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Hydrogeological Investigation
Proposed Development
Phase 1 – Lot A
774-782 Brant Street
Burlington, Ontario

Prepared for:

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

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■ 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 774, 778, 780, and 782 Brant Street in Burlington, Ontario. The proposed development is to comprise of a 14-storey and 25-storey towers connected by a three- and ten-storey podium, with three (3) levels of basement parking across 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	596497, 4798487	**Site Area (approx.)**	6,700 m^2 (1.66 acres)
Site Description	The site is situated in a developed predominantly commercial area and is bounded by Brant Street to the northeast and Ghent Avenue to the southeast. Commercial and residential premises bound the site to the northwest and southwest respectively. The site is currently undeveloped and covered mainly by unmaintained grasses and copse of trees, located along Ghent Avenue.		
Geology	Underlying the topsoil encountered at the surface is fill comprising of either sand or silt. The fill extends to depths of between 0.7 m and 1.5 m. Underlying the fill is a veneer of silty sand and sandy silt. Clayey silt till was encountered underlying the silty sand and sandy silt. The till extends to depths of between 3.5 m and 5.6 m below existing ground level. Red shale bedrock was encountered underlying the till.		
Groundwater	Depths to groundwater in monitoring wells installed at the Site were obtained manually on September 21 and 24, 2020, January 14, February 23, March 17, April 12, April 22, and My 10, 2021. It was determined that depth to groundwater ranged from 2.43 to 3.02 metres below ground surface.		

DEWATERING CONSIDERATIONS

Short Term	Dewatering rate outside periods of active precipitation was estimated to be approximately 185,553 L/day (~186 m3/day); while Dewatering during Spring/active precipitation period: is estimated to be approximately 185,553 L/day (radial flow into excavation) + 670,400 L/day (direct precipitation) = 855,953 L/day or ~856 m^3/day. 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	It is proposed that the basement parking 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 855,953 L/day or ~856 m^3/day (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 not to have significant amounts of 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 670 to 168 m^3/year based on the water balance calculations. This decrease in infiltration indicates that approximately 17% 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.

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1.0 INTRODUCTION

1.1 Background

Landtek Limited (Landtek) was retained by Molinaro Group to complete a Hydrogeological Investigation for the proposed development at 774-782 Brant Street in Burlington, Ontario (the 'site' or 'development property').

The Site is irregular in shape and comprises an area of approximately 6,704 m^2 (1.66 acres) of undeveloped largely naturally vegetated land with bare areas located to the west corner area of the intersection of the Brant Street and Ghent Avenue, south of Brant Street in Burlington. The Site is bound by Brant Street to the north, Ghent Avenue to the east, and developed properties to the west and south.

It is understood that the proposed development is to consist of a 14-storey and 25-storey towers connected by a three- and ten-storey podium, with three (3) levels 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 site plan 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. Previous investigations completed on the property were reviewed including the results of the Preliminary Geotechnical Investigation and Phase Two Environmental Site Assessment by Landtek in September 2018. 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 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.

Previous investigations completed on the property were reviewed including the results of the Preliminary Geotechnical Investigation and Phase Two Environmental Site Assessment by Landtek in September 2018.

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; four at the Site, four at the north adjacent property across Brant Street (769, 779, 783, and 789 Brant Street and 2023, 2027, and 2031 Ghent Avenue); and two at the property located at the east corner area of the intersection of Brant Street and Ghent Avenue (747 and 761 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 provided in Appendix B of this report.

The monitoring wells MW1, MW4, MW5, MW8, MW9, and MW11 at the Site and adjacent area 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 lengths 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 21, 2020, ground water samples were collected from on-site monitoring wells MW1 and MW4 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 undeveloped largely naturally vegetated land with bare areas at 92 to 93 masl. Rambo Creek is located approximately 188 m northeast of the Site while Lake Ontario is located approximately 1.5 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 in 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 MOE water well database for a radius of approximately 500 m from the proposed development. A total of 47 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 below.

Well Construction

- Wells terminated in bedrock 11
- Wells terminated in overburden 30
- Unknown 6
- **Total 47**

Well Uses

- Domestic 0
- Observation Wells 23
- Test Holes/Monitoring Wells 17
- Abandoned 4
- Unknown 3
- **Total 47**

Well Depth

- Less than 15 m 39
- 15 to 30 m 3
- Greater than 30 m 0
- No Data 5
- **Total 47**

The locations of all the MOE 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 BH1, BH2, BH3 and BH4 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 ground lithologies encountered by the boreholes are discussed further in the following sections.

Fill

A layer of fill ranging from 0.7 to 1.4 m in thickness was encountered in all the boreholes at the ground surface overlying sand in BH1 and BH2, and silty clay in BH3 and BH4.

Sand

A layer of sand of 0.8 to 1.8 m in thickness was encountered in BH 1 and BH2 overlying clayey silt.

Clayey Silt

A layer of clayey silt ranging from 2.0 to 3.1 m in thickness was encountered in all the boreholes overlying bedrock.

Bedrock

Shale bedrock was encountered below the clayey silt in all boreholes at depths ranging from 3.5 to 5.6 mbgs; and below silt in BH4 at 4.0 mbgs. The boreholes were terminated in bedrock at the maximum depth of approximately 18.4 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. Monitoring is ongoing to determine the seasonal high groundwater level. 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	
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	
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	
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	
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	
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	

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 direction for the Site was determined by using the groundwater elevations recorded in monitoring wells MW1, MW4, and MW5. 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 September 24, 2020 as shown on Figure 5 in Appendix A. The horizontal hydraulic gradient across the Site was approximately 0.016 m/m southeast toward Lake Ontario.

3.10 Estimated Hydraulic Conductivity

3.10.1 Hydraulic Conductivity Tests

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

Table 4. Estimated Hydraulic Conductivity

Monitoring Well	Hydraulic Conductivity (m/s)	Well Screened Material
MW1	1.847×10^{-5}	Bedrock
MW4	8.12×10^{-8}	Bedrock
MW5	1.871×10^{-5}	Bedrock
MW8	8.538×10^{-8}	Bedrock
MW11	1.597×10^{-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 1×10^{-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 8.252×10^{-7} m/s. As a result, the value of 8.252×10^{-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 MW1 and MW4 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: September 21, 2020

Parameter	G/S (mg/L)	MW1	MW4
		Lab Result (mg/L)	Lab Result (mg/L)
pH	6.5-8.5*	6.73	6.92
BOD	15	<2	<2
Total Cyanide	0.02	<0.002	<0.002
Phenols	0.008	<0.002	<0.002
Total Phosphorus	0.4	0.02	0.04
Total Suspended Solids	15	**19**	**25**
Total Arsenic	0.02	<0.015	<0.015
Total Cadmium	0.008	<0.005	<0.005
Total Chromium	0.08	<0.020	<0.020
Chromium VI	0.04	<0.005	<0.005
Total Copper	0.04	<0.020	<0.020
Total Lead	0.12	<0.020	<0.020
Total Manganese	0.05	**0.757**	**0.447**
Total Mercury	0.0004	<0.0002	<0.0002
Total Nickel	0.08	<0.030	<0.030
Total Selenium	0.02	**0.066**	**0.041**
Total Silver	0.12	<0.020	<0.020
Total Zinc	0.04	<0.020	<0.020
E. Coli	200**	2	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	0.0004	0.0004
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.

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 a 14-storey and 25-storey towers connected by a three- and ten-storey podium, with three (3) levels of basement parking across 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: ~ 97.5 m x 68.8 m = ~6,704 m2.

There will be three levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 10.1 mbgs (Level 1 = 4.1 m, Level 2 = 3.0 m, and Level 3 = 3.0 m). An elevator shaft extension is assumed to be 1.5 m. Therefore, a total excavation depth of 12.1 mbgs is required for the construction. A dewatering depth of approximately 0.5 m below the excavation bottom (12.1 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)

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, April 12, April 22, and May 10, 2021. The readings are presented in Table 3.

Based on the groundwater levels recorded in monitoring wells MW1 and MW4 located at the Site, it was determined that depth to groundwater ranged from 2.43 mbgs to 3.02 mbgs. The highest ground water level was determined to be 2.43 mbgs. Depth groundwater varies seasonally, and the water table is typically elevated during spring and periods of active precipitation. As a result, groundwater monitoring is ongoing and high groundwater level will be updated once the seasonal groundwater monitoring is completed at the Site, if required.

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 1.3 to account for expected seasonal high groundwater level in Spring will be 185,553 L/day. These calculations and associated assumptions are provided in Table 1, Appendix F.

4.2 Dewatering Considerations

4.2.1 Estimating Total 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) = (97.5 m x 68.8 m)*0.100 m = 670.4 m^3/day = 670,400 L/day

It is advised that dewatering should not be completed during period of active precipitation.

4.2.2 Short Term Dewatering Volume

- Dewatering rate outside periods of active precipitation: ~ 185,553 L/day (~186 m3/day)
- Dewatering during Spring/active precipitation period: ~185,553 L/day (radial flow into excavation) + 670,400 L/day (direct precipitation) = 855,953 L/day or ~856 m^3/day.

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 185,553 L/day = 186 m^3/day.

4.2.3 Long Term Groundwater Control (Post Construction)

The developer proposes that the proposed below ground structure 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.

4.2.4 Permit to Take Water

The maximum dewatering rate of groundwater for the proposed excavation is estimated to be approximately 855,953 L/day or ~856 m^3/day (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 Burlington Shale range from 1 x 10^{-8} m/s to 1 x 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 x 10^{-8} m/s above; and was determined to be approximately 16,392 L/day after a factor of safety of 1.3. 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 16,392 L/day (determined using the low-end value of hydraulic conductivity value for Burlington shale) to 855,953 L/day or ~856 m^3/day (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

Water extracted during construction dewatering is required to be discharged into an approved location which could be storm, sanitary or combined sewers or surface water body 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.

It is expected that the rate and total volume of the discharge during dewatering be recorded. This would require that the discharge line be equipped with a flow meter capable of monitoring the discharge rate and a volume totalizer to record the total volume of water discharge. The discharge rate and total daily flow will need to be recorded with the records maintained on site. This can be accommodated by installing a flow meter on the discharge line.

If needed, a weir tank and filter bag can be utilized during dewatering to reduce total suspended solids (TSS) and turbidity prior to discharging of the water into a sewer system.

A T-Coupling and valves should be installed downstream of the flow meter, which, if necessary, can be operated to divert flow for mitigation purposes.

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 188 m northeast of the Site, Lake Ontario is located approximately 1.5 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 only within the radius of influence of approximately 27 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 west corner area of the intersection of the Brant Street and Ghent Avenue in Burlington. The Site is bound by Brant Street to the north, Ghent Avenue to the East, and developed properties to the West and South. It is anticipated that there will be impact within the radius of influence of approximately 27 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.

Base 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 PROPOSED 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

Implementation of a settlement monitoring plan is recommended to be completed within an approximate radius of 27 m of the Site. Prior to commencing dewatering perform a condition

surveys of adjacent properties that could potentially be affected by dewatering considering anticipated effects and specific dewatering design should be completed.

A typical settlement monitoring system would comprise a series settlement marker 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.

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

6.0 PROPOSED MITIGATION PLAN

The groundwater dewatering activities will result in localized depression of the groundwater table, and it is anticipated that there will be no impact beyond the radius of influence of 27 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 are:

- Settlement associated with loss of fines can 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 is 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 boreholes to check that larger drawdowns than anticipated at distance from the excavation are not occurring.
- Differential settlement is most problematic; this can 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.
- Provide sufficient temporary support to excavations to maintain stability, where seeps might otherwise induce progressive collapse of the sides of the excavation.
- During dewatering implement staged drawdowns (where appropriate), and monitor field settlement and water level changes beyond the immediate site, comparing against theoretical settlements and water levels to allow warning of potential dewatering settlement issues.

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 consist of two 25-storey towers connected by three- and six-storey podiums, with four levels of basement parking across the full site area.

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

- Building roof area ..... 0.312 ha
- Parking Areas, Roadways, and other impervious Areas..... 0.191 ha
- Green space, SWMP, natural areas..... 0.168 ha
- **Total Area ..... 0.670 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 silt/sandy silt to depths varying from 2.5-4.0 mbgs, over clayey silt, which overlies bedrock, except in BH4 with the silt/sandy silt overlying bedrock directly. Drilling was terminated at a maximum depth of approximately 18.4 mbgs in bedrock.
- The water table recorded at the site ranges from 2.57 mbgs to 2.99 mbgs.
- There will be three levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 10.1 mbgs (Level 1 = 4.1 m, Level 2 = 3.0 m, and Level 3 = 3.0 m). An elevator shaft extension is assumed to be 1.5 m. Therefore, a total excavation depth of 12.1 mbgs is required for the construction. A dewatering depth of approximately 0.5 m below the excavation bottom (12.1 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.
- Groundwater flow direction within the bedrock at the site is interpreted to be towards the southeast.
- 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.

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 mainly 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 clayey silt beneath the site.

The water balance (pre- and post-development) is summarized in Table 5 below 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	6,235	4,083	670	1,482
Post-Development	6,235	1,020	168	5,047

The increase in run-off from 1,482 m^3 to 5,047 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 670 to 168 m^3/year based on the water balance calculations outlined in Appendix H. This decrease in infiltration indicates that approximately 17% 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 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 silt/clayey silt to depths varying from 3.5-5.6 mbgs, which overlies bedrock. Drilling was terminated at a maximum depth of approximately 18.4 mbgs in bedrock.
- Lake Ontario is located approximately 1.5 km southeast of the site. The direction of groundwater flow at the site is southeast towards Lake Ontario.
- Groundwater contour plot from groundwater monitoring levels recorded on September 24, 2020 indicates the direction of groundwater flow was southeast. The horizontal hydraulic gradient across the Site, was approximately 0.016 m/m southeast.
- The water table present within the shale bedrock at the site ranges from 2.43 meters mbgs to 3.02 mbgs.
- There will be three levels of underground parking. As a result, the maximum depth of the underground parking is estimated to be 10.1 mbgs (Level 1 = 4.1 m, Level 2 = 3.0 m, and Level 3 = 3.0 m). A dewatering depth of approximately 0.5 m below the excavation bottom (10.6 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.
- The maximum dewatering rate of groundwater for the proposed excavation under normal operation which does not include extreme weather events is estimated to be approximately 185,553 L/day = ~186 m3/day. 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.
- The maximum short term dewatering rate of groundwater for the proposed excavation is estimated to be approximately 855,953 L/day or ~856 m^3/day (radial inflow and direct precipitation).
- The developer proposes that the proposed below ground structure 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
- 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.
- A Dewatering Volume Plan should provide for dewatering volumes ranging from 17,364 L/day (determined using the low-end value of hydraulic conductivity value for Burlington shale) to 855,953 L/day or ~856 m^3/day (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 27 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.

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.

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 your 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.

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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.

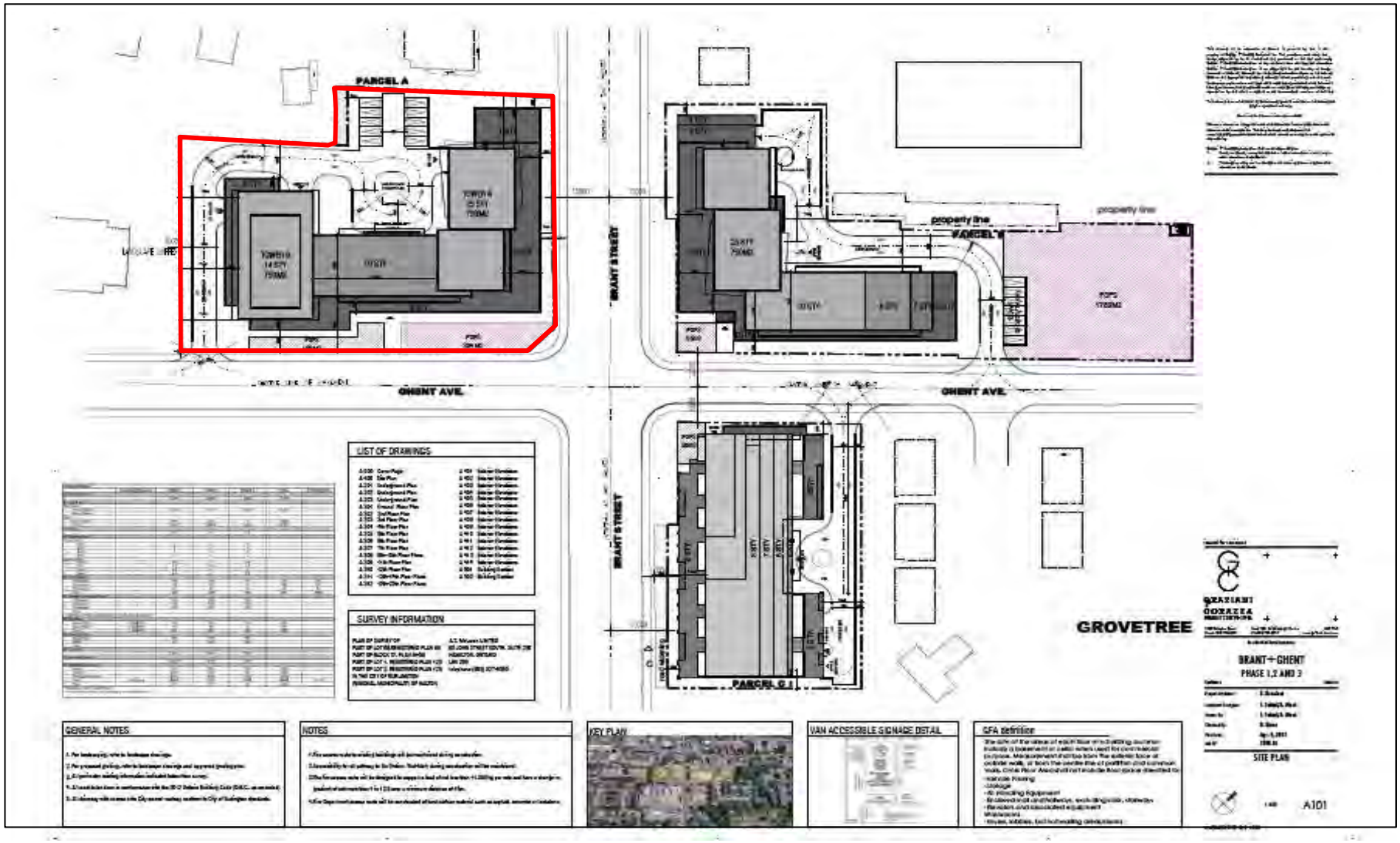
This report does not reflect environmental issues or concerns related to the property unless otherwise stated in the report. The design recommendations given in the report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details 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

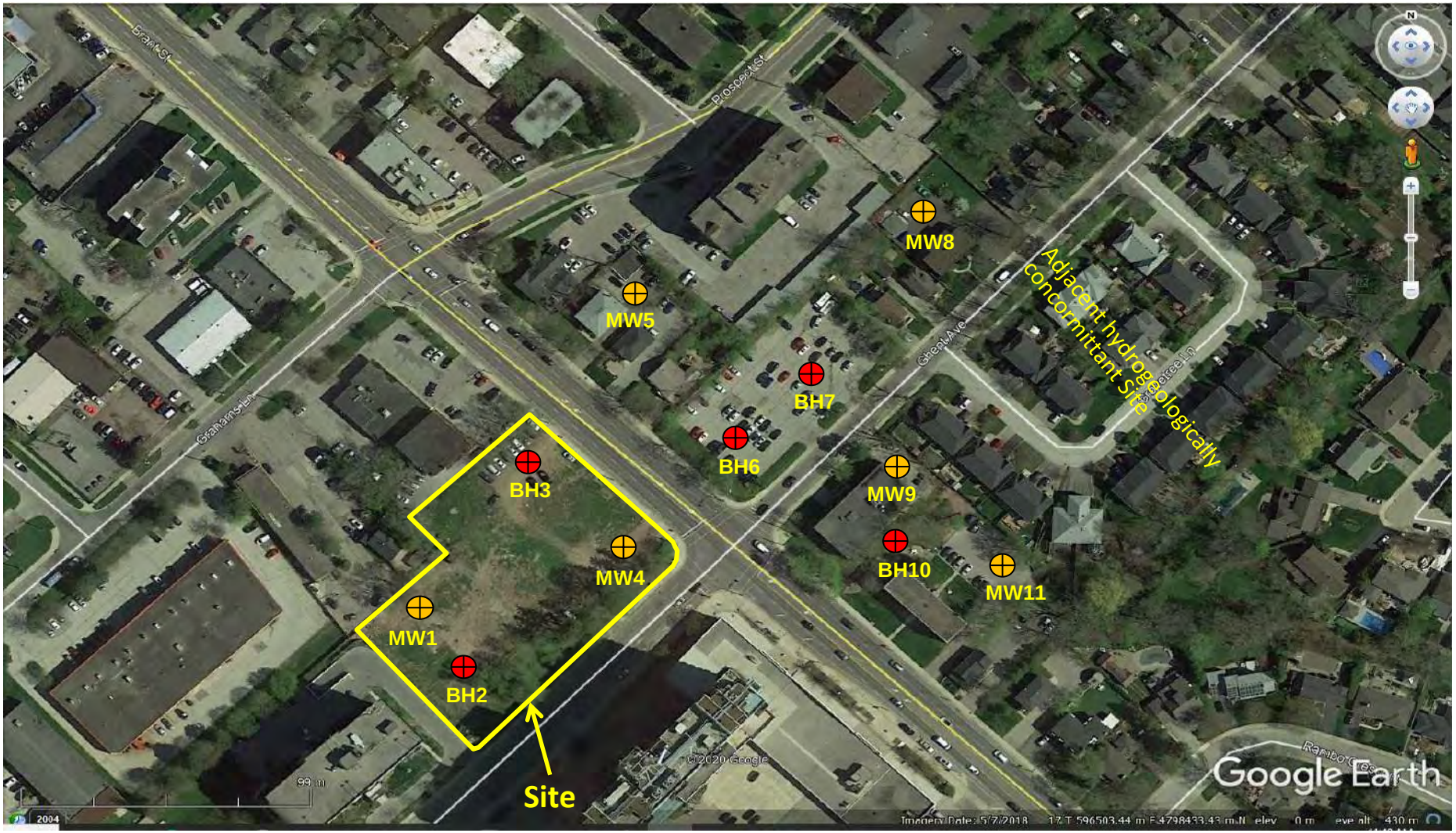


	LANDTEK LIMITED ***CONSULTING ENGINEERS*** **205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1**	
	Scale: See Map	Date: September 2020
Project:	Hydrogeological Investigation 774-782 Brant Street Burlington, Ontario	
Title:	Figure 1: Site Location	
Project No.	20255A	



Site

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



Monitoring Well Location

Borehole Location

LANDTEK LIMITED *CONSULTING ENGINEERS* **205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1**	
Scale: See Map	Date: September 2020
Project:	Hydrogeological Investigation 774-782 Brant Street Burlington, Ontario
Title:	Figure 3: Boreholes and Monitoring Wells Locations
Project No.	20255A



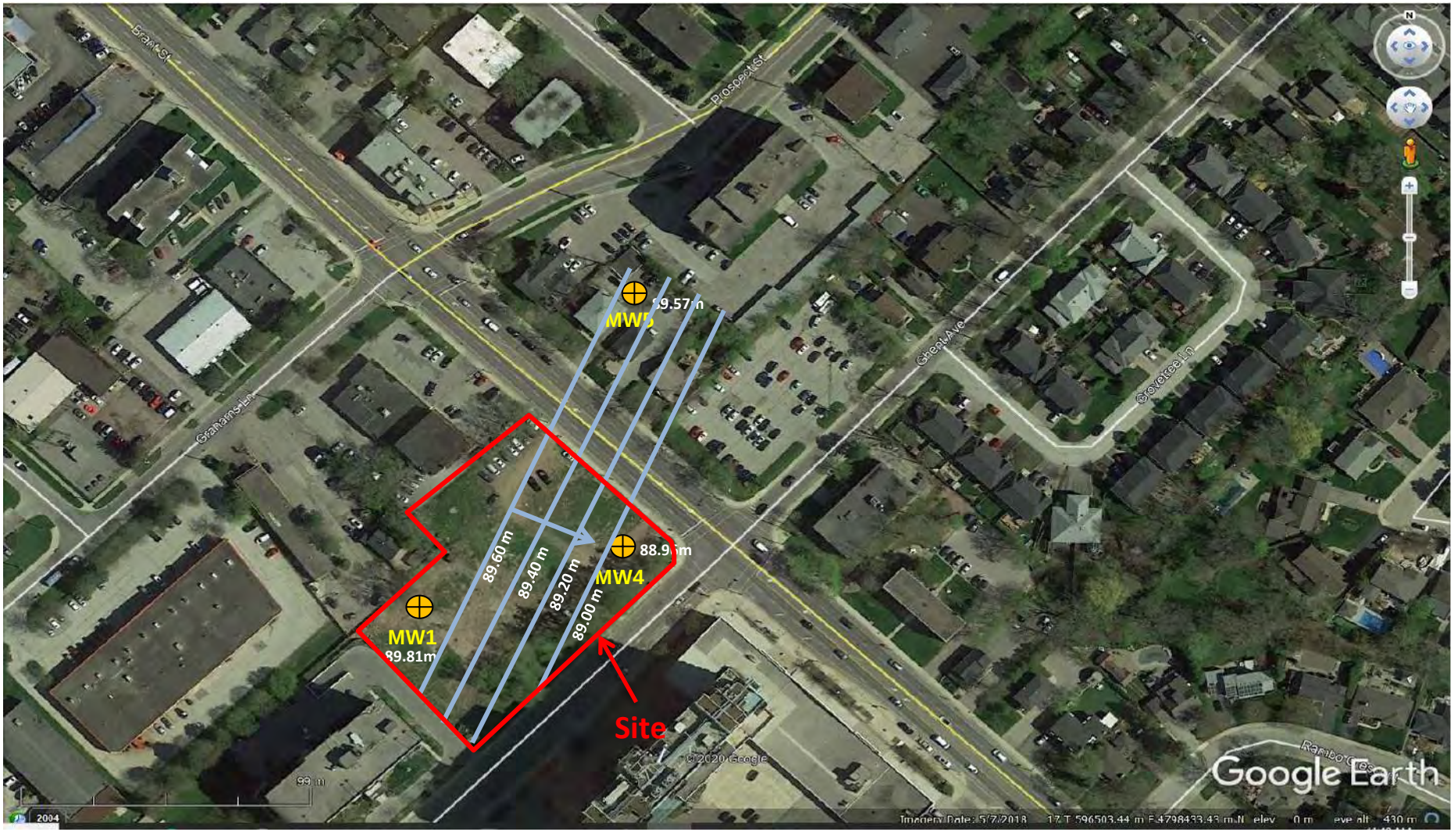
MOE Wells Locations

LANDTEK LIMITED

CONSULTING ENGINEERS

205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1

	Scale: See Map	Date: September 2020
Project:	Hydrogeological Investigation 774-782 Brant Street Burlington, Ontario	
Title:	Figure 4: MOE Wells Locations	
Project No.	20255A	



LEGEND

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

	LANDTEK LIMITED ***CONSULTING ENGINEERS*** **205 NEBO ROAD, HAMILTON, ONTARIO, L8W 2E1**
Scale: See Map	Date: September 2020
Project:	Hydrogeological Investigation 774-782 Brant Street Burlington, Ontario
Title:	Figure 5: Groundwater Contour Diagram
Project No.	20255A

APPENDIX B

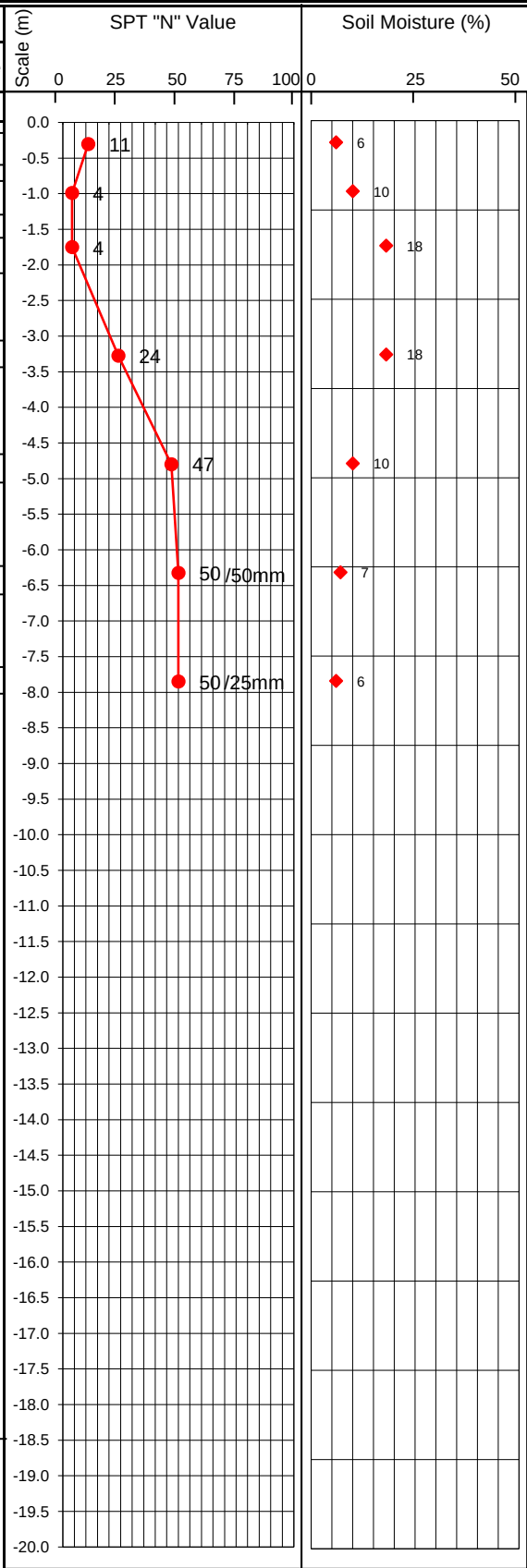
BOREHOLES & MONITORING WELLS LOGS

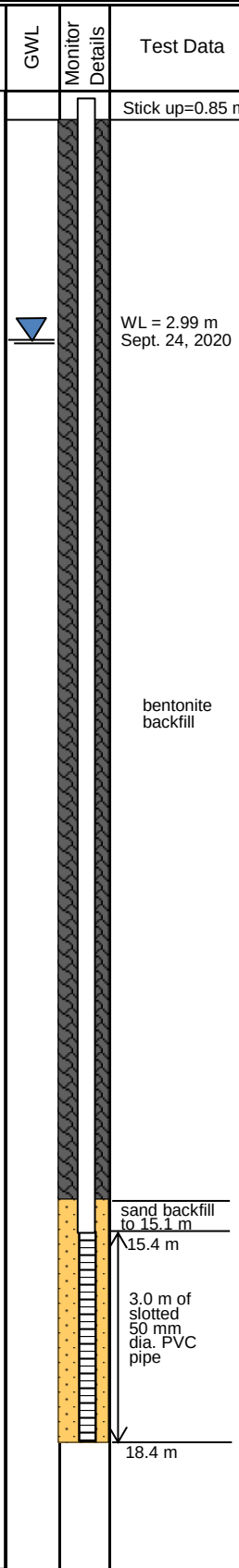
Landtek Limited

BH/MW 1

Project No.:	20255A	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	Test Data
Ground Surface		92.8			Stick up=0.85 m
±130 mm of Topsoil		0.0	1	SS	
FILL: sand, trace gravel, brown, compact					
SILTY SAND: fine to medium grained, trace gravel, brown, loose, moist		0.7	2	SS	
SANDY SILT: fine to medium grained sand, brown, loose, wet		1.5 90.3	3	SS	
CLAYEY SILT TILL: trace gravel, trace shale, brownish grey, very stiff, moist		2.5	4	SS	WL = 2.99 m Sept. 24, 2020
4.5 m to 5.6 m: reddish brown, hard, moist			5	SS	
		87.2			
SHALE BEDROCK (Queenston Formation) very weak to weak, highly weathered, red, moist		5.6	6	SS	
		84.8	7	SS	
slightly weathered to fresh, red and grey, medium strong Recovery = 100 %; RQD = 80 %		8.0	CORE RUN #1	63 mm Dia. Core	bentonite backfill
slightly weathered to fresh, red, strong Recovery = 100 %; RQD = 100 % ∂ = 25.5 kN/m^3; UCS strength = 72.7 MPa		9.3	CORE RUN #2		
slightly weathered to fresh, red and grey, medium strong Recovery = 100 %; RQD = 99 %		10.8	CORE RUN #3		
fresh, red and grey, medium strong Recovery = 100 %; RQD = 97 % ∂ = 25.5 kN/m^3; UCS strength = 44.3 MPa		12.2	CORE RUN #4		
fresh, red and grey, medium strong Recovery = 100 %; RQD = 100 %		13.7	CORE RUN #5		
fresh, red and grey, medium strong Recovery = 100 %; RQD = 88 %		15.4	CORE RUN #6		sand backfill to 15.1 m 15.4 m 3.0 m of slotted 50 mm dia. PVC pipe
fresh, red and grey, medium strong Recovery = 100 %; RQD = 100 %		16.9 74.4	CORE RUN #7		
BOREHOLE TERMINATED		18.4			18.4 m





Notes:
1. Wet soils encountered at 1.5 m
2. Water level reading: 2.99 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

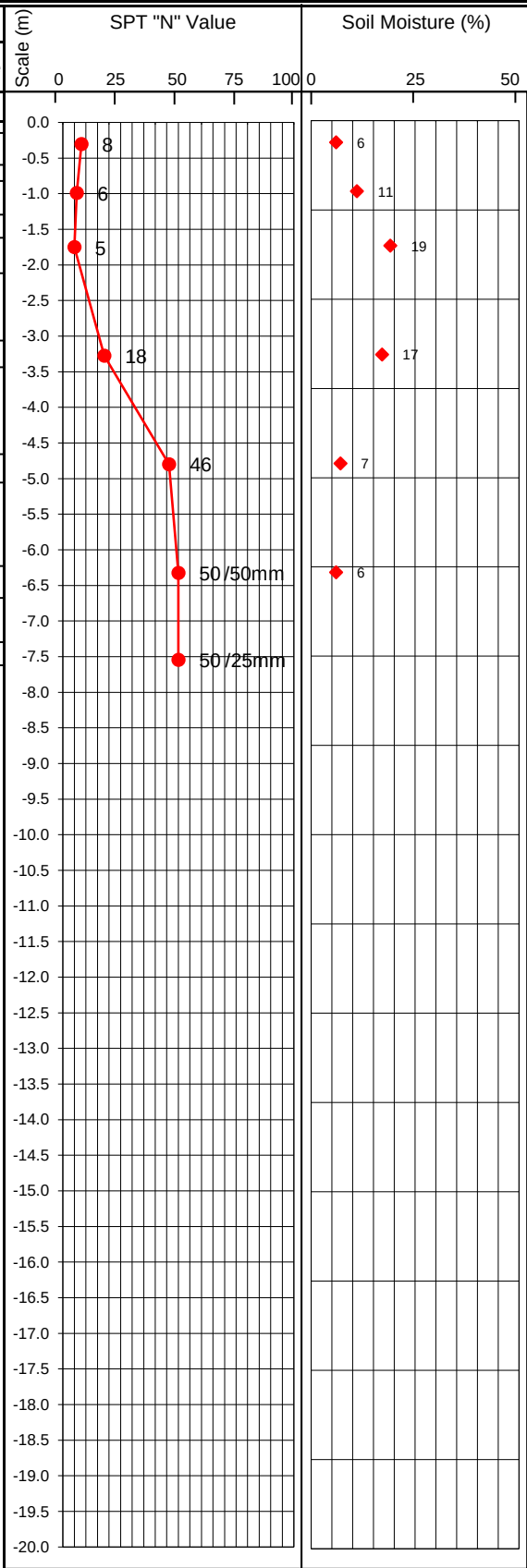
Landtek Limited
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

Landtek Limited

BH 2

Project No.:	20255A	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
Ground Surface		93.3		
±50 mm of Topsoil		0.0	1	SS
FILL: sand, brown, compact, moist		92.6		
SILTY SAND: fine to medium grained, trace gravel, brown, loose, moist		0.7	2	SS
1.5 m to 2.5 m: wet			3	SS
		90.8		
CLAYEY SILT TILL: trace gravel, trace shale, brownish grey, very stiff, moist		2.5	4	SS
4.5 m to 5.0 m: hard		88.3	5	SS
SHALE BEDROCK (Queenston Formation) very weak to weak, highly weathered, red, moist		5.0	6	SS
		85.7	7	SS
AUGER REFUSAL **BOREHOLE TERMINATED**		7.6		



GWL	Monitor Details	Test Data

Notes: 1. Wet soils encountered at 1.5 m

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

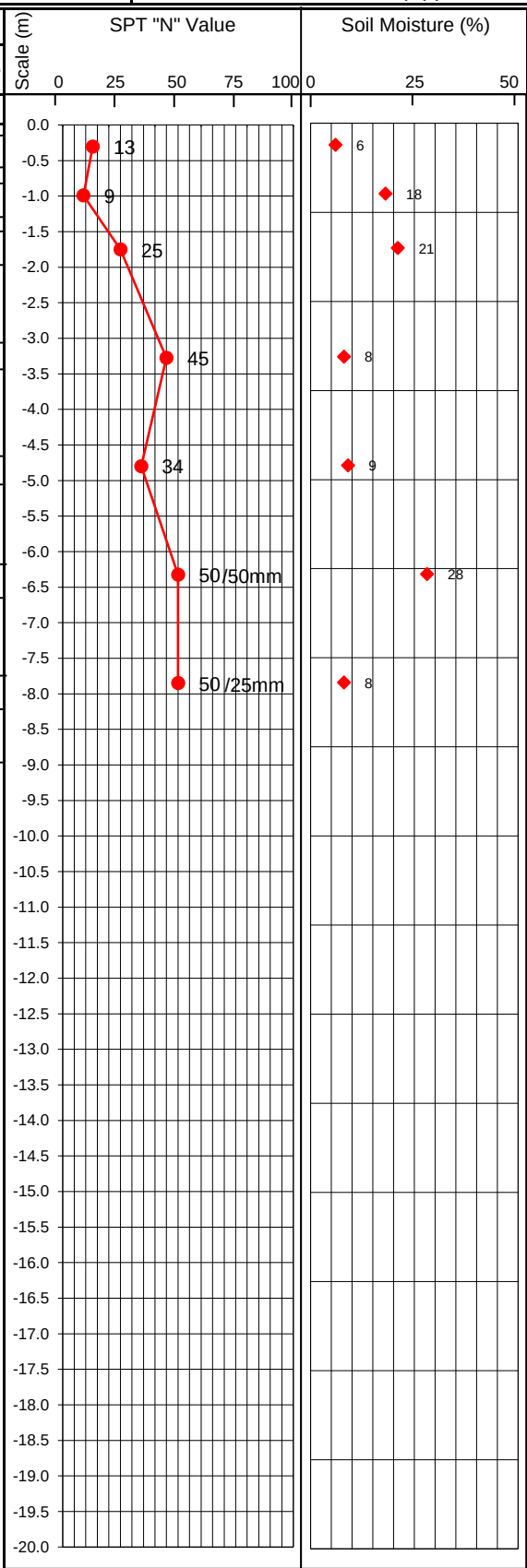
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Landtek Limited

BH 3

Project No.:	20255A	Drill Date:	September 1, 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	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		91.9							
±50 mm of Topsoil		0.0							
FILL: clayey silt, trace iron staining, brown, stiff, moist			1	SS	13	6			
			2	SS	9	18			
		90.4							
CLAYEY SILT TILL: trace gravel, trace shale, brownish grey, very stiff, moist		1.5	3	SS	25	21			
3.0 m to 4.0 m: reddish brown, hard			4	SS	45	8			
		87.9							
SHALE BEDROCK (Queenston Formation) very weak to weak, highly weathered, red, moist		4.0	5	SS	34	9			
4.3 m to 8.0 m: wet			6	SS	50/50mm	28			
8.0 m to 9.1 m: slightly weathered to fresh			7	SS	50/25mm	8			
		82.8							
		9.1							
AUGER REFUSAL									
BOREHOLE TERMINATED									



Notes: 1. Groundwater encountered at 4.3 m depth 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

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BH/MW 4

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

Material Description	Elev. Depth	Samples No.	Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface	91.5							Stick up=0.91 m
±50 mm of Topsoil	0.0	1	SS	11	12			
FILL: silty sand and silt, trace iron staining, brown, loose to compact, moist		2	SS	7	11			
	90.0							
CLAYEY SILT TILL: trace gravel, trace shale, brownish grey, very stiff, moist	1.5	3	SS	20	24			
3.0 m to 3.5 m: wet	88.0	4	SS	50/100 mm	12			WL = 2.57 m Sept. 24, 2020
SHALE BEDROCK (Queenston Formation) very weak to weak, highly weathered, red, moist	3.5	5	SS	50/100 mm	3			bentonite backfill
		6	SS	50/50mm	2			
	83.5							
slightly weathered to fresh, red and grey, medium strong	8.0		TRICONE DRILLING					sand backfill to 15.1 m
	73.1							15.4 m
								3.0 m of slotted 50 mm dia. PVC pipe
BOREHOLE TERMINATED	18.4							18.4 m

Scale (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0, -14.5, -15.0, -15.5, -16.0, -16.5, -17.0, -17.5, -18.0, -18.5, -19.0, -19.5, -20.0

SPT "N" Value: 0, 25, 50, 75, 100

Soil Moisture (%): 0, 25, 50

Notes: 1. Wet soils encountered at 3.5 m 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

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APPENDIX C

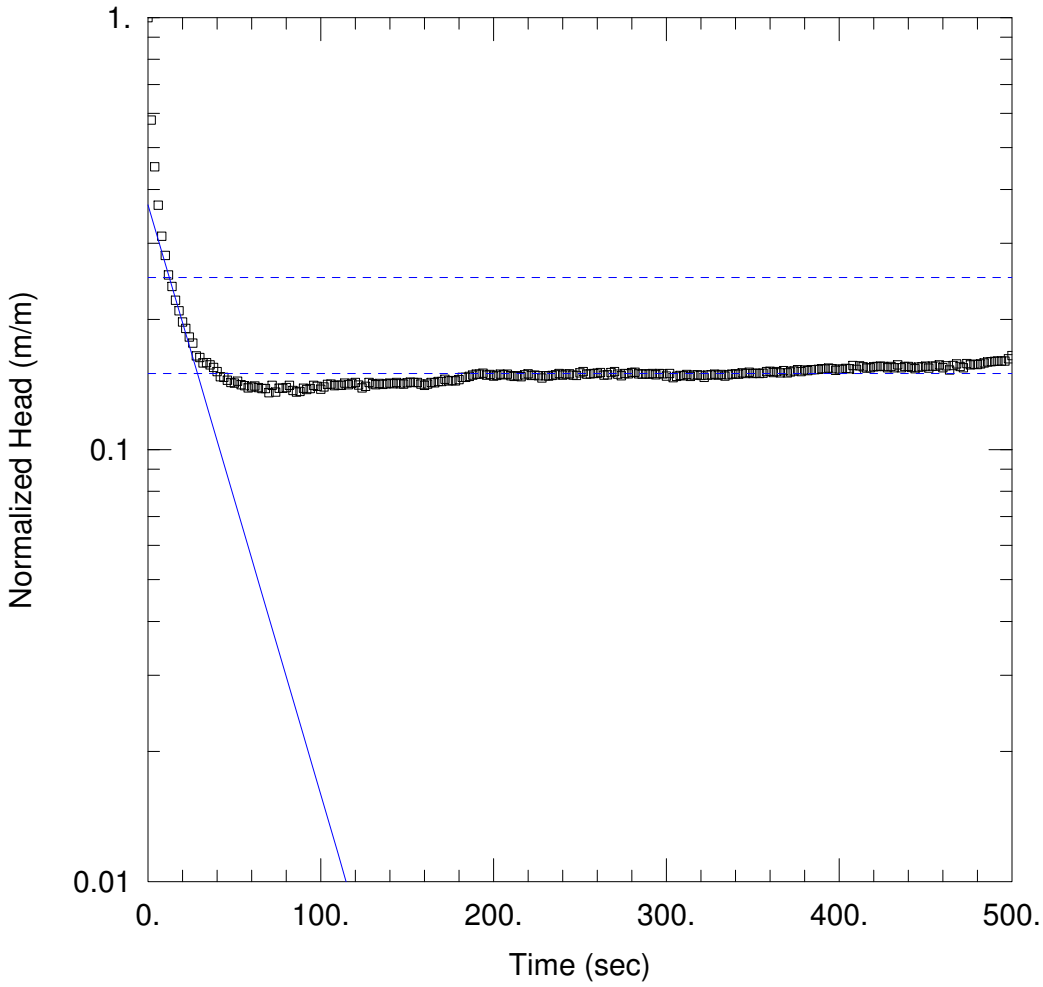
SUMMARY OF MOE WELL RECORDS

774-782 Brant Street, Burlington

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	2810058	05-Jul-04	23-Sep-04	596231	4798928	NA	NA	NA	Observation Well	Observation Well	24.93	7.60	Bedrock	903 Brant Street	BURLINGTON
2	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
3	2810214	21-Mar-05	26-Apr-05	596212	4798276	6.6	NA	NA	Observation Well	NA	14.8	4.51	Overburden	NA	BURLINGTON
4	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
5	6715010	06-Jul-04	31-Aug-04	596235	4798927	10.5	NA	Fresh	Observation Well	Monitoring Well	14.8	4.51	Overburden	131 Ontario Street	BURLINGTON
6	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
7	7047125	04-Jun-07	26-Jul-07	596126	4798177	9.8	NA	NA	Observation Well	Observation Well	11.8	3.60	Overburden	1380 Grahams Lane	BURLINGTON
8	7128794	09-Jan-08	01-Sep-09	596186	4798748	NA	NA	NA	Abandoned	Monitoring Well	22.3	6.80	Overburden	2075 Fairview Street	BURLINGTON
9	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
10	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
11	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
12	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
13	7187211	NA	17-Sep-12	596799	4798762	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Bedrock	2096 Hent Avenue	BURLINGTON
14	7187212	NA	17-Sep-12	596775	4798734	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Bedrock	2084 Ghgnt Avenue	BURLINGTON
15	7220604	21-Apr-14	20-May-14	596782	4798703	NA	NA	NA	Monitoring Well	Monitoring Well	17	5.18	Bedrock	2702 Ghent Avenue	BURLINGTON
16	7220605	21-Apr-14	20-May-14	596782	4798703	NA	NA	NA	Abandoned	NA	20	6.10	NA	2702 Ghent Avenue	BURLINGTON
17	7243101	29-Apr-15	16-Jun-15	596193	4798975	NA	NA	NA	Monitoring Well	Monitoring Well	25	7.62	Bedrock	923 Brant Street	BURLINGTON
18	7244979	03-Jun-15	21-Jul-15	596883	4798686	7	NA	NA	Abandoned	NA	NA	NA	NA	2086 Grant Avenue	BURLINGTON
19	7244980	03-Jun-15	21-Jul-15	596883	4798686	NA	NA	NA	Observation Well	Monitoring Well	18	5.5	Bedrock	2086 Grant Avenue	BURLINGTON
20	7244981	03-Jun-15	21-Jul-15	596883	4798686	NA	NA	NA	Observation Well	NA	18	5.49	Bedrock	2086 Grant Avenue	BURLINGTON
21	7244982	03-Jun-15	21-Jul-15	596825	4798636	NA	NA	NA	Abandoned	NA	NA	NA	NA	2086 Grant Avenue	BURLINGTON
22	7251865	11-Sep-15	10-Nov-15	596782	4798684	NA	NA	NA	Monitoring Well	Monitoring Well	20	6.10	Bedrock	2068 Ghent Avenue	BURLINGTON
23	7252011	04-Sep-15	10-Nov-15	596736	4798745	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Bedrock	2071 Ghent Avenue	BURLINGTON
24	7265586	10-Mar-16	24-Jun-16	596019	4798801	NA	NA	NA	NA	NA	NA	NA	NA	NA	BURLINGTON
25	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
26	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
27	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
28	7290057	26-May-17	07-Jul-17	596301	4798815	NA	NA	NA	Observation Well	Test Hole	20	6.10	Overburden	833 Brant Street	BURLINGTON
29	7290058	26-May-17	07-Jul-17	596289	4798790	NA	NA	NA	Observation Well	Test Hole	20	6.10	Overburden	855 Brant Street	BURLINGTON
30	7291911	12-Jun-17	02-Aug-17	596224	4798347	NA	NA	NA	NA	NA	NA	NA	NA	NA	BURLINGTON
31	7292314	21-Jun-17	11-Aug-17	596336	4798785	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Overburden	849 Brant Street	BURLINGTON
32	7292315	21-Jun-17	11-Aug-17	596336	4798786	NA	NA	NA	Observation Well	Monitoring Well	30	9.15	Overburden	849 Brant Street	BURLINGTON
33	7292316	21-Jun-17	11-Aug-17	596361	4798743	NA	NA	NA	Observation Well	Monitoring Well	18	5.49	Overburden	849 Brant Street	BURLINGTON
34	7292317	21-Jun-17	11-Aug-17	596352	4798776	NA	NA	NA	Observation Well	Monitoring Well	18	5.49	Overburden	849 Brant Street	BURLINGTON
35	7314898	04-Jul-18	19-Jul-18	596295	4798451	NA	NA	NA	Observation Well	Monitoring Well	15	4.57	Overburden	1416 Graham Lane	BURLINGTON
36	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
37	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
38	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
39	7323581	05-Oct-18	06-Dec-18	596643	4798961	NA	NA	NA	Test Hole	Test Hole	20	6.10	Overburden	2103 Prospect Street	BURLINGTON
40	7330854	14-Feb-19	01-Apr-19	596270	4798655	NA	NA	NA	Observation Well	Monitoring Well	13	3.96	Overburden	850 Brant Street	BURLINGTON
41	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
42	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
43	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
44	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
45	7330859	14-Feb-19	01-Apr-19	596288	4798651	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Overburden	850 Brant Street	BURLINGTON
46	7331850	23-Aug-18	23-Apr-19	596494	4798533	NA	NA	NA	Observation Well	Monitoring Well	20	6.10	Overburden	280 Brant Street	BURLINGTON
47	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

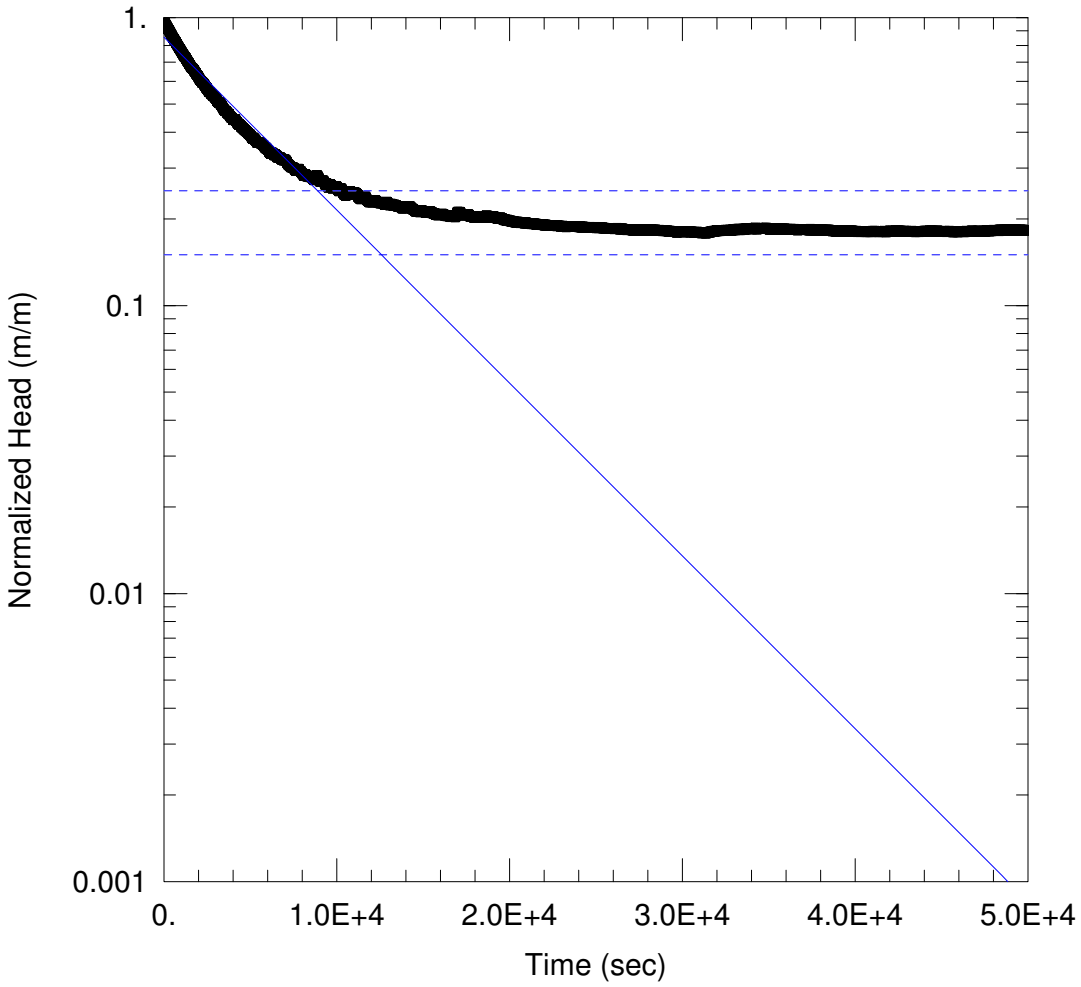
Saturated Thickness: 15.4 m
Anisotropy Ratio (Kz/Kr): 1.

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.

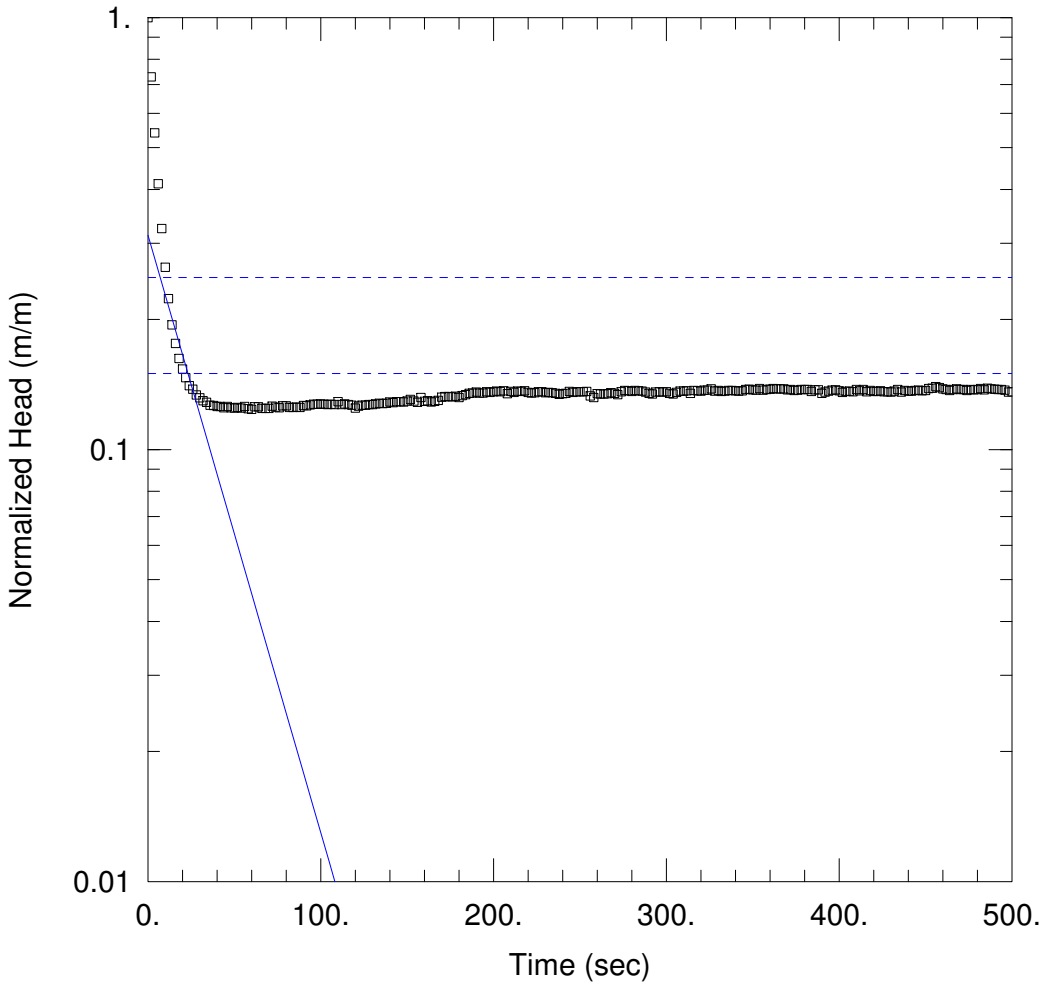
WELL DATA (MW4)

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.

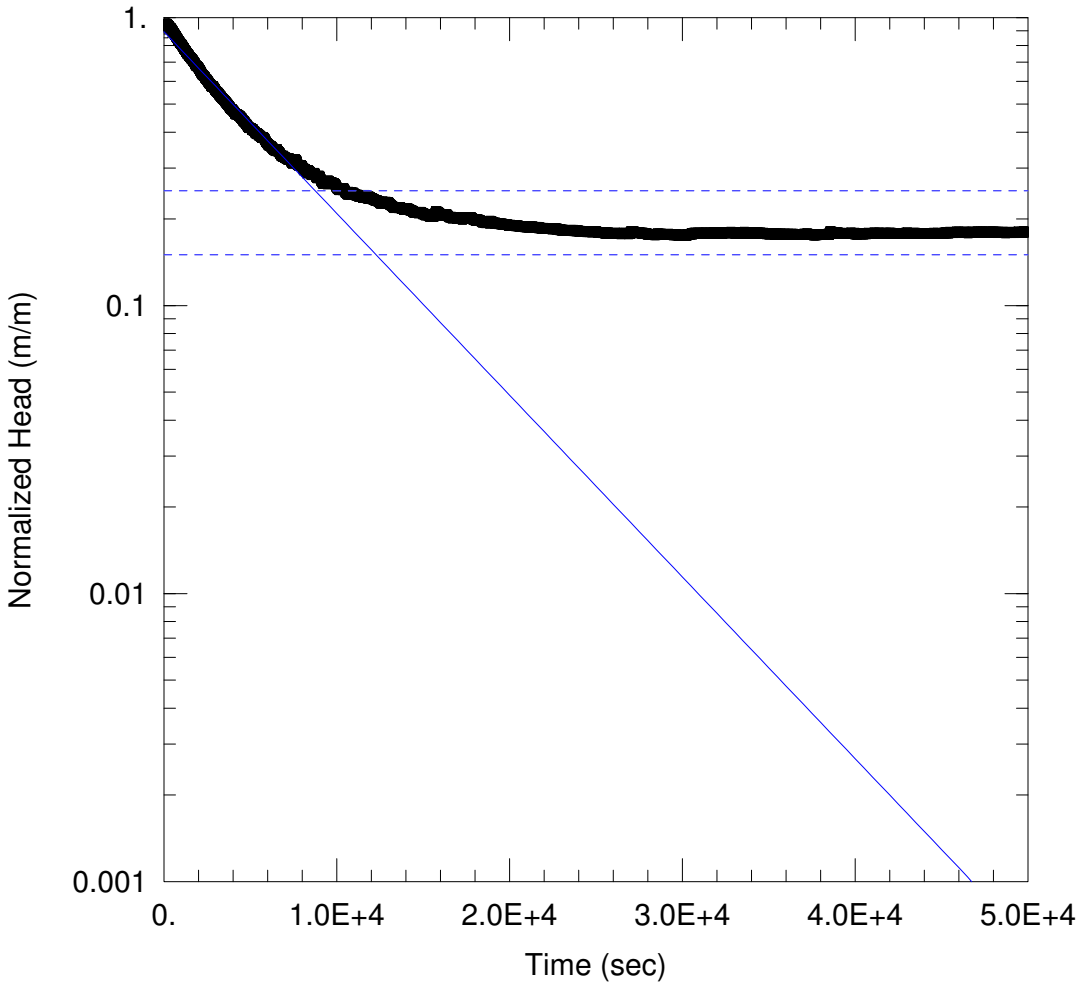
WELL DATA (MW5)

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.

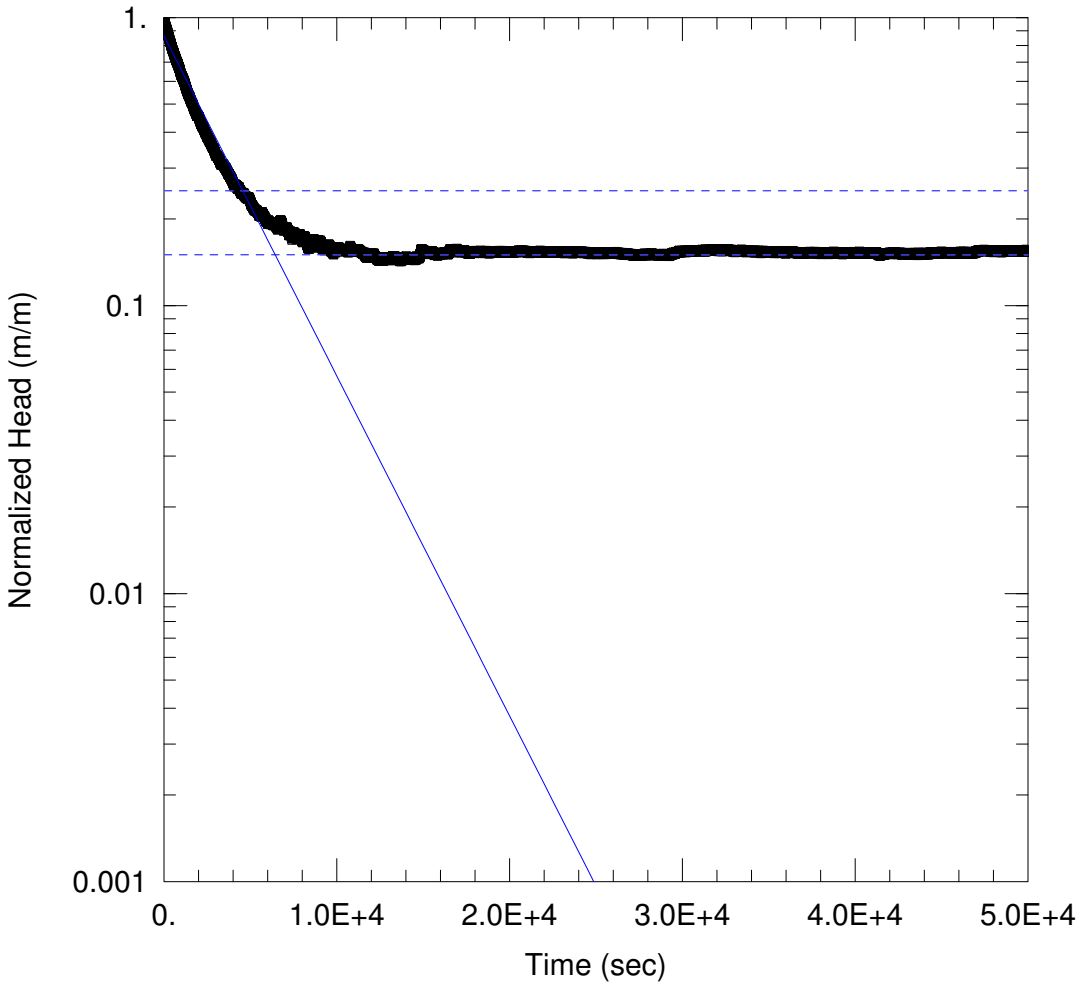
WELL DATA (MW8)

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	1×10^{-9}	
Various	Gartner Lee Ltd (1978)	Queenston Shale	8.10×10^{-7}	
Various	Gartner Lee Ltd (1978)	Lacustrine Clay Silt (Peel Plain)	1×10^{-8}	
Georgetown	Gartner Lee Ltd. (1993)	Queenston Shale	1×10^{-6}	
Burlington	Gartner Lee Ltd. (1983)	Shale	1×10^{-8}	1×10^{-6}
Oakville (East)	MOE (1979)	Peel Plain	5×10^{-6}	4×10^{-5}
Oakville (East)	MOE (1979)	Queenston Shale	3.2×10^{-5}	2.3×10^{-6}
Oakville (East)	MOE (1979)	Georgian Bay Shale	5.1×10^{-6}	
Milton	International Water Consultants (1977)	Upper Sand and Gravel	2.83×10^{-3}	
Mississauga	Conestoga Rovers and Associates (2013)	Shale	2.4×10^{-5}	

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

Source: Holysh (1997)

APPENDIX F

LABORATORY CERTIFICATE OF ANALYSIS

AGAT Laboratories

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http://www.agatlabs.com

CLIENT NAME: LANDTEK LTD.
205 NEBO ROAD, UNIT 3
HAMILTON, ON L8W2E1
(905) 383-3733
ATTENTION TO: Henry Erober
PROJECT: 20255A
AGAT WORK ORDER: 20T653951
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 20T653951, 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.*
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Environmental Services Association of Alberta (ESAA)

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Certificate of Analysis

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLING SITE:

SAMPLED BY:

E. Coli (Using MI Agar)

DATE RECEIVED: 2020-09-22

DATE REPORTED: 2020-10-02

		SAMPLE DESCRIPTION:		**MW1**	**MW4**
		SAMPLE TYPE:		**Water**	**Water**
		DATE SAMPLED:		**2020-09-21 13:30**	**2020-09-21 13:30**
Parameter	**Unit**	**G / S**	**RDL**	**1468787**	**1468793**
Escherichia coli	CFU/100mL	200	1	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.

1468793 ND - Not Detected.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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Certificate of Analysis

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLING SITE:

SAMPLED BY:

Burlington Storm Sewer - Organics

DATE RECEIVED: 2020-09-22

DATE REPORTED: 2020-10-02

		SAMPLE DESCRIPTION:		MW1	MW4
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2020-09-21 13:30	2020-09-21 13:30
Parameter	Unit	G / S	RDL	1468787	1468793
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	0.0004	0.0004
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:

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Certificate of Analysis

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLING SITE:

SAMPLED BY:

Nonylphenol and Nonylphenol Ethoxylates (Ontario, mg/L)

DATE RECEIVED: 2020-09-22

DATE REPORTED: 2020-10-02

				SAMPLE DESCRIPTION:	MW1	MW4
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2020-09-21 13:30	2020-09-21 13:30
Parameter	**Unit**	**G / S**	**RDL**		**1468787**	**1468793**
Total Nonylphenol	mg/L	0.001	0.001		<0.001	<0.001
NP1EO	mg/L		0.001		0.002	0.001
NP2EO	mg/L		0.0003		<0.0003	<0.0003
Total Nonylphenol Ethoxylates	mg/L	0.01	0.001		0.002	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

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Certificate of Analysis

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLING SITE:

SAMPLED BY:

BOD-Toronto

DATE RECEIVED: 2020-09-22

DATE REPORTED: 2020-10-02

				SAMPLE DESCRIPTION:	MW1	MW4
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2020-09-21 13:30	2020-09-21 13:30
Parameter	Unit	G / S	RDL		1468787	1468793
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

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Certificate of Analysis

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLING SITE:

SAMPLED BY:

Burlington Storm Sewer Use By-law - Inorganics

DATE RECEIVED: 2020-09-22

DATE REPORTED: 2020-10-02

		SAMPLE DESCRIPTION:		MW1	MW4
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2020-09-21 13:30	2020-09-21 13:30
Parameter	**Unit**	**G / S**	**RDL**	**1468787**	**1468793**
pH	pH Units	6.5 - 8.5	NA	6.73	6.92
Total Suspended Solids	mg/L	15	10	**19**	**25**
Total Cyanide	mg/L	0.02	0.002	<0.002	<0.002
Phenols	mg/L	0.008	0.002	<0.002	<0.002
Total Phosphorus	mg/L	0.4	0.02	0.02	0.04
Total Arsenic	mg/L	0.02	0.015	<0.015	<0.015
Total Cadmium	mg/L	0.008	0.005	<0.005	<0.005
Total Chromium	mg/L	0.08	0.020	<0.020	<0.020
Chromium VI	mg/L	0.04	0.005	<0.005	<0.005
Total Copper	mg/L	0.04	0.020	<0.020	<0.020
Total Lead	mg/L	0.12	0.020	<0.020	<0.020
Total Manganese	mg/L	0.05	0.020	**0.757**	**0.447**
Total Mercury	mg/L	0.0004	0.0002	<0.0002	<0.0002
Total Nickel	mg/L	0.08	0.030	<0.030	<0.030
Total Selenium	mg/L	0.02	0.020	**0.066**	**0.041**
Total Silver	mg/L	0.12	0.020	<0.020	<0.020
Total Zinc	mg/L	0.04	0.020	<0.020	<0.020

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: Iris Verástegui

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

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Exceedance Summary

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Henry Erober

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
1468787	MW1	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Manganese	mg/L	0.05	0.757
1468787	MW1	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Selenium	mg/L	0.02	0.066
1468787	MW1	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Suspended Solids	mg/L	15	19
1468793	MW4	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Manganese	mg/L	0.05	0.447
1468793	MW4	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Selenium	mg/L	0.02	0.041
1468793	MW4	ON Burlington SM	Burlington Storm Sewer Use By-law - Inorganics	Total Suspended Solids	mg/L	15	25

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

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Quality Assurance

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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:



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

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Quality Assurance

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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:



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

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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%

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Quality Assurance

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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	1468130		<10	<10	NA	< 10	104%	80%	120%						
Total Cyanide	1438860		<0.002	<0.002	NA	< 0.002	90%	70%	130%	101%	80%	120%	103%	70%	130%
Phenols	1468787	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	1471475		<0.015	<0.015	NA	< 0.015	104%	70%	130%	104%	80%	120%	106%	70%	130%
Total Cadmium	1471475		<0.005	<0.005	NA	< 0.005	99%	70%	130%	100%	80%	120%	105%	70%	130%
Total Chromium	1471475		<0.020	<0.020	NA	< 0.020	96%	70%	130%	101%	80%	120%	98%	70%	130%
Chromium VI	1468718		<0.005	<0.005	NA	< 0.005	100%	70%	130%	100%	80%	120%	97%	70%	130%
Total Copper	1471475		<0.020	<0.020	NA	< 0.020	98%	70%	130%	103%	80%	120%	92%	70%	130%
Total Lead	1471475		<0.020	<0.020	NA	< 0.020	95%	70%	130%	106%	80%	120%	98%	70%	130%
Total Manganese	1471475		0.021	<0.020	NA	< 0.020	99%	70%	130%	109%	80%	120%	101%	70%	130%
Total Mercury	1472485		<0.0002	<0.0002	NA	< 0.0002	103%	70%	130%	96%	80%	120%	97%	70%	130%
Total Nickel	1471475		<0.030	<0.030	NA	< 0.030	88%	70%	130%	99%	80%	120%	97%	70%	130%
Total Selenium	1471475		<0.020	<0.020	NA	< 0.020	106%	70%	130%	105%	80%	120%	102%	70%	130%
Total Silver	1471475		<0.020	<0.020	NA	< 0.020	90%	70%	130%	101%	80%	120%	93%	70%	130%
Total Zinc	1471475		<0.020	<0.020	NA	< 0.020	105%	70%	130%	111%	80%	120%	104%	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

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QA Violation

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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	MW4	49%	60%	140%	NA	60%	140%	NA	60%	140%

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

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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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

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Method Summary

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 20T653951

PROJECT: 20255A

ATTENTION TO: Henry Erober

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

Mobi

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)

Laboratory Use Only
Work Order #: 20T653951
Cooler Quantity:
Arrival Temperatures: 6.0 | 6 | 6.2
6 | 6 | 6.4
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: ICP

Report Information:
Company: Landtek Limited
Contact: Henry Ecker
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:

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

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

Project Information:
Project: 20255A
Site Location: 774 to 782 Brant St. Burlington
Sampled By: LB and HG
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:

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: ☐ Mtls ☐ 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)
MW1	21-Sep-22	1:30 PM		GW		N												✓	✓					
MW4	"	"		"		✓												✓	✓					
		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): K. Crisfield	Date Sept. 22/22	Time 2:00pm	Samples Received By (Print Name and Sign): John Chupka	Date Sept 22	Time 1:45
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign): John Chupka	Date Sept 22	Time 4:30
Samples Relinquished By (Print Name and Sign):	Date	Time			

Page ____ of ____
No: 109222

Document ID: DW-75-1511-018

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: August 24, 2020

AGAT Laboratories

Sample Temperature Log

Client: Landtek

# of Coolers: 8

COC# or Work Order #: 20T653951

# 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-78-3511.003
Date Issued: 2017-2-23

Page: _____ of _____

APPENDIX G

DEWATERING ASSUMPTIONS AND 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 = 14.9 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 Parking	H (m)	h_w (m)	R (m)	r_e (m)	Q L/day	Q L/day (with 1.3 Factor of Safety
	17.57	7.9	~26.4	~46.2.0	~142,733 (1.652 x 10-3 m3/s)	~ 185,553

Assumptions for hydrogeological setting:

1. A confined aquifer is presumed to exist locally with a water table determined to be 2.43 mbgs at MW4 on January14, 2021 and extending to an estimated depth of approximately 20.0 mbgl.
2. The maximum dewatering depth of construction activities is assumed to be 12.1 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 8.252×10^{-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 = 14.9 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	H (m)	h_w (m)	R (m)	r_e (m)	Q L/day	Q L/day (with 1.3 Factor of Safety
	17.57	7.90	~2.90	~46.2	~12,609 (1.50 x 10-4 m3/s)	~ 16,392

Assumptions for hydrogeological setting:

1. A confined aquifer is presumed to exist locally with a water table determined to be 2.43 mbgs at MW4 on January14, 2021 and extending to an estimated depth of approximately 20.0 mbgl.
2. The maximum dewatering depth of construction activities is assumed to be 12.1 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 1.0×10^{-8} m/s

APPENDIX H

WATER BALANCE

APPENDIX H: D ETAILED WATER BALANCE - 774-782 Brant Street (Phase 1), 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 mainly underlain by clayey 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	0.000	ha	0	m^2
Parking Areas, Roadways, Other impervious Areas	0.000	ha	0	m^2
Green space, open space, natural areas	0.670	ha	6,704	m^2
TOTAL	0.670	ha	6,704	m^2

Post-Development:

Building Roof	0.312	ha	3,122	m^2
Parking Areas, Roadways, Other impervious Areas	0.191	ha	1,906	m^2
Green space, SWMP, natural areas	0.168	ha	1,676	m^2
TOTAL	0.670	ha	6,704	m^2

Industrial Buildings

Landscape coverage (25.0%)	0.168	ha	1,676	m^2
Parking Areas, Roadways, Other impervious Areas (28.4%)	0.191	ha	1,906	m^2
Building Roof (46.6%)	0.312	ha	3,122	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	0	0	-	-	0
Green Space	6,704	6,235	4,083	670	1,482
Roads, Other impervious	0	0	-	-	0
TOTAL	6,704	6,235	4,083	670	1,482

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	3,122	2,903	-	-	2,903
Roads, Other impervious	1,906	1,773	-	-	1,773
Green space, open space, natural areas	1,676	1,558	1,020	168	370
TOTAL	6,704	6,235	1,020	168	5,047

6. Comparison of Pre-Development and Post-Development

		Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development		6,235	4,083	670	1,482
Post-Development		6,235	1,020	168	5,047

7. Post development infiltration measures

Post-development infiltration volume	168	m^3
Pre-development infiltration volume	670	m^3
Deficit from pre to post-development infiltration	503	m^3
Percentage of water collected from roof area required to match pre-development infiltration	17	%

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.

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		

