S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing Report

2020 LAKESHORE ROAD

PROPOSED MIX-USE BUILDING

CITY OF BURLINGTON

OCTOBER 2021

SLA File: 21082

3228 South Service Road, Suite 105, East Wing Burlington, Ontario L7N 3H8
Tel. (905) 631-6978 www.sla.on.ca

TABLE OF CONTENTS

1.0 INTRODUCTION AND BACKGROUND 2
1.1 OVERVIEW 2
1.2 BACKGROUND INFORMATION 2
1.3 GEOTECHNICAL INVESTIGATION 3
1.4 HYDROGEOLOGICAL DEWATERING ASSESSMENT 3
2.0 STORMWATER MANAGEMENT 4
2.1 EXISTING CONDITIONS 4
2.2 PROPOSED CONDITIONS 5
2.3 SEDIMENT AND EROSION CONTROL 6
3.0 SANITARY SEWER SERVICING 6
3.1 EXSTING CONDITIONS 6
3.2 SANITARY DEMAND 6
3.3 PROPOSED SANITARY SERVICING 7
3.4 SANITARY CAPACITY ANALYSIS 7
4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING 7
4.1 EXISTING CONDITIONS 7
4.2 DOMESTIC WATER DEMAND 8
4.3 FIRE FLOW DEMAND 8
4.4 PROPOSED WATER SERVICING AND ANALYSIS 9
5.0 CONCLUSIONS AND RECOMMENDATIONS 9

TABLES

Table 2.1 – Existing Conditions Catchment Areas 4
Table 2.2 – Existing Conditions Stormwater Discharge 5
Table 2.3 – Proposed Condition Catchment Areas 5
Table 2.4 – Proposed Conditions Stormwater Discharge 5
Table 3.1 – Proposed Population 6
Table 3.2 – Proposed Sanitary Sewer Discharge 7
Table 4.1 – Proposed Domestic Water Demand 8
Table 4.2 – Hydrant Flow Test Data 9

FIGURES

Figure 1.0 - Location Plan 3

APPENDICIES

Appendix A – Stormwater Management Information ……..Encl.
Appendix B – Wastewater Analysis Information ……..Encl.
Appendix C – Water Analysis Information ……Encl.
Appendix D – Geotechnical & Hydrogeological Investigations.……Encl.

1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Burlington 2020 Lakeshore Inc. to provide consulting engineering services for the proposed development located at 2020 Lakeshore Road in the City of Burlington (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed overall development.

The proposed development consists of constructing a 30 to 35-storey mixed-use building containing approximately 557 residential units, 122 hotel rooms, 4,483m^2 of commercial area, and 4 levels of underground parking. The proposed site will also include concrete curbing/sidewalk, asphalt drive aisle and landscaped areas.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by NEUF Architects for additional information.

1.2 BACKGROUND INFORMATION

The following documents were referenced in the preparation of this report:

Ref. 1: MOE Stormwater Management Planning and Design Manual (Ministry of Environment, March 2003)

Ref. 2: Erosion & Sediment Control Guidelines for Urban Construction (December 2006)

Ref. 3: Low Impact Development Stormwater Management Planning and Design Guide (Toronto and Region Conservation Authority & Credit Valley Conservation, 2010)

Ref. 4: Sustainable Halton Water and Wastewater Master Plan (Aecom, October 2011)

Ref. 5: Water and Wastewater Linear Design Manual (Regional Municipality of Halton, October 2019)

Ref. 6: Stormwater Management Design Guidelines (City of Burlington, May 2020)



Figure 1.0 - Location Plan

1.3 GEOTECHNICAL INVESTIGATION

A geotechnical investigation was prepared by Soil-Mat Engineers & Consultants Ltd. dated August 27, 2021. Seven (7) boreholes were drilled between April 5 to 8, 2021 to approximate depths ranging between 7.6m and 20.1m below grade. Topsoil and pavement structure were encountered ranging in thickness from 0.1m to 1.32m below grade. Silty clay and clayey silt fill was encountered below the pavement and topsoil at all boreholes ranging in depths of approximately 1.5 to 7.0m below grade. Native soils of silty clay and clayey silt were found underlaying the fill soils. Queenston Shale was encountered below the native silty clay/clayey silt layer in all boreholes at depths ranging from 2.13m to 7.92m below grade.

Groundwater was encountered in six (6) of the boreholes at depths ranging between 3.87m and 9.19m below grade (elevations of 74.88m to 73.78m). For more information refer to the geotechnical investigation in Appendix D.

1.4 HYDROGEOLOGICAL DEWATERING ASSESSMENT

A draft hydrogeological dewatering assessment was prepared by Terra-Dynamics Consulting Inc. dated September 16, 2021. Temporary construction dewatering is expected to be 37,018 l/day (0.428 l/s). Since the dewatering rate is less than 50,000 l/day, a Ministry of the Environment, Conservation & Parks (MECP) Environmental Activity and Sector Registry (EASR) will not be required.

The groundwater quality was analysed and the results were compared to the City of Burlington Storm Sewer Discharge Limits and the Region of Halton Sanitary Sewer By-Law Discharge Limits. It was found that a number of parameters were in exceedance of the City of Burlington Storm Sewer Discharge Limits, including biological oxygen demand, 4AAP-phenolics, manganese, zinc, chloroform and nonylphenol. The Region of Halton Sanitary Sewer By-law Discharge Limits were only in exceeded for the total suspended solids (TSS) and only in one of four boreholes tested. Based on these results, any dewatering would need to be filtered and approved by the Region of

Halton prior to discharging to the municipal sanitary sewer. For more information refer to the hydrogeological dewatering assessment in Appendix D.

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Burlington requirements and as per a meeting with the City of Burlington and Conservation Halton which took place on July 28, 2021:

Quantity Control

The City of Burlington requires the stormwater discharge rate from the proposed site to be controlled to the 5-year pre-development conditions discharge rate for all storm events (2 to 100-year storm events) however, due to the close proximity of the site to Lake Ontario, it is recommended that the site discharge flows uncontrolled.

Quality Control

The stormwater runoff from the proposed site must meet Level 1 (Enhanced) stormwater quality control (80% TSS removal, 90% average annual runoff treatment).

Erosion Control

Erosion and sediment control measures will be implemented in accordance with the standards of the City of Burlington.

2.1 EXISTING CONDITIONS

In the existing conditions, the 0.76ha site consists of the Waterfront Hotel Burlington, with a restaurant, banquet hall, and associated parking lot. The site is bound by Lakeshore Road to the north, Elizabeth Street to the east, and the Waterfront Trail to the south and west. An existing 300mmø storm sewer is located adjacent to the north property line, flowing west along Lakeshore Road towards the Waterfront Trail. Existing 825mmø and 1400mmø storm sewers are located adjacent to the west property line, flowing south along the Waterfront Trail, ultimately discharging to Lake Ontario. Existing 600mmø and 675mmø storm sewers are located adjacent to the east property line, flowing south along Elizabeth Street, ultimately discharging to Lake Ontario.

The topography of the existing site generally slopes from north to south with the majority of the site being collected by an on-site storm sewer network, which ultimately discharges to Lake Ontatio.

One (1) catchment area, Catchment 101, has been identified in the existing condition. See Table 2.1 and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

Catchment 101 represents the existing conditions discharge from the subject site draining towards Lake Ontario.

Table 2.1 – Existing Conditions Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious (%)	Runoff Coefficient (C)
101	Drainage from the subject lands south towards Lake Ontario	0.76	95	0.87

An analysis was performed on Catchment 101 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2 to 100-year City of Burlington 6-hour

Chicago Design Storms. A summary of the results can be found in Table 2.2 and detailed SWMHYMO input/output information can be found in Appendix A.

Table 2.2 – Existing Conditions Stormwater Discharge

Storm Event	2-year	5-year	10-year	25-year	50-year	100-year
Q (m^3/s)	0.158	0.205	0.236	0.275	0.304	0.333

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 30 to 35-storey mix-use building containing approximately 557 residential units, 122 hotel rooms, 4,483m^2 of commercial area, and 4 levels of underground parking. The proposed site will also include concrete curbing/sidewalk, asphalt drive aisle and landscaped areas. It is proposed to service the site with a private storm sewer system designed and constructed in accordance with the standards and specifications of the City of Burlington, directing all captured stormwater runoff to Lake Ontario.

One (1) catchment area, Catchment 201, has been identified in the proposed condition. Refer to Table 2.3 below and the Proposed Condition Drainage Area Plan in Appendix A for details.

Catchment 201 represents the drainage area for the site which will discharge to the adjacent storm sewers on Elizabeth Street and the Waterfront Trail, ultimately discharge to Lake Ontario.

Table 2.3 – Proposed Condition Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
201	Uncontrolled drainage to Lake Ontario	0.76	97	0.88

Water Quantity Control

It is proposed that stormwater quantity control not be implemented for this development due to the close proximity of the site to Lake Ontario (approximately 75m). Given the size and capacity of the existing municipal storm sewers servicing the site, post development peak storm flows will discharge the site, enter and be conveyed through the municipal storm sewers to Lake Ontario prior to the upstream watershed peak flows reaching the point of confluence.

An analysis was performed on Catchment 201 using the SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2 to 100-year City of Burlington 6-hour Chicago Design Storms. A summary of the results can be found in Table 2.4 and detailed SWMHYMO input/output information can be found in Appendix A.

Table 2.4 – Proposed Conditions Stormwater Discharge

Storm Event	2-year	5-year	10-year	25-year	50-year	100-year
Q (m^3/s)	0.161	0.208	0.240	0.279	0.309	0.338

As seen in Table 2.4, the increase in percent impervious of 2% (from 95% to 97%) increases the stormwater discharge from the site by a maximum of 0.005m^3/s (5 l/s) for all storm events.

Water Quality Control

There will be no quality control measures implemented for the proposed development. All stormwater drainage on-site will be captured by roof and walkway areas, which are considered "clean runoff".

2.3 SEDIMENT AND EROSION CONTROL

In order to minimize erosion during the grading and site servicing period of construction, the following measures will be implemented:

- Install sediment control (silt sacks) in the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system; and
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.

For details on the proposed erosion and sediment control for the proposed site, see the Preliminary Grading & Erosion Control Plan included in the engineering drawings.

3.0 SANITARY SEWER SERVICING

3.1 EXSTING CONDITIONS

The site is located at 2020 Lakeshore Road, with an existing 450mmø sanitary sewer located along Lakeshore Road flowing east which services the existing building on site.

3.2 SANITARY DEMAND

The proposed development consists of constructing a 30 to 35-storey mixed-use building containing 557 residential units, 122 hotel rooms, 4,483m^2 of commercial area, and 4 levels of underground parking. Wastewater generation for the site was calculated based on Tables 3-1 Residential Dry Weather Flow and 3-2 Commercial, Industrial, and Community Dry Weather Flow of the 2019 Regional Municipality of Halton Water and Wastewater Linear Design Manual.

Table 3.1 summarizes the population and Table 3.2 summarizes the sanitary sewer discharge rates from the proposed site.

Table 3.1 – Proposed Population

Occupancy Type	No. of Units [A]	Gross Floor Area (m^2) [A]	Population Density [B]	Population
Residential	679	---	1.62 per/unit	1,100
Commercial	---	8,831	90 per/ha	80
			Total Population [C]:	**1,180**

[A] Information from project statistics prepared by NEUF Architects., dated February 26, 2021.
[B] Population density per Sustainable Halton Water and Wastewater Master Plan, Appendix 1-6 and Region of Halton Water and Wastewater Linear Design Manual, Table 3-1.
[C] Total population = Residential Population + Commercial Population

Table 3.2 – Proposed Sanitary Sewer Discharge

Site Area (ha)	Population [A]	Avg. Demand [B] (l/s)	Peak Factor [C]	Infiltration [D] (l/s)	Peak Flow [E] (l/s)
0.76	1,180	3.76	3.77	0.22	**14.40**

[A] From Table 3.1.
[B] Based on a unit sewage flow of 0.275m^3pcd (as per Table 3-1 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[C] Based on the modified Harmon Formula (as per section 3.2.3 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
Peak Factor, $M = 1 + [14 / (4+P^{0.5})]$, where P is in thousands
[D] Based on an infiltration rate of 0.286 l/ha/s (as per Section 3.2.4 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[E] Peak Flow = (Avg. Demand x Peak Factor) + Infiltration

Based on the aforementioned, the estimate of sanitary demand for the mixed-use buildings is:

14.40 l/s

3.3 PROPOSED SANITARY SERVICING

The proposed mixed-use building will be serviced by a 200mmø sanitary sewer lateral, designed and constructed in accordance with the Region of Halton standards and to be submitted and approved by MECP. Drainage from this sewer will discharge to the existing 450mmø sanitary sewer along Lakeshore Road.

The minimum grade of the proposed 200mmø sanitary sewer will be 1.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.033 m^3/s (33 l/s). Therefore, the proposed 200mmø sanitary sewer at 1.0% grade is adequately sized to service the proposed development.

3.4 SANITARY CAPACITY ANALYSIS

A sanitary capacity analysis was completed for 2069 Lakeshore Road by S. Llewellyn & Associates dated April 23, 2021 (see Appendix B). The development site (2020 Lakeshore Road) was included in the sanitary sewer discharge to Ex. MH2 as both residential and commercial (refer to Table 2 in Sanitary Capacity Analysis Memo).

The sanitary sewer design sheet has been revised to reflect the proposed sanitary demands shown in Table 3.2. The population for the site under existing conditions was calculated to be 171 people as per the aforementioned sanitary capacity analysis (135 ppl/ha x 0.76ha residential + 90 ppl/ha x 0.76ha commercial). Since the proposed population has been calculated to be 1,180 persons, the population to Ex. MH2 of the sanitary capacity analysis has been increases by 929 persons (1,180 prop. – 171 ex.). Based on the revised sanitary sewer capacity analysis, it was determined that the existing sanitary network has adequate capacity to service the proposed development. For further details refer to Appendix B.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 300mmø watermain located on Lakeshore Road. Existing fire hydrants are located within the west boulevard of John Street, at the corner of its intersection with Lakeshore Road in front of 3 Elizabeth Street (the Pearle Hotel) and at the northwest corner of the site within the property limits.

4.2 DOMESTIC WATER DEMAND

Water demand for the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual. Table 4.1 summarizes the domestic water demand requirements for Average Day, Maximum Day and Peak Hour demand scenarios.

Table 4.1 – Proposed Domestic Water Demand

Occupancy Type	Population / Gross Floor Area [A]	Avg. Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	Max. Daily Demand [E] (l/s)	Max. Hourly Demand [F] (l/s)
Residential	1,100 per	3.50	2.25	4	**7.88**	14.00
Commercial	8,831 m^2	0.25	2.25	2.25	**0.56**	0.56
				Total:	**8.44**	14.56

[A] From Table 3.1.
[B] Based on a unit sewage flow of 0.275m^3pcd for residential and 24.75m^3/ha/day (as per Tables 3-1 and 3-2 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[C] From Section 2.4.1 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual.
[D] From Table 2-2 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual.
[E] Max. Daily Demand = Avg. Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Avg. Daily Demand x Max. Hourly Peaking Factor

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), the Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA). Since FUS criteria provides adjustments for sprinklered buildings (OBC does not), the FUS method was used to determine the fire flow demand for the proposed development.

The proposed development consists of constructing a 30 to 35-storey mix-use building. A hydrant exists at the northwest corner of the John Street and Lakeshore Road intersection within 90m separation to the building face of the proposed building (per Sentence 3.2.5.7 of the Ontario Building Code).

The proposed building is fire-resistive construction (C=0.6), with limited combustible occupancy (-15% correction) and a fully supervised sprinkler system (-50% correction). Exposure components are based on the following:

North Face: 30.1 to 45m (5% correction)
South Face: >45m (0% correction)
East Face: 20.1 to 30m (10% correction)
West Face: >45m (0% correction)

It is estimated that the required fire flow for the proposed development will be **133 l/s**. See the Fire Flow Demand Requirements in Appendix C for details.

A hydrant flow test was performed by Aquacom Contracting on the private fire hydrant located at the northwest corner of the John Street and Lakeshore Road intersection to determine the performance of the existing water distribution system. The following hydrant flow test data has been analyzed to determine if the municipal system adjacent to the site is adequate to provide

the required fire flow, with a minimum pressure of 20 psi. Table 4.2 summarizes the hydrant flow data, provided by Auquacom Contracting.

Table 4.2 – Hydrant Flow Test Data

Location	John Street, NW corner of Lakeshore
Static Pressure	76 psi
Residual Pressure During Test Flow	72 psi
Test Flow Rate	2,468 USGPM (155.7 l/s)
Theoretical Flow @ 20 psi	**10,263 USGPM (647.5 l/s)**

Based on the above hydrant flow test data, the theoretical maximum available flow rate from the hydrant is **647.5 l/s**, while the maximum required fire flow for the proposed development is only **133 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site. However, booster pumps will be required within the building to satisfy the fire and domestic consumption needs at upper levels.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting a two 150mmø watermains (as per Ontario Building Code for buildings over 84m tall), one of which will be split at property line to provide a 100mmø domestic and 150mmø fire water service for the proposed development. Water services for the site are to be designed and constructed in accordance with City of Burlington and Region of Halton standards. It is acknowledged that the proposed water service connection will require a precast concrete valve chamber containing three isolation valves connecting to the existing 300mmø watermain on Lakeshore Road, as per Region of Halton standards. This has been provided on the Preliminary Servicing Plan prepared by S. Llewellyn and Associates.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development at 2020 Lakeshore Road can be constructed to meet the requirements of the City of Burlington and Region of Halton. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Preliminary Grading & Erosion Control Plan and the Preliminary Site Servicing Plan prepared by S. Llewellyn & Associates Limited;
- Erosion and sediment controls be installed as described in this report to meet City of Burlington requirements; and
- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development.

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED





A. Porco, E.I.T.

S. Frankovich, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION

S:\21082\current\working\21082 - DAPs.dwg

10/12/2021 10:46:05 AM - Alexandra Porco

LAKESHORE ROAD

ELIZABETH STREET

EX. 300mm± WATERMAIN (Approx. Location)

EX. 450mm± SANITARY SEWER @ 0.12%±

EX. 450mm± SANITARY SEWER @ 0.32%±

EX. 450mm± SANITARY SEWER @ 0.26%±

EX. 200mm± STORM SEWER

EX. 600mm± STORM SEWER @ 2.00%±

EX. CENTRE LINE OF PAVEMENT

EX. CONCRETE CURB

EX. CONCRETE SIDEWALK

EX. PARKING

EX. GRAVEL DRIVE

EX. EDGE OF ASPHALT

EX. APPROXIMATE WATER'S EDGE BY PLAN 92

"BEAVER & BULLDOG"
EX. BRICK & STUCCO SIDED BUILDING No. 2020

EX. PATIO STONES

EX. CURB STONE

EX. BRICK WALL

EX. BOARD FENCE

EX. CHAIN LINK FENCE

EX. ASPHALT WALKWAY

EX. STM MH T/G=83.19 W.INV. 80.99±

EX. STM MH T/G=83.19 N.INV. 80.15± E.INV. 80.15± S.INV. 80.11±

EX. SAN MH T/G=83.08 W.INV. 77.36± E.INV. 77.34±

EX. SAN MH T/G=83.27 W.INV. 77.25± E.INV. 77.24±

EX. SAN MH T/G=82.08 W.INV. 77.09± E.INV. 77.08±

EX. WATERBOX

EX. FH (Not Surveyed) (Approx. Location)

EX. CB

EX. CBMH

EX. MH

EX. PS

EX. ILS

EX. GRATE

EX. DRIPPES

EX. DRIVEWAY

EX. LANDING

EX. WINDOW

EX. TOP LANDING

EX. STM MH

EX. VAULT

EX. CONCRETE QUAD CONC

EX. CONCRETE SIDEWALK

EX. CURB STONE

EX. EDGE OF ASPHALT

EX. CENTRE LINE OF PAVEMENT

EX. 600mm± STORM SEWER @ 2.00%±

EX. 200mm± STORM SEWER

EX. STORM SEWER

EX. BOTTOM OF BANK

EX. TOP OF BANK

FX BOTTOM OF BANK

FX TOP OF BANK

LOCATION OF LIMIT OF 30m EROSION ALLOWANCE & STABLE TOP OF BANK @ 3:1 AS ACCEPTED BY CONSERVATION HALTON

PAINTED

STEP PAINTED

101
0.76
95
0.87

LEGEND:

- CATCHMENT AREA BOUNDARY
- PERVIOUS AREA
- 101 / 0.76 / 95 / 0.87 — DRAINAGE AREA ID / DRAINAGE AREA (ha) / PERCENT IMPERVIOUS / RUNOFF COEFFICIENT
- EXISTING DIRECTION OF DRAINAGE

FIGURE A1
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 2020 LAKSHORE ROAD, BURLINGTON, ON
PROJECT No.: 21082

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Tel. (905) 631-6978
Website: www.sla.on.ca
email: info@sla.on.ca

3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

S:\21082\current\working\21082 - DAPs.dwg

10/1/2021 5:43:12 PM - Alexandra Porco

LAKESHORE ROAD

ELIZABETH STREET

EX. 300mm± WATERMAIN (Approx. Location)

CENTRE LINE OF PAVEMENT

EX. 300mm± STORM SEWER @ 0.8%±

EX. 450mm± SANITARY SEWER @ 0.12%±

EX. SAN MH
T/G=83.02
W.INV. 77.36±
E.INV. 77.34±

EX. 250mm± SANITARY LATERAL

EX. 200mm± WATERMAIN (Approx. Location)

EX. STM MH
T/G=83.19
W.INV. 80.99±

EX. 450mm± SANITARY SEWER @ 0.32%±

EX. SAN MH
T/G=83.27
W.INV. 77.25±
E.INV. 77.24±

EX. CENTRE LINE OF PAVEMENT

EX. 450mm± SANITARY SEWER @ 0.26%±

EX. STM MH
T/G=83.19
N.INV. 80.15±
E.INV. 80.15±
S.INV. 80.11±

EX. SAN MH
T/G=82.98
W.INV. 77.09±
E.INV. 77.08±

EX. 200mm± STORM SEWER

EX. 600mm± STORM SEWER @ 2.11%±

EX. CENTRE LINE OF PAVEMENT

EX. CB

EX. MH

EX. CBMH

EX. GV

EX. TOP OF BANK

EX. BOTTOM OF BANK

EX. EDGE OF ASPHALT

EX. CONCRETE

EX. GRAVEL DRIVE

EX. STORM SEWER

EX. 1800mm± STORM SEWER @ 3.5%±

EX. 200mm± STORM SEWER

LOCATION OF LIMIT OF 30m EROSION ALLOWANCE & STABLE TOP OF BANK @ 3:1 AS ACCEPTED BY CONSERVATION HALTON

201
0.76
97
0.88

LEGEND:

- CATCHMENT AREA BOUNDARY
- PERVIOUS AREA
- 201 / 0.76 / 97 / 0.88 — DRAINAGE AREA ID, DRAINAGE AREA (ha), PERCENT IMPERVIOUS, RUNOFF COEFFICIENT
- PROPOSED OVERLAND FLOW ROUTE

FIGURE A1
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 2020 LAKSHORE ROAD, BURLINGTON, ON
PROJECT No.: 21082

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Tel. (905) 631-6978
Website: www.sla.on.ca
email: info@sla.on.ca

3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

```
00001> 2     Metric units
00002> *#************************************************************************|
00003> *#  Project Name: 2020 LAKESHORE ROAD
00004> *#               BURLINGTON, ONTARIO
00005> *#  JOB NUMBER  : 21082
00006> *#       Date   : OCTOBER 2021
00007> *#    Revised   :
00008> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00009> *#       File   : 21082.DAT
00010> *#************************************************************************|
00011> *
00012> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
00013>                     BUR6_002.stm
00014> *
00015> READ STORM          STORM_FILENAME "STORM.001"
00016> *
00017> *#************************************************************************|
00018> *#
00019> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00020> *#        ==============================================
00021> *#
00022> **#***********************************************************************|
00023> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00024> CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.76](ha),
00025>                     XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[2],
00026>                     SCS curve number CN=[74],
00027>                     Pervious   surfaces: IAper=[8.92](mm), SLPP=[2.0](%),
00028>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
00029>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.0](%),
00030>                                          LGI=[15](m), MNI=[0.013], SCI=[0](min),
00031>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00032> *%-----------------|---------------------------------------------------------|
00033> *#************************************************************************|
00034> *#
00035> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00036> *#        ==============================================
00037> *#
00038> **#***********************************************************************|
00039> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00040> CALIB STANDHYD      ID=[2], NHYD=["201"], DT=[1](min), AREA=[0.76](ha),
00041>                     XIMP=[0.97], TIMP=[0.97], DWF=[0](cms), LOSS=[2],
00042>                     SCS curve number CN=[74],
00043>                     Pervious   surfaces: IAper=[8.92](mm), SLPP=[2.0](%),
00044>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
00045>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.0](%),
00046>                                          LGI=[15](m), MNI=[0.013], SCI=[0](min),
00047>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00048> *%-----------------|---------------------------------------------------------|
00049> *# AREA CHECK
00050> ADD HYD             IDsum=[10], NHYD=["CHECK"], IDs to add=[1,2]
00051> *%-----------------|---------------------------------------------------------|
00052> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00053> *
00054> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
00055>                     BUR6_005.stm
00056> *
00057> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
00058>                     BUR6_010.stm
00059> *
00060> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
00061>                     BUR6_025.stm
00062> *
00063> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
00064>                     BUR6_050.stm
00065> *
00066> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
00067>                     BUR6_100.stm
00068> *
00069> *%-----------------|---------------------------------------------------------|
00070> FINISH
00071>
00072>
00073>
00074>
00075>
00076>
00077>
00078>
00079>
00080>
```

```
00001> ================================================================================
00002>
00003>    SSSSS  W    W  M    M  H    H  Y    Y  M    M    OOO         999    999    =========
00004>    S      W W W  MM  MM  H    H  Y Y    MM  MM   O   O       9   9  9   9
00005>    SSSSS  W W W  M MM M  HHHHH   Y     M M M  O   O  ##   9   9  9   9    Ver  4.05
00006>        S  W W W  M    M  H    H  Y     M    M  O   O       9999   9999    Sept 2011
00007>    SSSSS   W W   M    M  H    H  Y     M    M   OOO            9      9    =========
00008>                                                             9   9  9   9    # 3902680
00009>          StormWater Management HYdrologic Model              999    999    =========
00010>
00011>  ********************************************************************************
00012>  ***************************** SWMHYMO Ver/4.05  ********************************
00013>  *********  A single event and continuous hydrologic simulation model  *********
00014>  *********     based on the principles of HYMO and its successors      *********
00015>  *********                   OTTHYMO-83 and OTTHYMO-89.                *********
00016>  ********************************************************************************
00017>  ******** Distributed by:  J.F. Sabourin and Associates Inc.           *********
00018>  *********                  Ottawa,  Ontario: (613) 836-3884           *********
00019>  *********                  Gatineau, Quebec: (819) 243-6858           *********
00020>  *********                  E-Mail: swmhymo@jfsa.com                   *********
00021>  ********************************************************************************
00022>
00023>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00024>  +++++++++ Licensed user: S. Llewellyn & Associates Ltd                 +++++++++
00025>  +++++++++                 Burlington          SERIAL#:3902680        +++++++++
00026>  ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
00027>
00028>  ********************************************************************************
00029>  *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++             *********
00030>  *********           Maximum value for ID numbers  :     10            *********
00031>  *********           Max. number of rainfall points: 105408            *********
00032>  *********           Max. number of flow points    : 105408            *********
00033>  ********************************************************************************
00034>
00035>
00036>  **********************   D E T A I L E D   O U T P U T   **********************
00037>  ********************************************************************************
00038>  *         DATE: 2021-10-01     TIME: 15:37:05     RUN COUNTER: 000319          *
00039>  ********************************************************************************
00040>  * Input   filename: T:\PROJECTS\21082\SWMHYMO\21082.dat                        *
00041>  * Output  filename: T:\PROJECTS\21082\SWMHYMO\21082.out                        *
00042>  * Summary filename: T:\PROJECTS\21082\SWMHYMO\21082.sum                        *
00043>  * User comments:                                                              *
00044>  * 1:_____________________________________________________________________     *
00045>  * 2:_____________________________________________________________________     *
00046>  * 3:_____________________________________________________________________     *
00047>  ********************************************************************************
00048>
00049> --------------------------------------------------------------------------------
00050> 001:0001-----------------------------------------------------------------------
00051> *#*****************************************************************************|
00052> *#  Project Name: 2020 LAKESHORE ROAD
00053> *#               BURLINGTON, ONTARIO
00054> *#  JOB NUMBER  : 21082
00055> *#       Date   : OCTOBER 2021
00056> *#    Revised   :
00057> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00058> *#       File   : 21082.DAT
00059> *#*****************************************************************************|
00060> *
00061>   ** END OF RUN :   1
00062>
00063> ********************************************************************************
00064>
00065>
00066>
00067>
00068>
00069> --------------------
00070> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00071> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00072>     TZERO =   .00 hrs on       0
00073>     METOUT=   2 (output = METRIC)
00074>     NRUN  = 002
00075>     NSTORM=   1
00076>               #  1=BUR6_002.stm
00077> --------------------------------------------------------------------------------
00078> 002:0002-----------------------------------------------------------------------
00079> *#*****************************************************************************|
00080> *#  Project Name: 2020 LAKESHORE ROAD
00081> *#               BURLINGTON, ONTARIO
00082> *#  JOB NUMBER  : 21082
00083> *#       Date   : OCTOBER 2021
00084> *#    Revised   :
00085> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00086> *#       File   : 21082.DAT
00087> *#*****************************************************************************|
00088> *
00089> --------------------------------------------------------------------------------
00090> 002:0002-----------------------------------------------------------------------
00091> *
00092> --------------------
00093> | READ STORM       |    Filename: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00094> | Ptotal=  40.93 mm|    Comments: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00095> --------------------
00096>                TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00097>                 hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00098>                 .17   1.715 |   1.67   8.325 |   3.17   4.467 |   4.67   2.213
00099>                 .33   1.858 |   1.83  19.646 |   3.33   3.978 |   4.83   2.105
00100>                 .50   2.032 |   2.00  78.391 |   3.50   3.595 |   5.00   2.008
00101>                 .67   2.247 |   2.17  25.776 |   3.67   3.286 |   5.17   1.920
00102>                 .83   2.522 |   2.33  13.777 |   3.83   3.030 |   5.33   1.841
00103>                1.00   2.888 |   2.50   9.511 |   4.00   2.815 |   5.50   1.769
00104>                1.17   3.399 |   2.67   7.331 |   4.17   2.632 |   5.67   1.703
00105>                1.33   4.172 |   2.83   6.005 |   4.33   2.474 |   5.83   1.642
00106>                1.50   5.492 |   3.00   5.111 |   4.50   2.335 |   6.00   1.586
00107>
00108> --------------------------------------------------------------------------------
00109> 002:0003-----------------------------------------------------------------------
00110> *
00111> *#*****************************************************************************|
00112> *#
00113> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00114> *#        ==============================================
00115> *#
00116> **#****************************************************************************|
00117> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00118> ----------------------
00119> | CALIB STANDHYD     |   Area    (ha)=     .76
00120> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00121> ----------------------
00122>                              IMPERVIOUS    PERVIOUS (i)
00123>      Surface Area     (ha)=        .72          .04
00124>      Dep. Storage     (mm)=       1.00         8.92
00125>      Average Slope     (%)=       1.00         2.00
00126>      Length            (m)=      15.00        10.00
00127>      Mannings n            =       .013         .250
00128>
00129>      Max.eff.Inten.(mm/hr)=      78.39        12.22
00130>                 over (min)        1.00         8.00
00131>      Storage Coeff.  (min)=        .90 (ii)    8.03 (ii)
00132>      Unit Hyd. Tpeak (min)=       1.00         8.00
00133>      Unit Hyd. peak  (cms)=       1.14          .14
00134>                                                          *TOTALS*
00135>      PEAK FLOW       (cms)=        .16          .00          .158 (iii)
00136>      TIME TO PEAK    (hrs)=       2.00         2.12         2.000
00137>      RUNOFF VOLUME    (mm)=      39.93         8.45        38.359
00138>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00139>      RUNOFF COEFFICIENT   =        .98          .21          .937
00140>
00141>         (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00142>             CN* =  74.0    Ia = Dep. Storage  (Above)
00143>        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00144>             THAN THE STORAGE COEFFICIENT.
00145>       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00146>
00147> --------------------------------------------------------------------------------
00148> 002:0004-----------------------------------------------------------------------
00149> *#*****************************************************************************|
00150> *#
00151> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00152> *#        ==============================================
00153> *#
00154> **#****************************************************************************|
00155> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00156> ----------------------
00157> | CALIB STANDHYD     |   Area    (ha)=     .76
00158> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00159> ----------------------
00160>                              IMPERVIOUS    PERVIOUS (i)
00161>      Surface Area     (ha)=        .74          .02
00162>      Dep. Storage     (mm)=       1.00         8.92
00163>      Average Slope     (%)=       1.00         2.00
00164>      Length            (m)=      15.00        10.00
00165>      Mannings n            =       .013         .250
00166>
00167>      Max.eff.Inten.(mm/hr)=      78.39        12.22
00168>                 over (min)        1.00         8.00
00169>      Storage Coeff.  (min)=        .90 (ii)    8.03 (ii)
00170>      Unit Hyd. Tpeak (min)=       1.00         8.00
00171>      Unit Hyd. peak  (cms)=       1.14          .14
00172>                                                          *TOTALS*
00173>      PEAK FLOW       (cms)=        .16          .00          .161 (iii)
00174>      TIME TO PEAK    (hrs)=       2.00         2.12         2.000
00175>      RUNOFF VOLUME    (mm)=      39.93         8.45        38.988
00176>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00177>      RUNOFF COEFFICIENT   =        .98          .21          .952
00178>
00179>         (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00180>             CN* =  74.0    Ia = Dep. Storage  (Above)
00181>        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00182>             THAN THE STORAGE COEFFICIENT.
00183>       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00184>
00185> --------------------------------------------------------------------------------
00186> 002:0005-----------------------------------------------------------------------
00187> *# AREA CHECK
00188> ------------------------
00189> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00190> ------------------------                 (ha)     (cms)   (hrs)   (mm)    (cms)
00191>                        ID1 01:101          .76     .158    2.00  38.36    .000
00192>                       +ID2 02:201          .76     .161    2.00  38.99    .000
00193>                        ========================================================
00194>                        SUM 10:CHECK        1.52     .318    2.00  38.67    .000
00195>
00196>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00197>
00198> --------------------------------------------------------------------------------
00199> 002:0006-----------------------------------------------------------------------
00200> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00201> *
00202>   ** END OF RUN :   4
00203>
00204> ********************************************************************************
00205>
00206>
00207>
00208>
00209>
00210> --------------------
00211> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00212> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00213>     TZERO =   .00 hrs on       0
00214>     METOUT=   2 (output = METRIC)
00215>     NRUN  = 005
00216>     NSTORM=   1
00217>               #  1=BUR6_005.stm
00218> --------------------------------------------------------------------------------
00219> 005:0002-----------------------------------------------------------------------
00220> *#*****************************************************************************|
00221> *#  Project Name: 2020 LAKESHORE ROAD
00222> *#               BURLINGTON, ONTARIO
00223> *#  JOB NUMBER  : 21082
00224> *#       Date   : OCTOBER 2021
00225> *#    Revised   :
00226> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00227> *#       File   : 21082.DAT
00228> *#*****************************************************************************|
00229> *
00230> --------------------------------------------------------------------------------
00231> 005:0002-----------------------------------------------------------------------
00232> *
00233> --------------------
00234> | READ STORM       |    Filename: Burlington 5-yr 6hr CHICAGO    (A=802.04
00235> | Ptotal=  53.05 mm|    Comments: Burlington 5-yr 6hr CHICAGO    (A=802.04
00236> --------------------
00237>                TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00238>                 hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00239>                 .17   2.348 |   1.67  10.690 |   3.17   5.897 |   4.67   3.004
00240>                 .33   2.537 |   1.83  24.479 |   3.33   5.279 |   4.83   2.862
00241>                 .50   2.766 |   2.00 101.312 |   3.50   4.790 |   5.00   2.734
00242>                 .67   3.048 |   2.17  31.941 |   3.67   4.394 |   5.17   2.619
00243>                 .83   3.407 |   2.33  17.333 |   3.83   4.065 |   5.33   2.514
00244>                1.00   3.881 |   2.50  12.145 |   4.00   3.788 |   5.50   2.419
00245>                1.17   4.539 |   2.67   9.469 |   4.17   3.550 |   5.67   2.331
00246>                1.33   5.523 |   2.83   7.826 |   4.33   3.344 |   5.83   2.251
00247>                1.50   7.185 |   3.00   6.709 |   4.50   3.164 |   6.00   2.176
00248>
00249> --------------------------------------------------------------------------------
00250> 005:0003-----------------------------------------------------------------------
00251> *
00252> *#*****************************************************************************|
00253> *#
00254> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00255> *#        ==============================================
00256> *#
00257> **#****************************************************************************|
00258> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00259> ----------------------
00260> | CALIB STANDHYD     |   Area    (ha)=     .76
00261> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00262> ----------------------
00263>                              IMPERVIOUS    PERVIOUS (i)
00264>      Surface Area     (ha)=        .72          .04
00265>      Dep. Storage     (mm)=       1.00         8.92
00266>      Average Slope     (%)=       1.00         2.00
00267>      Length            (m)=      15.00        10.00
00268>      Mannings n            =       .013         .250
00269>
00270>      Max.eff.Inten.(mm/hr)=     101.31        26.36
```

```
00271>                over (min)        1.00         6.00
00272>     Storage Coeff.  (min)=        .81 (ii)    6.05 (ii)
00273>     Unit Hyd. Tpeak (min)=       1.00         6.00
00274>     Unit Hyd. peak  (cms)=       1.20          .19
00275>                                                      *TOTALS*
00276>     PEAK FLOW       (cms)=        .20          .00          .205 (iii)
00277>     TIME TO PEAK    (hrs)=       2.00         2.07         2.000
00278>     RUNOFF VOLUME    (mm)=      52.05        14.60        50.180
00279>     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
00280>     RUNOFF COEFFICIENT   =        .98          .28          .946
00281>
00282>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00283>           CN* =  74.0    Ia = Dep. Storage  (Above)
00284>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00285>           THAN THE STORAGE COEFFICIENT.
00286>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00287>
00288> ---------------------------------------------------------------------------
00289> 005:0004-----------------------------------------------------------------------
00290> *#*************************************************************************|
00291> *#
00292> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00293> *#        ==============================================
00294> *#
00295> **#************************************************************************|
00296> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00297> ----------------------
00298> | CALIB STANDHYD     |   Area    (ha)=     .76
00299> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00300> ----------------------
00301>                              IMPERVIOUS    PERVIOUS (i)
00302>     Surface Area     (ha)=        .74          .02
00303>     Dep. Storage     (mm)=       1.00         8.92
00304>     Average Slope     (%)=       1.00         2.00
00305>     Length            (m)=      15.00        10.00
00306>     Mannings n            =       .013         .250
00307>
00308>     Max.eff.Inten.(mm/hr)=     101.31        26.36
00309>                over (min)        1.00         6.00
00310>     Storage Coeff.  (min)=        .81 (ii)    6.05 (ii)
00311>     Unit Hyd. Tpeak (min)=       1.00         6.00
00312>     Unit Hyd. peak  (cms)=       1.20          .19
00313>                                                      *TOTALS*
00314>     PEAK FLOW       (cms)=        .21          .00          .208 (iii)
00315>     TIME TO PEAK    (hrs)=       2.00         2.07         2.000
00316>     RUNOFF VOLUME    (mm)=      52.05        14.60        50.929
00317>     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
00318>     RUNOFF COEFFICIENT   =        .98          .28          .960
00319>
00320>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00321>           CN* =  74.0    Ia = Dep. Storage  (Above)
00322>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00323>           THAN THE STORAGE COEFFICIENT.
00324>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00325>
00326> ---------------------------------------------------------------------------
00327> 005:0005-----------------------------------------------------------------------
00328> *# AREA CHECK
00329> ------------------------
00330> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00331> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
00332>                       ID1 01:101            .76     .205    2.00  50.18    .000
00333>                      +ID2 02:201            .76     .208    2.00  50.93    .000
00334>                       ========================================================
00335>                       SUM 10:CHECK          1.52     .413    2.00  50.55    .000
00336>
00337>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00338>
00339> ---------------------------------------------------------------------------
00340> 005:0006-----------------------------------------------------------------------
00341> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00342> *
00343> ---------------------------------------------------------------------------
00344> 005:0002-----------------------------------------------------------------------
00345> *
00346>   ** END OF RUN :   9
00347>
00348> ***************************************************************************
00349>
00350>
00351>
00352>
00353>
00354> --------------------
00355> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00356> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00357>     TZERO =   .00 hrs on        0
00358>     METOUT=   2 (output = METRIC)
00359>     NRUN  = 010
00360>     NSTORM=   1
00361>              #  1=BUR6_010.stm
00362> ---------------------------------------------------------------------------
00363> 010:0002-----------------------------------------------------------------------
00364> *#*************************************************************************|
00365> *#  Project Name: 2020 LAKESHORE ROAD
00366> *#               BURLINGTON, ONTARIO
00367> *#  JOB NUMBER  : 21082
00368> *#       Date   : OCTOBER 2021
00369> *#    Revised   :
00370> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00371> *#       File   : 21082.DAT
00372> *#*************************************************************************|
00373> *
00374> ---------------------------------------------------------------------------
00375> 010:0002-----------------------------------------------------------------------
00376> *
00377> --------------------
00378> | READ STORM       |    Filename: Burlington 10-yr 6hr CHICAGO      (A=918.
00379> | Ptotal=  61.10 mm|    Comments: Burlington 10-yr 6hr CHICAGO      (A=918.
00380> --------------------
00381>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00382>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00383>                .17   2.714 |   1.67  12.326 |   3.17   6.808 |   4.67   3.472
00384>                .33   2.933 |   1.83  28.176 |   3.33   6.095 |   4.83   3.308
00385>                .50   3.197 |   2.00 116.310 |   3.50   5.532 |   5.00   3.161
00386>                .67   3.523 |   2.17  36.748 |   3.67   5.075 |   5.17   3.027
00387>                .83   3.937 |   2.33  19.967 |   3.83   4.696 |   5.33   2.907
00388>               1.00   4.483 |   2.50  14.001 |   4.00   4.376 |   5.50   2.796
00389>               1.17   5.242 |   2.67  10.921 |   4.17   4.102 |   5.67   2.695
00390>               1.33   6.377 |   2.83   9.030 |   4.33   3.864 |   5.83   2.602
00391>               1.50   8.291 |   3.00   7.743 |   4.50   3.656 |   6.00   2.516
00392>
00393> ---------------------------------------------------------------------------
00394> 010:0003-----------------------------------------------------------------------
00395> *
00396> *#*************************************************************************|
00397> *#
00398> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00399> *#        =============================================
00400> *#
00401> **#************************************************************************|
00402> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00403> ----------------------
00404> | CALIB STANDHYD     |   Area    (ha)=     .76
00405> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00406> ----------------------
00407>                              IMPERVIOUS    PERVIOUS (i)
00408>     Surface Area     (ha)=        .72          .04
00409>     Dep. Storage     (mm)=       1.00         8.92
00410>     Average Slope     (%)=       1.00         2.00
00411>     Length            (m)=      15.00        10.00
00412>     Mannings n            =       .013         .250
00413>
00414>     Max.eff.Inten.(mm/hr)=     116.31        37.31
00415>                over (min)        1.00         5.00
00416>     Storage Coeff.  (min)=        .77 (ii)    5.33 (ii)
00417>     Unit Hyd. Tpeak (min)=       1.00         5.00
00418>     Unit Hyd. peak  (cms)=       1.24          .22
00419>                                                      *TOTALS*
00420>     PEAK FLOW       (cms)=        .23          .00          .236 (iii)
00421>     TIME TO PEAK    (hrs)=       2.00         2.05         2.000
00422>     RUNOFF VOLUME    (mm)=      60.10        19.25        58.059
00423>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00424>     RUNOFF COEFFICIENT   =        .98          .32          .950
00425>
00426>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00427>           CN* =  74.0    Ia = Dep. Storage  (Above)
00428>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00429>           THAN THE STORAGE COEFFICIENT.
00430>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00431>
00432> ---------------------------------------------------------------------------
00433> 010:0004-----------------------------------------------------------------------
00434> *#*************************************************************************|
00435> *#
00436> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00437> *#        ==============================================
00438> *#
00439> **#************************************************************************|
00440> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00441> ----------------------
00442> | CALIB STANDHYD     |   Area    (ha)=     .76
00443> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00444> ----------------------
00445>                              IMPERVIOUS    PERVIOUS (i)
00446>     Surface Area     (ha)=        .74          .02
00447>     Dep. Storage     (mm)=       1.00         8.92
00448>     Average Slope     (%)=       1.00         2.00
00449>     Length            (m)=      15.00        10.00
00450>     Mannings n            =       .013         .250
00451>
00452>     Max.eff.Inten.(mm/hr)=     116.31        37.31
00453>                over (min)        1.00         5.00
00454>     Storage Coeff.  (min)=        .77 (ii)    5.33 (ii)
00455>     Unit Hyd. Tpeak (min)=       1.00         5.00
00456>     Unit Hyd. peak  (cms)=       1.24          .22
00457>                                                      *TOTALS*
00458>     PEAK FLOW       (cms)=        .24          .00          .240 (iii)
00459>     TIME TO PEAK    (hrs)=       2.00         2.05         2.000
00460>     RUNOFF VOLUME    (mm)=      60.10        19.25        58.876
00461>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00462>     RUNOFF COEFFICIENT   =        .98          .32          .964
00463>
00464>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00465>           CN* =  74.0    Ia = Dep. Storage  (Above)
00466>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00467>           THAN THE STORAGE COEFFICIENT.
00468>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00469>
00470> ---------------------------------------------------------------------------
00471> 010:0005-----------------------------------------------------------------------
00472> *# AREA CHECK
00473> ------------------------
00474> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00475> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
00476>                       ID1 01:101            .76     .236    2.00  58.06    .000
00477>                      +ID2 02:201            .76     .240    2.00  58.88    .000
00478>                       ========================================================
00479>                       SUM 10:CHECK          1.52     .475    2.00  58.47    .000
00480>
00481>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00482>
00483> ---------------------------------------------------------------------------
00484> 010:0006-----------------------------------------------------------------------
00485> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00486> *
00487> ---------------------------------------------------------------------------
00488> 010:0002-----------------------------------------------------------------------
00489> *
00490> ---------------------------------------------------------------------------
00491> 010:0002-----------------------------------------------------------------------
00492> *
00493>   ** END OF RUN :  24
00494>
00495> ***************************************************************************
00496>
00497>
00498>
00499>
00500>
00501> --------------------
00502> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00503> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00504>     TZERO =   .00 hrs on        0
00505>     METOUT=   2 (output = METRIC)
00506>     NRUN  = 025
00507>     NSTORM=   1
00508>              #  1=BUR6_025.stm
00509> ---------------------------------------------------------------------------
00510> 025:0002-----------------------------------------------------------------------
00511> *#*************************************************************************|
00512> *#  Project Name: 2020 LAKESHORE ROAD
00513> *#               BURLINGTON, ONTARIO
00514> *#  JOB NUMBER  : 21082
00515> *#       Date   : OCTOBER 2021
00516> *#    Revised   :
00517> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00518> *#       File   : 21082.DAT
00519> *#*************************************************************************|
00520> *
00521> ---------------------------------------------------------------------------
00522> 025:0002-----------------------------------------------------------------------
00523> *
00524> --------------------
00525> | READ STORM       |    Filename: Burlington 25-yr 6hr CHICAGO      (A=106
00526> | Ptotal=  71.35 mm|    Comments: Burlington 25-yr 6hr CHICAGO      (A=106
00527> --------------------
00528>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00529>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00530>                .17   3.182 |   1.67  14.410 |   3.17   7.968 |   4.67   4.068
00531>                .33   3.437 |   1.83  32.881 |   3.33   7.135 |   4.83   3.876
00532>                .50   3.746 |   2.00 135.380 |   3.50   6.477 |   5.00   3.704
00533>                .67   4.128 |   2.17  42.866 |   3.67   5.943 |   5.17   3.548
00534>                .83   4.612 |   2.33  23.321 |   3.83   5.499 |   5.33   3.407
00535>               1.00   5.251 |   2.50  16.365 |   4.00   5.125 |   5.50   3.278
00536>               1.17   6.138 |   2.67  12.771 |   4.17   4.805 |   5.67   3.160
00537>               1.33   7.465 |   2.83  10.563 |   4.33   4.527 |   5.83   3.051
00538>               1.50   9.700 |   3.00   9.061 |   4.50   4.284 |   6.00   2.950
00539>
00540> ---------------------------------------------------------------------------
```

```
00541> 025:0003--------------------------------------------------------------------------------
00542> *
00543> *#*****************************************************************************|
00544> *#
00545> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00546> *#        ==============================================
00547> *#
00548> **#*****************************************************************************|
00549> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00550> ---------------------
00551> | CALIB STANDHYD     |   Area    (ha)=     .76
00552> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00553> ---------------------
00554>                              IMPERVIOUS    PERVIOUS (i)
00555>      Surface Area     (ha)=        .72          .04
00556>      Dep. Storage     (mm)=       1.00         8.92
00557>      Average Slope     (%)=       1.00         2.00
00558>      Length            (m)=      15.00        10.00
00559>      Mannings n             =       .013         .250
00560>
00561>      Max.eff.Inten.(mm/hr)=     135.38        50.84
00562>                  over (min)        1.00         5.00
00563>      Storage Coeff.  (min)=        .73 (ii)    4.75 (ii)
00564>      Unit Hyd. Tpeak (min)=       1.00         5.00
00565>      Unit Hyd. peak  (cms)=       1.27          .23
00566>                                                          *TOTALS*
00567>      PEAK FLOW       (cms)=        .27          .00          .275 (iii)
00568>      TIME TO PEAK    (hrs)=       2.00         2.03         2.000
00569>      RUNOFF VOLUME    (mm)=      70.35        25.69        68.114
00570>      TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
00571>      RUNOFF COEFFICIENT   =        .99          .36          .955
00572>
00573>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00574>            CN* =  74.0    Ia = Dep. Storage  (Above)
00575>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00576>            THAN THE STORAGE COEFFICIENT.
00577>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00578>
00579> --------------------------------------------------------------------------------
00580> 025:0004--------------------------------------------------------------------------------
00581> *#*****************************************************************************|
00582> *#
00583> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00584> *#        ===============================================
00585> *#
00586> **#*****************************************************************************|
00587> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00588> ---------------------
00589> | CALIB STANDHYD     |   Area    (ha)=     .76
00590> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00591> ---------------------
00592>                              IMPERVIOUS    PERVIOUS (i)
00593>      Surface Area     (ha)=        .74          .02
00594>      Dep. Storage     (mm)=       1.00         8.92
00595>      Average Slope     (%)=       1.00         2.00
00596>      Length            (m)=      15.00        10.00
00597>      Mannings n             =       .013         .250
00598>
00599>      Max.eff.Inten.(mm/hr)=     135.38        50.84
00600>                  over (min)        1.00         5.00
00601>      Storage Coeff.  (min)=        .73 (ii)    4.75 (ii)
00602>      Unit Hyd. Tpeak (min)=       1.00         5.00
00603>      Unit Hyd. peak  (cms)=       1.27          .23
00604>                                                          *TOTALS*
00605>      PEAK FLOW       (cms)=        .28          .00          .279 (iii)
00606>      TIME TO PEAK    (hrs)=       2.00         2.03         2.000
00607>      RUNOFF VOLUME    (mm)=      70.35        25.69        69.007
00608>      TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
00609>      RUNOFF COEFFICIENT   =        .99          .36          .967
00610>
00611>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00612>            CN* =  74.0    Ia = Dep. Storage  (Above)
00613>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00614>            THAN THE STORAGE COEFFICIENT.
00615>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00616>
00617> --------------------------------------------------------------------------------
00618> 025:0005--------------------------------------------------------------------------------
00619> *# AREA CHECK
00620> ------------------------
00621> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00622> ------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
00623>                       ID1 01:101          .76      .275    2.00  68.11    .000
00624>                      +ID2 02:201          .76      .279    2.00  69.01    .000
00625>                       ========================================================
00626>                       SUM 10:CHECK        1.52     .554    2.00  68.56    .000
00627>
00628>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00629>
00630> --------------------------------------------------------------------------------
00631> 025:0006--------------------------------------------------------------------------------
00632> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00633> *
00634> --------------------------------------------------------------------------------
00635> 025:0002--------------------------------------------------------------------------------
00636> *
00637> --------------------------------------------------------------------------------
00638> 025:0002--------------------------------------------------------------------------------
00639> *
00640> --------------------------------------------------------------------------------
00641> 025:0002--------------------------------------------------------------------------------
00642> *
00643>   ** END OF RUN :  49
00644>
00645> ********************************************************************************
00646>
00647>
00648>
00649>
00650>
00651> --------------------
00652> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00653> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00654>     TZERO =   .00 hrs on       0
00655>     METOUT=   2 (output = METRIC)
00656>     NRUN  = 050
00657>     NSTORM=   1
00658>              #  1=BUR6_050.stm
00659> --------------------------------------------------------------------------------
00660> 050:0002--------------------------------------------------------------------------------
00661> *#*****************************************************************************|
00662> *#  Project Name: 2020 LAKESHORE ROAD
00663> *#               BURLINGTON, ONTARIO
00664> *#  JOB NUMBER  : 21082
00665> *#       Date   : OCTOBER 2021
00666> *#    Revised   :
00667> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00668> *#       File   : 21082.DAT
00669> *#*****************************************************************************|
00670> *
00671> --------------------------------------------------------------------------------
00672> 050:0002--------------------------------------------------------------------------------
00673> *
00674> --------------------
00675> | READ STORM       |    Filename: Burlington 50-yr 6hr CHICAGO     (A=1172
00676> | Ptotal=  78.93 mm|    Comments: Burlington 50-yr 6hr CHICAGO     (A=1172
00677> --------------------
00678>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00679>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00680>                .17   3.533 |   1.67  15.961 |   3.17   8.836 |   4.67   4.516
00681>                .33   3.817 |   1.83  36.356 |   3.33   7.913 |   4.83   4.304
00682>                .50   4.160 |   2.00 149.296 |   3.50   7.185 |   5.00   4.113
00683>                .67   4.582 |   2.17  47.374 |   3.67   6.593 |   5.17   3.940
00684>                .83   5.119 |   2.33  25.806 |   3.83   6.102 |   5.33   3.783
00685>               1.00   5.827 |   2.50  18.121 |   4.00   5.688 |   5.50   3.640
00686>               1.17   6.809 |   2.67  14.149 |   4.17   5.333 |   5.67   3.509
00687>               1.33   8.278 |   2.83  11.707 |   4.33   5.025 |   5.83   3.388
00688>               1.50  10.753 |   3.00  10.045 |   4.50   4.755 |   6.00   3.277
00689>
00690> --------------------------------------------------------------------------------
00691> 050:0003--------------------------------------------------------------------------------
00692> *
00693> *#*****************************************************************************|
00694> *#
00695> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00696> *#        ==============================================
00697> *#
00698> **#*****************************************************************************|
00699> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00700> ---------------------
00701> | CALIB STANDHYD     |   Area    (ha)=     .76
00702> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00703> ---------------------
00704>                              IMPERVIOUS    PERVIOUS (i)
00705>      Surface Area     (ha)=        .72          .04
00706>      Dep. Storage     (mm)=       1.00         8.92
00707>      Average Slope     (%)=       1.00         2.00
00708>      Length            (m)=      15.00        10.00
00709>      Mannings n             =       .013         .250
00710>
00711>      Max.eff.Inten.(mm/hr)=     149.30        63.40
00712>                  over (min)        1.00         4.00
00713>      Storage Coeff.  (min)=        .70 (ii)    4.38 (ii)
00714>      Unit Hyd. Tpeak (min)=       1.00         4.00
00715>      Unit Hyd. peak  (cms)=       1.29          .27
00716>                                                          *TOTALS*
00717>      PEAK FLOW       (cms)=        .30          .01          .304 (iii)
00718>      TIME TO PEAK    (hrs)=       2.00         2.03         2.000
00719>      RUNOFF VOLUME    (mm)=      77.93        30.78        75.574
00720>      TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
00721>      RUNOFF COEFFICIENT   =        .99          .39          .957
00722>
00723>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00724>            CN* =  74.0    Ia = Dep. Storage  (Above)
00725>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00726>            THAN THE STORAGE COEFFICIENT.
00727>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00728>
00729> --------------------------------------------------------------------------------
00730> 050:0004--------------------------------------------------------------------------------
00731> *#*****************************************************************************|
00732> *#
00733> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00734> *#        ===============================================
00735> *#
00736> **#*****************************************************************************|
00737> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00738> ---------------------
00739> | CALIB STANDHYD     |   Area    (ha)=     .76
00740> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00741> ---------------------
00742>                              IMPERVIOUS    PERVIOUS (i)
00743>      Surface Area     (ha)=        .74          .02
00744>      Dep. Storage     (mm)=       1.00         8.92
00745>      Average Slope     (%)=       1.00         2.00
00746>      Length            (m)=      15.00        10.00
00747>      Mannings n             =       .013         .250
00748>
00749>      Max.eff.Inten.(mm/hr)=     149.30        63.40
00750>                  over (min)        1.00         4.00
00751>      Storage Coeff.  (min)=        .70 (ii)    4.38 (ii)
00752>      Unit Hyd. Tpeak (min)=       1.00         4.00
00753>      Unit Hyd. peak  (cms)=       1.29          .27
00754>                                                          *TOTALS*
00755>      PEAK FLOW       (cms)=        .31          .00          .309 (iii)
00756>      TIME TO PEAK    (hrs)=       2.00         2.03         2.000
00757>      RUNOFF VOLUME    (mm)=      77.93        30.78        76.517
00758>      TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
00759>      RUNOFF COEFFICIENT   =        .99          .39          .969
00760>
00761>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00762>            CN* =  74.0    Ia = Dep. Storage  (Above)
00763>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00764>            THAN THE STORAGE COEFFICIENT.
00765>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00766>
00767> --------------------------------------------------------------------------------
00768> 050:0005--------------------------------------------------------------------------------
00769> *# AREA CHECK
00770> ------------------------
00771> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00772> ------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
00773>                       ID1 01:101          .76      .304    2.00  75.57    .000
00774>                      +ID2 02:201          .76      .309    2.00  76.52    .000
00775>                       ========================================================
00776>                       SUM 10:CHECK        1.52     .613    2.00  76.05    .000
00777>
00778>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00779>
00780> --------------------------------------------------------------------------------
00781> 050:0006--------------------------------------------------------------------------------
00782> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00783> *
00784> --------------------------------------------------------------------------------
00785> 050:0002--------------------------------------------------------------------------------
00786> *
00787> --------------------------------------------------------------------------------
00788> 050:0002--------------------------------------------------------------------------------
00789> *
00790> --------------------------------------------------------------------------------
00791> 050:0002--------------------------------------------------------------------------------
00792> *
00793> --------------------------------------------------------------------------------
00794> 050:0002--------------------------------------------------------------------------------
00795> *
00796>   ** END OF RUN :  99
00797>
00798> ********************************************************************************
00799>
00800>
00801>
00802>
00803>
00804> --------------------
00805> | START            |  Project  dir.: T:\PROJECTS\21082\SWMHYMO\
00806> --------------------  Rainfall dir.: T:\PROJECTS\21082\SWMHYMO\
00807>     TZERO =   .00 hrs on       0
00808>     METOUT=   2 (output = METRIC)
00809>     NRUN  = 100
00810>     NSTORM=   1
```

```
00811>            #  1=BUR6_100.stm
00812> ------------------------------------------------------------------------------
00813> 100:0002------------------------------------------------------------------------
00814> *#*************************************************************************|
00815> *#  Project Name: 2020 LAKESHORE ROAD
00816> *#               BURLINGTON, ONTARIO
00817> *#  JOB NUMBER  : 21082
00818> *#       Date   : OCTOBER 2021
00819> *#    Revised   :
00820> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00821> *#       File   : 21082.DAT
00822> *#*************************************************************************|
00823> *
00824> ------------------------------------------------------------------------------
00825> 100:0002------------------------------------------------------------------------
00826> *
00827> --------------------
00828> | READ STORM       |    Filename: Burlington 100-yr 6hr CHICAGO        (A=
00829> | Ptotal=  86.27 mm|    Comments: Burlington 100-yr 6hr CHICAGO        (A=
00830> --------------------
00831>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00832>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00833>                .17   3.862 |   1.67  17.445 |   3.17   9.657 |   4.67   4.936
00834>                .33   4.172 |   1.83  39.736 |   3.33   8.649 |   4.83   4.704
00835>                .50   4.546 |   2.00 163.177 |   3.50   7.853 |   5.00   4.495
00836>                .67   5.008 |   2.17  51.779 |   3.67   7.206 |   5.17   4.306
00837>                .83   5.595 |   2.33  28.205 |   3.83   6.670 |   5.33   4.135
00838>               1.00   6.369 |   2.50  19.806 |   4.00   6.217 |   5.50   3.979
00839>               1.17   7.443 |   2.67  15.465 |   4.17   5.829 |   5.67   3.835
00840>               1.33   9.048 |   2.83  12.795 |   4.33   5.492 |   5.83   3.703
00841>               1.50  11.752 |   3.00  10.979 |   4.50   5.197 |   6.00   3.581
00842>
00843> ------------------------------------------------------------------------------
00844> 100:0003------------------------------------------------------------------------
00845> *
00846> *#*************************************************************************|
00847> *#
00848> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00849> *#        ==============================================
00850> *#
00851> **#************************************************************************|
00852> *# CATCHMENT 101 - EXISTING CONDITIONS (TO LAKE ONTARIO)
00853> ----------------------
00854> | CALIB STANDHYD     |   Area    (ha)=     .76
00855> | 01:101    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
00856> ----------------------
00857>                               IMPERVIOUS    PERVIOUS (i)
00858>      Surface Area     (ha)=         .72          .04
00859>      Dep. Storage     (mm)=        1.00         8.92
00860>      Average Slope     (%)=        1.00         2.00
00861>      Length            (m)=       15.00        10.00
00862>      Mannings n            =        .013         .250
00863>
00864>      Max.eff.Inten.(mm/hr)=     163.18        74.59
00865>                    over (min)        1.00         4.00
00866>      Storage Coeff.  (min)=         .67 (ii)    4.13 (ii)
00867>      Unit Hyd. Tpeak (min)=        1.00         4.00
00868>      Unit Hyd. peak  (cms)=        1.31          .28
00869>                                                          *TOTALS*
00870>      PEAK FLOW       (cms)=         .33          .01          .333 (iii)
00871>      TIME TO PEAK    (hrs)=        2.00         2.02         2.000
00872>      RUNOFF VOLUME    (mm)=       85.27        35.91        82.803
00873>      TOTAL RAINFALL   (mm)=       86.27        86.27        86.271
00874>      RUNOFF COEFFICIENT   =         .99          .42          .960
00875>
00876>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00877>            CN* =  74.0    Ia = Dep. Storage  (Above)
00878>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00879>            THAN THE STORAGE COEFFICIENT.
00880>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00881>
00882> ------------------------------------------------------------------------------
00883> 100:0004------------------------------------------------------------------------
00884> *#*************************************************************************|
00885> *#
00886> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00887> *#        ===============================================
00888> *#
00889> **#************************************************************************|
00890> *# CATCHMENT 201 - PROPOSED CONDITIONS (TO LAKE ONTARIO)
00891> ----------------------
00892> | CALIB STANDHYD     |   Area    (ha)=     .76
00893> | 02:201    DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   97.00
00894> ----------------------
00895>                               IMPERVIOUS    PERVIOUS (i)
00896>      Surface Area     (ha)=         .74          .02
00897>      Dep. Storage     (mm)=        1.00         8.92
00898>      Average Slope     (%)=        1.00         2.00
00899>      Length            (m)=       15.00        10.00
00900>      Mannings n            =        .013         .250
00901>
00902>      Max.eff.Inten.(mm/hr)=     163.18        74.59
00903>                    over (min)        1.00         4.00
00904>      Storage Coeff.  (min)=         .67 (ii)    4.13 (ii)
00905>      Unit Hyd. Tpeak (min)=        1.00         4.00
00906>      Unit Hyd. peak  (cms)=        1.31          .28
00907>                                                          *TOTALS*
00908>      PEAK FLOW       (cms)=         .33          .00          .338 (iii)
00909>      TIME TO PEAK    (hrs)=        2.00         2.02         2.000
00910>      RUNOFF VOLUME    (mm)=       85.27        35.91        83.790
00911>      TOTAL RAINFALL   (mm)=       86.27        86.27        86.271
00912>      RUNOFF COEFFICIENT   =         .99          .42          .971
00913>
00914>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00915>            CN* =  74.0    Ia = Dep. Storage  (Above)
00916>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00917>            THAN THE STORAGE COEFFICIENT.
00918>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00919>
00920> ------------------------------------------------------------------------------
00921> 100:0005------------------------------------------------------------------------
00922> *# AREA CHECK
00923> ------------------------
00924> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00925> ------------------------                 (ha)     (cms)   (hrs)   (mm)    (cms)
00926>                       ID1 01:101           .76      .333    2.00  82.80    .000
00927>                      +ID2 02:201           .76      .338    2.00  83.79    .000
00928>                       ==========================================================
00929>                       SUM 10:CHECK         1.52     .671    2.00  83.30    .000
00930>
00931>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00932>
00933> ------------------------------------------------------------------------------
00934> 100:0006------------------------------------------------------------------------
00935> * RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
00936> *
00937> ------------------------------------------------------------------------------
00938> 100:0002------------------------------------------------------------------------
00939> *
00940> ------------------------------------------------------------------------------
00941> 100:0002------------------------------------------------------------------------
00942> *
00943> ------------------------------------------------------------------------------
00944> 100:0002------------------------------------------------------------------------
00945> *
00946> ------------------------------------------------------------------------------
00947> 100:0002------------------------------------------------------------------------
00948> *
00949> ------------------------------------------------------------------------------
00950> 100:0002------------------------------------------------------------------------
00951> *
00952>       FINISH
00953> ------------------------------------------------------------------------------
00954> ********************************************************************************
00955>      WARNINGS / ERRORS / NOTES
00956>      -------------------------
00957>    Simulation ended on 2021-10-01     at 15:37:07
00958> ================================================================================
00959>
```

APPENDIX B

WASTEWATER ANALYSIS INFORMATION

Project No. 21082
Checked by: SF
Computed by: AP
Date: Oct-21

City of Burlington

SANITARY SEWER DESIGN

Project: 2020 Lakeshore Road

PROPOSED CONDITION

Design flow factor (Commercial) = 24750 l/ha/day
Design flow factor (Residential) = 275 l/cap/day
Infiltration factor = 0.29 l/s/ha

Vmin = 0.60m/s
Vmax = 3.0m/s
n=0.013 (>600mm)
n=0.013 (<600mm)

Area No.	Street Name	From MH	To MH	Pop. Density [per/ha]	Incremental Area [ha]	Cumulative Area [ha]	Population Increment [per]	Cumulative Population [per]	Peaking Factor M		Average Flow l/s	Peak Flow l/s	Infil-tration l/s	Total Flow l/s	Proposed Sewer Design					% Full	Remarks
															Diameter [mm]	Material	Grade %	Capacity l/s	Velocity m/s		
-	Pearl Street	-	EX. MH1	-	-	2.66	320	320	4.07	4.00	1.01	4.04	0.76	4.80	200	PVC	0.50%	23.55	0.74	20.4	
1	Pearl Street	EX. MH1	EX. MH2	90	0.06	2.72	5	325	4.06	4.00	0.78	3.12	0.78	3.89	200	PVC	0.40%	21.07	0.66	18.5	
2	**Proposed Site**	EX. MH1	EX. MH2	-	0.25	2.97	**869**	1194	3.75	3.75	3.80	14.25	0.85	15.10	200	PVC	0.40%	21.07	0.66	71.7	
							Pop. based on Functional Servicing Report (dated Apr 2021)														
3	Pearl Street	EX. MH1	EX. MH2	**572**	0.25	3.22	143	1337	3.72	3.72	**4.26**	15.81	0.92	16.73	200	PVC	0.40%	21.07	0.66	79.4	
				Pop. Density based on mixed-use development							**Average flow based on residential design flow factor (275 l/cap/day)**										
4	Pearl Street	EX. MH1	EX. MH2	0	0.01	3.23	0	1337	3.72	3.72	4.26	15.81	0.92	16.74	200	PVC	0.40%	21.07	0.66	79.5	
-	Lakeshore Road	-	EX. MH2	-	-	26.62	3910	3910	3.34	3.34	13.66	50.25	7.61	57.86	450	VC	0.31%	165.41	1.01	35.0	Updated to include revised population for site
5	Lakeshore Road	EX. MH2	EX. MH3	0	0.26	30.11	0	5247	3.23	3.23	16.70	53.87	8.61	62.48	450	VC	0.27%	154.37	0.94	40.5	
-	Martha Street	-	EX. MH3	-	-	2.38	716	716	3.89	3.89	2.27	8.97	0.68	9.65	200	VC	0.80%	29.79	0.94	32.4	
6	Lakeshore Road	EX. MH3	EX. MH4	0	0.01	32.50	0	5963	3.17	3.17	18.98	60.23	9.30	69.53	450	VC	0.27%	154.37	0.94	45.0	
7	Lakeshore Road	EX. MH4	EX. MH5	0	0.14	32.64	0	5963	3.17	3.17	18.98	60.23	9.34	69.57	450	VC	0.27%	154.37	0.94	45.1	
8	Lakeshore Road	EX. MH5	EX. MH6	135	0.40	33.04	54	6017	3.17	3.17	19.15	60.70	9.45	70.15	450	VC	0.27%	154.37	0.94	45.4	
9	Lakeshore Road	EX. MH5	EX. MH6	0	0.13	33.17	0	6017	3.17	3.17	19.15	60.70	9.49	70.19	450	VC	0.27%	154.37	0.94	45.5	
-	Old Lakeshore Road	-	EX. MH8	0	-	3.76	1459	1459	3.69	3.69	4.65	17.64	1.08	18.72	450	VC	0.20%	132.86	0.81	14.1	
10	Lakeshore Road	EX. MH8	EX. Pump Station	0	0.02	36.95	0	7476	3.08	3.08	23.80	73.27	10.57	83.83	450	VC	0.20%	132.86	0.81	63.1	

***Note: Average flows for Area 1 was calculated based on Commercial design flow factor (24750 l/ha/day). Average flows from Area 2 and onwards were calculated based on Residential design flow factor (275 l/cap/day).**

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Technical Memorandum

To:	Lakeshore (Burlington) Inc.	**From:**	A. Klashoff
		Date:	23-04-2021
		Pages:	7 + 3 attachments
		Job #:	16149
Re:	Sanitary Sewer Capacity Analysis – 2069 Lakeshore Road		

Introduction

S. Llewellyn & Associates Limited has been retained by Lakeshore (Burlington) Inc. to provide Consulting Engineering services for the proposed re-development located at 2069 Lakeshore Road in the City of Burlington. This memorandum will include an overall capacity analysis of the existing sanitary sewer network encompassing the subject lands.

Sanitary Sewer Analysis

Sanitary discharge within the drainage area of the subject lands was estimated in accordance with the following documents:

- Halton Region Water and Wastewater Linear Design Manual (Halton Region, October 2019)

Tables 1, 2, 3 and 4 below contain the total estimate peak flow rates up to EX. MH1, EX. MH2, EX. MH3 and EX. MH8, respectively, as shown on the External Sanitary Drainage Area Plan included with this memorandum.

Table 1: Sanitary Sewer Discharge to Ex. MH1 (Pearl St)							
Land Use Type	Area (ha)	Population Density [A]	Population	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
Residential	0.20	135	27 persons	0.08	4.00	0.06	**0.38**
Apartment Residential	0.29	107	174 persons	0.55	4.00	0.08	**2.28**
Commercial	1.18	90	107 persons	0.34	4.00	0.34	**1.70**
Community Services	0.30	40	12 persons	0.04	4.00	0.08	**0.24**
Right-of-Way	0.69					0.20	**0.20**
						Total Peak Flow	**4.80**

[A] Population Density:
Residential (Townhouse) = 135 persons/ha
Apartment Residential = 1.62 persons/unit (High Density)
Commercial = 90 persons/hectare
Community Services = 40 persons/hectare

[B] Average demand:
Residential=275 l/cap/day
Commercial=24,750 l/ha/day
Community Services=11,000 l/ha/day

[C] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0

[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area

[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Table 2: Sanitary Sewer Discharge to Ex. MH2 (Lakeshore Rd)							
Land Use Type	Area (ha)	Population Density [A]	Population	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
Residential	5.48	95	521 persons	1.66	3.96	1.57	**8.14**
Apartment Residential	3.08	1232	1996 persons	6.35	3.59	0.88	**23.68**
Commercial [F]	4.09	90	369 persons	1.17	4.00	0.76	**5.44**
Community Services	2.36	40	95 persons	0.30	4.00	0.67	**1.87**
Right-of-Way	13.04					3.73	**3.73**
						Total Peak Flow	**42.86**

[A] Population Density:
Residential (Single Family/Townhouse) = (55 + 135 persons/ha)/3 =95 persons/ha
Apartment Residential = 1.62 persons/unit (High Density)
Commercial = 90 persons/hectare
Community Services = 40 persons/hectare

[B] Average demand:
Residential=275 l/cap/day
Commercial=24,750 l/ha/day
Community Services=11,000 l/ha/day

[C] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0

[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area

[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

[F] Commercial infiltration=4.09 ha – 1.43 ha (Mixed Use)= 2.66 ha

Table 3: Sanitary Sewer Discharge to Ex. MH3 (Martha St)							
Land Use Type	Area (ha)	Population Density [A]	Population	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
Residential	1.04	95	99 persons	0.31	4.00	0.30	**1.54**
Apartment Residential	0.66	360	584 persons	1.86	3.94	0.19	**7.52**
Commercial [F]	0.29	90	27 persons	0.08	4.00	0.05	**0.37**
Community Services	0.14	40	6 persons	0.02	4.00	0.04	**0.12**
Right-of-Way	0.37					0.10	**0.10**
						Total Peak Flow	**9.65**

[A] Population Density:
Residential (Single Family/Townhouse) = (55 + 135 persons/ha)/3 = 95 persons/ha
Apartment Residential = 1.62 persons/unit (High Density)
Commercial = 90 persons/hectare
Community Services = 40 persons/hectare

[B] Average demand:
Residential=275 l/cap/day
Commercial=24,750 l/ha/day
Community Services=11,000 l/ha/day

[C] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0

[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area

[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

[F] Commercial infiltration=0.29 ha – 0.12 ha (Mixed Use)= 0.17 ha

Table 4: Sanitary Sewer Discharge to Ex. MH8 (Old Lakeshore Rd & Lakeshore Rd)							
Land Use Type	Area (ha)	Population Density [A]	Population	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
Residential	0.30	135	41 persons	0.13	4.00	0.08	**0.60**
Apartment Residential	1.25	740	1199 persons	3.82	3.75	0.36	**14.69**
Commercial [F]	2.43	90	219 persons	0.70	4.00	0.47	**3.27**
Right-of-Way	0.58					0.17	**0.17**
						Total Peak Flow	**18.72**

[A] Population Density:
Residential (Townhouse) = 135 persons/ha
Apartment Residential = 1.62 persons/unit (High Density)
Commercial = 90 persons/hectare
[B] Average demand:
Residential=275 l/cap/day
Commercial=24,750 l/ha/day
[C] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area
[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration
[F] Commercial infiltration=2.43 ha – 0.80 ha (Mixed Use)= 1.63 ha

A sanitary sewer capacity analysis was completed from Ex. MH1 to the existing pump station as shown on the External Sanitary Drainage Area Plan. It is estimated that 30% to 52% of the capacity within the existing sanitary sewer system along Lakeshore Road has already been accounted for. Refer to the Existing Condition Sanitary Sewer Design Sheet for further details.

As per Halton Region standards, 450mmØ sanitary sewers may be triggered for upsizing once the sewer system reaches 70% full flow capacity. The subject lands are estimated to be currently contributing 0.35 l/s to the Lakeshore Road sewer system. As per the current Functional Servicing Report (dated April 2021), it is proposed that **10.59 l/s of dry weather flow and 0.07 l/s of infiltration allowance** will be contributed by the proposed re-development. This would increase the existing sanitary sewer system to contain 57% full flow capacity on Lakeshore Rd discharging to the existing pumping station. Refer to the Proposed Condition Sanitary Sewer Design Sheet for further details.

Table 5 below summarizes the proposed discharge for the proposed re-development.

Table 5 – Discharge for Proposed Development (2069 Lakeshore Rd)

Land Use Type	Area (ha)	Population Density [A]	Population [B]	Avg. Demand [C] (l/s)	Peaking Factor [D]	Infiltration [E] (l/s)	**Peak Flow [F] (l/s)**
Residential	0.25		862 persons	1.56	3.84	0.072	**10.59**
Commercial [G]	0.07	90	7 persons	0.02	3.54	N/A	**0.07**
						Total Peak Flow	**10.66**

[A] Population Density:
Commercial = 90 persons/hectare
[B] Population:
Apartment Residential = (185 x 1 bdr units x 2 cap/bdr) + (99 x 2 bdr units x 2 cap/bdr) + (16 x 3 bdr units x 2 cap/bdr) = 862 persons
[C] Average demand:
Residential=275 l/cap/day
Commercial=24,750 l/ha/day
[D] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0
[E] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area
[F] Peak Flow = (Average Flow x Peaking Factor) + Infiltration
[G] Total Gross Floor Area = GFA retail unit ($465m^2$) + GFA live/work unit ($214m^2$) = $679m^2$ = 0.07 ha

An analysis was also completed to determine the estimated theoretical flows to the existing pumping station for residential lands east of the existing pumping station, and is summarized in Table 6 below:

Table 6: Estimate of Existing Flows to Ex. Pumping Station

Land Use Type	Area (ha)	Population Density [A]	Population	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
Residential	44.39	95	4218 persons	13.43	3.31	12.70	**57.15**
Apartment Residential	3.14	469	760 persons	2.42	3.87	0.90	**10.27**
Institutional	1.39		261 persons	0.41	4.00	0.40	**2.04**
Right-of-Way	13.7					3.92	**3.92**
						Total Peak Flow	**73.38**

[A] Population Density:
Residential (Single Family/Townhouse) = (55 + 135 persons/ha)/3 = 95 persons/ha
Apartment Residential = 1.62 persons/unit (High Density)
Institutional (School) = Number of Students + Employees
[B] Average demand:
Residential=275 l/cap/day
Institutional=135/cap/day
[C] Peaking Factor:
Peaking Factor= $1+((14/(4+P^{0.5}))$ with P expressed in thousands Min=2.0, Max=4.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Area
[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Total Existing Flows to Pumping Station = 68.48 l/s (West) + 73.38 l/s (East)
Total Existing Flows to Pumping Station = 141.86 l/s

Conclusions

The analysis determined that with the addition of the proposed mixed-use development at 2069 Lakeshore, it is estimated that the existing sanitary sewer system on Lakeshore Road is at a maximum of **57% capacity** before discharging to the existing pump station. Therefore, it was determined that the existing sanitary sewer system on Lakeshore Road has sufficient capacity to service the proposed mixed-use development at 2069 Lakeshore Road.

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED

A. Klashoff, Dip. T.



S. Llewellyn, P. Eng.

Project No. 16149
Checked by: SL
Computed by: AK
Date: Apr-21

City of Burlington

SANITARY SEWER DESIGN

Project: 2069 Lakeshore Road

EXISTING CONDITION

Design flow factor (Commercial) = 24750 l/ha/day
Design flow factor (Residential) = 275 l/cap/day
Infiltration factor = 0.29 l/s/ha

Vmin = 0.60m/s
Vmax = 3.0m/s
n=0.013 (>600mm)
n=0.013 (<600mm)

Area No.	Street Name	From MH	To MH	Pop. Density [per/ha]	Incremental Area [ha]	Cumulative Area [ha]	Population Increment [per]	Cumulative Population [per]	Peaking Factor M		Average Flow l/s	Peak Flow l/s	Infil-tration l/s	Total Flow l/s	Proposed Sewer Design					% Full	Remarks
															Diameter [mm]	Material	Grade %	Capacity l/s	Velocity m/s		
-	Pearl Street	-	EX. MH1	-	-	2.66	320	320	4.07	4.00	1.01	4.04	0.76	4.80	200	PVC	0.50%	23.55	0.74	20.4	Refer to Table 1
1	Pearl Street	EX. MH1	EX. MH2	90	0.06	2.72	5	325	4.06	4.00	0.78	3.12	0.78	3.89	200	PVC	0.40%	21.07	0.66	18.5	
2	**Existing Site**	EX. MH1	EX. MH2	90	0.25	2.97	23	348	4.05	4.00	0.85	3.40	0.85	4.25	200	PVC	0.40%	21.07	0.66	20.2	
3	Pearl Street	EX. MH1	EX. MH2	**572**	0.25	3.22	143	491	3.98	3.98	**1.56**	6.22	0.92	7.14	200	PVC	0.40%	21.07	0.66	33.9	
				Pop. Density based on mixed-use development							**Average flow based on residential design flow factor (275 l/cap/day)**										
4	Pearl Street	EX. MH1	EX. MH2	0	0.01	3.23	0	491	3.98	3.98	1.56	6.22	0.92	7.14	200	PVC	0.40%	21.07	0.66	33.9	
-	Lakeshore Road	-	EX. MH2	-	-	26.62	2981	2981	3.44	3.44	9.48	35.25	7.61	42.86	450	VC	0.31%	165.41	1.01	25.9	Refer to Table 2
5	Lakeshore Road	EX. MH2	EX. MH3	0	0.26	30.11	0	3472	3.39	3.39	11.05	37.44	8.61	46.05	450	VC	0.27%	154.37	0.94	29.8	
-	Martha Street	-	EX. MH3	-	-	2.38	716	716	3.89	3.89	2.27	8.97	0.68	9.65	200	VC	0.80%	29.79	0.94	32.4	Refer to Table 3
6	Lakeshore Road	EX. MH3	EX. MH4	0	0.01	32.50	0	4188	3.32	3.32	13.33	44.19	9.30	53.49	450	VC	0.27%	154.37	0.94	34.6	
7	Lakeshore Road	EX. MH4	EX. MH5	0	0.14	32.64	0	4188	3.32	3.32	13.33	44.19	9.34	53.53	450	VC	0.27%	154.37	0.94	34.7	
8	Lakeshore Road	EX. MH5	EX. MH6	135	0.40	33.04	54	4242	3.31	3.31	13.50	44.69	9.45	54.14	450	VC	0.27%	154.37	0.94	35.1	
9	Lakeshore Road	EX. MH5	EX. MH6	0	0.13	33.17	0	4242	3.31	3.31	13.50	44.69	9.49	54.18	450	VC	0.27%	154.37	0.94	35.1	
-	Old Lakeshore Road	-	EX. MH8	0	-	3.76	1459	1459	3.69	3.69	4.65	17.64	1.08	18.72	450	VC	0.20%	132.86	0.81	14.1	Refer to Table 4
10	Lakeshore Road	EX. MH8	EX. Pump Station	0	0.02	36.95	0	5701	3.19	3.19	18.15	57.91	10.57	68.48	450	VC	0.20%	132.86	0.81	51.5	

***Note: Average flows for Areas 1 & 2 were calculated based on Commercial design flow factor (24750 l/ha/day). Average flows from Area 3 and onwards were calculated based on Residential design flow factor (275 l/cap/day).**

Project No. 16149
Checked by: SL
Computed by: AK
Date: Apr-21

City of Burlington

SANITARY SEWER DESIGN

Project: 2069 Lakeshore Road

PROPOSED CONDITION

Design flow factor (Commercial) = 24750 l/ha/day
Design flow factor (Residential) = 275 l/cap/day
Infiltration factor = 0.29 l/s/ha

Vmin = 0.60m/s
Vmax = 3.0m/s
n=0.013 (>600mm)
n=0.013 (<600mm)

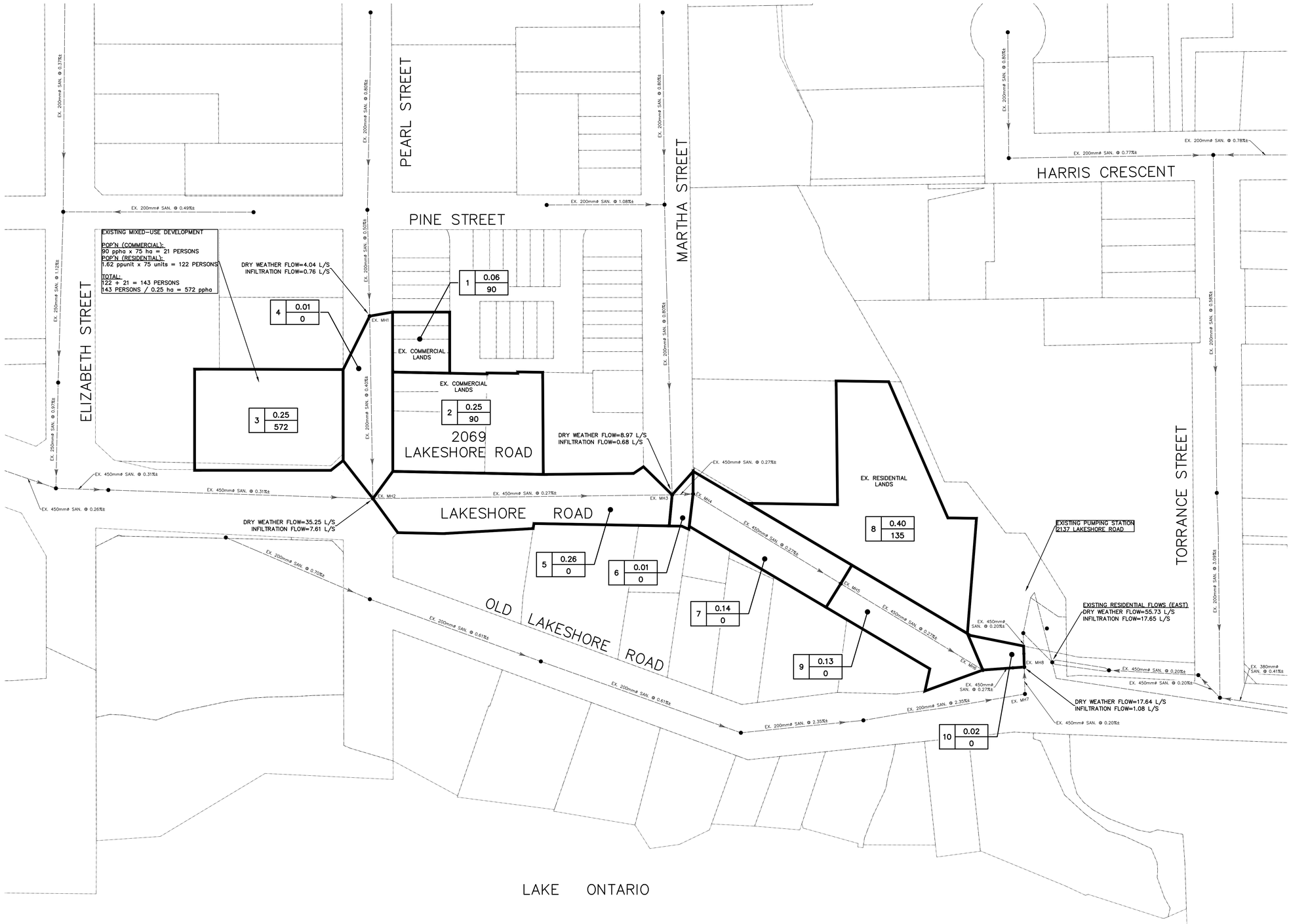
Area No.	Street Name	From MH	To MH	Pop. Density [per/ha]	Incremental Area [ha]	Cumulative Area [ha]	Population Increment [per]	Cumulative Population [per]	Peaking Factor M		Average Flow l/s	Peak Flow l/s	Infil-tration l/s	Total Flow l/s	Proposed Sewer Design					% Full	Remarks
															Diameter [mm]	Material	Grade %	Capacity l/s	Velocity m/s		
-	Pearl Street	-	EX. MH1	-	-	2.66	320	320	4.07	4.00	1.01	4.04	0.76	4.80	200	PVC	0.50%	23.55	0.74	20.4	Refer to Table 1
1	Pearl Street	EX. MH1	EX. MH2	90	0.06	2.72	5	325	4.06	4.00	0.78	3.12	0.78	3.89	200	PVC	0.40%	21.07	0.66	18.5	
2	**Proposed Site**	EX. MH1	EX. MH2	-	0.25	2.97	**869**	1194	3.75	3.75	3.80	14.25	0.85	15.10	200	PVC	0.40%	21.07	0.66	71.7	
							Pop. based on Functional Servicing Report (dated Apr 2021)														
3	Pearl Street	EX. MH1	EX. MH2	**572**	0.25	3.22	143	1337	3.72	3.72	**4.26**	15.81	0.92	16.73	200	PVC	0.40%	21.07	0.66	79.4	
				Pop. Density based on mixed-use development							**Average flow based on residential design flow factor (275 l/cap/day)**										
4	Pearl Street	EX. MH1	EX. MH2	0	0.01	3.23	0	1337	3.72	3.72	4.26	15.81	0.92	16.74	200	PVC	0.40%	21.07	0.66	79.5	
-	Lakeshore Road	-	EX. MH2	-	-	26.62	2981	2981	3.44	3.44	9.48	35.25	7.61	42.86	450	VC	0.31%	165.41	1.01	25.9	Refer to Table 2
5	Lakeshore Road	EX. MH2	EX. MH3	0	0.26	30.11	0	4318	3.30	3.30	13.74	45.40	8.61	54.02	450	VC	0.27%	154.37	0.94	35.0	
-	Martha Street	-	EX. MH3	-	-	2.38	716	716	3.89	3.89	2.27	8.97	0.68	9.65	200	VC	0.80%	29.79	0.94	32.4	Refer to Table 3
6	Lakeshore Road	EX. MH3	EX. MH4	0	0.01	32.50	0	5034	3.24	3.24	16.02	51.95	9.30	61.25	450	VC	0.27%	154.37	0.94	39.7	
7	Lakeshore Road	EX. MH4	EX. MH5	0	0.14	32.64	0	5034	3.24	3.24	16.02	51.95	9.34	61.29	450	VC	0.27%	154.37	0.94	39.7	
8	Lakeshore Road	EX. MH5	EX. MH6	135	0.40	33.04	54	5088	3.24	3.24	16.20	52.44	9.45	61.89	450	VC	0.27%	154.37	0.94	40.1	
9	Lakeshore Road	EX. MH5	EX. MH6	0	0.13	33.17	0	5088	3.24	3.24	16.20	52.44	9.49	61.93	450	VC	0.27%	154.37	0.94	40.1	
-	Old Lakeshore Road	-	EX. MH8	0	-	3.76	1459	1459	3.69	3.69	4.65	17.64	1.08	18.72	450	VC	0.20%	132.86	0.81	14.1	Refer to Table 4
10	Lakeshore Road	EX. MH8	EX. Pump Station	0	0.02	36.95	0	6547	3.13	3.13	20.84	65.32	10.57	75.89	450	VC	0.20%	132.86	0.81	57.1	

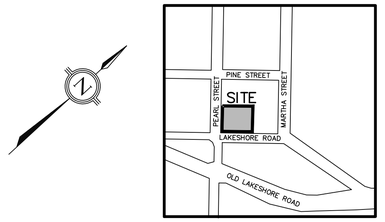
***Note: Average flows for Area 1 was calculated based on Commercial design flow factor (24750 l/ha/day). Average flows from Area 2 and onwards were calculated based on Residential design flow factor (275 l/cap/day).**

DWG No.: 16149-SANDAP-1

EXTERNAL SANITARY DRAINAGE AREA PLAN

S:\16149\Working\Current\16149-External Sanitary Drainage Area Plan.dwg





KEY MAP
N.T.S.

LEGEND:

1 | 0.15 | 0 — AREA IN HECTARES; PERSONS PER HECTARE; AREA NUMBER

SANITARY DRAINAGE AREA BOUNDARY

NO.	DATE	BY	REVISIONS

NOTES TO CONTRACTOR:

1. CONTRACTORS AND SUBCONTRACTORS SHALL NOT SCALE FROM THIS DRAWING.
2. ANY INCONSISTENCIES AND OMISSIONS FOUND ON THE DRAWINGS MUST BE REPORTED TO THE ENGINEER FOR CLARIFICATION BEFORE COMMENCING THE WORK.
3. PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND ELEVATIONS AND REPORT ALL FINDINGS TO THE ENGINEER. ONCE CONSTRUCTION HAS COMMENCED, THE CONTRACTOR ACCEPTS RESPONSIBILITY FOR ALL DIMENSIONS, ELEVATIONS, AND SITE CONDITIONS.
4. THE POSITIONS OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVER-GROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE DRAWINGS. WHERE SHOWN ON THE DRAWING, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM THEMSELVES OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
5. ALL DRAWINGS REMAIN THE PROPERTY OF THE ENGINEER AND SHALL NOT BE REPRODUCED, REUSED, OR REVISED WITHOUT THE WRITTEN CONSENT OF S. LLEWELLYN AND ASSOCIATES LIMITED.

DESIGN	AK	CHK'D	SL	DATE
DRAWN	AK	CHK'D	SL	Apr. 21, 21

SCALE 1:750 (0, 5, 15, 25, 50, 75)

APPROVALS

STAMP

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS
Tel. (905) 631-6978
Website: www.sla.on.ca
email: info@sla.on.ca
3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

CLIENT

LAKESHORE (BURLINGTON) INC.

PROJECT NAME

2069 LAKESHORE ROAD
CITY OF BURLINGTON
MUNICIPAL PLANNING #535-013/20

TITLE

EXTERNAL SANITARY DRAINAGE AREA PLAN

PROJECT No.	DRAWING No.
16149	SANDAP-1

S:\16149\Working\Current\16149-External Sanitary Drainage Area Plan.dwg
Plotted: Thursday, April 22, 2021 11:46:40 AM By: Ashley Kloshoff

APPENDIX C

WATER ANALYSIS INFORMATION

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: 21082
Project Name: 2020 Lakeshore Road
Date: Oct-21

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad (1)$$

where:

F the required fire flow in litres per minute
C coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A Total floor area in square metres

				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
Building / Location	# of Storeys	Total GFA (m^2)	Type of Construction	*Fire Flow "F"* (l/min)	(l/s)	*Occupancy* %	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	*Sprinkler* %	Adjustment (l/min)	*Exposure* %	Adjustment (l/min)	**(l/min)**	**(l/s)**
Condominium	**35**	**15876**	**0.6**	17000	283.3	**-25**	-4250.0	**12750.0**	**-50**	-6375.0	15	1912.5	**8000**	**133**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No Charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
30.1 to 45m	5%	exceed 75%
> 45m	0%	

Side	Exposure (m)	Charge (%)
North =	**40**	**5**
South =	**>45**	**0**
East =	**25**	**10**
West =	**>45**	**0**
Total Expoure =		***15***

APPENDIX D

GEOTECHNICAL INVESTIGATION

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

www.soil-mat.ca info@soil-mat.ca TF: 800.243.1922

Hamilton: 130 Lancing Drive L8W 3A1 T: 905.318.7440 F: 905.318.7455
Milton: PO Box 40012 Derry Heights PO L9T 7W4 T: 800.243.1922

PROJECT NO.: SM 301114-G August 27, 2021

BURLINGTON 2020 LAKESHORE INC.
366 King Street West
Hamilton, Ontario
L8P 1B3

Attention: Mr. Darko Vranich

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2020 LAKESHORE ROAD
BURLINGTON, ONTARIO

Dear Mr. Vranich,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing and report preparation in connection with the above noted project. The scope of work was completed in general accordance with our proposal P301114r1, dated December 1, 2020 and revised on March 8, 2021. Our comments and recommendations, based on our findings at the seven borehole locations, are presented herein.

1. INTRODUCTION

We understand that the project will involve the construction of a residential building approximately 30 to 40 storeys in height, with up to four underground parking levels at the property located at 2020 Lakeshore Road in Burlington, Ontario. The purpose of this geotechnical investigation work was to further assess the subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, such as additional storeys or basement levels, this office

must be consulted to review the new design with respect to the results of this investigation.

2. PROCEDURE

A total of seven [7] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment as well as HQ diamond barrel coring equipment, under the direction of a representative of SOIL-MAT ENGINEERS. The boreholes were advanced to depths of approximately 7.6 to 20.1 metres below the existing grade from April 5th to April 8th, 2021. Upon completion of drilling all boreholes were outfitted with groundwater monitoring wells as part of the Phase 2 Environmental Site Assessment work as well as the Hydrogeological Study being undertaken by TerraDynamics Consulting Inc. The wells installed consisted of 50-millimetre diameter PVC pipe, screened in the lower 3 metres. The monitoring wells were backfilled with well filter sand up to approximately 0.3 metres above the screened portion, then with bentonite 'hole plug' to the surface and fitted with a protective steel 'flushmount' casing.

As noted above the boreholes were advanced with HQ diamond coring equipment where the Queenston Shale Bedrock stopped advancement of power auger equipment. Rock Quality Designation [RQD] was calculated for the recovered core samples, and 7 selected samples of the recovered cores were subjected to unconfined compressive strength testing at our laboratory. The detailed results of these tests can be found appended to the end of this report.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., based on accessibility over the site and clearance of underground services. The ground surface elevation at the borehole locations was referenced to a geodetic benchmark, described as the brass plaque set in the northerly most wall of City Hall, located at 426 Brant Street, Burlington. This benchmark was noted to have a

geodetic elevation of 85.61 metres, based on local benchmark information provided to our office by the City of Burlington.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 7, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed at the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is currently comprised of the lands of the Waterfront Hotel located at 2020 Lakeshore Road in Burlington, Ontario. The site surrounding the existing 7-storey hotel building is primarily asphalt surfaced with grass covered areas downhill of the elevated parking areas towards Lake Ontario. The site is bounded by Lakeshore Road to the north, Elizabeth Street to the east, and waterfront trails to the west and south. The site slopes downward from north to south with a relief of approximately 3 metres. The asphalt paved parking area has been built into a plateau before sloping down drastically at the south end towards the green space and Lake Ontario.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole Nos. 1 to 5 were advanced through the existing pavement structure, which was found to consist of approximately 75 to 100 millimetres of asphaltic concrete overlying approximately 75 to 1220 millimetres of granular base material. The pavement structure encountered at the borehole locations has been summarized as follows:

Table A – Pavement Structure

Borehole No.	1	2	3	4	5
Asphaltic Concrete (mm)	100	75	90	100	100
Granular Base (mm)	1220	75	140	360	75

Topsoil

A surficial veneer of topsoil approximately 100 and 275 millimetres in thickness was encountered at Borehole Nos. 6 and 7, respectively. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations. It is also noted that the term 'topsoil' has been used from a geotechnical point of view, and does not necessarily reflect its nutrient content or ability to support plant life.

Silty Clay/Clayey Silt Fill

Silty clay/clayey silt fill was encountered below the pavement and topsoil at all borehole locations. The fill material was reddish brown in colour, contained some sand and gravel and was generally in a firm to very stiff consistency. The fill soils were found to be variable including gravel seams, shale fragments, construction debris and occasional hydrocarbons staining. The silty clay/clayey silt fill materials encountered were proven to depths of approximately 1.5 to 7.0 metres below the surrounding ground surface, generally deeper at the south end of the parking lot and shallower at the north end of the site and on the grass covered area to the south.

Silty Clay/Clayey Silt

Native silty clay/clayey silt soil was encountered below the fill deposits at Borehole Nos. 2 to 5, and 7. The silty clay/clayey silt was brown in colour, contained trace sand and gravel and was generally in a very stiff to hard consistency. The fine grained native soil was proven to depths of approximately 2.3 to 7.9 metres below the surrounding ground surface.

Queenston Shale

Queenston Shale was encountered beneath the native silty clay/clayey silt and silty clay/clayey silt fill at all borehole locations. The Shale was red, severely weathered in the upper levels, becoming sounder with depth, and containing occasional more resistant grey layers. The degree of weathering in the upper levels of the Queenston Shale is such that it tends to exhibit the properties of a hard cohesive soil, or weak rock, as evidenced by the ability to penetrate the bedrock with the solid stem augers of the drill. As such, the transition between hard soil and weak rock is somewhat indistinct.

As noted above, the bedrock was cored in Borehole Nos. 2, 3, 5, and 6 using HQ-size diamond core barrel equipment. The Rock Quality Designation [RQD] of the recovered rock cores was determined to range from approximately 55 to 100 per cent, generally indicative of a sound quality rock mass.

Compressive strength testing was carried out on seven [7] core samples, yielding unconfined strengths in the range of approximately 20.6 to 33.8 MPa [~3,000 to 4,900 psi]. The average of the samples taken from below or near the anticipated founding elevation yielded an average strength of 28.9 MPa [4,200 psi]. The compressive testing data is summarised as follows, with the detailed results appended to this report:

TABLE B
BEDROCK COMPRESSIVE STRENGTH DATA

Borehole No.	Depth	Geodetic Elevation (m)	q_u [MPa]
2	4.62 m	78.11	23.6
2	14.45 m	68.28	33.8
2	15.77 m	66.96	31.5
3	10.46 m	72.51	20.6
3	14.71 m	68.26	20.8
5	14.10 m	67.19	29.6
6	8.28 m	72.83	28.1

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subject site to be near the boundary of coarse textured glaciolacustrine deposits, clay to silt textured till, and shallow paleozoic bedrock. This is generally consistent with our experience in the area and observations during fieldwork.

Groundwater Observations

As mentioned above, all boreholes were fitted with monitoring wells to allow for measurement of the static groundwater level. The groundwater depth was measured at the wells with the following results:

Table C
Ground Water Level Measurements

Borehole No.	Elev [m]	May 26, 2021		June 15, 2021	
		Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)
1	82.38	Dry	-	Dry	-
2	82.73	8.17	74.56	7.93	74.66
3	82.97	8.81	74.16	9.19	73.78
4	82.77	6.43	76.34	6.51	76.27
5	81.29	6.25	75.04	6.41	74.88
6	81.11	6.49	74.62	6.55	74.56
7	78.75	3.87	74.88	3.87	74.88

Based on our observations during drilling, the available data, and our experience in the area, the static groundwater level is estimated at an elevation of approximately 74 to 76 metres, generally increasing as distance from Lake Ontario increases. The groundwater elevation was observed approximately 4 to 9 metres below the existing grade and would be expected to fluctuate seasonally. It is also noted that the groundwater level would be subject to seasonal variation due to prevailing weather conditions.

4. FOUNDATION CONSIDERATIONS

It is anticipated that the founding level for the structure will extend to depths of up to 13 to 14 metres below the existing grade at Lakeshore Road, to an elevation of approximately 69 metres. The sound Queenston Shale bedrock at depth is considered very competent in terms of support conditions for the proposed structure. Based on the results of our investigations, spread footings founded on the competent Shale bedrock may be designed using the following design bearing value:

SLS = ULS = 2,800 kPa [~ 58,000 psf]

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable settlement based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect an upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. It is noted the SLS and ULS

values are the same, as in order for serviceability limits of deflection to be realised, failure of the Queenston Shale bedrock would have to occur.

All footing beds must be hand cleaned of all loose or disturbed material, ponded water, etc. prior to the placement of foundation concrete. With footings founded on the competent Shale the amount of total and differential settlements are anticipated to be negligible.

In areas where it will be necessary to have adjacent footings at different founding elevations, the lower footing should be constructed prior to the higher footing, if possible, and the higher footing should be set below an imaginary line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical. This practice will limit stress transfer from the higher footings to lower footings.

As the static groundwater level is expected to be well above the anticipated founding level, it will be necessary for the foundations and lowest-level basement floor slab to be constructed as a continuous watertight box, and designed to resist the hydrostatic pressure associated with an elevated groundwater level, considering a water level at a geodetic elevation of approximately 78 metres. In the event that a raft slab is utilised, this should be readily accommodated at the excavation base with the raft slab itself.

Should the site plan include any supplemental structures founded at depths shallower than the proposed residential building, all footings exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

It is imperative that a geotechnical engineer be retained from this office to provide geotechnical engineering services during the excavation support and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the Borehole locations.

5. LATERAL EARTH PRESSURE

The lateral earth pressures on basement walls can be estimated on the basis of a retained soil unit weight, [γ_{wet}], of 20 kN/m^3 [~127 pcf]. The coefficient of lateral earth pressure may be taken as, K_o = 0.5 in fill against rigid walls [at rest condition]. Any

additional pressures due to surcharge loading, such as adjacent structures, roadways, parked vehicles, floor slab loading, etc. must be included in the design.

6. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12 (as amended). Based on the subsurface soil conditions encountered in this investigation the applicable Site Classification for the seismic design is Site Class B – Rock, based on the average soil characteristics for the site.

The seismic data, from Supplementary Standard SB-1 of the Ontario Building Code, for Burlington are as follows.

S_a[0.2]	S_a[0.5]	S_a[1.0]	S_a[2.0]	S_a[5.0]	S_a[10.0]	PGA	PGV
0.266	0.131	0.062	0.029	0.0068	0.0027	0.172	0.102

7. EXCAVATIONS AND EXCAVATION SUPPORT CONSIDERATIONS

As noted above the proposed building is anticipated to include four basement levels. It is anticipated that excavations for the proposed foundations, sewers and other underground services will extend to depths of up to 13 to 14 metres below the present grade. The upper level of the Queenston Shale bedrock is typically highly weathered and should yield to a heavy hydraulic excavator equipped with 'rock' teeth. However, the rate of excavation should be anticipated to slow with depth, below perhaps 3 to 8 metres varying by location, as the Shale bedrock becomes sounder and less weathered. As the Shale becomes more competent, or where more resistant layers are encountered, the use of mechanical rock splitters will be required.

The base of excavations into the Queenston Shale are expected to remain solid and stable. However, the exposed Shale will be prone to surface weathering and softening. It is recommended that a thin concrete ‘mud’ slab, perhaps 50 millimetres, be placed over the base of the excavations to protect the founding soils from weathering and to provide a clean working surface for the placement of reinforcing steel, formwork, etc.

EXCAVATION SUPPORT

It is anticipated that the new structure will approach the property limits. As such it is anticipated that open cut excavations may not be suitable and the construction will

require some level of excavation support. It is noted that a preconstruction survey of adjacent above and below grade structures should be conducted to assess the appropriate shoring requirements, as well as establish a baseline condition.

Excavation side slopes will remain stable at a slope of 45 degrees to the horizontal in the upper fill materials and 60 degrees to the horizontal in the native silty clay/clayey silt for the short construction period. The side slopes in the Queenston Shale should remain stable at near vertical slopes. Where workers are required to enter the excavations the sides should be thoroughly scaled of all loose rock debris and by routinely evaluated by a Senior Engineer from this office. Consideration could be given to covering the excavation faces with heavy construction tarps or debris netting, secured at top and bottom, to direct any lose rock debris that may come loose safely to the bottom of the excavation. Notwithstanding the foregoing, however, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects.

As mentioned above, some level of excavation support will likely be required to ensure the stability of the excavation faces with little or no horizontal movement. Such support may be accomplished in a number of methods, including rock anchors, 'soldier' pile/caissons and timber lagging, or continuous caisson wall.

Caissons to support either soldier piles or a continuous caisson wall should extend a minimum of 1.5 metres beyond the final depth of excavation, and may be designed on the basis of a nominal end bearing pressure of 2,800 kPa [~58,000 psf]. Where no lateral movements are acceptable the shoring should be designed considering an 'at rest' lateral earth pressure coefficient of Ko = 0.5. Where small lateral movements can be tolerated an 'active' earth pressure coefficient of Ka = 0.25 may be considered.

The caissons should be provided with lateral bracing, either by using a waler beam and raker supports, or with rock anchors. From a contractor's point of view, rock anchors would be preferred, provided permission can be obtained from the neighbouring property owners to extend the anchors under their property. It is noted that significant movements of the shoring system may take place if rakers are used to support the shores since compression of the rakers and the footings supporting the inclined raker loads must occur before the rakes can begin to carry load. In this regard, anchors are preferred since they pre-stress the shoring system to the design load even before the excavations reach their final grade.

Regardless of which method of support is pursued for the Shale excavations the overburden soils will need to be properly cut back or additionally supported. Where space is available to cut back the overburden, the soil should be removed completely a distance of at least 300 millimetres from the face of the Shale excavation and then

sloped up. Where there is not sufficient space to accommodate cutting back of the overburden soils, they may be supported at near vertical slopes with the provision of a soldier pile [support at depth by caissons] and timber lagging system, or with shotcrete.

The excavation support must be designed as required by the Occupational Health and Safety Act and Regulations for Construction Projects and the Canadian Foundation Engineering Manual. This office should be given the opportunity to review the shoring shop drawings and design parameters before construction, and a representative of SOIL-MAT ENGINEERS should be on site to observe the installation of the shoring. The shoring must be monitored for movements, and a plan must be available before the excavations begin, to rectify the shoring system should movements become apparent.

GROUNDWATER CONTROL

As noted above the static groundwater levels in the monitoring wells have been measured at a depth of approximately 4 to 9 metres below the existing grade. Evidently excavations to the depths required will extend below the static groundwater level and thus will experience groundwater infiltration through more permeable seams in the bedrock. It is noted the Shale bedrock tends to be layered and fissured, such that permeable seams are intermittently spaced. For excavations extending a short distance below the static groundwater level, it may be possible to adequately control any water that may seep into the excavations from more permeable seams in the fill material, silty clay/clayey silt and Queenston Shale and from surface water using conventional construction 'dewatering' techniques, such as pumping from sumps in the base of the excavations. The need for multiple sumps should be anticipated. Where deeper excavations are required the rate and volume of groundwater infiltration should be anticipated to be much greater. The groundwater control requirements will be significantly influenced by the excavation shoring method implemented, being greatest for open cuts into the Shale and much less for a continuous caisson wall. More water should be expected when connections are made with existing services. Surface water should be directed away from the excavations.

A detailed hydrogeological assessment of the site is being conducted by Terra-Dynamics Consulting Inc. The findings and recommendations found in the Hydrogeological assessment will be reviewed and any relevant construction considerations included in a separate letter.

8. FLOOR SLAB CONSIDERATIONS

As noted above, the proposed basement levels will extend below the measured static groundwater level. As such it will be necessary that the perimeter foundations and lowest-level basement raft slab be constructed as a water-tight box, making use of suitable membrane systems beneath the slab and against the exterior of foundation walls. This will likely require the use of foundation wall membrane systems intended for 'blind side' or 'single face' application. The system should also incorporate a water-stop component between the raft slab and perimeter foundation walls, and consideration should be given to using a concrete waterproofing admixture in all concrete used for the foundation walls and lowest-level slab. The foundation walls and lowest-level floor slab will also be required to be designed to resist the hydrostatic pressure, considering a groundwater level at an approximate geodetic elevation of 78 metres. Elevator pits extending below the general basement floor level should also be designed to be continuously water-tight with the surrounding structure.

9. BACKFILL CONSIDERATIONS

It is expected that the majority of the material excavated to accommodate the basement levels will be transported off-site. Where required select portions of the fill material and silty clay/clayey silt soils are considered suitable for use as backfill in service trenches, etc. provided it is free of organics or any other deleterious material. The use of Queenston Shale backfill is not recommended as it will require significant effort and will be prone to ongoing settlement for many years if it is not properly graded and moisture conditioned, even if it is well compacted.

The use of free draining, well-graded granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular B, Type II (crushed limestone bedrock) is often preferred for backfill against foundation walls. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for exterior concrete sidewalks, pavement, etc. The use of alternative materials, including recycled concrete aggregates, clear stone materials, etc., may be considered, however should be reviewed and approved by our office prior to use. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

Fine-grained cohesive soils such as those encountered on site are sensitive to moisture absorption and will become practically impossible to compact using conventional compaction equipment if they become wet during the 'wet' periods of the year. After a period of heavy precipitation, any near-surface wet, or softened material, should be

allowed to air-dry or be removed and discarded. These soils are not considered to be free draining and therefore should not be used where this characteristic is necessary. They should not be used in confined spaces where access for compaction is difficult.

Backfill materials used in service trenches or to raise the subgrade elevation under exterior pavement areas should have its moisture content within 3 per cent of its optimum moisture content. In service trenches the backfill material should be compacted to a minimum of 98 per cent of its standard Proctor maximum dry density [SPMDD]. Any fill required against the basement walls should consist of free draining granular material compacted to 98 per cent of its standard Proctor maximum dry density. Where asphalt or concrete paving extends up to the building the upper 1 metre of foundation wall backfill should be compacted to 100 per cent of its standard Proctor maximum dry density. Lift thickness would depend on the material type and moisture content of the backfill material and size of the compaction equipment used by the contractor. A representative of SOIL-MAT should be retained to monitor the backfilling and compaction operations to confirm uniform compaction of the backfill material to project specification requirements.

10. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved must be cleared of all organic and otherwise unsuitable materials, and the exposed subgrade proof rolled with 3 to 4 passes of a fully-loaded tandem-axle truck in the presence of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means should be sub-excavated and replaced with suitable backfill material. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50mm clear stone, 'rip rap' stone, etc.] 'punched' into the soft areas. It may also be prudent to consider the provision of a heavy geofabric over the subgrade to act as a separator between the subgrade and granular base materials.

The need for sub-excavations of softened subgrade materials will be reduced if construction is undertaken during dry periods of the year and careful attention is paid to the compaction operations. As noted above the on-site soils are sensitive to disturbance and moisture and may present difficulty for roadway construction during 'wet' periods of the year. Should pavement construction be undertaken during 'wet' periods of the year it should be anticipated that greater stabilisation efforts will be required and/or additional depth of OPSS Granular 'B', Type II sub-base course material may be required.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. SOIL-MAT should be given the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.

The suggested pavement structures outlined in Table D are based on subgrade parameters estimated on the basis of visual and tactile examinations of the on-site soils and past experience. The outlined pavement structure may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

TABLE D
RECOMMENDED PAVEMENT STRUCTURES

LAYER DESCRIPTION	COMPACTION REQUIREMENTS	LIGHT DUTY SECTIONS	HEAVY DUTY [TRUCK ROUTE]
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	92 per cent Marshall MRD	65 millimetres	40 millimetres
Binder Course OPSS HL 8	92 per cent Marshall MRD		65 millimetres
Base Course OPSS Granular 'A'	100% SPMDD	150 millimetres	150 millimetres
Sub-base Course OPSS Granular 'B' Type II	100% SPMDD	300 millimetres	450 millimetres

* Marshall MRD denotes Maximum Relative Density.

* SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often,

significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honeycomb surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

11. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgement in light of the information available at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. 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. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Yaroslav Mormil, P. Eng.
Project Engineer



Stephen R. Sears, B. Eng. Mgmt., P. Eng., QP_{ESA}
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 7, inclusive
Compressive Strength Test Results

Distribution: [redacted]. [1, plus pdf] Burlington 2020 Lakeshore Inc.



LEGEND

Borehole Location

BH#

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 301114-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Proposed Condominium
2020 Lakeshore Road
Burlington, Ontario

Borehole Location Plan

Project No. SM 301114-G

Date: April 2021

Drawn: MA | Checked: YM

SM 301114-G Borehole Location Plan

Drawing No. 1

Log of Borehole No. 01

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797540
E: 597648

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.38	Ground Surface							
0–3 / 0–1		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 1220 millimetres of compact granular base.	SS	1	11 9 8 6	17			
			SS	2	4 8 7 4	15			
3–6 / 1–2	81.06	**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, occasional hydrocarbons staining, firm.	SS	3	1 2 5 4	7			
6–25 / 2–7	80.25	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	9 36 50/4"	100			
			SS	5	36 50/1"	100			
			SS	6	50/2"	100			
			SS	7	50/2"	100			
25 / 7	74.56		SS	8	50/2"	100			
25–33 / 7–9		End of Borehole							

Well Data: Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 7.8 metres.

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 7.8 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 7.42 meters (dry)

Drill Method: Solid Stem Auger
Drill Date: 7/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.73	Ground Surface							
0 / 0		**Pavement Structure** Approximately 75 millimetres of asphaltic concrete, overlying 75 millimetres of compact granular base.	SS	1	5 5 4 5	9			
3 / 1		**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, occasional staining, very stiff.	SS	2	3 11 7 8	18			
5 / 1	81.21		SS	3	3 8 10 11	18			
7 / 2		**Silty Clay / Clayey Silt** Reddish brown, trace to some sand and gravel, very stiff.							
8 / 2	80.29		SS	4	21 40 43 50/3"	83			
10 / 3		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	5	50/3"	100			
11 / 3			HQ	6	RQD=90%				
13 / 4			HQ	7	RQD=86%				
17 / 5			HQ	8	RQD=96%				
23 / 7			HQ	9	RQD=94%				
27 / 8			HQ	10	RQD=74%				
33 / 9									

Moisture Content w%: 10 20 30 40

Standard Penetration Test blows/300mm: 20 40 60 80

Compressive Strength 23.6 MPa at 4.6 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34				HQ	N/A	RQD=90%					
35											
36	11										
37				HQ	N/A	RQD=96%					
38											
39	12										
40											
41											
42		NOTES:		HQ	N/A	RQD=97%					
43	13										
44		1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 17.1 metres.									
45											
46	14	2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
47				HQ	11	RQD=88%					Compressive Strength 33.8 MPa at 14.5 metres
48		3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
49	15										
50		4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 8.17 meters									
51											
52	16										Compressive Strength 31.5 MPa at 15.8 metres
53				HQ	12	RQD=98%					
54											
55											
56	17 65.63	End of Borehole									
57											
58											
59	18										
60											
61											
62	19										
63											
64											
65											

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.97	Ground Surface							
0 / 0	82.74	**Pavement Structure** Approximately 90 millimetres of asphaltic concrete over 140 millimetres of compact granular base.	SS	1	9 9 9 8	18			
4 / 1	81.47	**Silty Clay / Clayey Silt Fill** Reddish brown, some sand and gravel, occasional staining, very stiff.	SS	2	9 10 10 11	20			
		Silty Clay/Clayey Silt Brown, trace sand and gravel, very stiff.	SS	3	3 6 11 17	17			
9 / 2	80.21		SS	4	8 16 16 22	32			
		Queenston Shale Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	5	50/3"	100			
13 / 4			SS	6	50/3"	100			
			HQ	N/A	RQD=60%				
19 / 6			HQ	N/A	RQD=96%				
23 / 7			HQ	N/A	RQD=99%				
27 / 8			HQ	N/A	RQD=73%				
33									

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34					HQ	7	RQD=91%					Compressive Strength 20.6 MPa at 10.5 metres
35												
36	11											
37												
38			NOTES:									
39	12		1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 15.1 metres.		HQ	8	RQD=85%					
40												
41			2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
42	13											
43			3. Soil samples will be discarded after 3 months unless otherwise directed by our client.		HQ	9	RQD=55%					
44												
45			4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 8.81 meters									
46	14											
47					HQ	10	RQD=86%					Compressive Strength 20.8 MPa at 14.7 metres
48												
49	15	67.86										
50			End of Borehole									
51												
52	16											
53												
54												
55												
56	17											
57												
58												
59	18											
60												
61												
62	19											
63												
64												
65												

Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 04

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

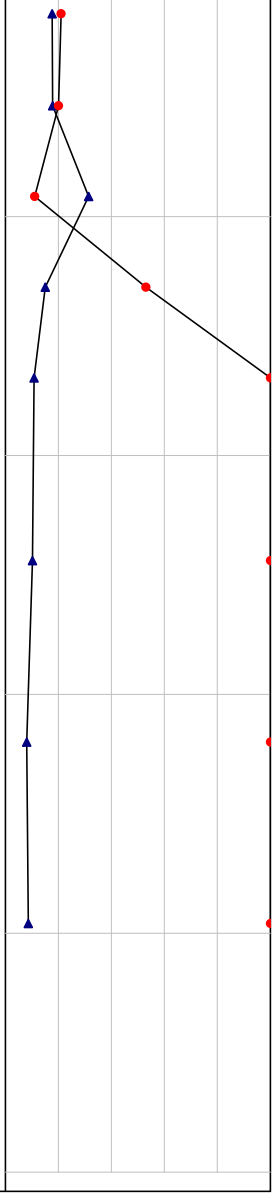
Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797596
E: 597738

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.77	Ground Surface							
0 / 0	82.31	**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 360 millimetres of compact granular base.	SS	1	13 13 8 10	21			
3 / 1	81.17	**Silty Clay / Clayey Silt Fill** Brown, occasional organics in the upper levels, some sand and gravel, very stiff.	SS	2	9 9 11 10	20			
5 / 2	80.38	**Silty Clay/Clayey Silt** Brown, trace sand and gravel, stiff.	SS	3	2 3 8 15	11			
8 / 3		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	4 21 32 50	53			
10 / 3			SS	5	45 50/2"	100			
15 / 4			SS	6	50/2"	100			
20 / 6			SS	7	50/2"	100			
25 / 7	75.15		AS	8	50/0"	100			
25 / 8		End of Borehole							

1. Borehole was advanced using solid stem auger equipment on April 6, 2021 to termination at a depth of 7.6 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 6.43 meters

Auger sample taken at 7.62 meters

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: 6/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

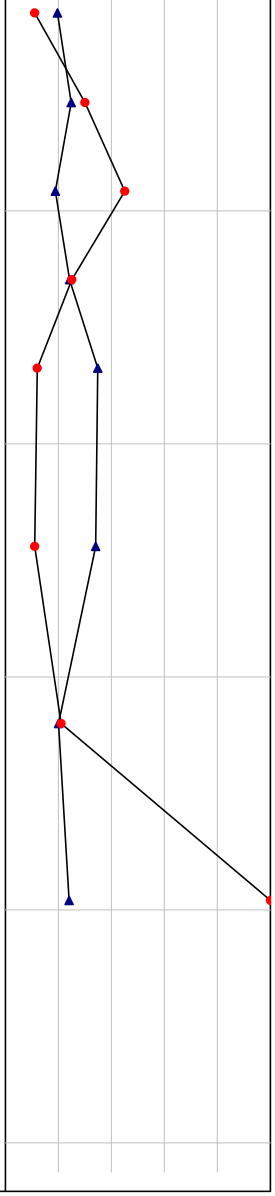
Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	81.29	Ground Surface							
0 / 0		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 75 millimetres of compact granular base.	SS	1	10 5 6 7	11			
		Silty Clay / Clayey Silt Fill Reddish brown, some sand and gravel, occasional organics, stiff to very stiff.	SS	2	5 16 14 12	30			
2 / 1			SS	3	17 23 22 18	45			
3 / 1			SS	4	14 16 9 8	25			
4 / 1			SS	5	4 6 6 7	12			
5 / 2			SS	6	7 6 5 16	11			
6 / 2	75.29	**Silty Clay / Clayey Silt** Greyish brown, trace sand and gravel, gravel seam, stiff to very stiff.	SS	7	13 13 8 12	21			
7 / 3			SS	8	50/1"	100			
8 / 3	73.37	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	HQ	9	RQD=88%				
9 / 4			HQ	10	RQD=77%				
10 / 4									

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34						10						
35												
36	11					11	Clean Up					
37												
38					HQ	12	RQD=89%					
39	12											
40												
41												
42					HQ	13	RQD=83%					
43	13											
44												
45												
46	14				HQ	14	RQD=97%					Compressive Strength 29.6 MPa at 14.1 metres
47												
48												
49	15											
50												
51												
52	16				HQ	15	RQD=91%					
53												
54			NOTES:									
55			1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 20.1 metres.									
56	17											
57			2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
58					HQ	16	RQD=101%					
59	18		3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
60												
61			4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 6.25 meters									
62	19											
63												
64					HQ	17	RQD=97%					
65												
66	20 61.15		End of Borehole									
67												

Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth ft	Depth m	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		81.11	Ground Surface							
0	0		**Topsoil** Approximately 100 millimetres of topsoil.							
1			**Silty Clay / Clayey Silt Fill** Reddish brown, occasional construction debris and organics, some sand and gravel, firm to very stiff.	SS	1	8 7 5 5	12			
2	1			SS	2	3 13 3 1	16			
3				SS	3	5 12 8 3	20			
4				SS	4	3 3 4 4	7			
5	2			SS	5	4 4 3 3	7			
6				SS	6	3 6 3 1	9			
7				SS	7	3 3 1 7	4			
8	3			SS	8	3 7 12 10	19			
9				SS	9	13 18 16 50/5"	32			
10				SS	10	50/2"	100			
11				HQ	11					
12	4			HQ	12	RQD=90%				
13										
14										
15										
16	5									
17										
18										
19										
20	6									
21										
22		74.11								
23	7		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.							
24										
25										
26	8									
27										
28										
29										
30	9									
31										
32										
33										

Moisture Content w%: 10 20 30 40
Standard Penetration Test blows/300mm: 20 40 60 80

Compressive Strength 28.1 MPa at 8.3 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34–65					HQ	13	RQD=91%					
					HQ	14	RQD=91%					
					HQ	15	RQD=93%					
					HQ	16	RQD=94%					
51	65.46		End of Borehole									

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 15.6 metres.

2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 6.49 meters

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 07

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Burlington 2020 Lakeshore Inc.

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797495
E: 597682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	78.75	Ground Surface							
0 / 0	78.47	**Topsoil** Approximately 275 millimetres of topsoil.							
1 / 0		**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, stiff to hard.	SS	1	4 3 3 12	6			
2 / 1			SS	2	6 11 23 12	34			
3 / 1			SS	3	6 12 15 16	27			
7 / 2			SS	4	2 3 8 10	11			
10 / 3	75.40		SS	5	3 8 10 8	18			
11 / 3		**Silty Clay / Clayey Silt** Redish brown, trace to some sand and gravel, very stiff.							
16 / 5	73.57		SS	6	4 4 15 18	19			
17 / 5		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.							
20 / 6			SS	7	50/3"	100			
25 / 7	70.93		SS	8	50/2"	100			
26 / 8		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:
1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 7.8 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 3.87 meters

Drill Method: Solid Stem Auger
Drill Date: 5/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

	Core	Depth [m]	Average Diameter D [mm]	Average Height H [mm]	Dry Weight (mass) [g]	Break Load Q_{ult} [lb]	Break Load Q_{ult} [N]	Aspect Ratio Factor C_F	Cross-Sectional Area A [m^2]	Calculated Volume V [m^3]	Calculated Unit Weight γ_{conc} [kN/m^3]	Calculated Density ρ_{conc} [kg/m^3]	Unconfined Compressive Strength [MPa]
A	BH6 C1	8.3	60.0	130	1084.0	17890	79574.7	1.00	0.00283	0.00037	28.9	2949.1	28.1
B	BH2 C2	14.5	60.0	129	1088.6	21500	95632.0	1.00	0.00283	0.00036	29.3	2984.6	33.8
C	BH2 C1	4.6	60.0	122	1010.4	15020	66809.0	1.00	0.00283	0.00034	28.7	2929.1	23.6
D	BH3 C1	10.5	60.0	109	913.0	13240	58891.5	0.99	0.00283	0.00031	29.0	2962.5	20.6
E	BH3 C2	14.7	60.0	100	880.0	13600	60492.8	0.97	0.00283	0.00028	30.5	3112.4	20.8
F	BH2 C3	15.8	60.0	120	1074.5	20020	89049.0	1.00	0.00283	0.00034	31.1	3166.9	31.5
G	BH5 C1	14.1	60.0	127	999.0	18840	83800.3	1.00	0.00283	0.00036	27.3	2782.1	29.6

Date Tested: 12-Apr-21

Date received:

Project/Contract No.: 301114

Structure:

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

COMPRESSIVE STRENGTH TEST - Shale Bedrock Cores

Project No.: 301114 **Lab Number: 21-332** April 12, 2021

Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

October 18, 2021

Mr. Darko Vranich
Burlington 2020 Lakeshore Inc.
366 King Street West
Hamilton, Ontario L8P 1B3

Re: Hydrogeological Dewatering Assessment –
Proposed Residential Development, 2020 Lakeshore Road, Burlington, ON

Dear Mr. Vranich,

1.0 Introduction, Background Information and Purpose

Terra-Dynamics Consulting Inc. respectfully submits this Dewatering Assessment for 2020 Lakeshore Road, Burlington (Site, Figure 1). It is our understanding that a residential building approximately 30 to 40 stories in height, with up to four underground parking levels are to be constructed at the Site (Figure 2). Construction of the basement parking levels will be below (i) the high-water level mark of Lake Ontario at Burlington by approximately 6.8 m, and (ii) the groundwater level in the underlying shale bedrock. The area is municipally serviced for water and sanitary services.

2.0 Methodology

The following methodologies were used to investigate the Site:

A. Submission to the City of Burlington, and acceptance, of a Hydrogeological Dewatering Assessment Terms of Reference (Appendix A).

B. Assessment of regional information including topography, overburden and bedrock.

C. Review of the Soil-Mat Engineers & Consultants Ltd. (Soil-Mat) (2021) geotechnical report and adjacent technical studies.

D. Investigation of Site conditions through monitoring well hydraulic conductivity testing, water level measurements and groundwater quality monitoring.

E. Preparation of a description of the hydrogeological setting using the geotechnical/geological information, water levels and *in-situ* hydraulic conductivity testing.

F. Groundwater Dewatering Assessment.

3.0 Physical Setting

The Site is fairly flat, with topography ranging from 83 to 81 metres above sea level (m ASL), sloping from the northwest to the southeast towards Lake Ontario (City of Burlington, 2020). The Site is an existing hotel with a parking lot within a municipally serviced area. The closest surface waterbody is

Lake Ontario, 50 metres to the south and east of the Site (Figure 2). The high-water level reported by the Department of Fisheries and Oceans is 75.5 metres above sea level (mASL) at the Burlington Station on Lake Ontario (DFO, 2021). The Site is located within the Halton Region Conservation Authority watershed with regulation limits mapped at the Site because of potential erosion hazard associated with the Lake Ontario shoreline.

3.1 Geology

In April, 2021, seven boreholes and monitoring wells into bedrock were completed under the supervision of Soil-Mat Engineers & Consultants Ltd. (Figure 2, Soil-Mat, 2021, Appendix B). Although the regional surficial geology is mapped as sand (Ontario Geological Survey (OGS), 2003), sand was not identified at the Site. The overburden noted in the boreholes was silty clay/clayey silt fill, with some areas of native silty clay/clayey silt beneath the fill as shown on the geologic cross-sections (Figures 3, 4 and 5). The thickness of overburden increases towards Lake Ontario from 2 metres near Lakeshore Road to 7 metres along the southeastern boundary of the Site (Figure 5).

The bedrock is the Queenston Formation, comprised of shales with minor interbeds of siltstones and limestones averaging 100 m in thickness (Singer et al, 2003) and extending further than 200 metres radially from the Site (OGS, 2011). The top of bedrock dips towards the southeast (i.e. towards Lake Ontario) from 79 to 75 m ASL (Figure 2).

Bedrock boreholes were constructed by one of two methods:

A. Boreholes BH2, BH3, BH5 and BH6 were constructed using HQ coring; and
B. Boreholes BH1, BH4 and BH7 were constructed using solid stem augers.

Boreholes were extended to various depths to characterize bedrock conditions (Figures 3, 4 and 5) and were classified herein as shallow (-S), intermediate (-I) or deep (-D) relative to their depth in the bedrock. However, monitoring well BH7-S was also screened across the overlying silty clay/clayey silt and the Queenston Shale bedrock.

3.2 Groundwater Levels

Manual groundwater levels were measured in May and June, 2021 (Table 1). Groundwater levels from June 15, 2021 are most representative of groundwater conditions (Figure 2), as earlier groundwater levels were measured before development of the monitoring wells was completed. Well development was completed as part of hydraulic conductivity testing at the monitoring wells (Section 3.3). Monitoring well BH1-S was dry during each site visit.

Bedrock groundwater levels transition across the Site from being '*unconfined*' in the bedrock along Lakeshore Road (i.e. monitoring wells BH2-I, BH3-I and BH4-S, Figure 4), to being '*confined*' with groundwater levels above the top of bedrock closer to Lake Ontario at monitoring wells BH5-D, BH6-I and BH7-S (Figure 3). This transition from unconfined to confined conditions is shown on cross-section C-C' (Figure 5). This is primarily a reflection of the depth to the bedrock being greater near Lake Ontario not a steep change in water level elevations across the Site. While groundwater levels on June 15, 2021 varied from 73.78-76.27 m ASL, if one excludes shallow monitor BH4-S, the intermediate and deep groundwater levels varied 1.1 metres. The average Lake Ontario water level was 74.75 mASL on June

15, 2021 very similar to the elevations at BH7-S and BH5-D, which are the groundwater monitors closest to Lake Ontario.

Vertical gradients were calculated at two locations, BH4-S/BH3-I and BH6-I/BH5-D. A downward vertical gradient is calculated from the shallow to the intermediate bedrock system at the northeast corner of the Site (BH4-S/BH3-I) of 0.39 m/m. An upward vertical gradient from the deep to the intermediate system (BH6-I/BH5-D) was calculated of 0.08 m/m. This upward vertical gradient indicates the potential for groundwater inflow to the excavation through the base of the excavation as well as the sides (horizontally) in the bedrock.

3.3 Bedrock Hydraulic Conductivity Analyses

Hydraulic conductivity testing of bedrock monitoring wells BH2 through BH7 was completed June 8, 2021 using a bail-down approach after the wells were developed. The test results were analyzed using Hvorslev (1951), or a Bouwer and Rice analysis (Bouwer, 1989) as recommended when the water level is within the screen (Bair, 2005). The analyses were completed in Aqtesolv™ and the results summarized in Table 2 with analyses presented in Appendix C.

There was considerable variation in the hydraulic conductivity testing results, ranging from 10^{-6} to 10^{-9} m/s, with a geometric mean value of $2x10^{-7}$ m/s, and values were lower than published values for weathered shale at 10^{-5} m/s (MECP, 2006). The highest hydraulic conductivity was noted for the deepest monitoring well (BH5-D) which also has an upward gradient (Section 3.2).

Testing of shale bedrock hydraulic conductivities immediately to the northeast of the Site also showed a wide range of hydraulic conductivities from 10^{-6} to 10^{-8} m/s (Peto MacCallum Limited, 2014).

Table 2 – Shale Hydraulic Conductivities

Location	Hydraulic Conductivity (m/s)	Screened Depth (m BGS*)	Screened Depth (m ASL)	Comments
BH2-I	$8x10^{-7}$	14.1-17.1	68.6-65.6	
BH3-I	$8x10^{-7}$	12.1-15.1	70.9-67.9	
BH4-S	$8x10^{-9}$	4.6-7.6	78.2-75.2	Water level within screen
BH5-D	$3x10^{-6}$	17.1-20.1	64.2-61.2	Highest value on-site
BH6-I	$7x10^{-9}$	12.6-15.6	68.5-65.5	
BH7-S	$6x10^{-7}$	4.6-7.6	74.2-71.2	

Note: BGS* - Below ground surface

3.4 Overburden Hydraulic Conductivity

If groundwater is present in the overburden very little contribution to dewatering is expected as the hydraulic conductivity is expected to be ~10^{-8} m/s (MECP, 2006) and bedrock water levels were only modestly above the top of bedrock along the southeast boundary (Figures 3 and 5). Consequently, overburden monitoring wells were not warranted.

3.5 Groundwater Quality Analyses

Groundwater quality samples were collected from monitoring wells (BH2-I, BH5-D, BH6-I and BH7-S, Figure 2) for chemical analyses. The results were compared to the (i) Region of Halton Sanitary Sewer By-law Discharge Limits (Region of Halton, 2003) and the (ii) City of Burlington DRAFT Storm Sewer Discharge Limits (City of Burlington, 2019). There are no provincial water quality critieria relevant to this hydrogeologic dewatering assessment. These four monitoring wells were chosen to represent conditions at various depths around the Site. The water quality results are summarized on Table 2 and the laboratory report in Appendix D.

Draft City of Burlington Storm Sewer Discharge Limits were exceeded for a number of parameters:

1. Biological oxygen demand (BH6-I),
2. 4AAP-Phenolics, (BH5-D and BH6-I),
3. Manganese (all locations),
4. Zinc (BH5-D),
5. Chloroform (BH6-I), and
6. Nonylphenol (BH5-D, BH6-I and BH7-S).

The elevated manganese concentrations (0.20-0.33 mg/L, Table 2) measured at all locations are considered natural/ambient for the Queenston Shale (Golder, 2006). It is our understanding the manganese can be reasonably treated for removal through chlorination, aeration and sedimentation (Tchobangoglous and Schroeder, 1987). However it is unclear if the other exceedances are natural or consistent concentrations, consequently additional groundwater sampling would be required to confirm.

Although the Region of Halton Sanitary Sewer By-law Discharge Limits were only exceeded for the total suspended solids (TSS) criterion at one location (BH7-S) and TSS can likely be addressed with filtration and/or settling of the future dewatering discharge, as well as dilution via other groundwater at the Site with lower total suspended solids, the Region of Halton does not allow construction dewatering water to be directed to the sanitary sewer (Region of Halton, 2021).

3.6 Hydrogeologic Setting

The overburden at the Site is not expected to contribute significantly to dewatering having a low hydraulic conductivity (Section 3.3) and may function as an aquitard. Consequently, if the overburden is saturated, this unit may increase dewatering volumes somewhat but volumes are expected to be small given the limited saturated thickness of the overburden along the southeast portion of the Site and low hydraulic conductivity (Section 3.2).

The upper shale bedrock is dry closer to Lakeshore Road (unconfined) with the water table above the top of bedrock (confined) at Lake Ontario. Although the hydraulic conductivities of the shale were generally low, the higher hydraulic conductivity at BH5-D of 10^{-6} m/s does not represent a low permeability unit (MECP, 2008) and an upward gradient was observed relative to BH6-I. Given this information, groundwater contribution to dewatering will include both (i) a rate per metre depth and (ii) from the base of the excavation.

4.0 Groundwater Dewatering Assessment

To estimate dewatering flow rates to drain the excavation for construction of underground parking, analytical equations for radial flow to both (a) a mixed, and (b) water table aquifers were used from Powers et al (2007) and a radius of influence calculation from Cashman and Preene (2021).

4.1 Horizontal Groundwater Inflow

The daily *horizontal* flow rate was calculated as between 16,953 to 26,440 L/day (Tables D-1 and D-2, Appendix E) based upon the following conservative assumptions which incorporate a number of safety factors:

1. Water level of 75.5 m ASL (representing the Lake Ontario high-water level as a substitution for March/April seasonally high water levels) above the base of excavation at 68.7 m ASL;
2. Hydraulic conductivity of $2x10^{-7}$ m/s, the geometric mean for the Site;
3. Rectangular excavation was modelled as two circular systems with some overlap;
4. Dewatering reaches equilibrium conditions after 2 weeks, at an average rate of between 12 to 18 Litres per minute (2.6 to 4.0 Imperial gallons per minute)

The range in horizontal discharge rate reflects the changing conditions across the Site from the groundwater level being within the bedrock along the northwest boundary (unconfined conditions, Table D-2) to above the top of bedrock closer to Lake Ontario (confined conditions, Table D-1). After a year, daily horizontal flow rates are calculated as less than 4,000 L/day (Tables D-3 and D-4, Appendix E).

4.2 Vertical Groundwater Inflow

There is also potential for vertical groundwater inflow through the base of the excavation. This is indicated by an upwards gradient in comparison of water levels at BH6-I and BH5-D (Section 3.2). However, this potential is associated with the deeper portions of the excavation, as the upper shallow bedrock along Lakeshore Road, showed a downward vertical gradient at BH4-S and BH3-I (Section 3.2).

The amount of vertical groundwater inflow was calculated as 10,578 L/day, based upon [*equation 1*].

$$Q=KiA \quad [\textit{equation 1}]$$

where Q=groundwater inflow, K=Hydraulic Conductivity ($2x10^{-7}$ m/s), i=vertical gradient (0.08 m/m) and A=Area of base of excavation (7,652 m^2)

4.3 Ministry of the Environment, Conservation & Parks (MECP) Permit to Take Water (PTTW) and Environment Activity and Sector Registry (EASR)

Construction dewatering upon full excavation is expected to be initially 37,018 L/day based upon a horizontal groundwater inflow of 26,440 L/day and a vertical groundwater inflow of 10,578 L/day and subsequently decline. Consequently, a Ministry of the Environment, Conservation & Parks (MECP) Environmental Activity and Sector Registry (EASR) temporary 'Construction Site Dewatering' approval is not required for Site dewatering with a dewatering rate less than 50,000 L/day (MECP, 2021). Groundwater

infiltration should be adequately controlled using construction dewatering techniques such as pumping from sumps in the base of the excavation (Preene, 2020).

4.4 Zone of Influence

The radial dewatering zone of influence was calculated as less than 50 metres from the excavation after 2 weeks of dewatering a full excavation (Tables D-1 and D-2, Appendix E). If dewatering of the full excavation continued for a year, the drawdown at 50 metres from the excavation is calculated as 1 m through extrapolation of the Cooper-Jacoub radius of influence (Tables D-3 and D-4, Appendix E). However, this a conservative value as it does not include precipitation.

Minimal risk of overburden settlement/damage is anticipated given water levels are already within the bedrock except adjacent Lake Ontario, and construction dewatering through the shale should not dewater Lake Ontario where the overburden is thicker.

5.0 Conclusions

The following conclusions are provided:

1. Groundwater levels at the Site were both within (unconfined conditions), and above the shale bedrock (unconfined conditions). Hydraulic conductivity values showed variation across the site and at depth similar to conditions to the northwest, where tested;

2. Construction dewatering for underground construction does not require an EASR from the MECP to dewater the shale bedrock to the proposed excavation depth;

3. The groundwater quality parameter of managanese is naturally occurring within the shale bedrock. Concentrations of manganese exceed the Draft City of Burlington Storm Sewer Water Quality Criteria and will require treatment for discharge to the storm sewer. A limited number of other parameters may also exceed the criteria;

4. The Region of Halton does not allow discharge of dewatering waters to their sanitary sewers; and

5. No negative effects to private wells or watercourses are expected from construction dewatering operations.

6.0 Recommendations

The following recommendations are provided:

1. Monitoring wells should be resampled for laboratory water quality analyses to confirm if any parameters except manganese require treatment for discharge of dewatering waters to the City of Burlington storm sewer;

2. Underground construction should be completed in a waterproof manner to prevent the need for permanent dewatering water treatment; and

3. Soil-Mat Engineers & Consultants Ltd. should evaluate the potential for base instability from buoyancy uplift associated with the upward gradient at the base of the excavation.

7.0 Limitations

Subsurface dewatering assessments, by their nature, have inherent limitations and uncertainties primarily due to the heterogeneities in geologic conditions causing differences in hydraulic conductivity and hydraulic gradients in areas of a site not investigated by boreholes and/or monitoring wells. It is believed that these uncertainties have been addressed through interpretation of other existing regional-based geologic conditions and site-specific data at the places investigated, e.g. the geometric mean hydraulic conductivity was used rather than the highest hydraulic conductivity measured. Conditions may vary in the subsurface at places not investigated. The assessment of dewatering potential, including the evaluation of risk and/or impact, is valid only for the assumptions and conditions outlined in this report and the conditions as they were observed at the time of the investigation. Should knowledge of the site conditions change, the assessments of risks posed by the site may differ from that presented in this report.

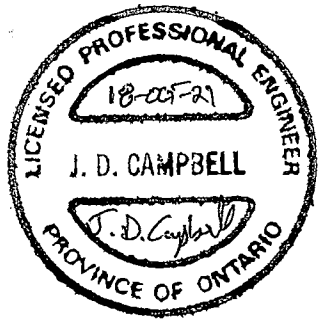
This report was prepared by Terra-Dynamics Consulting Inc. for Soil-Mat Engineers & Consultants Ltd and their client. The material in it reflects Terra-Dynamics' best judgment in light of the information available to Terra-Dynamics at the time of preparation. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. Terra-Dynamics accepts no responsibility for damages, if any, suffered by any third parties as a result of decisions made, or actions taken, based on this report.

We trust this information is sufficient. Please do not hesitate to contact us if you have any questions or require additional information for your review.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.

Jayme D. Campbell, P.Eng.
Senior Water Resource Engineer



Attachments
Figure 1 Location of Subject Lands
Figure 2 Site Details
Figure 3 Hydrogeologic Cross-section A-A'
Figure 4 Hydrogeologic Cross-section B-B'

Figure 5 Hydrogeologic Cross-section C-C'
Table 1 Manual Groundwater Level Measurements
Table 2 Groundwater Quality Sample results
Appendix A Terms of Reference
Appendix B Monitoring Well logs
Appendix C Hydraulic Conductivity Analyses
Appendix D Water Quality Analyses
Appendix E Dewatering Calculations

cc. Peter Horn, Horn Design & Consulting Inc.
Stephen Sears and Yaroslav Mormil, Soil-Mat Engineers & Consultants Ltd

8.0 References

Bair, S.E., 2005. Analysis and Design of Aquifer Tests including Slug Tests and Fracture Flow. National Groundwater Association course, Dublin, Ohio.

Bouwer, H., 1989. The Bouwer and Rice Slug Test – An Update. Vol.27, No.3, Groundwater, p.7-9.

Cashman, P. M., and Preene, M., 2021. Groundwater Lowering in Construction, A Practical Guide to Dewatering, 3rd Edition.

City of Burlington, 2021. 1 m ground surface contours.

City of Burlington, 2019. DRAFT Storm Sewer Discharge By-law.

City of Burlington, 2002. Storm Sewer Discharge By-law Number 86-2002.

Conservation Halton, 2020. Regulation Limit.

Department of Fisheries and Oceans, 2021. Burlington 13150, Datum 74.2 metres above sea level.

EXP Services Inc., 2016. Hydrogeological Investigation, New Horizon Development Group.

Golder Associates, 2006. Report on 2005 Groundwater Monitoring, Hanson Brick – Niagara Quarry, Niagara-on-the-Lake, Ontario.

Hvorslev, M.J., 1951. Time lag and soil permeability in ground-water observation, Bulletin 36, US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, 55 p.

Ministry of the Environment, Conservation and Parks, 2021. Personal Communication, Michael Prusinski (Environmental Scientist, Permit to Take Water Unit) with Jayme Campbell (Terra-Dynamics).

Ministry of the Environment, (Conservation and Parks), 2008. Design Guidelines for Sewage Systems.

Ministry of the Environment, (Conservation and Parks), 2006. Assessment Report: Draft Guidance Module 3, Groundwater Vulnerability Analysis.

NEUF Architectes Canada Inc., 2021. Proposoed Mixed Use Development, Conceptual Architectural Drawings.

Ontario Geological Survey (OGS), 2003. Surficial geology of southern Ontario. Miscellaneous Release Data – 128. Project Summary and Technical Document, 53 pp.

OGS, 2011. 1:250,000 scale bedrock geology of Ontario; OGS, Miscellaneous Release – Data 126-Revision 1.

Peto MacCallum Ltd., 2014. Hydrogeological Site Assessment for Permit-to-take-Water, Bridgewater Development, 2042, 2048, 2054/2058 and 2080 Lakeshore Road, Burlington, Ontario for MADY Burlington Ltd.

Region of Halton, 2003. By-law Number 2-03. A by-law to prohibit, regulate and control discharges into bodes of waters within regional boundaries or into the regional sanitary sewers, sanitary sewage works and all tributary sewer systems.

Powers, J.P., Corwin, A.B., Schmall, P.C. and Kaeck, W.E., 2007. Construction Dewatering and Groundwater Control, 3rd Edition.

Preene, M., 2020. Conceptual modelling for the design of groundwater control systems. Quarterly Journal of Engineering Geology and Hydrogeology.

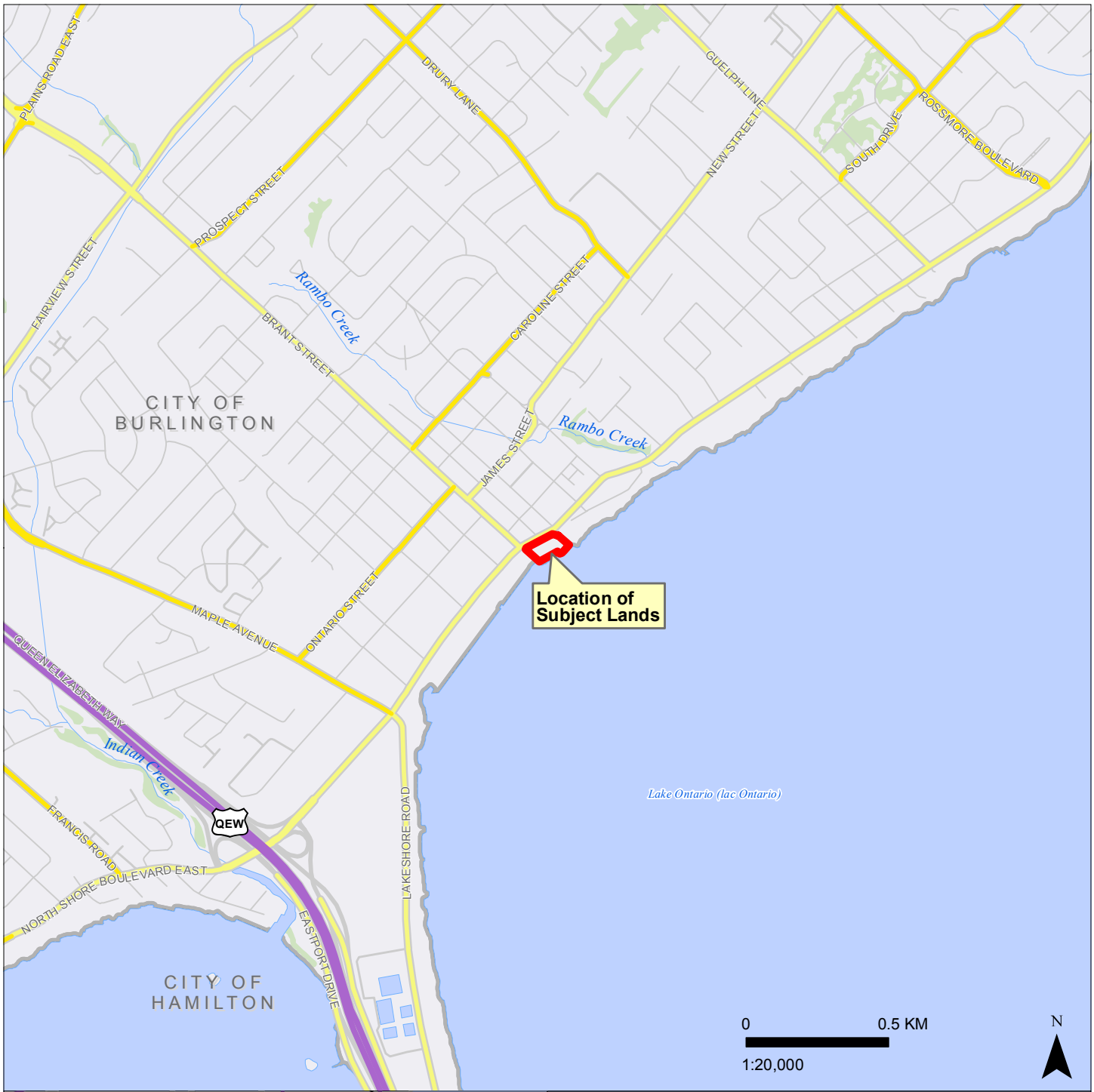
Region of Halton, 2021. Personal communication, email from Nicole Hill, Industrial Waste Inspector, Integrated Management Systems & Quality Assurance, Public Works, Halton Region.

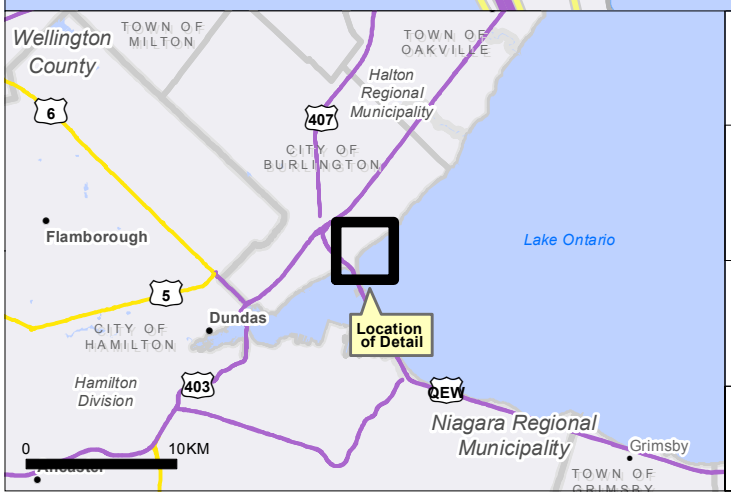
Soil-Mat Engineers & Consultants Ltd., 2021. Geotechnical Investigation, Proposed Residential Development, 2020 Lakeshore Road, Burlington, Ontario. Prepared for Burington 2020 Lakeshore Inc.

Singer, S.N., Cheng, C.K. and Scafe, M.G., 2003. The Hydrogeology of Southern Ontario, 2nd Edition.

Sykes, J.F., Sykes, E.A., Normani, S.D., Yin, Y. and Park, Y.J., 2008. Phase 1 Hydrogeologic Modelling, Supporting Technical Report, OPG's Deep Geologic Repository for Low & Intermediate Level Waste.

Tchobanoglous, G. and Schroeder, E.D., 1987. Water Quality.





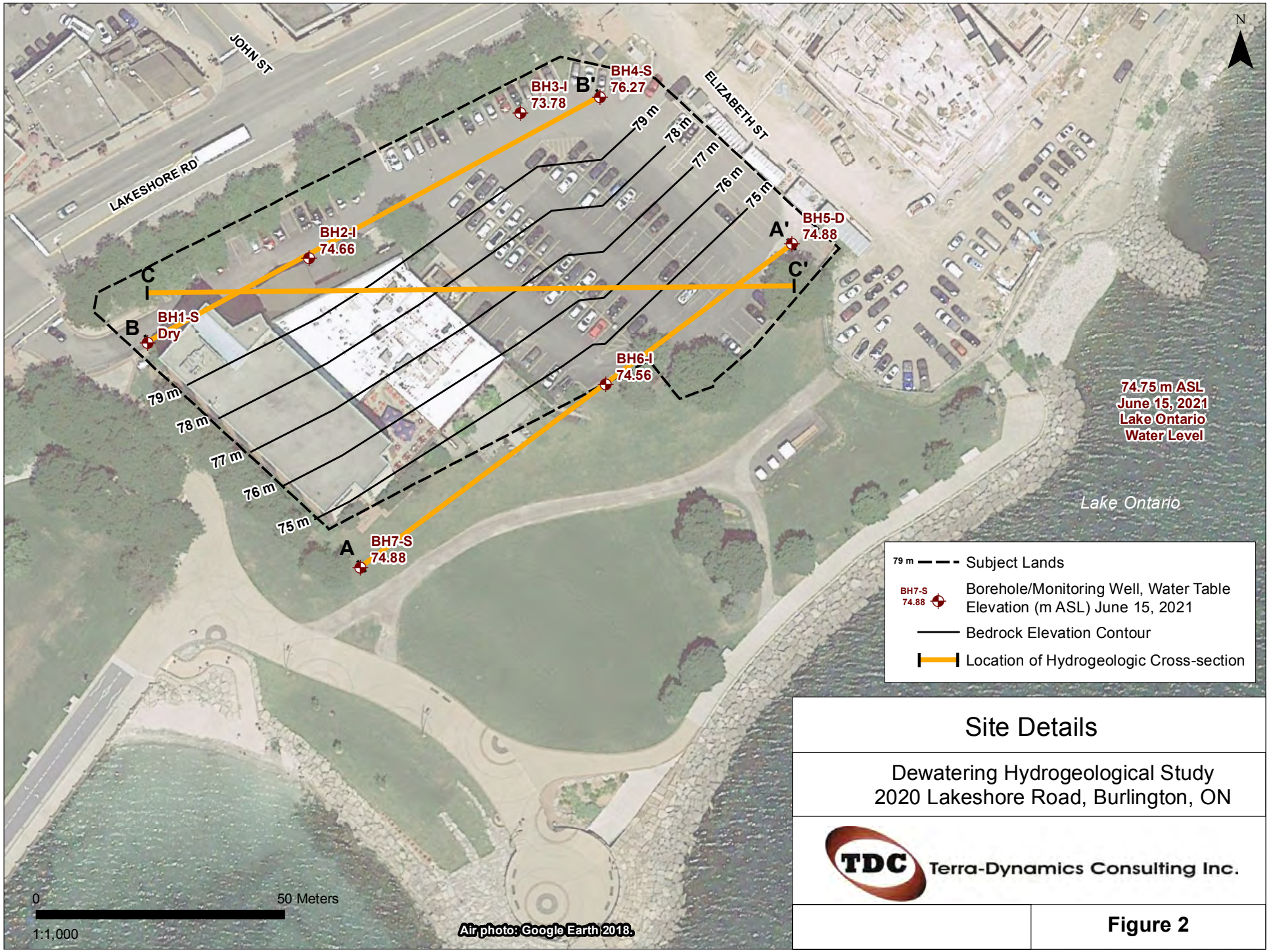
Location of Subject Lands

Dewatering Hydrogeological Study
2020 Lakeshore Road, Burlington, ON

TDC Terra-Dynamics Consulting Inc.

Figure 1

Path: H:\TERRA_DYNAMICS\9447 - TD ___ 2020 Lakeshore Road\gis\mxd\Figure 1 Location of Subject Lands.mxd Revised: June 25, 2021



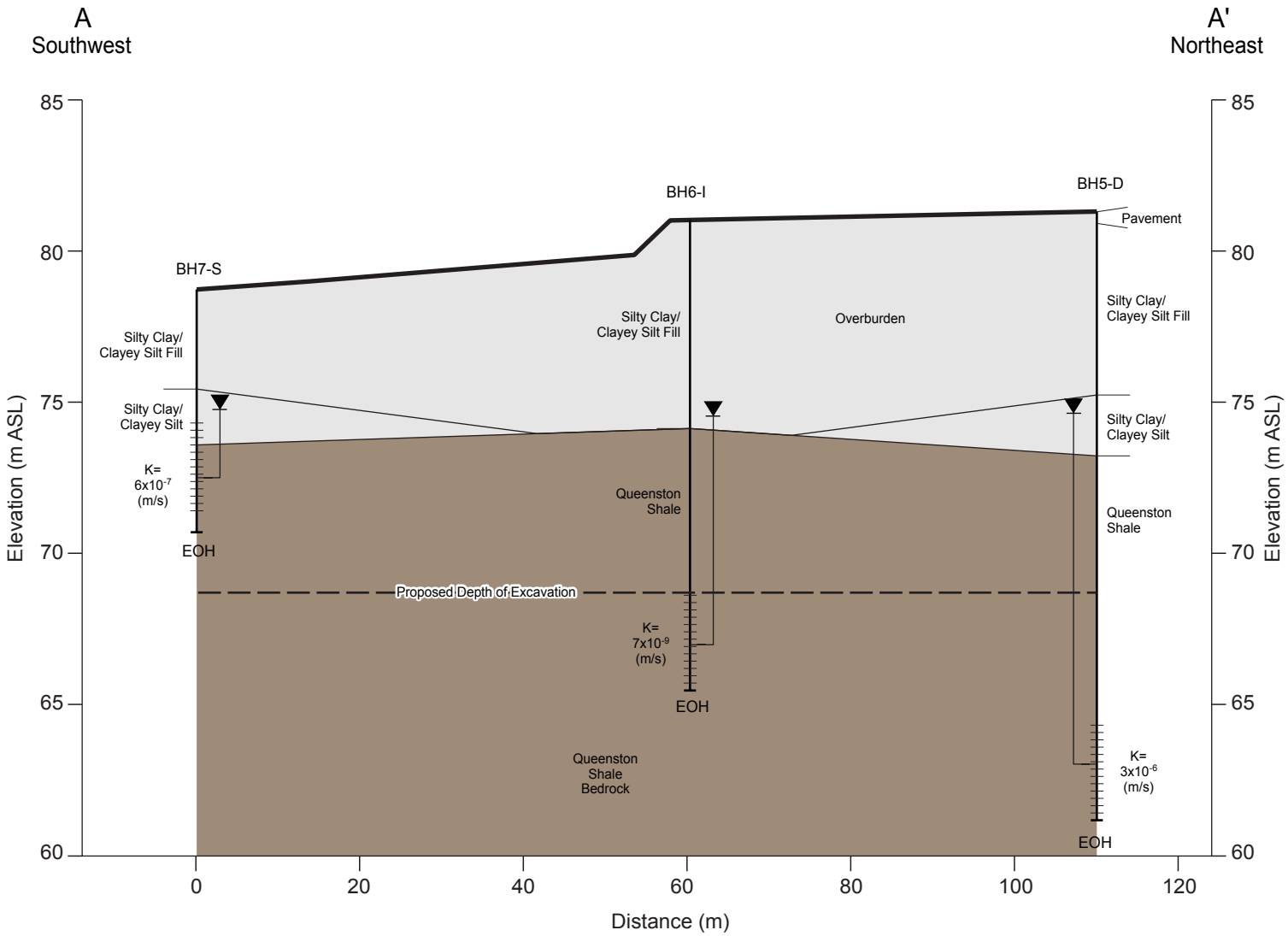
Site Details

Dewatering Hydrogeological Study
2020 Lakeshore Road, Burlington, ON

TDC Terra-Dynamics Consulting Inc.

Figure 2

Path: H:\TERRA_DYNAMICS\9447 - TD ___ 2020 Lakeshore Road\gis\mxd\Figure 2 Site Details.mxd Revised: September 13, 2021



- Water Level June 15, 2021 mASL
- Well Screen
- EOH End of Hole
- K= $3x10^{-7}$ Hydraulic Conductivity (m/s)
- Overburden
- Queenston Shale Bedrock

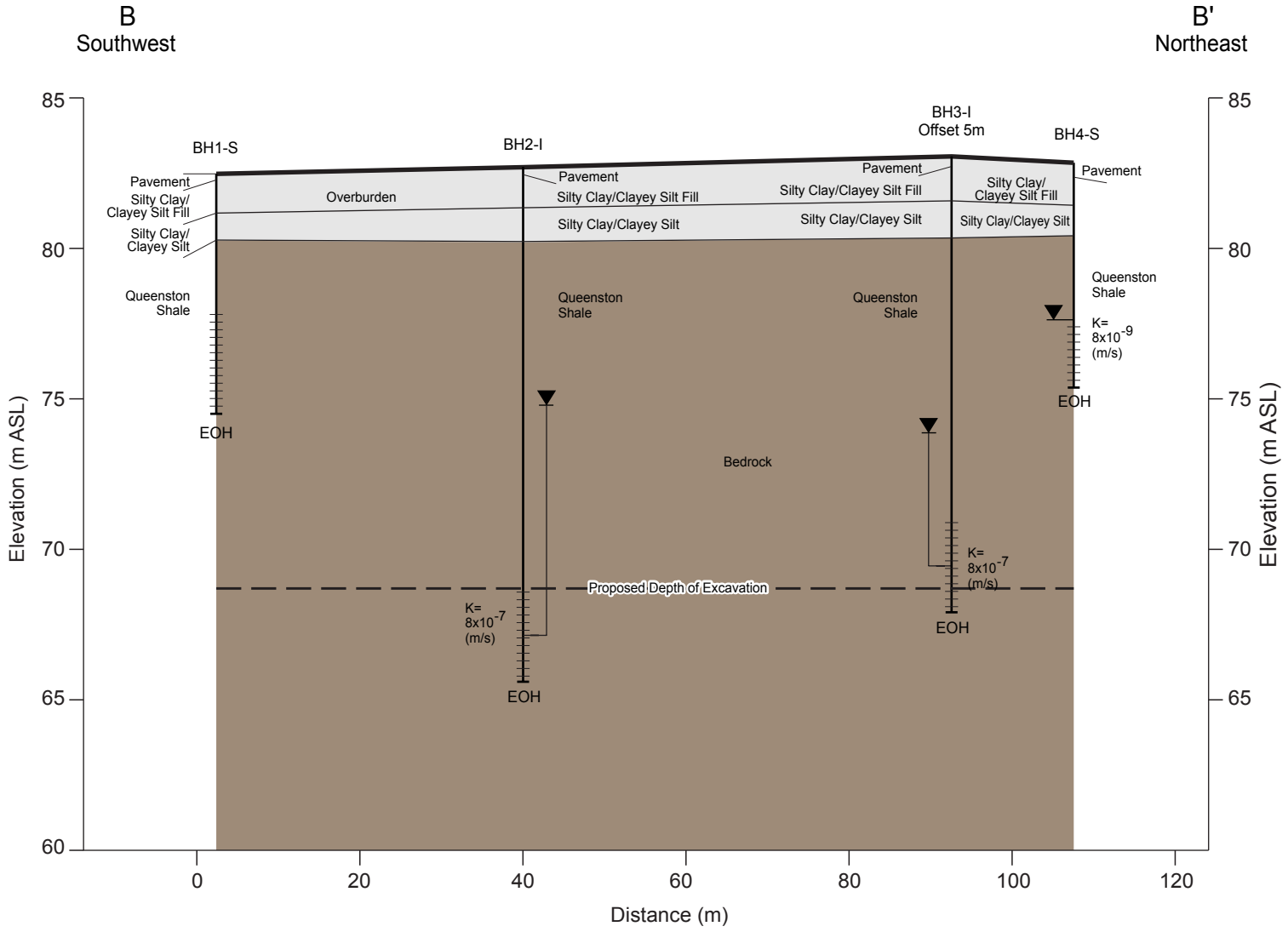
Hydrogeologic Cross-section A-A'

Dewatering Hydrogeological Study
2020 Lakeshore Road, Burlington, ON

Terra-Dynamics Consulting Inc.

Figure 3

H:\TERRA_DYNAMICS\9447 - TD ___ 2020 Lakeshore Road\corel\Figure 3 Hydrogeologic Cross-section A-A'.cdr Revised: Juy 22, 2021



▼ Water Level June 15, 2021 mASL

Well Screen

EOH End of Hole

K= $3x10^{-7}$ Hydraulic Conductivity (m/s)

Overburden

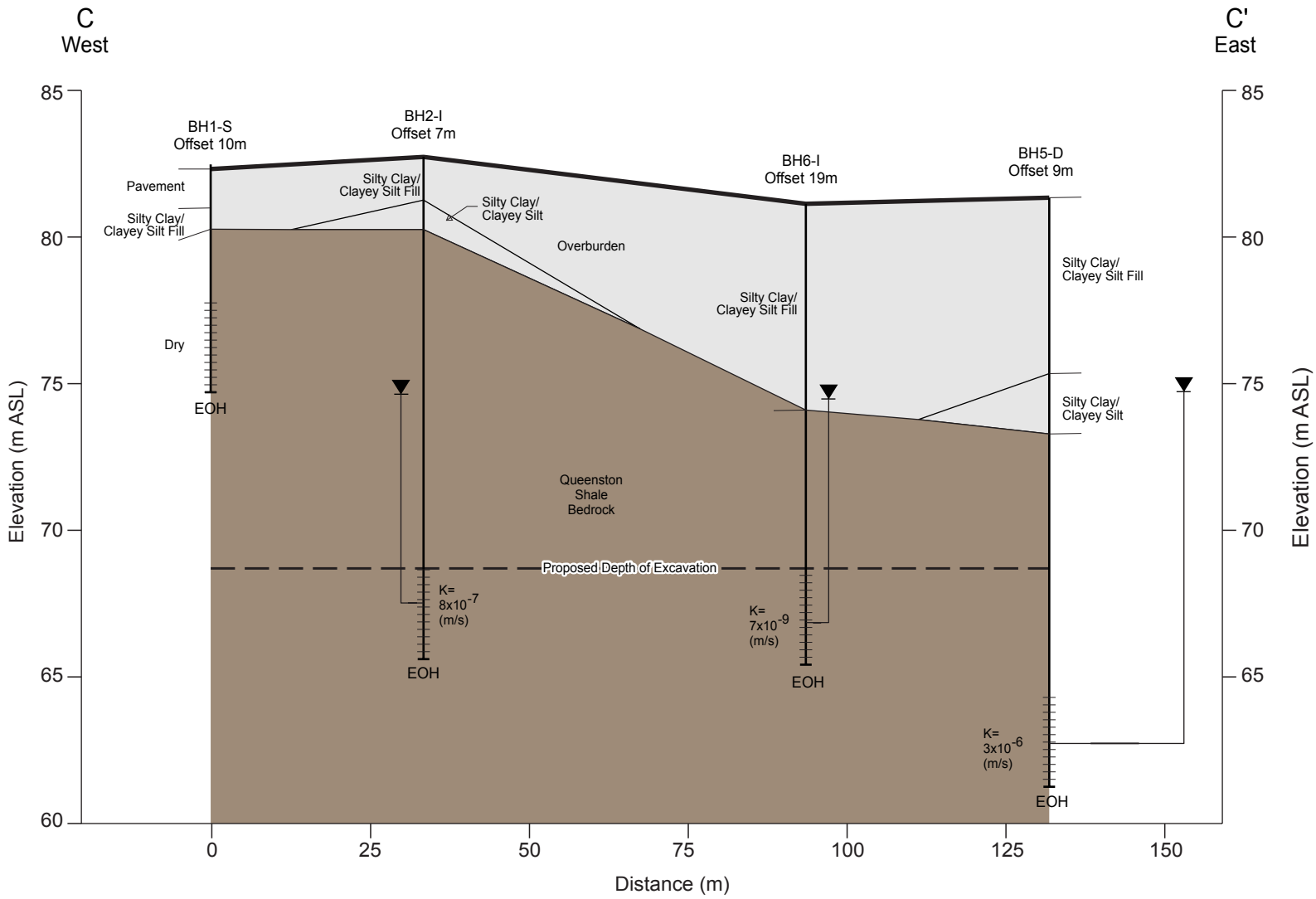
Queenston Shale Bedrock

Hydrogeologic Cross-section B-B'

Dewatering Hydrogeological Study
2020 Lakeshore Road, Burlington, ON

Terra-Dynamics Consulting Inc.

Figure 4



▼ Water Level June 15, 2021 mASL

Well Screen

EOH End of Hole

K= $3x10^{-7}$ Hydraulic Conductivity (m/s)

Overburden

Queenston Shale Bedrock

Hydrogeologic Cross-section C-C'

Dewatering Hydrogeological Study
2020 Lakeshore Road, Burlington, ON

Terra-Dynamics Consulting Inc.

Figure 5

Table 1
Manual Groundwater Level Measurements

Well I.D.	Ground Elevation (m ASL)	Stick-Up (m)	TOC Elevation (m ASL)	Well Depth Elevation (m ASL)	Well Depth below ground (m)	Depth to Shale (m)	Top of Shale Elevation (m ASL)	Date	Water level (m below TOC)	Water Level below ground (m)	Water Level Elevation (m ASL)
BH1-S	82.38	0.00	82.38	74.78	7.60	2.1	80.25	26-May-21	Dry	Dry	Dry
								08-Jun-21	Dry	Dry	Dry
BH2-I	82.73	-0.14	82.59	65.63	17.10	2.4	80.29	26-May-21	8.31	8.17	74.56
								08-Jun-21	7.97	8.11	74.62
								15-Jun-21	7.93	8.07	74.66
BH3-I	82.97	-0.19	82.78	67.86	15.11	2.8	80.21	26-May-21	9.00	8.81	74.16
								08-Jun-21	8.57	8.76	74.21
								15-Jun-21	9.00	9.19	73.78
BH4-S	82.77	-0.16	82.62	75.17	7.60	2.4	80.38	26-May-21	6.59	6.43	76.34
								08-Jun-21	6.06	6.22	76.55
								15-Jun-21	6.35	6.51	76.27
BH5-D	81.29	-0.13	81.16	61.19	20.10	7.9	73.37	26-May-21	6.38	6.25	75.04
								08-Jun-21	6.24	6.36	74.93
								15-Jun-21	6.28	6.41	74.88
BH6-I	81.11	-0.13	80.98	65.51	15.60	7.0	74.11	26-May-21	6.62	6.49	74.62
								08-Jun-21	6.30	6.43	74.68
								15-Jun-21	6.42	6.55	74.56
BH7-S	78.75	-0.16	78.59	71.15	7.60	5.2	73.57	26-May-21	4.03	3.87	74.88
								08-Jun-21	3.68	3.83	74.92
								15-Jun-21	3.71	3.87	74.88

Sample ID		Halton Sanitary Sewer By-law Limits	Burlington Storm Sewer Discharge Limits	BH2-I	BH5-D	BH6-I	BH7-S
Sample Date/Time				15-Jun-21 10:45	15-Jun-21 09:10	15-Jun-21 09:43	15-Jun-21 10:20
Analysis							
E. Coli	cfu/100mL	---		< 2	1140	2	20
pH	No unit	6.0-10.0	6.5-8.5	8.08	7.79	8.06	7.96
Biochemical Oxygen Demand (BOD5)	mg/L	300	15	< 4	12	**30**	< 4
Total Suspended Solids	mg/L	350	---	28	196	19	**1970**
Oil & Grease (total)	mg/L	---	---	< 2	< 2	< 2	< 2
Oil & Grease (animal/vegetable)	mg/L	150	---	< 4	< 4	< 4	< 4
Oil & Grease (mineral/synthetic)	mg/L	15	---	< 4	< 4	< 4	< 4
4AAP-Phenolics	mg/L	1	0.008	< 0.002	**0.011**	**0.011**	< 0.002
Total Kjeldahl Nitrogen	as N mg/L	100	---	2.1	4.5	4.8	1.3
Cyanide (total)	mg/L	2	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Fluoride	mg/L	10	---	0.27	0.10	0.64	0.87
Sulphate	mg/L	1500	---	230	720	810	58
Mercury (total)	mg/L	0.05	0.0004	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Aluminum (total)	mg/L	50	---	0.383	4.37	0.371	1.99
Antimony (total)	mg/L	5	---	< 0.0009	0.0018	< 0.0009	< 0.0009
Arsenic (total)	mg/L	1	0.02	0.0043	0.0043	0.0055	0.0056
Beryllium (total)	mg/L	5	---	0.000021	0.000130	0.000017	0.000098
Cadmium (total)	mg/L	1.0	0.008	0.000008	0.000103	0.000032	0.000058
Chromium (total)	mg/L	3	---	0.00185	0.01238	0.00194	0.00404
Cobalt (total)	mg/L	5	---	0.000537	0.00274	0.000831	0.00177
Copper (total)	mg/L	3	0.04	0.0011	0.0338	0.0015	0.0025
Iron (total)	mg/L	50	---	2.65	4.52	0.464	3.27
Lead (total)	mg/L	3	0.12	0.00047	0.00838	0.00052	0.0192
Manganese (total)	mg/L	5	0.05	**0.198**	**0.296**	**0.327**	**0.319**
Molybdenum (total)	mg/L	5	---	0.00513	0.00652	0.0379	0.0195
Nickel (total)	mg/L	3	0.08	0.0016	0.0105	0.0032	0.0045
Phosphorus (total)	mg/L	10	0.4	0.027	0.347	0.056	0.324
Selenium (total)	mg/L	5	0.02	0.00005	0.00030	0.00028	0.00022
Silver (total)	mg/L	5	0.12	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Tin (total)	mg/L	5	---	0.00972	0.0246	0.0221	0.00969
Titanium (total)	mg/L	5	---	0.0100	0.0451	0.00583	0.0297
Zinc (total)	mg/L	3	0.04	0.007	**0.104**	0.007	0.016
Naphthalene	mg/L	0.14	---	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Benzene	mg/L	0.01	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chloroform	mg/L	0.04	0.002	< 0.0005	< 0.0005	**0.0025**	< 0.0005
1,4-Dichlorobenzene	mg/L	0.08	0.0068	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	mg/L	0.16	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methylene Chloride	mg/L	2	0.0052	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	1	0.0044	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toluene	mg/L	0.016	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichloroethylene	mg/L	0.4	0.0076	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Chromium VI	µg/L	---	0.08	< 0.2	< 0.2	< 0.2	< 0.2
Polychlorinated Biphenyls (PCBs) - Total	µg/L	---	0.4	< 0.04	< 0.04	< 0.04	< 0.04
Nonylphenol	µg/L	---	1	< 1	**4.2**	**< 2**	**1.5**
Nonylphenol diethoxylate	µg/L	---	---	< 10	< 10	< 10	< 10
Nonylphenol Ethoxylates	µg/L	---	10	< 10	< 10	< 10	< 10
Nonylphenol monoethoxylate	µg/L	---	---	< 10	< 10	< 10	< 10

Notes: Bold and shading indicates a criteria exceedence

Appendix A

Terms of Reference

Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

Thomas Douglas, RPP, MCIP
Planner, City of Burlington
426 Brant St., Burlington ON
L7R 3Z6

October 7, 2021

Re: Hydrogeological Study Dewatering – Amended Terms of Reference
Proposed Waterfront Hotel, 2020 Lakeshore Road, Burlington, ON

1.0 Introduction, Background Information and Purpose

Terra-Dynamics Consulting Inc. (Terra-Dynamics) respectfully submits this Terms of Reference to complete a Hydrogeological Study to assess expected dewatering conditions and requirements for construction of a Proposed Waterfront Hotel, at 2020 Lakeshore Road, Burlington (Site). It is our understanding a 30-40 storey building is to be constructed which will include four basement parking levels (NEUF Architectes Canada Inc., 2021). Construction of the basement parking levels will be below (i) the high-water level mark of Lake Ontario, and (ii) the groundwater level in the underlying shale bedrock. As a result, both construction and post-construction dewatering may be required. An Environmental Activity and Sector Registry (EASR) for construction dewatering may be required, with the possibility of a Permit to Take Water (PTTW) needed depending upon the hydraulic conductivity of the shale. However, the area is municipally serviced for water and sanitary services.

2.0 Scope of Work

2.1 Description of Geologic and Hydrogeologic Setting

The Site's geologic and hydrogeologic settings will be described both in a regional, and local context. Available geologic information will be summarized and documented in the report. Other published data sources will be incorporated where appropriate such as nearby geotechnical reporting.

2.2 Field Investigations

Seven bedrock boreholes will be completed across the Site to characterize conditions, and seven bedrock monitoring wells constructed in the boreholes, by a drilling contractor supervised by Soil-Mat Engineers & Consultants. The monitoring wells will be screened at various depths in order to characterize the hydrogeologic bedrock conditions throughout and below the depth of excavation. Monitoring wells will only be completed in the overburden if saturated conditions are encountered in granular materials.

The groundwater monitoring wells will facilitate:

i. Monitoring of water levels in various depths of the shale to determine the vertical gradient;
ii. Characterization of the hydraulic conductivities; and
iii. Collection of groundwater quality samples.

Terra-Dynamics' will complete monitoring well hydraulic conductivity testing of each of the monitoring wells constructed. Testing will be completed using bail-down methods with recovery monitoring completed using datalogging pressure transducers.

During monitoring well testing, four groundwater samples will be collected from the shale for laboratory analysis of water quality. The results will be compared applicable criteria including the City of Burlington's DRAFT Storm Sewer By-law (City of Burlington, 2019) and the Region of Halton Sanitary Sewer By-Law Discharge Limits (Region of Halton, 2003).

2.3 Dewatering Assessment

A conceptual model of flow will be prepared for the Site in hydrogeologic cross-section and include:

a) Analyses of water levels collected;
b) Calculation of vertical and horizontal hydraulic gradients; and
c) Analysis of hydraulic conductivity testing.

These results will be used to calculate the (i) expected dewatering rates for construction and built-out conditions and (ii) the zone of influence. This will use the high-water level from Lake Ontario to represent high water level conditions. Risk of settlement from construction dewatering will also be considered.

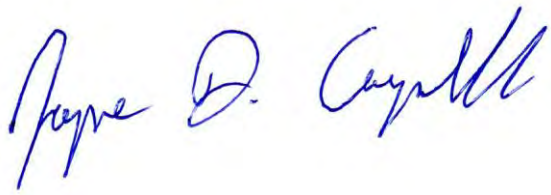
2.4 Provision of a Letter Report

A letter report documenting the results of the above tasks will be prepared for agency review. The report will make recommendations for construction dewatering and future waterproofing including whether an EASR or PTTW is recommended. Information regarding future application to Halton Region for any discharge of construction dewatering will also be provided.

We trust this information is sufficient for your present needs. Please do not hesitate to contact us if you have any questions. Thank you for the opportunity to submit this proposal.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.



Jayme D. Campbell, P. Eng.
Senior Water Resource Engineer

3.0 References

City of Burlington, 2002. Storm Sewer Discharge By-law Number 86-2002.

City of Burlington, 2019. DRAFT Storm Sewer Discharge By-law.

NEUF Architectes Canada Inc., 2021. Proposed Mixed Use Development, Conceptual Architectural Drawings.

Region of Halton, 2003. By-law Number 2-03. A by-law to prohibit, regulate and control discharges into bodes of waters within regional boundaries or into the regional sanitary sewers, sanitary sewage works and all tributary sewer systems.

Appendix B

Monitoring Well Logs

Log of Borehole No. 01

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797540
E: 597648

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.38	Ground Surface							
0–4 / 0–1		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 1220 millimetres of compact granular base.	SS	1	11 9 8 6	17			
			SS	2	4 8 7 4	15			
4–7 / 1–2	81.06	**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, occasional hydrocarbons staining, firm.	SS	3	1 2 5 4	7			
7–25 / 2–8	80.25	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	9 36 50/4"	100			
			SS	5	36 50/1"	100			
			SS	6	50/2"	100			
			SS	7	50/2"	100			
			SS	8	50/2"	100			
25 / 8	74.56	End of Borehole							

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 7.8 metres.

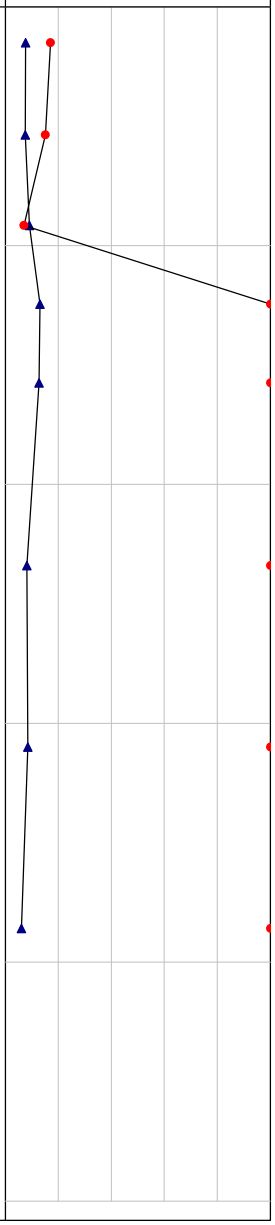
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 7.42 meters (dry)

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: 7/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	82.73	Ground Surface							
		Pavement Structure Approximately 75 millimetres of asphaltic concrete, overlying 75 millimetres of compact granular base.	SS	1	5 5 4 5	9			
		Silty Clay / Clayey Silt Fill Brown, some sand and gravel, occasional staining, very stiff.	SS	2	3 11 7 8	18			
1 / 5	81.21	**Silty Clay / Clayey Silt** Reddish brown, trace to some sand and gravel, very stiff.	SS	3	3 8 10 11	18			
2 / 8	80.29	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	21 40 43 50/3"	83			
			SS	5	50/3"	100			
			HQ	6	RQD=90%				
4 / 13			HQ	7	RQD=86%				
5 / 16			HQ	8	RQD=96%				
7 / 23			HQ	9	RQD=94%				
8 / 26			HQ	10	RQD=74%				
9 / 29									
33									

Moisture Content w%: 10 20 30 40

Standard Penetration Test blows/300mm: 20 40 60 80

Compressive Strength
23.6 MPa at 4.6 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 02

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797567
E: 597669

Depth	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
34			HQ	N/A	RQD=90%				
35									
36	11								
37									
38			HQ	N/A	RQD=96%				
39	12								
40									
41									
42			HQ	N/A	RQD=97%				
43	13								
44									
45									
46	14		HQ	11	RQD=88%				
47									
48									
49	15								
50									
51									
52			HQ	12	RQD=98%				
53	16								
54									
55									
56	17	65.63							
57		End of Borehole							
58									
59	18								
60									
61									
62	19								
63									
64									
65									

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 17.1 metres.

2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 8.17 meters

Moisture Content w%
10 20 30 40

Standard Penetration Test blows/300mm
20 40 60 80

Compressive Strength
33.8 MPa at 14.5 metres

Compressive Strength
31.5 MPa at 15.8 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

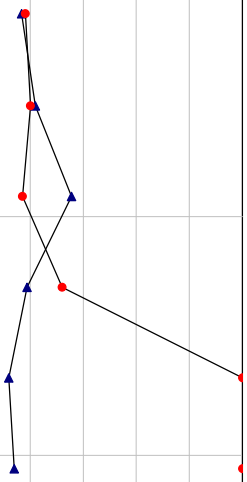
Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		82.97	Ground Surface							
0	0	82.74	**Pavement Structure** Approximately 90 millimetres of asphaltic concrete over 140 millimetres of compact granular base.							
1				SS	1	9 9 9 8	18			
2				SS	2	9 10 10 11	20			
3	1	81.47	**Silty Clay / Clayey Silt Fill** Reddish brown, some sand and gravel, occasional staining, very stiff.							
4				SS	3	3 6 11 17	17			
5			**Silty Clay/Clayey Silt** Brown, trace sand and gravel, very stiff.							
6	2			SS	4	8 16 16 22	32			
7		80.21	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	5	50/3"	100			
8				SS	6	50/3"	100			
9	3			HQ	N/A	RQD=60%				
10										
11										
12										
13	4			HQ	N/A	RQD=96%				
14										
15										
16										
17	5									
18										
19										
20	6			HQ	N/A	RQD=99%				
21										
22										
23	7									
24										
25										
26										
27	8			HQ	N/A	RQD=73%				
28										
29										
30										
31	9									
32										
33										

Well Data

SAMPLE

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 03

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797595
E: 597727

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34–65			NOTES: 1. Borehole was advanced using solid stem auger equipment on April 8, 2021 to termination at a depth of 15.1 metres. 2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client. 4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 8.81 meters		HQ	7	RQD=91%					Compressive Strength 20.6 MPa at 10.5 metres
					HQ	8	RQD=85%					
					HQ	9	RQD=55%					
					HQ	10	RQD=86%					Compressive Strength 20.8 MPa at 14.7 metres
49	67.86		End of Borehole									

Drill Method: Solid Stem Augers
Drill Date: 08/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 04

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

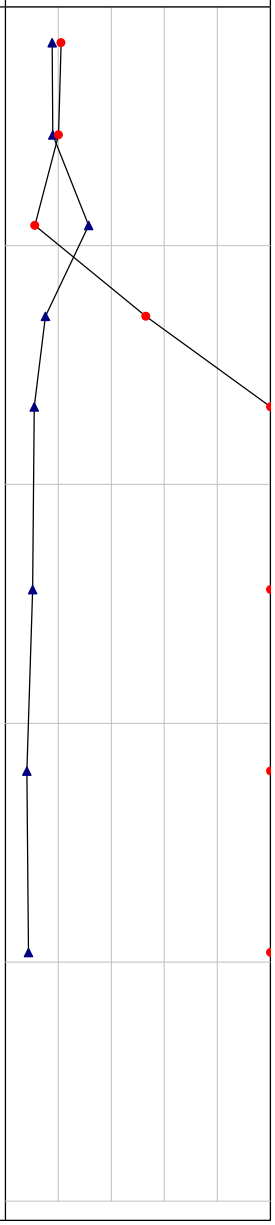
Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797596
E: 597738

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		82.77	Ground Surface							
0	0	82.31	**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 360 millimetres of compact granular base.							
1			**Silty Clay / Clayey Silt Fill** Brown, occasional organics in the upper levels, some sand and gravel, very stiff.	SS	1	13 13 8 10	21			
2				SS	2	9 9 11 10	20			
3	1	81.17	**Silty Clay/Clayey Silt** Brown, trace sand and gravel, stiff.	SS	3	2 3 8 15	11			
4		80.38	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	4	4 21 32 50	53			
5				SS	5	45 50/2"	100			
6	2			SS	6	50/2"	100			
7				SS	7	50/2"	100			
8										
9	3									
10										
11										
12										
13	4		1. Borehole was advanced using solid stem auger equipment on April 6, 2021 to termination at a depth of 7.6 metres.							
14										
15			2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.							
16										
17	5		3. Soil samples will be discarded after 3 months unless otherwise directed by our client.							
18										
19										
20	6		4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 6.43 meters							
21										
22										
23	7									
24										
25		75.15	End of Borehole	AS	8	50/0"	100			
26	8									
27										
28										
29										
30	9									
31										
32										
33										

Auger sample taken at 7.62 meters

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: 6/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

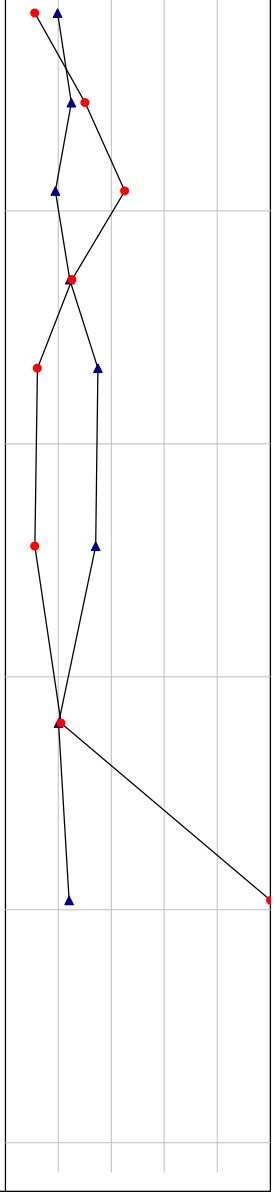
Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	81.29	Ground Surface							
0 / 0		**Pavement Structure** Approximately 100 millimetres of asphaltic concrete over 75 millimetres of compact granular base.							
		Silty Clay / Clayey Silt Fill Reddish brown, some sand and gravel, occasional organics, stiff to very stiff.	SS	1	10 5 6 7	11			
			SS	2	5 16 14 12	30			
			SS	3	17 23 22 18	45			
			SS	4	14 16 9 8	25			
			SS	5	4 6 6 7	12			
			SS	6	7 6 5 16	11			
20 / 6	75.29	**Silty Clay / Clayey Silt** Greyish brown, trace sand and gravel, gravel seam, stiff to very stiff.	SS	7	13 13 8 12	21			
26 / 8	73.37	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	8	50/1"	100			
			HQ	9	RQD=88%				
33 / 10			HQ	10	RQD=77%				

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 05

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797571
E: 597768

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34						10						
35												
36	11					11	Clean Up					
37												
38					HQ	12	RQD=89%					
39	12											
40												
41												
42					HQ	13	RQD=83%					
43	13											
44												
45												
46	14				HQ	14	RQD=97%					Compressive Strength 29.6 MPa at 14.1
47												
48												
49	15											
50												
51												
52	16				HQ	15	RQD=91%					
53												
54			NOTES:									
55			1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 20.1 metres.									
56	17											
57			2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.									
58					HQ	16	RQD=101%					
59	18		3. Soil samples will be discarded after 3 months unless otherwise directed by our client.									
60												
61			4. A monitoring well was installed. The following free groundwater level readings have been measured: May 26, 2021 - 6.25 meters									
62	19											
63					HQ	17	RQD=97%					
64												
65												
66	20 61.15		End of Borehole									
67												

Drill Method: Solid Stem Augers
Drill Date: 05/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		81.11	Ground Surface							
0	0		**Topsoil** Approximately 100 millimetres of topsoil.							
1–6	0–2		**Silty Clay / Clayey Silt Fill** Reddish brown, occasional construction debris and organics, some sand and gravel, firm to very stiff.	SS	1	8 7 5 5	12			
				SS	2	3 13 3 1	16			
				SS	3	5 12 8 3	20			
				SS	4	3 3 4 4	7			
				SS	5	4 4 3 3	7			
				SS	6	3 6 3 1	9			
				SS	7	3 3 1 7	4			
				SS	8	3 7 12 10	19			
23	7	74.11	**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.	SS	9	13 18 16 50/5"	32			
				SS	10	50/2"	100			
26	8			HQ	11					
28–33	9			HQ	12	RQD=90%				

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

Compressive Strength
28.1 MPa at 8.3 metres

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 2

Log of Borehole No. 06

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797533
E: 597735

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
34–65					HQ	13	RQD=91%					
					HQ	14	RQD=91%					
					HQ	15	RQD=93%					
					HQ	16	RQD=94%					
51	65.46		End of Borehole									

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 7, 2021 to termination at a depth of 15.6 metres.

2. Borehole was recorded as open upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 6.49 meters

Drill Method: Solid Stem Augers
Drill Date: 07/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 2 of 2

Log of Borehole No. 07

Project No: SM 301114-G
Project: Proposed Condominium Development
Location: 2020 Lakeshore Road
Client: Vrancor Developments

Project Manager: Yaroslav Mormil, P.Eng.
Borehole Location: See Drawing No.1
UTM Coordinates - N: 4797495
E: 597682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	78.75	Ground Surface							
0 / 0	78.47	**Topsoil** Approximately 275 millimetres of topsoil.							
1 / 0		**Silty Clay / Clayey Silt Fill** Brown, some sand and gravel, stiff to hard.	SS	1	4 3 3 12	6			
2 / 1			SS	2	6 11 23 12	34			
3 / 1			SS	3	6 12 15 16	27			
7 / 2			SS	4	2 3 8 10	11			
10 / 3	75.40		SS	5	3 8 10 8	18			
11 / 3		**Silty Clay / Clayey Silt** Redish brown, trace to some sand and gravel, very stiff.							
16 / 4			SS	6	4 4 15 18	19			
16 / 5	73.57								
17 / 5		**Queenston Shale** Red, with more resistant grey layers, highly weathered in upper levels, becoming more sound with depth, hard.							
20 / 6			SS	7	50/3"	100			
25 / 7	70.93		SS	8	50/2"	100			
26 / 8		End of Borehole							

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:
1. Borehole was advanced using solid stem auger equipment on April 5, 2021 to termination at a depth of 7.8 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
4. A monitoring well was installed. The following free groundwater level readings have been measured:
May 26, 2021 - 3.87 meters

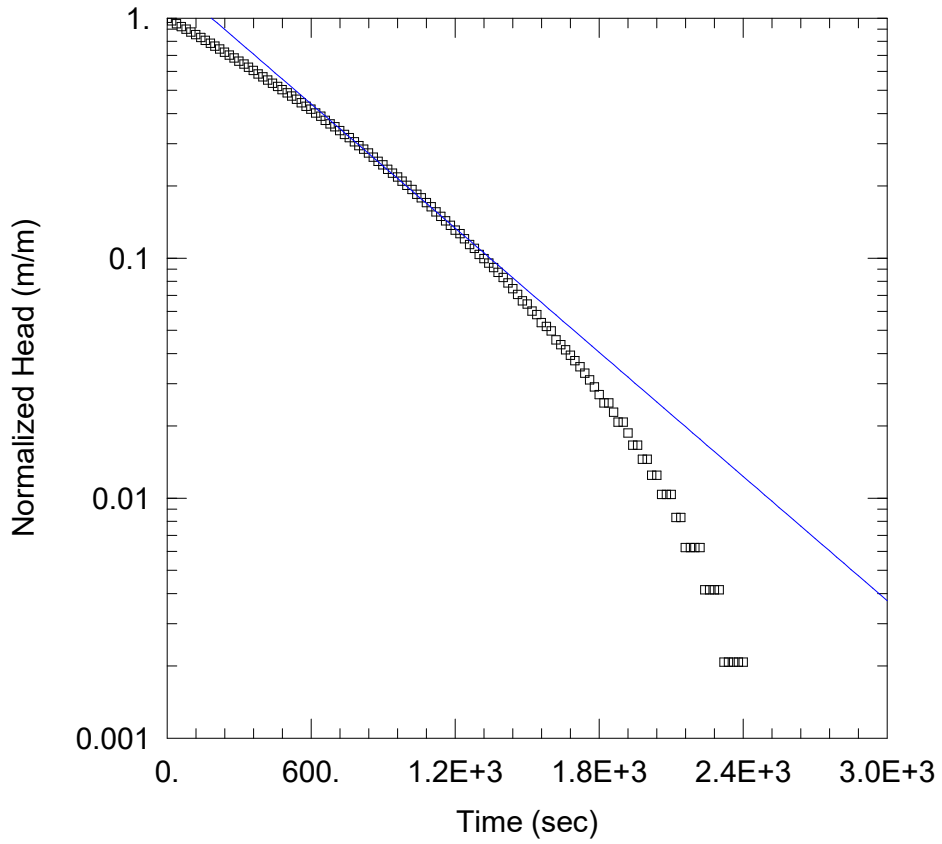
Drill Method: Solid Stem Auger
Drill Date: 5/04/21
Hole Size: 150 millimeters
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: MA
Checked by: YM
Sheet: 1 of 1

Appendix C

Hydraulic Conductivity Analyses



RISING-HEAD TEST

Data Set: C:\...\BH2.aqt
Date: 06/23/21 Time: 08:57:13

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH2
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

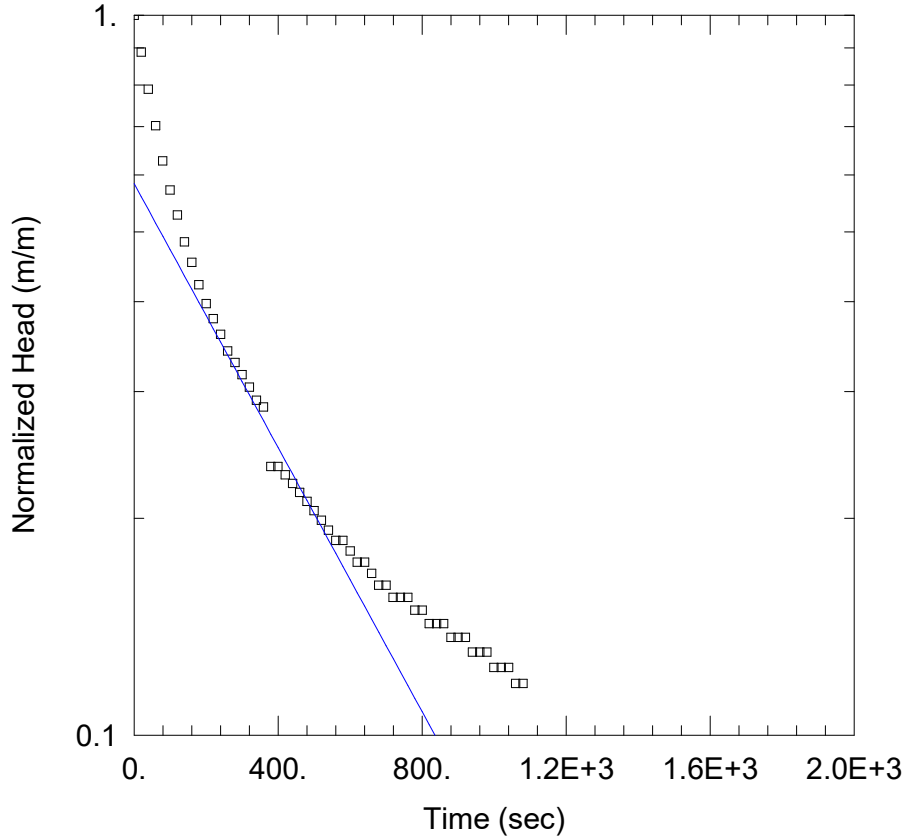
K = 7.848E-7 m/sec
y0 = 6.963 m

AQUIFER DATA

Saturated Thickness: 8.99 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH2)

Initial Displacement: 4.82 m
Total Well Penetration Depth: 8.99 m
Casing Radius: 0.025 m
Static Water Column Height: 8.99 m
Screen Length: 3.05 m
Well Radius: 0.048 m



RISING-HEAD TEST

Data Set: C:\...\BH3.aqt
Date: 06/23/21 Time: 08:59:40

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH3
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

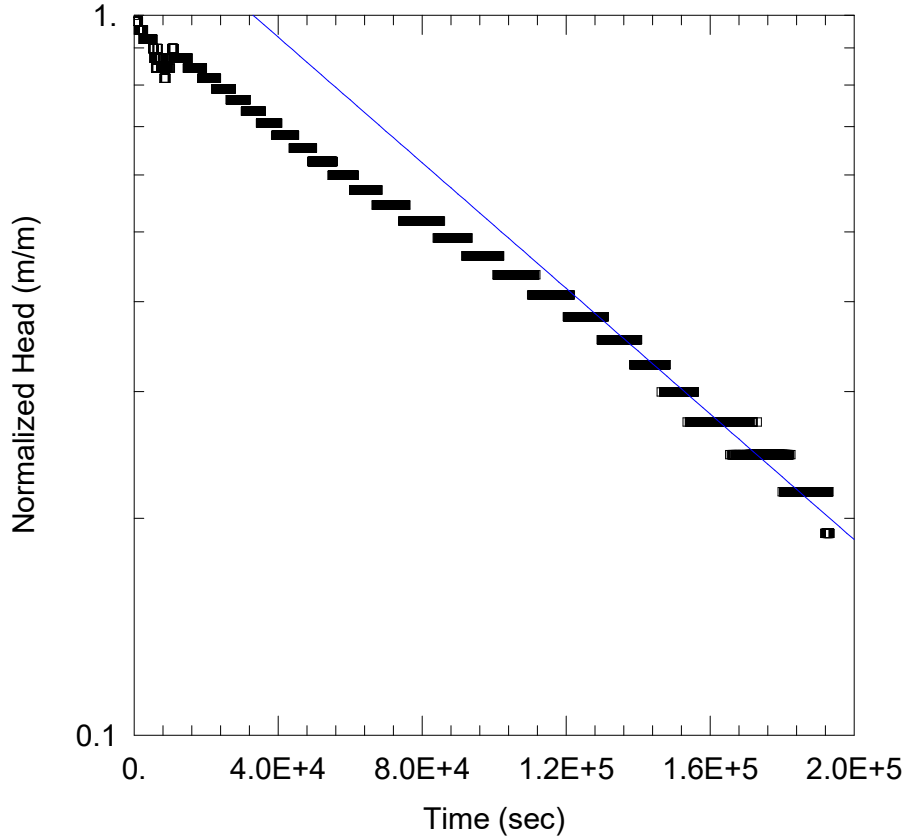
K = 7.773E-7 m/sec
y0 = 0.9395 m

AQUIFER DATA

Saturated Thickness: 5.82 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH3)

Initial Displacement: 1.61 m
Total Well Penetration Depth: 5.82 m
Casing Radius: 0.025 m
Static Water Column Height: 5.82 m
Screen Length: 3.05 m
Well Radius: 0.048 m



RISING-HEAD TEST

Data Set: C:\...\BH4.aqt
Date: 06/22/21 Time: 14:31:23

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH4
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

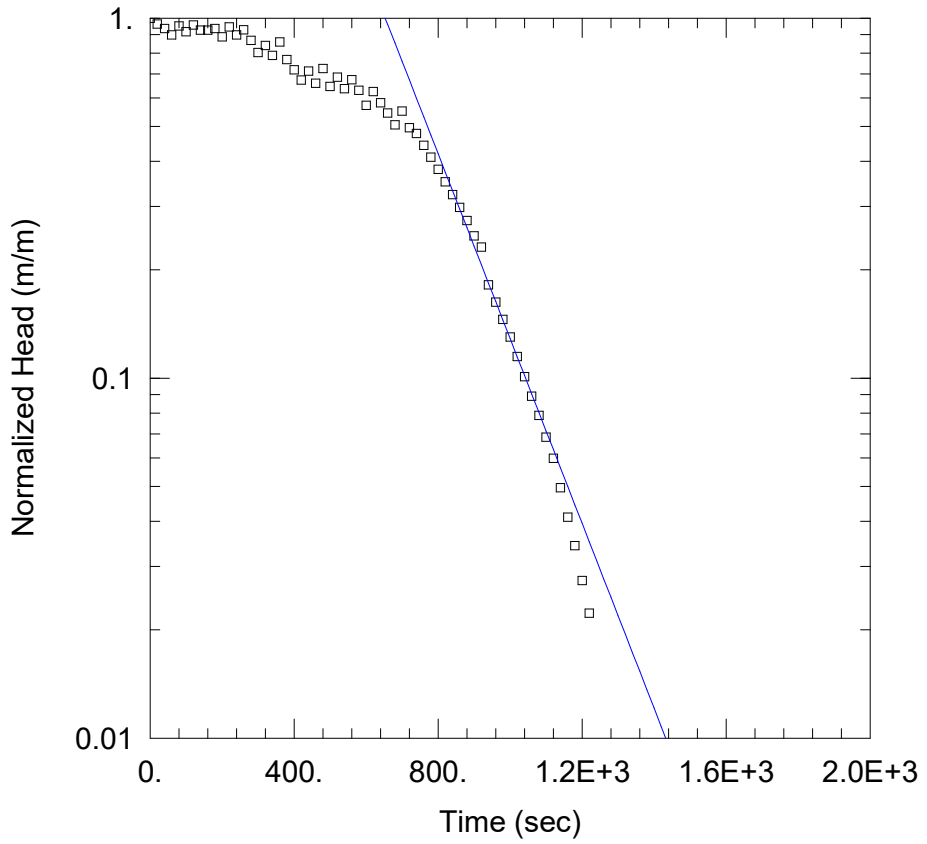
K = 7.917E-9 m/sec
y0 = 0.5115 m

AQUIFER DATA

Saturated Thickness: 0.9758 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH4)

Initial Displacement: 0.3672 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.025 m
Static Water Column Height: 0.9758 m
Screen Length: 3.05 m
Well Radius: 0.075 m



RISING-HEAD TEST

Data Set: C:\...\BH5.aqt
Date: 06/23/21 Time: 09:03:35

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH5
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

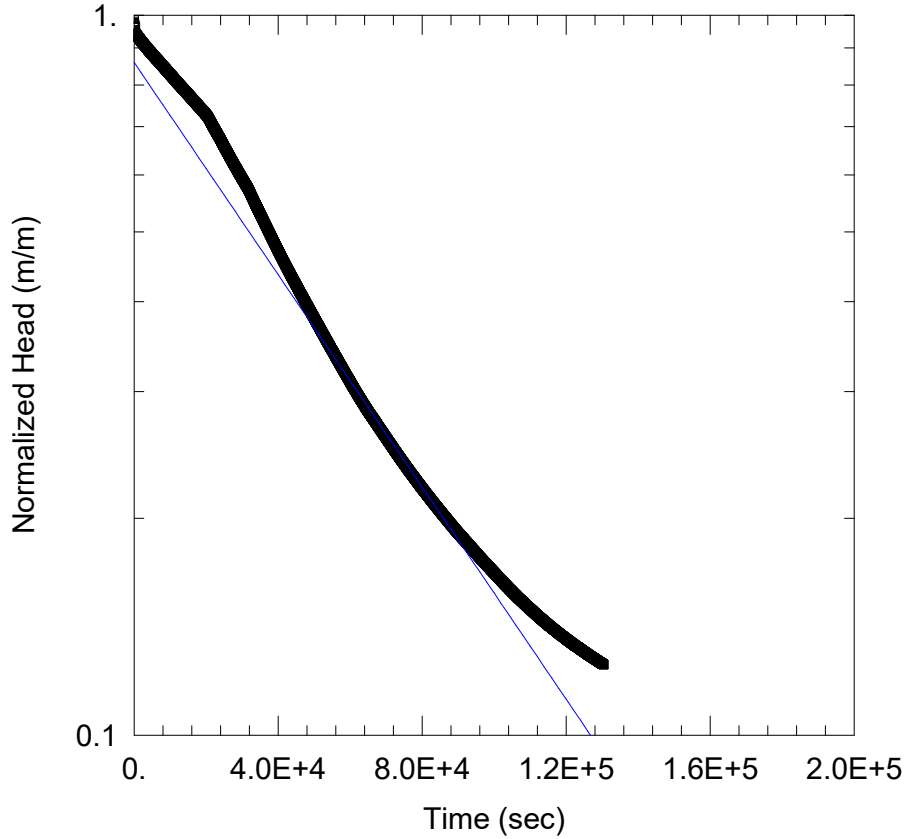
K = 2.515E-6 m/sec
y0 = 277.7 m

AQUIFER DATA

Saturated Thickness: 13.74 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH5)

Initial Displacement: 5.84 m
Total Well Penetration Depth: 13.74 m
Casing Radius: 0.025 m
Static Water Column Height: 13.74 m
Screen Length: 3.05 m
Well Radius: 0.048 m



RISING-HEAD TEST

Data Set: C:\...\BH6.aqt
Date: 06/23/21 Time: 09:01:28

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH6
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

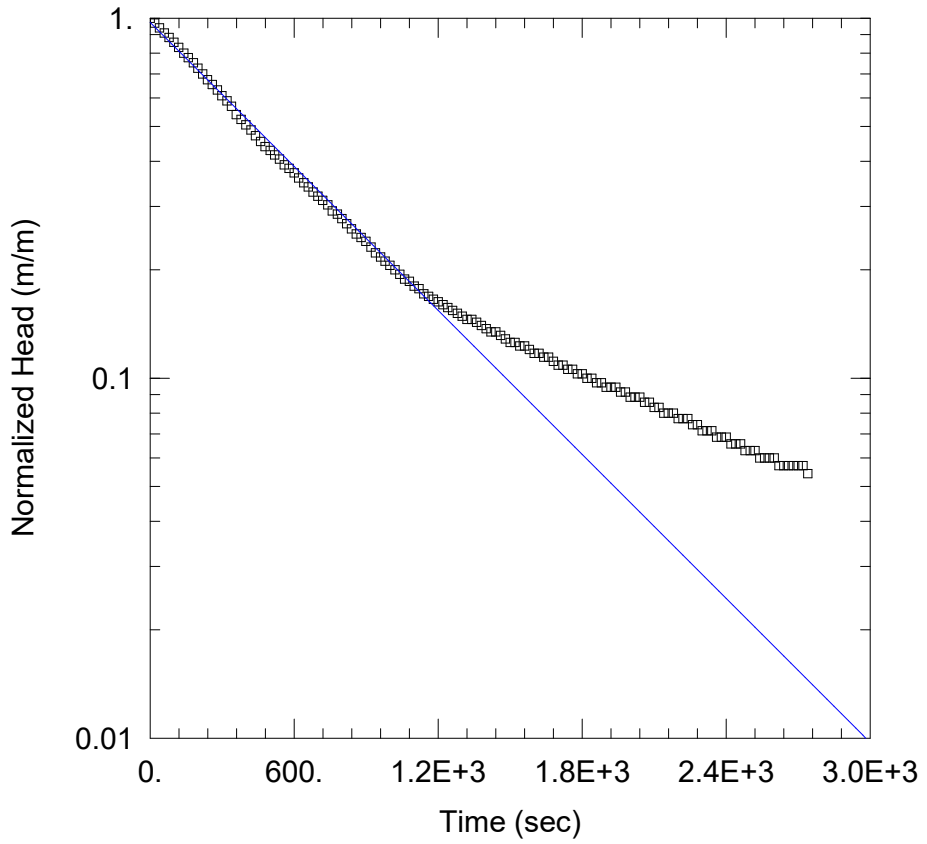
K = 6.728E-9 m/sec
y0 = 7.359 m

AQUIFER DATA

Saturated Thickness: 9.17 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH6)

Initial Displacement: 8.56 m
Total Well Penetration Depth: 9.17 m
Casing Radius: 0.025 m
Static Water Column Height: 9.17 m
Screen Length: 3.05 m
Well Radius: 0.048 m



RISING-HEAD TEST

Data Set: C:\...\BH7.aqt
Date: 06/22/21 Time: 15:15:58

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Soil-Mat
Location: 2020 Lakeshore Road, Burlingto
Test Well: BH7
Test Date: June 8, 2021

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 5.83E-7 m/sec
y0 = 3.408 m

AQUIFER DATA

Saturated Thickness: 3.77 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH7)

Initial Displacement: 3.5 m
Total Well Penetration Depth: 3.77 m
Casing Radius: 0.025 m
Static Water Column Height: 3.77 m
Screen Length: 3.05 m
Well Radius: 0.075 m

Appendix D

Water Quality Analyses





FINAL REPORT

CA15407-JUN21 R2

Prepared for

Terra-Dynamics Consulting Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Terra-Dynamics Consulting Inc.
Address	404 Queenston Street St. Catharines, ON L2P 2Y2. Canada
Contact	David Slaine
Telephone	905-646-7931
Facsimile	
Email	dslaine@terra-dynamics.com; kslaine@terra-dynamics.com
Project	
Order Number	
Samples	Solution (4)

LABORATORY DETAILS

Project Specialist	Catharine Arnold, B.Sc., C.Chem
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2618
Facsimile	705-652-6365
Email	catharine.arnold@sgs.com
SGS Reference	CA15407-JUN21
Received	06/16/2021
Approved	06/25/2021
Report Number	CA15407-JUN21 R2
Date Reported	06/25/2021

COMMENTS

SIGNATORIES

Catharine Arnold, B.Sc., C.Chem



TABLE OF CONTENTS

First Page..... 1

Index..... 2

Results..... 3-8

Exceedance Summary..... 9

QC Summary..... 10-20

Legend..... 21

Annexes..... 22-24

Client: Terra-Dynamics Consulting Inc.
Project:
Project Manager: David Slaine
Samplers: Briar MacIntyre

PACKAGE: **SANSEW - General Chemistry**
(WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
General Chemistry								
Biochemical Oxygen Demand (BOD5)	mg/L	2	300		12	30	< 4↑	< 4↑
Total Suspended Solids	mg/L	2	350		196	19	1970	28
Total Kjeldahl Nitrogen	as N mg/L	0.5	100		4.5	4.8	1.3	2.1

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics								
Cyanide (total)	mg/L	0.01	2		< 0.01	< 0.01	< 0.01	< 0.01
Fluoride	mg/L	0.06	10		0.10	0.64	0.87	0.27
Sulphate	mg/L	0.2	1500		720	810	58	230
Aluminum (total)	mg/L	0.001	50		4.37	0.371	1.99	0.383
Antimony (total)	mg/L	0.0009	5		0.0018	< 0.0009	< 0.0009	< 0.0009
Arsenic (total)	mg/L	0.0002	1		0.0043	0.0055	0.0056	0.0043
Beryllium (total)	mg/L	0.000007	5		0.000130	0.000017	0.000098	0.000021
Cadmium (total)	mg/L	0.000003	1		0.000103	0.000032	0.000058	0.000008

Client: Terra-Dynamics Consulting Inc.
Project:
Project Manager: David Slaine
Samplers: Briar MacIntyre

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Metals and Inorganics (continued)								
Chromium (total)	mg/L	0.00008	3		0.01238	0.00194	0.00404	0.00185
Cobalt (total)	mg/L	0.000004	5		0.00274	0.000831	0.00177	0.000537
Copper (total)	mg/L	0.0002	3		0.0338	0.0015	0.0025	0.0011
Iron (total)	mg/L	0.007	50		4.52	0.464	3.27	2.65
Lead (total)	mg/L	0.00009	3		0.00838	0.00052	0.0192	0.00047
Manganese (total)	mg/L	0.00001	5		0.296	0.327	0.319	0.198
Molybdenum (total)	mg/L	0.00004	5		0.00652	0.0379	0.0195	0.00513
Nickel (total)	mg/L	0.0001	3		0.0105	0.0032	0.0045	0.0016
Phosphorus (total)	mg/L	0.003	10		0.347	0.056	0.324	0.027
Selenium (total)	mg/L	0.00004	5		0.00030	0.00028	0.00022	0.00005
Silver (total)	mg/L	0.00005	5		< 0.00005	< 0.00005	< 0.00005	< 0.00005
Tin (total)	mg/L	0.00006	5		0.0246	0.0221	0.00969	0.00972
Titanium (total)	mg/L	0.00005	5		0.0451	0.00583	0.0297	0.0100
Zinc (total)	mg/L	0.002	3		0.104	0.007	0.016	0.007

Client: Terra-Dynamics Consulting Inc.
Project:
Project Manager: David Slaine
Samplers: Briar MacIntyre

PACKAGE: **SANSEW - Microbiology** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Microbiology								
E. Coli	cfu/100mL	-		200	1140	2	20	< 2↑

PACKAGE: **SANSEW - Nonylphenol and Ethoxylates** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Nonylphenol and Ethoxylates								
Nonylphenol	µg/L	1.0			4.2	< 2↑	1.5	< 1
Nonylphenol diethoxylate	µg/L	10			< 10	< 10	< 10	< 10
Nonylphenol Ethoxylates	µg/L	10			< 10	< 10	< 10	< 10
Nonylphenol monoethoxylate	µg/L	10			< 10	< 10	< 10	< 10

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Oil and Grease								
Oil & Grease (total)	mg/L	2			< 2	< 2	< 2	< 2
Oil & Grease (animal/vegetable)	mg/L	4	150		< 4	< 4	< 4	< 4

Client: Terra-Dynamics Consulting Inc.
Project:
Project Manager: David Slaine
Samplers: Briar MacIntyre

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

					Sample Number	8	9	10	11
					Sample Name	BH-5	BH-6	BH-7	BH-2
					Sample Matrix	Solution	Solution	Solution	Solution
					Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Oil and Grease (continued)								
Oil & Grease (mineral/synthetic)	mg/L	4	15		< 4	< 4	< 4	< 4

PACKAGE: **SANSEW - Other (ORP)** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

					Sample Number	8	9	10	11
					Sample Name	BH-5	BH-6	BH-7	BH-2
					Sample Matrix	Solution	Solution	Solution	Solution
					Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Other (ORP)								
pH	No unit	0.05	10	8.5	7.79	8.06	7.96	8.08
Mercury (total)	mg/L	0.00001	0.05		< 0.00001	< 0.00001	0.00000	< 0.00001
Chromium VI	µg/L	0.2			< 0.2	< 0.2	< 0.2	< 0.2

PACKAGE: **SANSEW - PCBs** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

					Sample Number	8	9	10	11
					Sample Name	BH-5	BH-6	BH-7	BH-2
					Sample Matrix	Solution	Solution	Solution	Solution
					Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
PCBs								
Polychlorinated Biphenyls (PCBs) - Total	µg/L	0.04			< 0.04	< 0.04	< 0.04	< 0.04

Client: Terra-Dynamics Consulting Inc.
Project:
Project Manager: David Slaine
Samplers: Briar MacIntyre

PACKAGE: **SANSEW - Phenols** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
Phenols								
4AAP-Phenolics	mg/L	0.002	1		0.011	0.011	< 0.002	< 0.002

PACKAGE: **SANSEW - SVOCs - PAHs** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
SVOCs - PAHs								
Naphthalene	mg/L	0.0005	0.14		< 0.0005	< 0.0005	< 0.0005	< 0.0005

PACKAGE: **SANSEW - VOCs** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

				Sample Number	8	9	10	11
				Sample Name	BH-5	BH-6	BH-7	BH-2
				Sample Matrix	Solution	Solution	Solution	Solution
				Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
VOCs								
Chloroform	mg/L	0.0005	0.04		< 0.0005	0.0025	< 0.0005	< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005	0.08		< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methylene Chloride	mg/L	0.0005	2		< 0.0005	< 0.0005	< 0.0005	< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	1		< 0.0005	< 0.0005	< 0.0005	< 0.0005
Trichloroethylene	mg/L	0.0005	0.4		< 0.0005	< 0.0005	< 0.0005	< 0.0005

Client: Terra-Dynamics Consulting Inc.

Project:

Project Manager: David Slaine

Samplers: Briar MacIntyre

PACKAGE: **SANSEW - VOCs - BTEX** (WATER)

L1 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03

L2 = SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03

					Sample Number	8	9	10	11
					Sample Name	BH-5	BH-6	BH-7	BH-2
					Sample Matrix	Solution	Solution	Solution	Solution
					Sample Date	15/06/2021	15/06/2021	15/06/2021	15/06/2021
Parameter	**Units**	**RL**	**L1**	**L2**	**Result**	**Result**	**Result**	**Result**
VOCs - BTEX								
Benzene	mg/L	0.0005	0.01		< 0.0005	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	mg/L	0.0005	0.16		< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toluene	mg/L	0.0005	0.016		< 0.0005	< 0.0005	< 0.0005	< 0.0005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	SANSEW / WATER / - - Halton Sewer Discharge By Law - Sanitary and Combined Sewer Discharge - BL_2_03 L1	SANSEW / WATER / - - Halton Sewer Discharge By Law - Storm Sewer Discharge - BL_2_03 L2
BH-5					
E.Coli	SM 9222D	cfu/100mL	1140		200
BH-7					
Total Suspended Solids	SM 2540D	mg/L	1970	350	

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphate	DIO0385-JUN21	mg/L	0.2	<0.2	8	20	96	90	110	92	75	125
Sulphate	DIO0387-JUN21	mg/L	0.2	<0.2	2	20	100	90	110	90	75	125
Sulphate	DIO0393-JUN21	mg/L	0.2	<0.2	7	20	96	90	110	NV	75	125

Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0033-JUN21	mg/L	2	< 2	2	30	105	70	130	109	70	130

QC SUMMARY

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0187-JUN21	mg/L	0.01	<0.01	ND	10	93	90	110	82	75	125

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-[ENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0351-JUN21	mg/L	0.06	<0.06	0	10	104	90	110	107	75	125

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A I Internal ref.: ME-CA-[ENVISKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA0193-JUN21	ug/L	0.2	<0.2	ND	20	99	80	120	92	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0021-JUN21	mg/L	0.00001	< 0.00001	ND	20	101	80	120	123	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0112-JUN21	mg/L	0.00005	<0.00005	ND	20	107	90	110	93	70	130
Aluminum (total)	EMS0112-JUN21	mg/L	0.001	<0.001	1	20	108	90	110	70	70	130
Arsenic (total)	EMS0112-JUN21	mg/L	0.0002	<0.0002	11	20	105	90	110	108	70	130
Beryllium (total)	EMS0112-JUN21	mg/L	0.000007	<0.00007	0	20	93	90	110	95	70	130
Cadmium (total)	EMS0112-JUN21	mg/L	0.000003	<0.000003	0	20	102	90	110	107	70	130
Cobalt (total)	EMS0112-JUN21	mg/L	0.000004	<0.000004	1	20	104	90	110	99	70	130
Chromium (total)	EMS0112-JUN21	mg/L	0.00008	<0.00008	9	20	102	90	110	104	70	130
Copper (total)	EMS0112-JUN21	mg/L	0.0002	<0.0002	1	20	102	90	110	111	70	130
Iron (total)	EMS0112-JUN21	mg/L	0.007	<0.007	5	20	105	90	110	125	70	130
Manganese (total)	EMS0112-JUN21	mg/L	0.00001	<0.00001	0	20	100	90	110	109	70	130
Molybdenum (total)	EMS0112-JUN21	mg/L	0.00004	<0.00004	4	20	105	90	110	103	70	130
Nickel (total)	EMS0112-JUN21	mg/L	0.0001	<0.0001	2	20	104	90	110	92	70	130
Lead (total)	EMS0112-JUN21	mg/L	0.00009	<0.00001	3	20	107	90	110	95	70	130
Phosphorus (total)	EMS0112-JUN21	mg/L	0.003	<0.003	1	20	99	90	110	NV	70	130
Antimony (total)	EMS0112-JUN21	mg/L	0.0009	<0.0009	ND	20	99	90	110	102	70	130
Selenium (total)	EMS0112-JUN21	mg/L	0.00004	<0.00004	ND	20	106	90	110	107	70	130
Tin (total)	EMS0112-JUN21	mg/L	0.00006	<0.00006	11	20	101	90	110	NV	70	130
Titanium (total)	EMS0112-JUN21	mg/L	0.00005	<0.00005	13	20	101	90	110	NV	70	130
Zinc (total)	EMS0112-JUN21	mg/L	0.002	<0.002	1	20	102	90	110	85	70	130
Silver (total)	EMS0120-JUN21	mg/L	0.00005	<0.00005	ND	20	98	90	110	100	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Aluminum (total)	EMS0120-JUN21	mg/L	0.001	<0.001	4	20	94	90	110	110	70	130
Arsenic (total)	EMS0120-JUN21	mg/L	0.0002	<0.0002	13	20	98	90	110	105	70	130
Beryllium (total)	EMS0120-JUN21	mg/L	0.000007	<0.00007	9	20	92	90	110	87	70	130
Cadmium (total)	EMS0120-JUN21	mg/L	0.000003	<0.000003	13	20	99	90	110	111	70	130
Cobalt (total)	EMS0120-JUN21	mg/L	0.000004	<0.000004	3	20	98	90	110	101	70	130
Chromium (total)	EMS0120-JUN21	mg/L	0.00008	<0.00008	2	20	100	90	110	109	70	130
Copper (total)	EMS0120-JUN21	mg/L	0.0002	<0.0002	1	20	95	90	110	78	70	130
Iron (total)	EMS0120-JUN21	mg/L	0.007	<0.007	ND	20	104	90	110	100	70	130
Manganese (total)	EMS0120-JUN21	mg/L	0.00001	<0.00001	1	20	96	90	110	99	70	130
Molybdenum (total)	EMS0120-JUN21	mg/L	0.00004	<0.00004	4	20	98	90	110	105	70	130
Nickel (total)	EMS0120-JUN21	mg/L	0.0001	<0.0001	7	20	97	90	110	96	70	130
Lead (total)	EMS0120-JUN21	mg/L	0.00009	<0.00001	5	20	103	90	110	106	70	130
Phosphorus (total)	EMS0120-JUN21	mg/L	0.003	<0.003	15	20	100	90	110	NV	70	130
Antimony (total)	EMS0120-JUN21	mg/L	0.0009	<0.0009	9	20	103	90	110	107	70	130
Selenium (total)	EMS0120-JUN21	mg/L	0.00004	<0.00004	5	20	91	90	110	98	70	130
Tin (total)	EMS0120-JUN21	mg/L	0.00006	<0.00006	ND	20	95	90	110	NV	70	130
Titanium (total)	EMS0120-JUN21	mg/L	0.00005	<0.00005	5	20	94	90	110	NV	70	130
Zinc (total)	EMS0120-JUN21	mg/L	0.002	<0.002	4	20	96	90	110	116	70	130

QC SUMMARY

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-IENVIMIC-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
E. Coli	BAC9318-JUN21	cfu/100mL	-	ACCEPTED	ACCEPTED							

Nonylphenol and Ethoxylates

Method: ASTM D7065-06 | Internal ref.: ME-CA-IENVIGC-LAK-AN-015

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nonylphenol	GCM0319-JUN21	ug/L	1.0	< 1			88	55	120			
Nonylphenol diethoxylate	GCM0319-JUN21	ug/L	10	< 10			88	55	120			
Nonylphenol Ethoxylates	GCM0319-JUN21	ug/L	10	< 10								
Nonylphenol monoethoxylate	GCM0319-JUN21	ug/L	10	< 10			90	55	120			

QC SUMMARY

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0348-JUN21	mg/L	2	<2	NSS	20	98	75	125			

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0348-JUN21	mg/L	4	< 4	NSS	20	NA	70	130			
Oil & Grease (mineral/synthetic)	GCM0348-JUN21	mg/L	4	< 4	NSS	20	NA	70	130			

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0338-JUN21	No unit	0.05	NA	0		100			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0186-JUN21	mg/L	0.002	<0.002	0	10	96	80	120	103	75	125
4AAP-Phenolics	SKA0201-JUN21	mg/L	0.002	<0.002	ND	10	100	80	120	87	75	125

Polychlorinated Biphenyls

Method: MOE E3400/EPA 8082A | Internal ref.: ME-CA-[ENV]GC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Polychlorinated Biphenyls (PCBs) - Total	GCM0313-JUN21	ug/L	0.04	< 0.04	ND	30	96	60	140	128	60	140

QC SUMMARY

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Naphthalene	GCM0347-JUN21	mg/L	0.0005	< 0.0005	ND	30	95	50	140	99	50	140

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0347-JUN21	mg/L	2	< 2	0	10	95	90	110	NA		
Total Suspended Solids	EWL0381-JUN21	mg/L	2	< 2	2	10	105	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0232-JUN21	as N mg/L	0.5	<0.5	1	10	93	90	110	92	75	125

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,4-Dichlorobenzene	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	93	60	130	99	50	140
Benzene	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	98	60	130	102	50	140
Chloroform	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	94	60	130	99	50	140
Ethylbenzene	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	97	60	130	103	50	140
Methylene Chloride	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	96	60	130	99	50	140
Tetrachloroethylene (perchloroethylene)	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	97	60	130	101	50	140
Toluene	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	96	60	130	101	50	140
Trichloroethylene	GCM0353-JUN21	mg/L	0.0005	<0.0005	ND	30	96	60	130	99	50	140

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --

SGS Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

No: 014815

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page _____ of _____

Laboratory Information Section - Lab use only

Received By: Hillary N
Received Date: 06 / 16 / 21 (mm/dd/yy)
Received Time: 9 : 45 (hr : min)
Received By (signature): xm
Custody Seal Present: Yes ☐ No ☑
Custody Seal Intact: Yes ☐ No ☑
Cooling Agent Present: Yes ☑ No ☐ Type: Ice Pack
Temperature Upon Receipt (°C) 16 , 16 , 16
LAB LIMS #: CA15407-Jun21

REPORT INFORMATION	INVOICE INFORMATION
Company: Terra - Dynamics Consulting	☒ (same as Report Information)
Contact: David Slaine	Company:
Address: 432 Niagara St unit 2 St. Catharines, ON, L2M 4W3	Contact:
Phone:	Address:
Fax:	Phone:
Email: dslaine@terra-dynamics.com	Email: jcampbell@terra-dynamics.com

Quotation #: 2021 879
Project #: 2020 Lakeshore Rd.
P.O. #:
Site Location/ID: Burlington

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: _____

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium
☐ Table 3 ☐ Agri/Other ☐ Fine
☐ Table _____

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA _____

Sewer By-Law:
☒ Sanitary
☑ Storm
Municipality: Burlington Storm, Halton Sewer

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	Time ~~DATE~~ SAMPLED	Date ~~TIME~~ SAMPLED	# OF BOTTLES	MATRIX
1	BH-5	9:10	06/15/21	14	
2	BH-6	9:45	↓	↓	
3	BH-7	10:20			
4	BH-2	10:45			
5					
6					
7					
8					
9					
10					
11					
12					

M & I: Field Filtered (Y/N); Metals & Inorganics incl CrVI, CN, Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na-water); Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI; ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni, Se,Ag,Ti,U,V,Zn

SVOC: PAHs only; SVOCs all incl PAHs, ABNs, CPs

PCB: PCBs Total ☐ Aroclor ☐

PHC: F1-F4 + BTEX; F1-F4 only no BTEX

VOC: VOCs all incl BTEX; BTEX only

Pest: Pesticides Organochlorine or specify other

Other (please specify): Sewer Use: Specify pkg:; Water Characterization Pkg General ☐ Extended ☐

TCLP: Specify TCLP tests ☐M&I ☐VOC ☐PCB ☐B(a)P ☐ABN ☐Ignit.

COMMENTS:

☒ Please See Attached ☒ Encoding list

☒ Note: 4 Coolers ☒

Observations/Comments/Special Instructions

Sampled By (NAME): Brian MacIntyre Signature:
Relinquished by (NAME): PRESTYN SIDER Signature:
Date: 06 / 15 / 21 (mm/dd/yy)
Date: 06 / 15 / 21 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.2
Date of Issue: 09 Sept, 2019

Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

COST SUMMARY

	Unit Cost	Qty	Cost
Burlington Storm and Halton Sanitary pH, BOD, TSS, Sulphate, O&G(tot), O&G(animal/vegetable), O&G(mineral/synthetic), Phenolics (4AAP), TKN, Cyanide, Fluoride, Mercury, Silver, Aluminum, Arsenic, Beryllium, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Molybdenum, Nickel, Phosphorus, Lead, Antimony, Selenium, Tin, Titanium, Zinc, Benzene, Chloroform, 1,4 Dichlorobenzene, Ethylbenzene, Methylene Chloride, Tetrachloroethylene, Toluene, Trichloroethylene, Naphthalene Plus: NP/NPE, PCBs, pH, CrVI	CA$ 603.50	4	CA$ 2,414.00
Environmental Disposal Fee (routine samples)	CA$ 5.00	4	CA$ 20.00
		Subtotal	**CA$ 2,434.00**

- **Prices shown are based on sample quantities indicated, and can change based on quantities submitted.**
- **Turnaround times for routine samples indicated in this quote are 5-7 days from receipt of samples.**

RE: [EXTERNAL] SGS_HP_MFP Scan Document

Arnold, Catharine (Lakefield) <Catharine.Arnold@sgs.com>
Wed 2021-06-16 12:03 PM
To: Thompson, Lisa (Lakefield) <Lisa.Thompson@sgs.com>; LR.Envlogin1 (Lakefield) <LR.Envlogin1@sgs.com>

Please analyze the E.Coli for this sample as per the client (Jayme Campbell).

-----Original Message-----
From: Thompson, Lisa (Lakefield) <Lisa.Thompson@sgs.com>
Sent: Wednesday, June 16, 2021 11:19 AM
To: Arnold, Catharine (Lakefield) <Catharine.Arnold@sgs.com>
Subject: FW: [EXTERNAL] SGS_HP_MFP Scan Document

Can you look into this?

-----Original Message-----
From: SGS_HP_MFP [mailto:SGS_HP_MFP@sgsna.com]
Sent: June-16-21 11:09 AM
To: Thompson, Lisa (Lakefield) <Lisa.Thompson@sgs.com>
Cc: LR.Envlogin1 (Lakefield) <LR.Envlogin1@sgs.com>
Subject: [EXTERNAL] SGS_HP_MFP Scan Document

*** WARNING: this message is from an EXTERNAL SENDER. Please be cautious, particularly with links and attachments. *** _____

We rec'd bacti bottles but no micro tests indicated on their attached quote. Just looking to confirm their tests as we also dont have a Burlington storm template.

Appendix E

Dewatering Calculations

Table E-1 Dewatering Assessment
2 Weeks

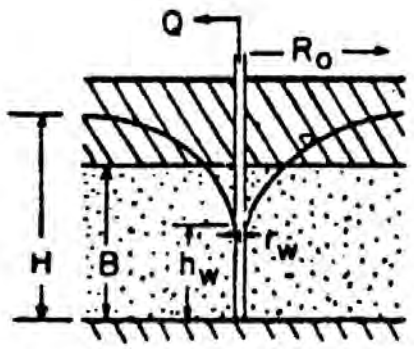
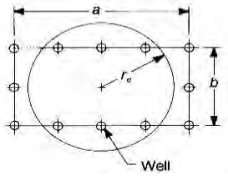
Radial flow, mixed aquifer	Inputs	Comments
H=Initial water level (m)	6.8	
h_w=Remaining saturated thickness (m)	0	
B=aquifer thickness (m)	5.6	
K=Hydraulic Conductivity (m/s)	2.E-07	
a=Rectangular Excavation Length (m)	60	Modelled as two circular systems to keep a/b < 1.5, actual length 120 metres
b=Rectangular Excavation Width (m)	65	
	Calculations	
R_w=Re=Effective radius Calc (m)	35	$r_e = \sqrt{\frac{ab}{\pi}}$
Time of dewatering (hours)	336	
Specific Storage	1.E-04	Sykes et al, 2008 (S_s = 1x10-4)
R_0=Radius of Influence Calc (Cooper&Jacob) (m)	47	$R_o = \sqrt{\frac{2.25kDt}{S}}$
Q_w=Flow Rate (m^3/s)	9.8E-05	$Q_w = \frac{\pi K(2BH - B^2 - h_w^2)}{\ln R_0/r_w}$
Q_w=Flow Rate (m^3/day)	8	
Q_w=Flow Rate (L/day)	8,476	
Q_w=Flow Rate (L/day)*2 [as excavation split up]	16,953	Flow rate multiplied by two representing two circular systems for entire excavation

Table E-2 Dewatering Assessment
2 Weeks

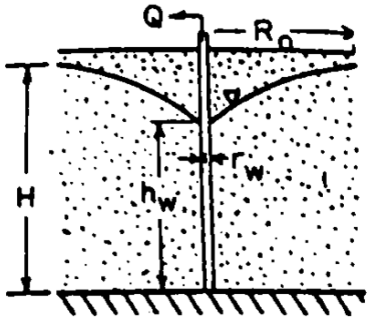
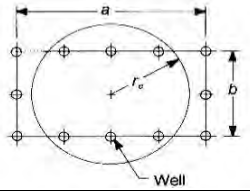
Radial flow, water table aquifer	Inputs	Comments
H=Initial saturated thickness (m)	6.8	
h_w=Remaining saturated thickness (m)	0	
K=Hydraulic Conductivity (m/s)	2.E-07	
a=Rectangular Excavation Length (m)	60	Modelled as two circular systems to keep a/b < 1.5, actual length 90 metres
b=Rectangular Excavation Width (m)	65	
	Calculations	
R_w=Re=Effective radius Calc (m)	35	$r_e = \sqrt{\frac{ab}{\pi}}$
Time of dewatering (hours)	336	
Specific Storage	1.E-04	Sykes et al, 2008 (S_s = 1x10-4)
R_0=Radius of Influence Calc (Cooper&Jacob) (m)	43	$R_o = \sqrt{\frac{2.25kDt}{S}}$
Q_w=Flow Rate (m^3/s)	0.000153	$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$
Q_w=Flow Rate (m^3/day)	13	
Q_w=Flow Rate (L/day)	13,220	
Q_w=Flow Rate (L/day)*2 [as excavation split up]	26,440	Flow rate multiplied by two representing two circular systems for entire excavation

Table E-3 Dewatering Assessment

1 Year

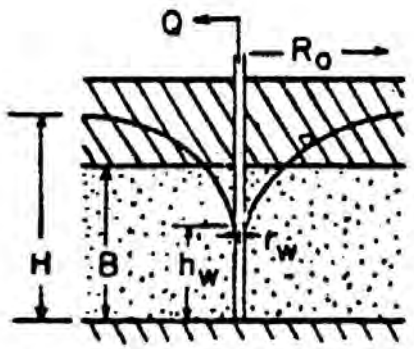
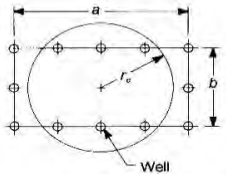
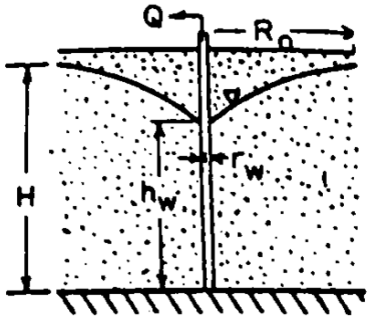
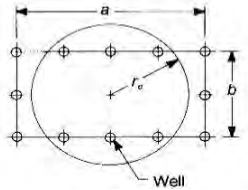
Radial flow, mixed aquifer	Inputs	Comments
H=Initial water level (m)	6.8	
h_w=Remaining saturated thickness (m)	0	
B=aquifer thickness (m)	5.6	
K=Hydraulic Conductivity (m/s)	2.E-07	
a=Rectangular Excavation Length (m)	60	Modelled as two circular systems to keep a/b < 1.5, actual length 120 metres
b=Rectangular Excavation Width (m)	65	
	Calculations	
R_w=Re=Effective radius Calc (m)	35	$r_e = \sqrt{\frac{ab}{\pi}}$
Time of dewatering (hours)	8766	
Specific Storage	1.E-04	Sykes et al, 2008 (S_s = 1x10-4)
R_0=Radius of Influence Calc (Cooper&Jacob) (m)	240	$R_o = \sqrt{\frac{2.25kDt}{S}}$
Q_w=Flow Rate (m^3/s)	1.5E-05	$Q_w = \frac{\pi K(2BH - B^2 - h_w^2)}{\ln R_0/r_w}$
Q_w=Flow Rate (m^3/day)	1	
Q_w=Flow Rate (L/day)	1,269	
Q_w=Flow Rate (L/day)*2 [as excavation split up]	2,537	Flow rate multiplied by two representing two circular systems for entire excavation

Table E-4 Dewatering Assessment

1 Year

Radial flow, water table aquifer	Inputs	Comments
H=Initial saturated thickness (m)	6.8	
h_w=Remaining saturated thickness (m)	0	
K=Hydraulic Conductivity (m/s)	3.E-07	
a=Rectangular Excavation Length (m)	60	Modelled as two circular systems to keep a/b < 1.5, actual length 90 metres
b=Rectangular Excavation Width (m)	65	
	Calculations	
R_w=Re=Effective radius Calc (m)	35	$r_e = \sqrt{\frac{ab}{\pi}}$
Time of dewatering (hours)	8766	
Specific Storage	1.E-04	Sykes et al, 2008 (S_s = 1x10-4)
R_0=Radius of Influence Calc (Cooper&Jacob) (m)	266	$R_o = \sqrt{\frac{2.25kDt}{S}}$
Q_w=Flow Rate (m^3/s)	0.000022	$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$
Q_w=Flow Rate (m^3/day)	2	
Q_w=Flow Rate (L/day)	1,862	
Q_w=Flow Rate (L/day)*2 [as excavation split up]	3,723	Flow rate multiplied by two representing two circular systems for entire excavation