 18 | 7251865 | 11-Sep-15 | 10-Nov-15 | 596782 | 4798684 | NA | NA | NA | Monitoring Well | Monitoring Well | 20 | 6.10 | Bedrock | 2068 Ghent Avenue | BURLINGTON |
| 19 | 7252011 | 04-Sep-15 | 10-Nov-15 | 596736 | 4798745 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Bedrock | 2071 Ghent Avenue | BURLINGTON |
| 20 | 7283351 | 04-Nov-16 | 17-Mar-17 | 596640 | 4798358 | NA | NA | NA | Monitoring and Test hole | Test Hole | 20 | 6.10 | Overburden | 730 Brant Street | BURLINGTON |
| 21 | 7284939 | 07-Mar-17 | 10-Apr-17 | 596319 | 4798254 | NA | NA | NA | Monitoring and Test hole | Test Hole | 15 | 4.57 | Bedrock | 770 Haggar Avenue East | BURLINGTON |
| 22 | 7284940 | 07-Mar-17 | 10-Apr-17 | 596309 | 4798244 | NA | NA | NA | Monitoring and Test hole | Test Hole | 15 | 4.57 | Bedrock | 770 Haggar Avenue East | BURLINGTON |
| 23 | 7290057 | 26-May-17 | 07-Jul-17 | 596301 | 4798815 | NA | NA | NA | Observation Well | Test Hole | 20 | 6.10 | Overburden | 833 Brant Street | BURLINGTON |
| 24 | 7290058 | 26-May-17 | 07-Jul-17 | 596289 | 4798790 | NA | NA | NA | Observation Well | Test Hole | 20 | 6.10 | Overburden | 855 Brant Street | BURLINGTON |
| 25 | 7291911 | 12-Jun-17 | 02-Aug-17 | 596224 | 4798347 | NA | NA | NA | NA | NA | NA | NA | NA | NA | BURLINGTON |
| 26 | 7292314 | 21-Jun-17 | 11-Aug-17 | 596336 | 4798785 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Overburden | 849 Brant Street | BURLINGTON |
| 27 | 7292315 | 21-Jun-17 | 11-Aug-17 | 596336 | 4798786 | NA | NA | NA | Observation Well | Monitoring Well | 30 | 9.15 | Overburden | 849 Brant Street | BURLINGTON |
| 28 | 7292316 | 21-Jun-17 | 11-Aug-17 | 596361 | 4798743 | NA | NA | NA | Observation Well | Monitoring Well | 18 | 5.49 | Overburden | 849 Brant Street | BURLINGTON |
| 29 | 7292317 | 21-Jun-17 | 11-Aug-17 | 596352 | 4798776 | NA | NA | NA | Observation Well | Monitoring Well | 18 | 5.49 | Overburden | 849 Brant Street | BURLINGTON |
| 30 | 7314898 | 04-Jul-18 | 19-Jul-18 | 596295 | 4798451 | NA | NA | NA | Observation Well | Monitoring Well | 15 | 4.57 | Overburden | 1416 Graham Lane | BURLINGTON |
| 31 | 7320914 | 22-Aug-18 | 18-Oct-18 | 596673 | 4798937 | NA | NA | NA | Test Hole | Test Hole | 65.6 | 20.00 | Overburden | 2087 Prospect Street | BURLINGTON |
| 32 | 7320915 | 22-Aug-18 | 18-Oct-18 | 596624 | 4798918 | NA | NA | NA | Test Hole | Test Hole | 65.6 | 20.00 | Overburden | 2087 Prospect Street | BURLINGTON |
| 33 | 7320916 | 22-Aug-18 | 18-Oct-18 | 596697 | 4798876 | NA | NA | NA | Test Hole | Test Hole | 65.6 | 20.00 | Overburden | 2087 Prospect Street | BURLINGTON |
| 34 | 7323581 | 05-Oct-18 | 06-Dec-18 | 596643 | 4798961 | NA | NA | NA | Test Hole | Test Hole | 20 | 6.10 | Overburden | 2103 Prospect Street | BURLINGTON |
| 35 | 7330854 | 14-Feb-19 | 01-Apr-19 | 596270 | 4798655 | NA | NA | NA | Observation Well | Monitoring Well | 13 | 3.96 | Overburden | 850 Brant Street | BURLINGTON |
| 36 | 7330855 | 14-Feb-19 | 01-Apr-19 | 596305 | 4798644 | NA | NA | NA | Observation Well | Monitoring Well | 15.6 | 4.76 | Overburden | 850 Brant Street | BURLINGTON |
| 37 | 7330856 | 15-Feb-19 | 01-Apr-19 | 596261 | 4798608 | NA | NA | NA | Monitoring and Test hole | Monitoring Well | 15.6 | 4.76 | Overburden | 850 Brant Street | BURLINGTON |
| 38 | 7330857 | 15-Feb-19 | 01-Apr-19 | 596254 | 4798731 | NA | NA | NA | Monitoring and Test hole | Monitoring Well | 15.6 | 4.76 | Overburden | 850 Brant Street | BURLINGTON |
| 39 | 7330858 | 15-Feb-19 | 01-Apr-19 | 596259 | 4798693 | NA | NA | NA | Monitoring and Test hole | Monitoring Well | 15.6 | 4.76 | Overburden | 850 Brant Street | BURLINGTON |
| 40 | 7330859 | 14-Feb-19 | 01-Apr-19 | 596288 | 4798651 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Overburden | 850 Brant Street | BURLINGTON |
| 41 | 7331850 | 23-Aug-18 | 23-Apr-19 | 596494 | 4798533 | NA | NA | NA | Observation Well | Monitoring Well | 20 | 6.10 | Overburden | 280 Brant Street | BURLINGTON |
| 42 | 7332300 | NA | 08-May-19 | 596425 | 4798027 | NA | NA | NA | NA | NA | NA | NA | NA | NA | BURLINGTON |

# APPENDIX D

## HYDRAULIC CONDUCTIVITY TESTING ANALYSIS RESULTS




## HYDRGEOLOGICAL INVESTIGATION

Data Set: F:\...\MW1-update.aqt
Date: 10/07/20 Time: 09:51:07

## PROJECT INFORMATION

Company: Landtek Limited
Client: Milinaro Group
Project: 20255-A
Location: 774-780 Brant Street E.
Test Well: MW1
Test Date: September 24, 2020

## AQUIFER DATA

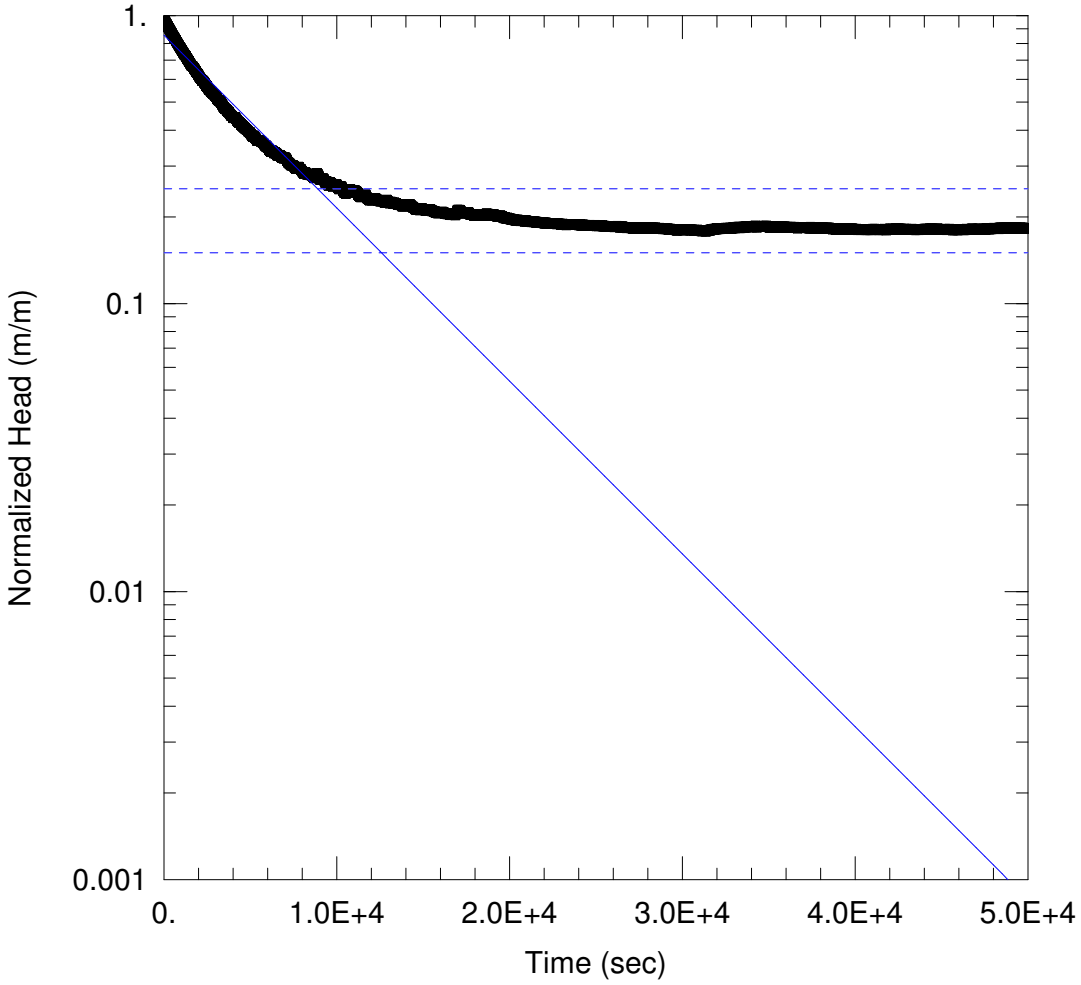
Saturated Thickness: 15.4 m
Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (MW1)

Initial Displacement: 0.311 m
Total Well Penetration Depth: 18.4 m
Casing Radius: 0.0254 m
Static Water Column Height: 15.4 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.847E-5 m/sec
y0 = 0.1147 m




## HYDRGEOLOGICAL INVESTIGATION

Data Set: F:\...\MW4.aqt
Date: 10/07/20 Time: 09:04:22

## PROJECT INFORMATION

Company: Landtek Limited
Client: Milinaro Group
Project: 20255-A
Location: 774-780 Brant Street E.
Test Well: MW4
Test Date: September 24, 2020

## AQUIFER DATA

Saturated Thickness: 14.4 m Anisotropy Ratio (Kz/Kr): 1.

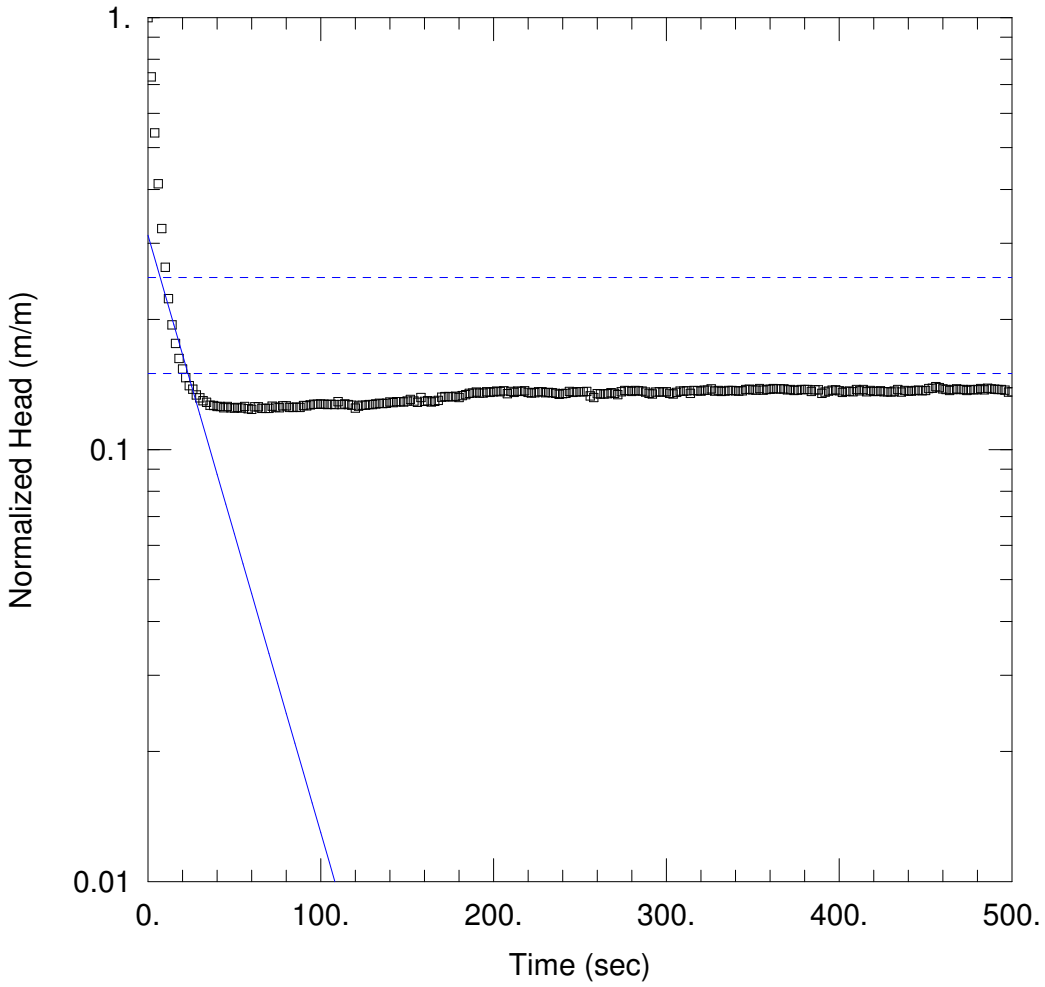
## WELL DATA (MW4)

Initial Displacement: 0.5121 m
Total Well Penetration Depth: 18.4 m
Casing Radius: 0.0254 m
Static Water Column Height: 14.92 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 8.12E-8 m/sec y0 = 0.4371 m




## HYDRGEOLOGICAL INVESTIGATION

Data Set: F:\...\MW5.aqt
Date: 10/07/20 Time: 09:07:35

## PROJECT INFORMATION

Company: Landtek Limited
Client: Milinaro Group
Project: 20255-B
Location: 769-789 Brant St.
Test Well: MW5
Test Date: September 24, 2020

## AQUIFER DATA

Saturated Thickness: 6.5 m Anisotropy Ratio (Kz/Kr): 1.

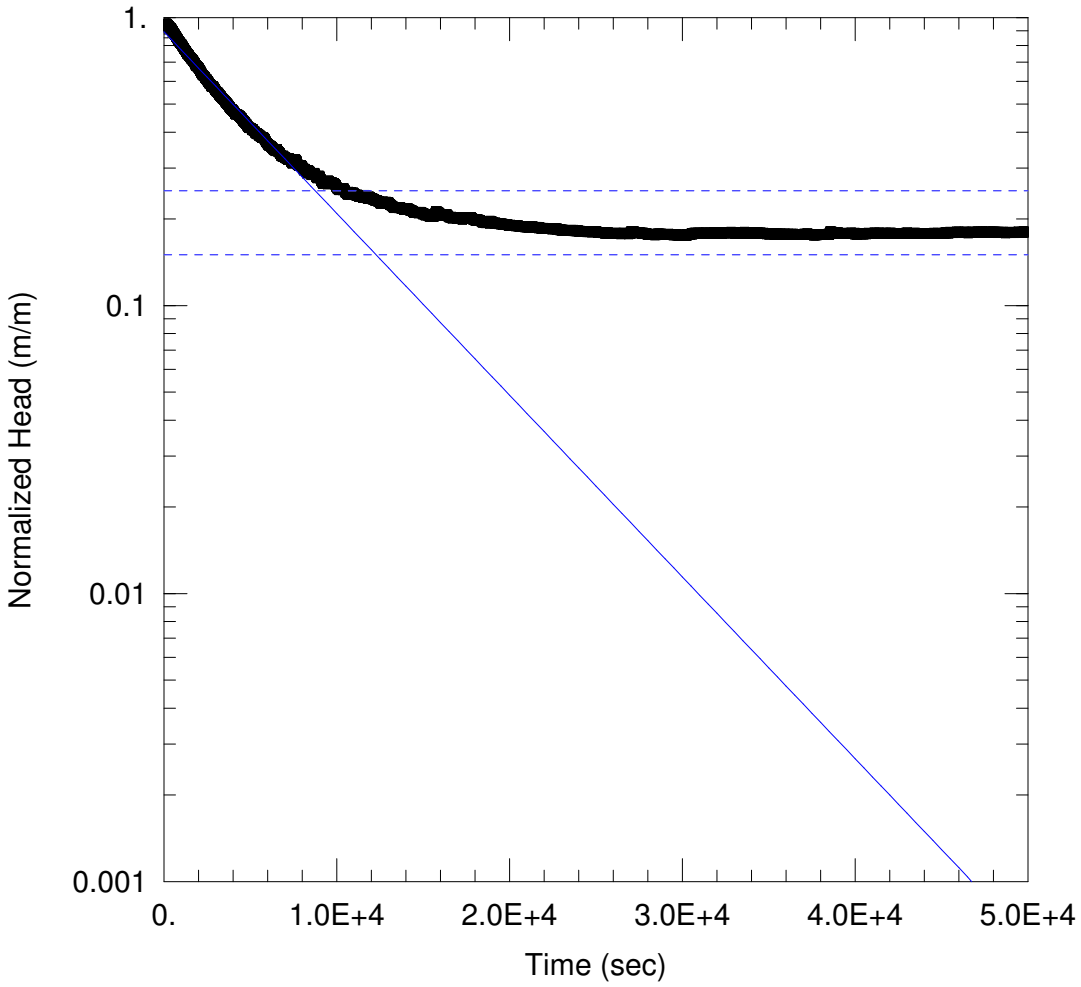
## WELL DATA (MW5)

Initial Displacement: 0.4104 m
Total Well Penetration Depth: 9.9 m
Casing Radius: 0.0254 m
Static Water Column Height: 9.9 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.871E-5 m/sec y0 = 0.1285 m




## HYDRGEOLOGICAL INVESTIGATION

Data Set: F:\...\MW8.aqt
Date: 10/07/20 Time: 09:09:17

## PROJECT INFORMATION

Company: Landtek Limited
Client: Milinaro Group
Project: 20255-B
Location: 769-789 Brant Street
Test Well: MW8
Test Date: September 24, 2020

## AQUIFER DATA

Saturated Thickness: 9.6 m Anisotropy Ratio (Kz/Kr): 1.

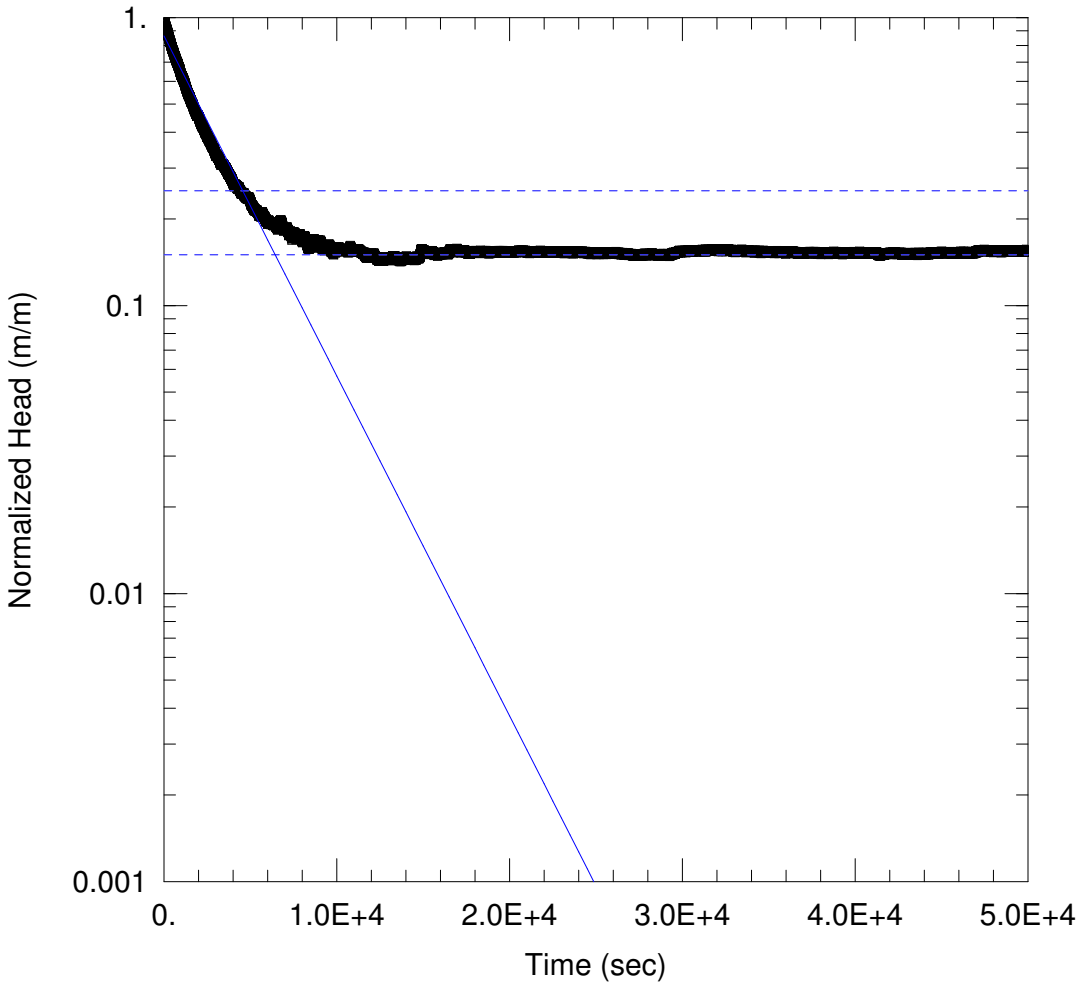
## WELL DATA (MW8)

Initial Displacement: 0.4756 m
Total Well Penetration Depth: 10.25 m
Casing Radius: 0.0254 m
Static Water Column Height: 10.25 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 8.538E-8 m/sec y0 = 0.4245 m




## HYDRGEOLOGICAL INVESTIGATION

Data Set: F:\...\MW11.aqt
Date: 10/07/20 Time: 09:10:53

## PROJECT INFORMATION

Company: ppppppp
Client: Milinaro Group
Project: 20255-C
Location: 747 & 761 Brant Street
Test Well: MW11
Test Date: September 24, 2020

## AQUIFER DATA

Saturated Thickness: 6.8 m
Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (MW11)

Initial Displacement: 0.4362 m
Total Well Penetration Depth: 7.35 m
Casing Radius: 0.0254 m
Static Water Column Height: 7.35 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.597E-7 m/sec
y0 = 0.3765 m

# APPENDIX E

## SUMMARY OF HYDRAULIC CONDUCTIVITY RESULTS FROM PREVIOUS INVESTIGATIONS

## Appendix G
## Summary of Hydraulic Conductivity Results from Previous Investigations

| Location | Author | Unit | K - Hydraulic Conductivity (m/sec) | |
|---|---|---|---|---|
| | | | Low | High |
| Various | Gartner Lee Ltd (1978) | Halton Till | $1 \times 10^{-9}$ | |
| Various | Gartner Lee Ltd (1978) | Queenston Shale | $8.10 \times 10^{-7}$ | |
| Various | Gartner Lee Ltd (1978) | Lacustrine Clay Silt (Peel Plain) | $1 \times 10^{-8}$ | |
| Georgetown | Gartner Lee Ltd. (1993) | Queenston Shale | $1 \times 10^{-6}$ | |
| Burlington | Gartner Lee Ltd. (1983) | Shale | $1 \times 10^{-8}$ | $1 \times 10^{-6}$ |
| Oakville (East) | MOE (1979) | Peel Plain | $5 \times 10^{-6}$ | $4 \times 10^{-5}$ |
| Oakville (East) | MOE (1979) | Queenston Shale | $3.2 \times 10^{-5}$ | $2.3 \times 10^{-6}$ |
| Oakville (East) | MOE (1979) | Georgian Bay Shale | $5.1 \times 10^{-6}$ | |
| Milton | International Water Consultants (1977) | Upper Sand and Gravel | $2.83 \times 10^{-3}$ | |
| Mississauga | Conestoga Rovers and Associates (2013) | Shale | $2.4 \times 10^{-5}$ | |

| Geometric Mean | K (m/sec) |
|---|---|
| Halton Till | $1 \times 10^{-9}$ |
| Peel Plain | $2.5 \times 10^{-6}$ |
| Sand/Gravel | $2.83 \times 10^{-3}$ |
| Queenston Shale | $1.1 \times 10^{-5}$ |
| Georgian Bay Shale | $5.1 \times 10^{-6}$ |

Source: Holysh (1997)

# APPENDIX F

## LABORATORY CERTIFICATE OF ANALYSIS

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

**CLIENT NAME: LANDTEK LTD.**
**205 NEBO ROAD, UNIT 3**
**HAMILTON, ON L8W2E1**
**(905) 383-3733**
**ATTENTION TO: Henry Erebor**
**PROJECT: 20255C**
**AGAT WORK ORDER: 20T653959**
**MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer**
**TRACE ORGANICS REVIEWED BY: Pinkal Patel, Report Reviewer**
**ULTRA TRACE REVIEWED BY: Philippe Morneau, chimiste**
**WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer**
**DATE REPORTED: Oct 02, 2020**
**PAGES (INCLUDING COVER): 16**
**VERSION*: 2**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

VERSION 2:Version 2 supersedes work order 20T653959, Version 1, issued October 1, 2020. Complete.

*Disclaimer:*

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*



Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. Measurement Uncertainty is not taken into consideration when stating conformity with a specified requirement.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## E. Coli (Using MI Agar)

**DATE RECEIVED: 2020-09-22**

**DATE REPORTED: 2020-10-02**

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **SAMPLE DESCRIPTION:** | | **MW9** | | **MW11** |
| | | **SAMPLE TYPE:** | | **Water** | | **Water** |
| | | **DATE SAMPLED:** | | **2020-09-22 11:27** | | **2020-09-22 12:15** |
| **Parameter** | **Unit** | **G / S** | **RDL** | **1468718** | **RDL** | **1468726** |
| Escherichia coli | CFU/100mL | 200 | 1 | ND | 2 | ND |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON Burlington Storm 086-2002
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

**1468718** ND - Not Detected.

**1468726** ND - Not Detected.
Presence of sediments was observed upon receipt.
If RDL >1 indicates dilutions of the sample.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:






*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Burlington Storm Sewer - Organics

**DATE RECEIVED: 2020-09-22**

**DATE REPORTED: 2020-10-02**

| | | SAMPLE DESCRIPTION: | | MW9 | MW11 |
|---|---|---|---|---|---|
| | | SAMPLE TYPE: | | Water | Water |
| | | DATE SAMPLED: | | 2020-09-22 11:27 | 2020-09-22 12:15 |
| Parameter | Unit | G / S | RDL | 1468718 | 1468726 |
| Methylene Chloride | mg/L | 0.0052 | 0.0003 | <0.0003 | <0.0003 |
| trans-1,3-Dichloropropylene | mg/L | 0.0056 | 0.0003 | <0.0003 | <0.0003 |
| cis- 1,2-Dichloroethylene | mg/L | 0.0056 | 0.0002 | <0.0002 | <0.0002 |
| Chloroform | mg/L | 0.002 | 0.0002 | <0.0002 | <0.0002 |
| Benzene | mg/L | 0.002 | 0.0002 | <0.0002 | 0.0002 |
| Trichloroethylene | mg/L | 0.0076 | 0.0002 | 0.0002 | 0.0002 |
| Toluene | mg/L | 0.002 | 0.0002 | <0.0002 | <0.0002 |
| Tetrachloroethylene | mg/L | 0.0044 | 0.0001 | <0.0001 | <0.0001 |
| Ethylbenzene | mg/L | 0.002 | 0.0002 | <0.0002 | <0.0002 |
| 1,1,2,2-Tetrachloroethane | mg/L | 0.017 | 0.0002 | <0.0002 | <0.0002 |
| 1,2-Dichlorobenzene | mg/L | 0.0056 | 0.0002 | <0.0002 | <0.0002 |
| 1,4-Dichlorobenzene | mg/L | 0.0068 | 0.0002 | <0.0002 | <0.0002 |
| Xylenes (Total) | mg/L | 0.0044 | 0.0002 | <0.0002 | <0.0002 |
| PCBs | mg/L | 0.0004 | 0.0002 | <0.0002 | <0.0002 |
| Pentachlorophenol | mg/L | 0.002 | 0.0005 | <0.0005 | <0.0005 |
| Di-n-butyl phthalate | mg/L | 0.015 | 0.0005 | <0.0005 | <0.0005 |
| 3,3'-Dichlorobenzidine | mg/L | 0.0008 | 0.0001 | <0.0001 | <0.0001 |
| Bis(2-Ethylhexyl)phthalate | mg/L | 0.0088 | 0.0005 | <0.0005 | <0.0005 |
| Total PAHs | mg/L | 0.002 | 0.0003 | <0.0003 | <0.0003 |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON Burlington Storm 086-2002
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Pinkal Patel



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Nonylphenol and Nonylphenol Ethoxylates (Ontario, mg/L)

**DATE RECEIVED: 2020-09-22**

**DATE REPORTED: 2020-10-02**

| | | | | SAMPLE DESCRIPTION: | MW9 | MW11 |
|---|---|---|---|---|---|---|
| | | | | SAMPLE TYPE: | Water | Water |
| | | | | DATE SAMPLED: | 2020-09-22 11:27 | 2020-09-22 12:15 |
| Parameter | Unit | G / S | RDL | | 1468718 | 1468726 |
| Total Nonylphenol | mg/L | 0.001 | 0.001 | | <0.001 | <0.001 |
| NP1EO | mg/L | | 0.001 | | <0.001 | <0.001 |
| NP2EO | mg/L | | 0.0003 | | <0.0003 | <0.0003 |
| Total Nonylphenol Ethoxylates | mg/L | 0.01 | 0.001 | | <0.001 | <0.001 |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON Burlington Storm 086-2002
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Montreal (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## BOD-Toronto

**DATE RECEIVED: 2020-09-22**

**DATE REPORTED: 2020-10-02**

| | | | | SAMPLE DESCRIPTION: | MW9 | MW11 |
|---|---|---|---|---|---|---|
| | | | | SAMPLE TYPE: | Water | Water |
| | | | | DATE SAMPLED: | 2020-09-22 11:27 | 2020-09-22 12:15 |
| Parameter | Unit | G / S | RDL | | 1468718 | 1468726 |
| Biochemical Oxygen Demand, Total | mg/L | 15 | 2 | | <2 | <2 |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON Burlington Storm 086-2002
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By: Iris Verástegui



Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Certificate of Analysis

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Burlington Storm Sewer Use By-law - Inorganics

**DATE RECEIVED: 2020-09-22**

**DATE REPORTED: 2020-10-02**

| | | | | SAMPLE DESCRIPTION: | | MW11 |
|---|---|---|---|---|---|---|
| | | | | SAMPLE TYPE: | | Water |
| | | | | DATE SAMPLED: | | 2020-09-22 12:15 |
| Parameter | Unit | G / S | RDL | 1468718 | RDL | 1468726 |
| pH | pH Units | 6.5 - 8.5 | NA | 7.76 | NA | 7.72 |
| Total Suspended Solids | mg/L | 15 | 10 | **39** | 10 | **202** |
| Total Cyanide | mg/L | 0.02 | 0.002 | <0.002 | 0.002 | <0.002 |
| Phenols | mg/L | 0.008 | 0.002 | <0.002 | 0.002 | 0.005 |
| Total Phosphorus | mg/L | 0.4 | 0.02 | 0.10 | 0.2 | **2.75** |
| Total Arsenic | mg/L | 0.02 | 0.015 | <0.015 | **0.030** | <0.030 |
| Total Cadmium | mg/L | 0.008 | 0.005 | <0.005 | **0.010** | <0.010 |
| Total Chromium | mg/L | 0.08 | 0.020 | <0.020 | 0.040 | **0.086** |
| Chromium VI | mg/L | 0.04 | 0.005 | <0.005 | 0.005 | <0.005 |
| Total Copper | mg/L | 0.04 | 0.020 | <0.020 | 0.040 | **0.068** |
| Total Lead | mg/L | 0.12 | 0.020 | <0.020 | 0.040 | <0.040 |
| Total Manganese | mg/L | 0.05 | 0.020 | **0.164** | 0.040 | **3.45** |
| Total Mercury | mg/L | 0.0004 | 0.0002 | <0.0002 | 0.0002 | <0.0002 |
| Total Nickel | mg/L | 0.08 | 0.030 | <0.030 | 0.060 | **0.115** |
| Total Selenium | mg/L | 0.02 | 0.020 | <0.020 | **0.040** | <0.040 |
| Total Silver | mg/L | 0.12 | 0.020 | <0.020 | 0.040 | <0.040 |
| Total Zinc | mg/L | 0.04 | 0.020 | <0.020 | 0.040 | **0.238** |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON Burlington Storm 086-2002
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

**1468726** Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Iris Verástegui



*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Exceedance Summary

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**CLIENT NAME: LANDTEK LTD.**

**ATTENTION TO: Henry Erebor**

| SAMPLEID | SAMPLE TITLE | GUIDELINE | ANALYSIS PACKAGE | PARAMETER | UNIT | GUIDEVALUE | RESULT |
|---|---|---|---|---|---|---|---|
| 1468718 | MW9 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Manganese | mg/L | 0.05 | 0.164 |
| 1468718 | MW9 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Suspended Solids | mg/L | 15 | 39 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Chromium | mg/L | 0.08 | 0.086 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Copper | mg/L | 0.04 | 0.068 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Manganese | mg/L | 0.05 | 3.45 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Nickel | mg/L | 0.08 | 0.115 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Phosphorus | mg/L | 0.4 | 2.75 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Suspended Solids | mg/L | 15 | 202 |
| 1468726 | MW11 | ON Burlington SM | Burlington Storm Sewer Use By-law - Inorganics | Total Zinc | mg/L | 0.04 | 0.238 |



*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Quality Assurance

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Microbiology Analysis

| RPT Date: Oct 02, 2020 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **E. Coli (Using MI Agar)** | | | | | | | | | | | | | | | |
| Escherichia coli | 1468036 | | ND | ND | NA | < 1 | | | | | | | | | |

Comments: ND - Not Detected, NA - % RPD Not Applicable

Certified By:






AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Quality Assurance

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Trace Organics Analysis

| RPT Date: Oct 02, 2020 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **Burlington Storm Sewer - Organics** | | | | | | | | | | | | | | | |
| Methylene Chloride | 1467084 | | < 0.0003 | < 0.0003 | NA | < 0.0003 | 85% | 60% | 130% | 103% | 60% | 130% | 97% | 60% | 130% |
| trans-1,3-Dichloropropylene | 1467084 | | < 0.0003 | < 0.0003 | NA | < 0.0003 | 83% | 50% | 140% | 81% | 60% | 130% | 77% | 50% | 140% |
| cis- 1,2-Dichloroethylene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 99% | 60% | 130% | 106% | 60% | 130% | 114% | 60% | 130% |
| Chloroform | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 96% | 50% | 140% | 105% | 60% | 130% | 112% | 50% | 140% |
| Benzene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 88% | 50% | 140% | 110% | 60% | 130% | 115% | 50% | 140% |
| Trichloroethylene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 99% | 50% | 140% | 114% | 60% | 130% | 117% | 50% | 140% |
| Toluene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 102% | 50% | 140% | 102% | 60% | 130% | 92% | 50% | 140% |
| Tetrachloroethylene | 1467084 | | < 0.0001 | < 0.0001 | NA | < 0.0001 | 103% | 50% | 140% | 98% | 60% | 130% | 102% | 50% | 140% |
| Ethylbenzene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 107% | 50% | 140% | 105% | 60% | 130% | 113% | 50% | 140% |
| 1,1,2,2-Tetrachloroethane | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 114% | 50% | 140% | 102% | 60% | 130% | 96% | 50% | 140% |
| 1,2-Dichlorobenzene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 96% | 50% | 140% | 89% | 60% | 130% | 105% | 50% | 140% |
| 1,4-Dichlorobenzene | 1467084 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 103% | 50% | 140% | 98% | 60% | 130% | 102% | 50% | 140% |
| PCBs | 1470537 | | < 0.0002 | < 0.0002 | NA | < 0.0002 | 107% | 60% | 130% | 87% | 60% | 130% | 87% | 60% | 130% |
| Pentachlorophenol | 1466584 | | < 0.0001 | < 0.0001 | NA | < 0.0005 | 85% | 50% | 140% | 80% | 50% | 140% | 85% | 50% | 140% |
| Di-n-butyl phthalate | 1466584 | | < 0.0005 | < 0.0005 | NA | < 0.0005 | 88% | 50% | 140% | 99% | 50% | 140% | 89% | 50% | 140% |
| 3,3'-Dichlorobenzidine | 1466584 | | < 0.0005 | < 0.0005 | NA | < 0.0001 | 84% | 30% | 130% | 95% | 30% | 130% | 96% | 30% | 130% |
| Bis(2-Ethylhexyl)phthalate | 1466584 | | < 0.0005 | < 0.0005 | NA | < 0.0005 | 71% | 50% | 140% | 102% | 50% | 140% | 99% | 50% | 140% |
| Total PAHs | 1466584 | | < 0.0003 | < 0.0003 | NA | < 0.0003 | 70% | 60% | 130% | 100% | 60% | 130% | 80% | 60% | 130% |

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:





AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Quality Assurance

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Ultra Trace Analysis

| RPT Date: Oct 02, 2020 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **Nonylphenol and Nonylphenol Ethoxylates (Ontario, mg/L)** | | | | | | | | | | | | | | | |
| Total Nonylphenol | 1 | 1468783 | < 0.001 | < 0.001 | 0.0% | < 0.001 | 90% | 60% | 140% | NA | 60% | 140% | NA | 60% | 140% |
| NP1EO | 1 | 1468783 | < 0.001 | < 0.001 | 0.0% | < 0.001 | 49% | 60% | 140% | NA | 60% | 140% | NA | 60% | 140% |
| NP2EO | 1 | 1468783 | < 0.0003 | < 0.0003 | 0.0% | < 0.0003 | 88% | 60% | 140% | NA | 60% | 140% | NA | 60% | 140% |

Certified By:



AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Quality Assurance

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

## Water Analysis

| RPT Date: Oct 02, 2020 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **Burlington Storm Sewer Use By-law - Inorganics** | | | | | | | | | | | | | | | |
| pH | 1472945 | | 7.07 | 7.00 | 1.0% | NA | 100% | 90% | 110% | | | | | | |
| Total Suspended Solids | 1489514 | | <10 | <10 | NA | < 10 | 98% | 80% | 120% | | | | | | |
| Total Cyanide | 1468718 | 1468718 | <0.002 | <0.002 | NA | < 0.002 | 90% | 70% | 130% | 101% | 80% | 120% | 100% | 70% | 130% |
| Phenols | 1468787 | | <0.002 | <0.002 | NA | < 0.002 | 103% | 90% | 110% | 94% | 90% | 110% | 94% | 80% | 120% |
| Total Phosphorus | 1466850 | | 0.02 | 0.03 | NA | < 0.02 | 100% | 70% | 130% | 102% | 80% | 120% | 97% | 70% | 130% |
| Total Arsenic | 1453842 | | <0.015 | <0.015 | NA | < 0.015 | 99% | 70% | 130% | 103% | 80% | 120% | 102% | 70% | 130% |
| Total Cadmium | 1453842 | | <0.005 | <0.005 | NA | < 0.005 | 100% | 70% | 130% | 104% | 80% | 120% | 102% | 70% | 130% |
| Total Chromium | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 98% | 70% | 130% | 104% | 80% | 120% | 106% | 70% | 130% |
| Chromium VI | 1468718 | 1468718 | <0.005 | <0.005 | NA | < 0.005 | 100% | 70% | 130% | 100% | 80% | 120% | 97% | 70% | 130% |
| Total Copper | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 100% | 70% | 130% | 102% | 80% | 120% | 102% | 70% | 130% |
| Total Lead | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 94% | 70% | 130% | 88% | 80% | 120% | 88% | 70% | 130% |
| Total Manganese | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 96% | 70% | 130% | 102% | 80% | 120% | 104% | 70% | 130% |
| Total Mercury | 1472485 | | <0.0002 | <0.0002 | NA | < 0.0002 | 103% | 70% | 130% | 96% | 80% | 120% | 97% | 70% | 130% |
| Total Nickel | 1453842 | | <0.030 | <0.030 | NA | < 0.030 | 99% | 70% | 130% | 102% | 80% | 120% | 102% | 70% | 130% |
| Total Selenium | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 96% | 70% | 130% | 99% | 80% | 120% | 98% | 70% | 130% |
| Total Silver | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 95% | 70% | 130% | 100% | 80% | 120% | 95% | 70% | 130% |
| Total Zinc | 1453842 | | <0.020 | <0.020 | NA | < 0.020 | 101% | 70% | 130% | 115% | 80% | 120% | 117% | 70% | 130% |

Comments: NA signifies Not Applicable.
If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

**BOD-Toronto**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Biochemical Oxygen Demand, Total | 1470130 | 76 | 73 | 4.0% | < 2 | 91% | 70% | 130% | |

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By: Iris Verástegui



AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# QA Violation

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

| RPT Date: Oct 02, 2020 | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Sample Id | Sample Description | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **Nonylphenol and Nonylphenol Ethoxylates (Ontario, mg/L)** | | | | | | | | | | | |
| NP1EO | 1468783 | MW9 | 49% | 60% | 140% | NA | 60% | 140% | NA | 60% | 140% |



AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Method Summary

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| **Microbiology Analysis** | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| **Trace Organics Analysis** | | | |
| Methylene Chloride | VOL-91-5001 | EPA SW-846 5030B & 8260B | (P&T)GC/MS |
| trans-1,3-Dichloropropylene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| cis- 1,2-Dichloroethylene | VOL-91-5001 | EPA SW-846 5030B & 8260B | (P&T)GC/MS |
| Chloroform | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Benzene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Trichloroethylene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Toluene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Tetrachloroethylene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Ethylbenzene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| 1,1,2,2-Tetrachloroethane | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| 1,2-Dichlorobenzene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| 1,4-Dichlorobenzene | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| Xylenes (Total) | VOL-91-5001 | modified from EPA 5030B & EPA 8260D | (P&T)GC/MS |
| PCBs | ORG-91-5112 | EPA SW-846 3510C & 8082A | GC/ECD |
| Pentachlorophenol | ORG-91-5114 | EPA SW-846 3510C & 8270E | GC/MS |
| Di-n-butyl phthalate | ORG-91-5114 | EPA SW-846 3510C & 8270E | GC/MS |
| 3,3'-Dichlorobenzidine | ORG-91-5114 | EPA SW-846 3510C & 8270E | GC/MS |
| Bis(2-Ethylhexyl)phthalate | ORG-91-5114 | EPA SW-846 3510C & 8270E | GC/MS |
| Total PAHs | ORG-91-5114 | EPA SW-846 3510C & 8270E | GC/MS |
| **Ultra Trace Analysis** | | | |
| Total Nonylphenol | NA | ASTM D7065-6 | LC/MS/MS |
| NP1EO | NA | ASTM D7065-6 | LC/MS/MS |
| NP2EO | NA | ASTM D7065-6 | LC/MS/MS |
| Total Nonylphenol Ethoxylates | NA | ASTM D7065-6 | LC/MS/MS |



*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Method Summary

**CLIENT NAME: LANDTEK LTD.**

**AGAT WORK ORDER: 20T653959**

**PROJECT: 20255C**

**ATTENTION TO: Henry Erebor**

**SAMPLING SITE:**

**SAMPLED BY:**

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| **Water Analysis** | | | |
| Biochemical Oxygen Demand, Total | INOR-121-6023 | SM 5210 B | INCUBATOR |
| pH | INOR-93-6000 | modified from SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | modified from EPA 1684,ON MOECC E3139,SM 2540C,D | BALANCE |
| Total Cyanide | INOR-93-6051 | modified from MOECC E3015; SM 4500-CN- A, B, & C | TECHNICON AUTO ANALYZER |
| Phenols | INOR-93-6050 | MOE ROPHEN-E3179 & SM 5530 D | TECHNICON AUTO ANALYZER |
| Total Phosphorus | INOR-93-6022 | modified from SM 4500-P B and SM 4500-P E | SPECTROPHOTOMETER |
| Total Arsenic | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Cadmium | MET -93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Chromium | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Chromium VI | INOR-93-6034 | modified from SM 3500-CR B | SPECTROPHOTOMETER |
| Total Copper | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Lead | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Manganese | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Mercury | MET-93-6100 | modified from EPA 245.2 and SM 3112 B | CVAAS |
| Total Nickel | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Selenium | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Silver | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |
| Total Zinc | MET-93-6103 | modified from EPA 200.8, 3005A, 3010A & 6020B | ICP-MS |



*Results relate only to the items tested. Results apply to samples as received.*

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

# Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water consumed by humans)

## Report Information:

Company: Landtek Limited
Contact: Henry Ereba
Address: 205 Nebo Rd, Hamilton ON L8W 2E1
Phone: 289-880-3992 Fax:
*Reports to be sent to:*
1. Email: henry@landtek.ca
2. Email:

## Project Information:

Project: 20255C
Site Location: ~~747~~ and 761 ~~Ghent~~ Ghent Ave. Burlington
Sampled By: LB and HE
AGAT Quote #: PO:
*Please note: If quotation number is not provided, client will be billed full price for analysis.*

## Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

## Regulatory Requirements:

*(Please check all applicable boxes)*

☐ Regulation 153/04
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Excess Soils R406
Table _____ *Indicate One*
☐ Regulation 558
☐ CCME

☐ Sewer Use ☐ Sanitary ☑ Storm
_____ *Region*
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
_____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No

**Report Guideline on *Certificate of Analysis*** ☑ Yes ☐ No

## Laboratory Use Only

Work Order #: 20T653959
Cooler Quantity:
Arrival Temperatures: 6.2 | 6 | 6.2 / 6 | 6 | 6.4
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: Ice

## Turnaround Time (TAT) Required:

**Regular TAT** ☑ 5 to 7 Business Days

**Rush TAT** (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

**OR** Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

**For 'Same Day' analysis, please contact your AGAT CPM**

## Sample Matrix Legend

| | |
|---|---|
| B | Biota |
| GW | Ground Water |
| O | Oil |
| P | Paint |
| S | Soil |
| SD | Sediment |
| SW | Surface Water |

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Field Filtered - Metals, Hg, CrVI, DOC Y/N | O. Reg 153: Metals & Inorganics | Metals - CrVI, Hg, HWSB | BTEX, F1-F4 PHCs Analyze F4G if required ☐ Yes ☐ No | PAHs | PCBs | VOC | O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs | O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs | Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4 | Salt - EC/SAR | | Sewer Use | City of Burlington | Storm Sewer Discharge | & E. Coli | | | Potentially Hazardous or High Concentration (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW9 | 29-Sep-20 | 11:27 AM PM | | | | N | | | | | | | | | | | | ✓ | ✓ | | | | | |
| MW11 | " | 12:15 AM PM | | | | N | | | | | | | | | | | | ✓ | ✓ | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |
| | | AM PM | | | | | | | | | | | | | | | | | | | | | | |

| Samples Relinquished By (Print Name and Sign): | Date | Time | Samples Received By (Print Name and Sign): | Date | Time |
|---|---|---|---|---|---|
| K Urshot | Sept 22/20 | 2:00 pm | John Chyrycka | Sept 22 | 1:45 |
| | | | | | Page ____ of ____ |
| | Date | Time | Samples Received By (Print Name and Sign): | Date | Time |
| | | | John Chyrycka | Sept 22 | 4:30 |

No: 109218

# AGAT Laboratories

## Sample Temperature Log

Client: Landtek

# of Coolers: 8

COC# or Work Order #: 20T653959

# of Submissions:

### Arrival Temperatures - Branch/Driver

| | | | |
|---|---|---|---|
| Cooler #1: | 6.2 | 6 | 6.2 |
| Cooler #2: | 6.6 | 6.6 | 6.8 |
| Cooler #3: | 6 | 6.2 | 6 |
| Cooler #4: | 6.4 | 6 | 6.4 |
| Cooler #5: | 6.4 | 6.4 | 6.4 |
| Cooler #6: | 6.2 | 6.2 | 6.2 |
| Cooler #7: | 7.2 | 7 | 7.2 |
| ~~Cooler #8~~ | 7.1 | 7.4 | 7.5 |
| Cooler #9: | | | |
| Cooler #10: | | | |

IR Gun ID:

Taken By: John Chypyha

Date (yyyy/mm/dd): Sept 22 Time: 1:45 AM / PM

### Arrival Temperatures - Laboratory

| | | | |
|---|---|---|---|
| Cooler #1: | 6 | 6 | 6.4 |
| Cooler #2: | 6.8 | 6.6 | 7 |
| Cooler #3: | 6.6 | 6.6 | 6.8 |
| Cooler #4: | 6.6 | 6.8 | 6.8 |
| Cooler #5: | 7 | 6.8 | 7 |
| Cooler #6: | 6.4 | 6.6 | 6.6 |
| Cooler #7: | 7.4 | 7.6 | 7.8 |
| Cooler #8 | 7.8 | 7.6 | 7.6 |
| Cooler #9: | | | |
| Cooler #10: | | | |

IR Gun ID:

Taken By: John Chypyha

Date (yyyy/mm/dd): Sept 22 Time: 4:30 AM / ~~PM~~

Instructions for use of this form: 1) complete all fields of info including total # of coolers and # of submissions rec'd, 2) photocopy and place in each submission prior to giving a WO#, 3) Proceed as normal, write the WO# and scan ( please make sure to scan along with the COC)

Document ID: SR-78-0511.003
Date Issued: 2017-2-23

Page: _____ of _____

# APPENDIX G

## DEWATERING ASSUMPTIONS & CALCULATIONS – BASEMENT PARKING LEVELS

## Table 1 – Basement Excavation Dewatering Calculations-Scenario Based on Field Hydraulic Conductivity Tests

$$Q = 2\pi kD\,(H - h_w)/\ln\,(R_o/r_e)$$

Equation 1: The potential groundwater flow rate to the excavation was estimated using equation for full penetration by single well of confined aquifer (artesian conditions) fed by a circular source.

Where: Q = discharge rate ($m^3/s$)
K = hydraulic conductivity (m/s)
D = Aquifer thickness (m)
H = height of piezometer level above based of aquifer (m)
$h_w$ = height of water at outside edge of pumping wells after drawdown (m)
R = radius of influence (m)
$r_e$ = equivalent radius (m)
C = 3000
D = 6.3 m

$R = C*(H - h)*\sqrt{(K)}$ Radius of Influence - Sichardt's equation

$r_e = \sqrt{(L * B)}/\pi$ (applies when a/b>1.5 and R0 << rs)

$r_e = (L + B)/\pi$ (applies when a/b<1.5 and R0 >> rs)

| Basement + Elevator Shaft | H (m) | $h_w$ (m) | R (m) | $r_e$ (m) | Q L/day | Q L/day (1.5 Factor of Safety |
|---|---|---|---|---|---|---|
| | 9.0 | 0.9 | ~22.1 | ~35.0 | ~46,677 (5.40 x 10-4 m3/s) | ~ 70,016 |

Assumptions for hydrogeological setting:

1. A confined aquifer is presumed to exist locally with a water table determined to be 1.0 mbgs at MW11 on April 12, 2021 and extending to an estimated depth of approximately 10.0 mbgl.
2. The maximum dewatering depth of construction activities is assumed to be 9.1 mbgl (0.5 m below Excavation).
3. It is assumed that as a requirement of the proposed construction activities the excavation will be pumped dry.
4. The hydraulic conductivity values for the bedrock beneath the site was determined to be $8.252 \times 10^{-7}$ m/s

# Table 2 – Basement Excavation Dewatering Calculations-Scenario Based on Low Hydraulic Conductivity Values from Previous Investigations in Burlington Shale (Holysh, 1997)

$$Q = 2\pi kD\,(H - h_w)/\ln(R_o/r_e)$$

Equation 1: The potential groundwater flow rate to the excavation was estimated using equation for full penetration by single well of confined aquifer (artesian conditions) fed by a circular source.

Where: Q = discharge rate ($m^3/s$)
K = hydraulic conductivity (m/s)
D = Aquifer thickness (m)
H = height of piezometer level above based of aquifer (m)
$h_w$ = height of water at outside edge of pumping wells after drawdown (m)
R = radius of influence (m)
$r_e$ = equivalent radius (m)
C = 3000
D = 6.3 m

**R = C*(H – h)*√(K)** Radius of Influence - Sichardt's equation

**$r_e$ = √(L * B)/π** (applies when a/b>1.5 and R0 << rs)

**$r_e$ = (L + B)/π** (applies when a/b<1.5 and R0 >> rs)

| Basement + Elevator Shaft | H (m) | $h_w$ (m) | R (m) | $r_e$ (m) | Q L/day | Q L/day (1.5 Factor of Safety |
|---|---|---|---|---|---|---|
| | 9.0 | 2.4 | ~2.43 | ~35.0 | ~4,029 (4.78 x 10-5 m3/s) | ~ 6,044 |

Assumptions for hydrogeological setting:

1. A confined aquifer is presumed to exist locally with a water table determined to be 1.0 mbgs at MW11 on April 12, 2021 and extending to an estimated depth of approximately 10.0 mbgl.
2. The maximum dewatering depth of construction activities is assumed to be 9.1 mbgl (0.5 m below Excavation).
3. It is assumed that as a requirement of the proposed construction activities the excavation will be pumped dry.
4. The hydraulic conductivity values for the bedrock beneath the site was determined to be $1.0 \times 10^{-8}$ m/s

# APPENDIX H

## WATER BALANCE

## *APPENDIX H: D ETAILED WATER BALANCE - 747 and 761 Brant Street (Phase 3), Burlington, ON.*

### 1. Climate Information

| | | |
|---|---|---|
| Precipitation (collected from Env. Canada data) | 930 | mm/a |
| Evapotranspiration (calculated by Thornthwaite method | 609 | mm/a |
| Water Surplus | 321 | mm/a |

### 2. Infiltration Rates

*Infiltration Factors (Table 2)*

| | |
|---|---|
| Flat Land (average slope not exceeding 0.6 m per km) | 0.3 |
| Medium combinations of clay and loam | 0.2 |
| Cultivated Lands | 0.1 |
| TOTAL | 0.6 |

| | | |
|---|---|---|
| Infiltration | 193 | mm/a |
| Run-off | 128 | mm/a |

*Typical Recharge Rates (Table 3)*

| | | |
|---|---|---|
| Clayey Silt/Clayey Silt | 100 | mm/a |
| Silt | 125-150 | mm/a |
| silty sand to sandy silt | 150-200 | mm/a |

Site development area is underlain by silty sand to sandy silt.

| | | |
|---|---|---|
| Based on the above, the recharge rate is approximately | 100 | mm/a |
| with runoff of | 221 | mm/a |

### 3. Site Statistics

**Pre-Development:**

| | | | | |
|---|---|---|---|---|
| Building roofs | 0.086 | ha | 863 | $m^2$ |
| Parking Areas, Roadways, Other impervious Areas | 0.149 | ha | 1,495 | $m^2$ |
| Green space, open space, natural areas | 0.147 | ha | 1,473 | $m^2$ |
| TOTAL | 0.383 | ha | 3,831 | $m^2$ |

**Post-Development:**

| | | | | |
|---|---|---|---|---|
| Building Roof | 0.229 | ha | 2,289 | $m^2$ |
| Parking Areas, Roadways, Other impervious Areas | 0.087 | ha | 866 | $m^2$ |
| Green space, SWMP, natural areas | 0.068 | ha | 678 | $m^2$ |
| TOTAL | 0.383 | ha | 3,833 | $m^2$ |

*Industrial Buildings*

| | | | | |
|---|---|---|---|---|
| Landscape coverage (17.7%) | 0.068 | ha | 678 | $m^2$ |
| Parking/Roadway coverage (22.6%) | 0.087 | ha | 866 | $m^2$ |
| Building (59.7%) | 0.229 | ha | 2,289 | $m^2$ |

## 4. Annual Pre-Development Water Balance

| Land Use | Area ($m^2$) | Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Infiltration ($m^3$) | Run-Off ($m^3$) |
|---|---|---|---|---|---|
| Building Roofs | 863 | 803 | - | - | 803 |
| Green Space | 1,473 | 1,370 | 897 | 147 | 326 |
| Roads, Other impervious | 1,495 | 1,390 | - | - | 1,390 |
| TOTAL | 3,831 | 3,563 | 897 | 147 | 2,518 |

## 5. Annual Post-Development Water Balance

| Land Use | Area ($m^2$) | Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Infiltration ($m^3$) | Run-Off ($m^3$) |
|---|---|---|---|---|---|
| Building Roofs | 2,289 | 2,129 | - | - | 2,129 |
| Roads, Other impervious | 866 | 805 | - | - | 805 |
| Green space, open space, natural areas | 678 | 631 | 413 | 68 | 150 |
| TOTAL | 3,833 | 3,565 | 413 | 68 | 3,084 |

## 6. Comparison of Pre-Development and Post-Development

| | | Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Infiltration ($m^3$) | Run-Off ($m^3$) |
|---|---|---|---|---|---|
| Pre-Development | | 3,563 | 897 | 147 | 2,518 |
| Post-Development | | 3,565 | 413 | 68 | 3,084 |

## 7. Post development infiltration measures

| | | |
|---|---|---|
| Post-development infiltration volume | 68 | $m^3$ |
| Pre-development infiltration volume | 147 | $m^3$ |
| Deficit from pre to post-development infiltration | 79 | $m^3$ |
| Percentage of water collected from roof area required to match pre-development infiltration | 4 | % |

## *APPENDIX H: Thornthwaite Method For Calculating Evapotranspiration*

**Thornthwaite method for determining potential evapotranspiration**

A monthly index is obtained from the equation:

$i = (t/5)^{1.514}$

Summation of the 12 monthly values gives an appropriate heat index, I.

To calculate a, the expression is:

$a = 0.000000675I^3 - 0.0000771I^2 + 0.01792I + 0.49239$

From these relations, a general equation for potential evapotranspiration is obtained. It is:

$$e = 1.6\left(\frac{10t}{I}\right)^a$$

in which a has the value given in the equation above.

## *APPENDIX H: Thornthwaite Method For Calculating Evapotranspiration*

**Hamilton Airport Climate Data**

| | Daily Average Temp ($C^o$) | Monthly index (i) | Potential Evapotranspiration (cm) | Adjusted Potential Evaportranspiration (cm) |
|---|---|---|---|---|
| Jan | -5.5 | | | 0 |
| Feb | -4.6 | | | 0 |
| Mar | -0.1 | | | 0 |
| April | 6.7 | 1.557530876 | 2.946791827 | 3.300406846 |
| May | 12.8 | 4.150260027 | 6.038429267 | 7.608420877 |
| June | 18.3 | 7.13034204 | 8.973741023 | 11.48638851 |
| July | 20.9 | 8.718883818 | 10.39718 | 13.4123622 |
| August | 20 | 8.156781464 | 9.902149829 | 11.88257979 |
| September | 15.8 | 5.708555702 | 7.625570812 | 7.930593644 |
| October | 9.3 | 2.558836857 | 4.238152363 | 4.026244745 |
| November | 3.7 | 0.633894267 | 1.526004012 | 1.236063249 |
| Dec | -2.3 | | | 0 |
| | HEAT INDEX (I) = | 38.61508505 | | **60.88 cm/year** |
| | | | | **608.83 mm/year** |
| | a = | 1.108273042 | | |

