S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing and Stormwater Management Report

127 PLAINS ROAD WEST

CITY OF BURLINGTON

PROPOSED MIX-USE BUILDING

Prepared for:

Losani Investment Corporation

January 2025

SLA File: 23082

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Losani Homes to provide Consulting Engineering services for the proposed development located at the northwest corner of the intersection of Plains Road West and Howard Road in the City of Burlington. The property's municipal address is 127 Plains Road West. This report will outline the functional servicing strategy for the proposed development (see Figure 1.0 for location plan).

The proposed development consists of constructing a 24-storey mixed-use building, with a total of 240 residential units and 392m^2 of commercial area. The proposed site will also include four levels of underground parking, concrete curbing/sidewalk, asphalt drive aisle and landscaped areas.

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

1.2 BACKGROUND INFORMATION

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

Ref. 1: MOE Stormwater Management Practices 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: Water and Wastewater Linear Design Manual (Regional Municipality of Halton, October 2019)

Ref. 5: Preliminary Hydrogeological Assessment/Dewatering Study (Terra-Dynamics Consulting Inc., July 2024)

Ref. 6: Stormwater Management Design Guidelines (City of Burlington, May 21, 2020)

Ref. 7: Geotechnical Investigation (Soil-Mat Engineers & Consultants Ltd., June 2024)

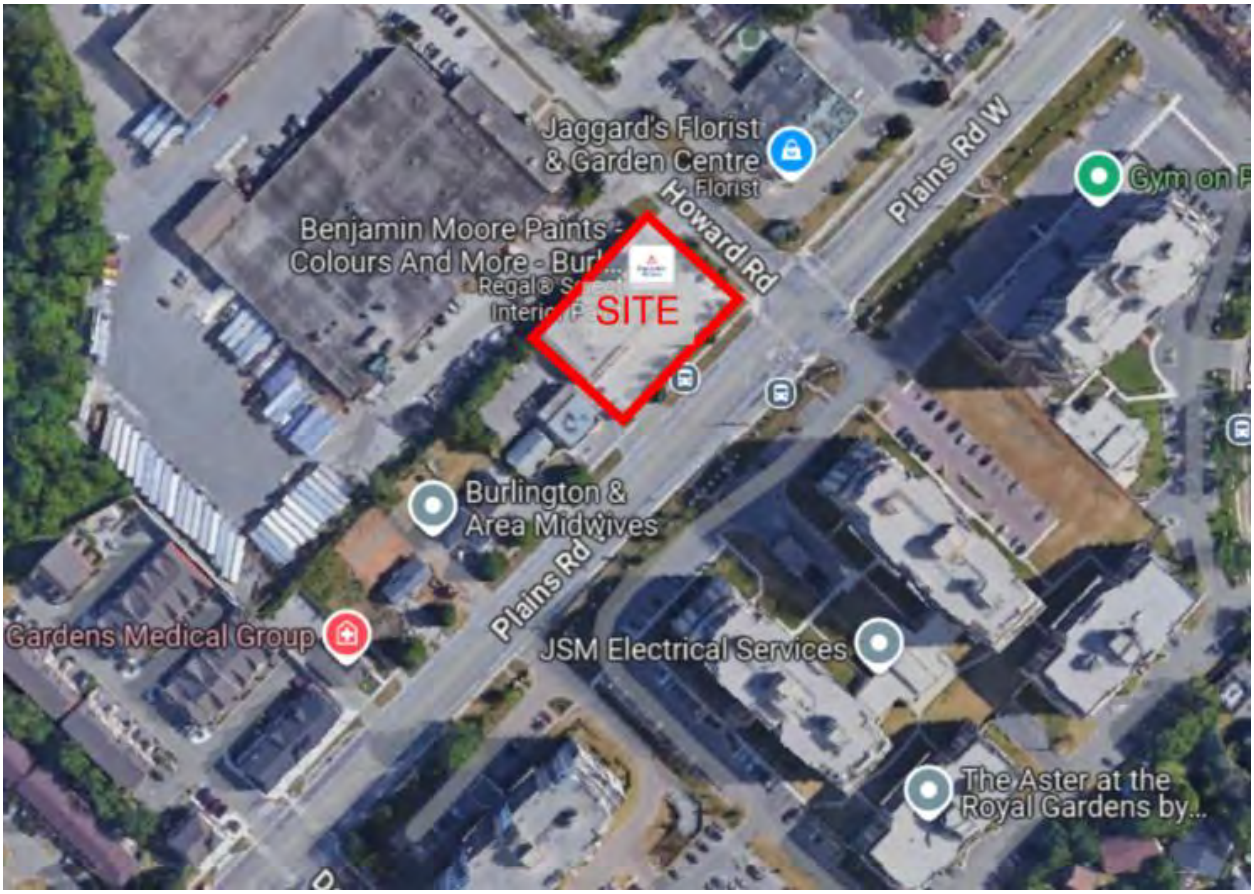


Figure 1.0 - Location Plan

2.0 HYDROGEOLOGICAL & GEOTECHNICAL INVESTIGATIONS

A preliminary hydrogeological assessment/dewatering study was prepared by Terra-Dynamics Consulting Inc., dated July 10, 2024, and a geotechnical investigation was prepared by Soil-Mat Engineers & Consultants Ltd., dated June 10, 2024. Eight (8) boreholes were drilled at the site between April 29 and May 7, 2024, to approximate depths ranging between 14.0 and 32.1m below grade, and eight (8) monitoring wells were installed. All boreholes were advanced through the existing pavement structure. Sand and gravel fill was encountered below the pavement structure in Boreholes 2, 3, 4, and 6 ranging in depths between 2.3 to 4.7m below grade. Sand fill was encountered below the pavement structure in Boreholes 1 and 5 ranging in depths between 2.1 to 2.2m below grade. A layer of native sand and gravel was encountered immediately beneath the fill material in all boreholes at depths between 4.1 to 10.3m below grade. Native sand material was encountered immediately beneath the native sand and gravel in all boreholes. Native silty clay/clayey silt soils of clayey silt were encountered beneath the native sand and gravel within Boreholes 6 and beneath the native sand in Boreholes 1 and 5, ranging in depth from 7.1 to 22.4m. Native sandy and silty gravel material was encountered beneath the silty clay/clayey silt in Boreholes 1 and 5 at depth ranging from 25.6 to 27.5m below grade. Queenston Shale was encountered beneath the native sandy and silty gravel in Boreholes 1 and 5.

Eight (8) groundwater monitoring wells were constructed to monitor two groundwater systems: the sand water table (Boreholes 1B, 2, 3, 4, 5B and 6) and the shale potentiometric surface (Boreholes 1A and 5A). The depth to the Sand Water Table was observed to be between 12.78 and 13.20m below grade (elevations of 90.39 to 89.88m). The groundwater elevation of the potentiometric surface varied between depths of 13.19 and 15.21m below grade (elevations of

90.00 to 87.86m). Temporary construction dewatering will be required, and the dewatering flow was calculated to be less than 40,000 l/day based upon preliminary groundwater levels. A permit to take water (PTTW) should not be required for this volume of water taking, as the estimated discharge rate is less than 50,000 l/day, however a dewatering taking plan will be prepared for discharge to the City of Burlington storm sewer. For additional information, refer to the Geotechnical Investigation and Preliminary Hydrogeological Assessment/Dewatering Study in Appendix D.

3.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, through pre-consultation comments (dated September 6, 2023) from the City of Burlington, Halton Region and Conservation Halton staff:

Quantity Control

The post-development stormwater discharge rates shall be controlled to the 5-year pre-development discharge rate from the site for all storm events (2 to 100-year and Regional storm events). The overland flow route is to flow to Plains Road West. Additionally, the maximum pre-development imperviousness of 36% is to be used for the pre-development calculations, as per City of Burlington requirements.

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).

Water Balance

It is recommended to retain/infiltrate the first 5mm on site.

Erosion Control

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

3.1 EXISTING CONDITIONS

In the existing conditions, the site, approximately 0.265 ha, consists of a two-storey mixed-use building with commercial property on the ground floor and residential units above. The site also consists of asphalt parking and drive aisles. The site is bound by Howard Road to the east, Plains Road West to the south, and existing commercial lands to the west and north. There exists an 825mmø storm sewer on Plains Road West adjacent to the property, at 0.45% flowing east and a 450mmø storm sewer on Howard Avenue adjacent to the property, flowing north at a slope of 0.37%.

The topography of the existing site generally slopes from north to south with the majority of the drainage being collected by existing on-site catchbasins within the parking lot area, ultimately outletting to the 825mmø storm sewer on Plains Road West. The remaining site area sheet drains to Howard Road where it is collected by existing catchbasins within the right-of-way.

Three (3) catchment areas, Catchments 101, 102 and EXT1 have been identified in the existing condition. See Table 3.1 and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

Catchment 101 represents the existing conditions discharge from the subject site collected by on-site catchbasins, ultimately draining towards the existing 825mmø storm sewer on Plains Road West.

Catchment 102 represents the existing conditions discharge from the subject site draining towards the existing 450mmø storm sewer on Howard Road.

Catchment EXT1 represents the existing conditions external drainage from the north lands through the site to on-site catchbasins, ultimately draining towards the existing 825mmø storm sewer on Plains Road West.

Table 3.1 – Existing Conditions Catchment Areas

Catchment ID	Description	Area (ha)	% Impervious	Runoff Coefficient (C)
101	Drainage from subject lands to Plains Road West	0.245	91	0.86
102	Drainage from subject lands to Howard Road	0.016	58	0.48
EXT1	External drainage from north lands to Plains Road West	0.004	100	0.90

An analysis was performed on Catchments 101, 102 and EXT1 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 and the Regional design storm. A summary of the results can be found in Table 3.2 and the detailed SWMHYMO input/output information in Appendix A. It should be noted that the allowable discharge rates are based on a maximum percent imperviousness of 36% (C=0.50), as per City of Burlington Standards.

Table 3.2 – Allowable Discharge from Site

Storm Event	Discharge to Plains Road West (m^3/s) [1]	Discharge to Howard Road (m^3/s)
2-year	0.021	0.001
5-year	**0.030**	**0.002**
10-year	0.037	0.002
25-year	0.047	0.003
50-year	0.055	0.004
100-year	0.063	0.004
Regional	0.035	0.002

[1] Based on Catchment 101 + Catchment EXT1. Refer to SWMHYMO Output in Appendix A.

3.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 24-storey mix-use building containing a total of 240 residential units, 392m^2 of retail area and four levels of underground parking. The proposed site will also include concrete curbing/sidewalk, asphalt parking spaces and 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 the 825mmø storm sewer located within Plains Road West.

Three (3) catchment areas, Catchment 201, 202 and 203, have been identified in the proposed condition. Refer to Table 3.3 and the Proposed Condition Drainage Area Plan in Appendix A for details.

Catchment 201 represents the drainage area for the portion of the site which will be captured via on-site storm sewer network and controlled by the proposed stormwater management tank which will ultimately discharge to the existing 825mmø storm sewer along Plains Road West.

Catchment 202 represents the drainage area for the portion of the site which will sheet drain uncontrolled to Howard Road, ultimately discharging to the existing 450mmø storm sewer on Howard Road.

Catchment 203 represents the drainage area for the portion of the site which will sheet drain uncontrolled north.

Table 3.3 – Proposed Condition Catchment Areas

Catchment ID	Description	Area (ha)	% Impervious	Run-off Coefficient (C)
201	Controlled drainage to Plains Road West	0.256	88	0.84
202	Uncontrolled drainage to Howard Road	0.005	100	0.90
203	Uncontrolled drainage north	0.004	0	0.25

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 95mmø cored hole orifice installed on the outlet of the proposed SWM vault, to restrict discharge from the site to the allowable 5-year pre-development discharge rate.

With the installation of on-site quantity control measures for Catchment 201, it will be required to provide stormwater storage during storm events up to and including the 100-year and Regional storm event. To provide the required storage, a cast-in-place storage vault within the underground parking structure with approximately 78m^3 of storage will be provided.

The proposed storage vault will be designed to drain via gravity through the cored hole orifice to MH2. Additionally, the vault will have an emergency overflow outlet (AD 4) above the vault, which will sheet drain to the Plains Road West right-of-way.

Details of the proposed stormwater management vault can be found on the Preliminary Servicing Plan. The stage-storage-discharge characteristics can be found in Table 3.4 and Appendix A for details.

Table 3.4 – Proposed Condition Stage-Storage-Discharge

Elevation (m)	Storage (m^3)	Discharge (m^3/s)	Comments
99.99	0	0.000	Bottom of Vault and Invert of 95mmø Cored Hole Orifice
100.52	20	0.019	¼ Depth of Vault
101.05	39	0.023	½ Depth of Vault
101.57	59	0.027	¾ Depth of Vault
102.10	78	0.030	Top of Vault

An analysis was performed on the Proposed Condition site using the SWMHYMO hydrologic modeling program to determine the required volume of stormwater storage during the 2 to 100-year City of Burlington design storms and Regional design storm. A summary of the results can be found in Table 3.5 and the detailed SWMHYMO input/output information can be found in Appendix A.

Table 3.5 – Proposed Condition Stormwater Discharge and Storage Volumes to Plains Road West

Storm Event	201 (Controlled) (m^3/s)[1]	Allowable Discharge (m^3/s)[2]	Required Storage (m^3)[1]	Storage Provided (m^3)[3]
2-Year	0.020	0.030	27	78
5-Year	0.023		37	
10-Year	0.024		44	
25-Year	0.026		54	
50-Year	0.027		62	
100-Year	0.029		70	
Regional	0.027		62	

[1] Based on SWMHYMO Output. Refer to Appendix A for details.
[2] Refer to Table 3.2.
[3] Refer to Table 3.4.

Table 3.6 – Proposed Condition Stormwater Discharge to Howard Road and North Lands

Storm Event	To Howard Road		To North Lands
	202 (Uncontrolled) (m^3/s)[1]	Allowable Discharge (m^3/s)[2]	203 (Uncontrolled) (m^3/s)[1]
2-Year	0.001	0.002	0.000
5-Year	0.001		0.000
10-Year	0.002		0.000
25-Year	0.002		0.000
50-Year	0.002		0.000
100-Year	0.002		0.000

[1] Based on SWMHYMO Output. Refer to Appendix A for details.
[2] Refer to Table 3.2.

This analysis determined the following:

- The proposed condition discharge rates will not exceed the 5-year allowable pre-development flow rates from the site.

- Catchment 201 will require 70m^3 of stormwater storage during the 100-year event (worse case scenario), which can be accommodated within the proposed storage vault, having a volume of 78m^3.

- Catchment 203 will produce less than 1l/s of stormwater drainage under all storm events. This is considered negligible.

Water Quality Control

The proposed development is required to achieve an "Enhanced" (80% TSS removal) level of water quality protection. To achieve this criterion, discharge from Catchment 201 will be subject to treatment from a Hydroworks HydroFilter before ultimately discharging to the existing 825mmø storm sewer within Plains Road West.

The HydroFilter manufacturer has provided sizing information and determined the filter unit for Catchment 201 will require 10 filter cartridges and be housed in an 1800mmø manhole. See the HF10 filter sizing procedures in Appendix B for details. The HydroFilter has been certified under the ETV for 83% removal efficiency. Based on the information provided to S.Llewellyn and Associates Limited, it is our opinion that the HydroFilter HF10 has been sized to be in conformance with the water quality targets for this site.

As part of a treatment train approach, area drains within the proposed asphalt parking lot will be fitted with the area drain manufacturer's specified sediment bucket. The installation of the sediment bucket will contribute to the removal of TSS and the capture of floatables within the area drains. These units will capture the coarser particles before entering the storm system which will help to prevent clogging of the filter unit.

HydroFilter units and sediment buckets require regular inspection and maintenance as per the manufacturer's specifications to ensure the unit operates properly. See the maintenance manual provided in Appendix E for details.

3.3 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 silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;
- Install sediment control (silt sacks) in the proposed area drains as well as 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.

To ensure and document the effectiveness of the erosion and sediment control structures, an appropriate inspection and maintenance program is necessary. The program will include the following activities:

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and
- The developer and/or his contractor shall be responsible for any costs incurred during the remediation of problem areas.

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

4.0 SANITARY SEWER SERVICING

4.1 EXSTING CONDITIONS

The site is located at 127 Plains Road West with an existing 375mmø sanitary sewer on Plains Road West flowing east and a 250mmø sanitary sewer on Howard Avenue flowing south, outletting to the Plains Road sanitary sewer.

4.2 SANITARY DEMAND

The proposed development consists of a 24-storey mix-use building containing a total of 240 residential units and 392m^2 of retail floor area. Wastewater generation for the site was calculated based on the Ontario Building Code (OBC) and 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 4.1 summarizes population and Table 4.2 summarizes the sanitary sewer discharge rates from the proposed site.

Table 4.1 – Proposed Population

Occupancy Type	No. of Beds [1]	Gross Floor Area (m^2) [1]	Population Density [2]	Population
Residential	281	---	2 per/bed	562
Commercial	---	392	3.7m^2/per	106
			Total Population [3]:	**668**

[1] Information from site plan prepared by Chamberlain Architect Services Limited, dated October 17, 2024.
[2] Residential population density per OBC 3.1.17.1.1(b); commercial population density as per OBC Table 3.1.13.1 (5).
[3] Total population = Residential Population + Commercial Population

Table 4.2 – Proposed Sanitary Sewer Discharge

Site Area (ha)	Population [1]	Avg. Demand [2] (l/s)	Peak Factor [3]	Infiltration [4] (l/s)	Peak Flow [5] (l/s)
0.265	668	2.13	3.9	0.08	**8.39**

[1] From Table 3.1.
[2] Based on a unit sewage flow of 0.275m^{3}pcd (as per Table 3-1 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[3] 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
[4] 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).
[5] Peak Flow = (Avg. Demand x Peak Factor) + Infiltration

Based on Table 4.2, the estimate of sanitary demand for the townhouse development is:

8.39 L/s

4.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed mix-use building will be serviced by a 250mmø sanitary sewer, designed and constructed in accordance with the Region of Halton standards. Drainage from this sewer will discharge to the existing 250mmø sanitary sewer along Howard Road.

The minimum grade of the proposed 250mmø sanitary sewer will be 2.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.084 m^3/s (84 l/s). Therefore, the proposed 250mmø sanitary sewer at 2.0% grade is adequately sized to service the proposed development. A sanitary sewer capacity will be completed at the detailed design stage to confirm the existing 250mmø sanitary sewer within Howard Road has capacity.

5.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

5.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 250mmø watermain located on Plains Road West and existing 150mmø and 250mmø watermains located on Howard Road. An existing fire hydrant is located adjacent to the site on Plains Road West.

5.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the proposed building. Water usage for the site was calculated based on the "Fixture Unit Method" as per Table 7.6.3.2.A. forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the 2012 Ontario Building Code. See Table 5.1 for fixture unit (FU) calculations.

Table 5.1 – Domestic Water Demand

Component	No. of Fixtures	FU/ Fixture	Total FU
Lavatory (8.3L/min or less per head) (Private)[1,3]	282	0.7	197.4
Shower Head (9.5L/min or less per head) (Private)[1]	281	1.4	393.4
Water Closet (6 LPF or less with flush tank) (Private)[1,3]	282	2.2	620.4
Sink (kitchen, domestic, 8.3 L/min or less) (Private)[2,3]	241	4	964.0
Dishwasher (Domestic)[2,3]	241	1.4	337.4
Clothes Washer (3.5 kg) (Private)[2]	240	1.4	336.0
Mop Sink[4]	4	3	12.0
		Total FU:	**2,860.6**
		Water Usage (l/s):	**25.59**

[1] Each 1-bedroom unit was assumed to have one full bathroom, and each 2-bedroom unit was assumed to have two full bathrooms
[2] Each unit was assumed to have one kitchen with dishwasher and one washing machine
[3] The building was assumed to have one common room that includes a kitchen with dishwasher and a half bathroom
[4] The building was assumed to have one mop sink per parking level

Total peak water usage for the site was derived below from the fixture unit count as per Table 7.4.10.5 of the Ontario Building Code.

Total Fixture Unit Count = 2,860.6 FU

Water Usage: 337.73 IGPM (25.59 l/s)

5.3 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, 2020), 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 24-storey mix-use building containing a total of 240 residential units, 392m^2 of commercial area and four levels of underground parking. An existing hydrant is located adjacent to the site on Plains Road West. The hydrant is within the

required 90m separation to the building face (as per Sentence 3.2.5.7 of the Ontario Building Code).

Proposed building is non-combustible construction (C=0.8), with limited combustible occupancy (-15% correction) and a fully supervised sprinkler system (-50% correction). Exposure components are based on the following:

North Face: >30m (0% correction)
South Face: >30m (0% correction)
East Face: >30m (0% correction)
West Face: 10.1 to 20m (15% correction)

It is estimated that the required fire flow for the proposed development will be **117 l/s**. See the Fire Flow Demand Requirements in Appendix C for details.

A hydrant flow test was performed by Vipond on the municipal hydrant closest to the site 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 5.2 summarizes the hydrant flow data provided by Vipond.

Table 5.2 – Hydrant Flow Test Data

Location	127 Plains Road West
Static Pressure	48 psi
Residual Pressure During Test Flow	39 psi
Test Flow Rate	1,420 USGPM (107.6 l/s)
Theoretical Flow @ 20 psi	**2,620 USGPM (199 l/s)**

Based on the above hydrant flow test data, the theoretical maximum available flow rate from the hydrant is **199 l/s**, while the maximum required fire flow for the proposed development is only **117 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

5.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting a 200mmø water service off of the existing 250mmø watermain adjacent to the site on Howard Street. The proposed 200mmø water service will provide domestic and fire water service for the proposed development. Water services for the site are to be designed and constructed in accordance with Region of Halton standards.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development at 127 Plains Road West 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 and Servicing Plans prepared by S. Llewellyn & Associates Limited;
- A 95mmø cored orifice be installed as per Preliminary Servicing Plan and this report to provide adequate quantity control;
- An underground storage vault be installed within the underground parking garage as per the Preliminary Servicing Plan and this report to provide effective stormwater storage during storm events;
- Erosion and sediment controls be installed as described in this report to meet City of Burlington requirements;
- HydroFilter, HF10, unit be installed to provide Enhanced (80% TSS Removal) quality control for the subject site;
- The proposed sanitary and water servicing system be installed as per the 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, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION

S:\23082\WORKING\CURRENT\23082-DAP.dwg

EXISTING COMMERCIAL AREA

EXT1
0.004
100
0.90

101
0.245
91
0.86

102
0.016
58
0.48

EX. 2 STOREY BRICK BUILDING #127

EX. 2 STOREY STUCCO BUILDING #141

EX. CLF

EX. TOP OF BANK

EX. BB

EX. CRW

EX. EDGE OF PAVEMENT

EX. CEDAR HEDGE

EX. BC

EX. EDGE OF PAVEMENT

EX. SIGN

EX. CB T/G=102.99

EX. MH T/G=103.15

EX. BOL

EX. GM

EX. CONC

EX. OVERHANG

EX. EDGE OF ASPHALT

EX. PIL

EX. 0.24ø TREE

EX. 0.25ø TREE

EX. 0.26ø TREE

EX. 0.2ø TREE

EX. 0.3ø TREE

EX. APP

EX. ASPHALT WALK

EX. CURB

EX. CB T/G=102.88

EX. 450mmø STM @ 0.37%

EX. 150mmø WTM

EX. CENTRE LINE OF PAVEMENT

EX. 250mmø SAN @ 0.46%

EX. CB T/G=102.92

EX. 250mmø WTM

EX. BC

EX. EDGE OF PAVEMENT

EX. SAN MH T/G=102.80 N INV. 98.70 S INV. 98.69

EX. 250mmø SAN @ 1.06%

EX. CB T/G=102.70 N. INV=100.89± S. INV=100.89±

EX. STM

EX. SAN MH T/G=102.85 N. INV. 98.55± W. INV= 98.76± E. INV= 98.38±

EX. STM MH T/G=102.91 NW. INV=98.81± NE. INV=98.81± W. INV=98.41±

EX. CB T/G=102.89

EX. CB T/G=102.93

EX. SAN MH T/G=102.62

EX. 375mmø SAN @ 0.47%

EX. 825mmø STM @ 0.45%

EX. CONCRETE SIDEWALK

EX. OVERHEAD HYDRO

EX. 250mmø WTM

EX. WV

EX. FH

EX. HP

EX. GW

EX. BUS STOP

EX. BIKE RACK

EX. TRAFFIC BOX

EX. GV

EX. TL

EX. STEPS

EX. MW

EX. 0.25ø TREE

PLAINS ROAD WEST

LEGEND

201 14.60 77 0.75	DRAINAGE AREA I.D. DRAINAGE AREA (ha) PERCENT IMPERVIOUS RUNOFF COEFFICENT
———	DRAINAGE BOUNDARY
- - -	EXTERNAL DRAINAGE BOUNDARY
---→	EXISTING DIRECTION OF SHEET FLOW

PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:300

127 PLAINS ROAD WEST, BURLINGTON, ON
23082

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Tel. (905) 631-6978
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3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

10/18/2024 3:39:25 PM - Alyssa Stiletto

S:\23082\WORKING\CURRENT\23082-DAP.dwg

EXISTING COMMERCIAL AREA

EX. TOP OF BANK
EX. BB
EX. CRW
EX. EDGE OF PAVEMENT
EX. CEDAR HEDGE
EX. BC
EX. CLF
EX. SIGN
EX. ASPHALT WALK
EX. CURB
EX. APP
EX. CB T/G=102.92
EX. 250mmø WTM
EX. BC
EX. EDGE OF PAVEMENT

203
0.004
0
0.25

PROP. HEATED RAMP TO UNDERGROUND
EX. CB T/G=102.99
(TO BE REMOVED)

PROP. BIKE PARKING
EX. MH T/G=103.15
TRANSFORMER
EX. SIGN
EX. BOL
EX. HV
EX. CONC
EX. CB T/G=102.88
EX. 450mmø STM @ 0.37%
EX. 150mmø WTM
EX. CENTRE LINE OF PAVEMENT
EX. 250mmø SAN @ 0.46%

EX. 2 STOREY BRICK BUILDING #127

201
0.256
88
0.84

EX. OVERHANG
EX. EDGE OF ASPHALT
EX. PIL
EX. GM
EX. CONC
EX. HP
EX. GW
EX. EB
0.24ø TREE
EOA

EX. 2 STOREY STUCCO BUILDING #141
EX. CONCRETE SIDEWALK
EX. STEPS
EX. MW
EX. WV
EX. CURB
EX. LS
EX. SAN MH T/G=102.62

PROP. 24 STOREY MIXED USE BUILDING FFE=103.20

EX. CB T/G=102.89
EX. CB T/G=102.93
EX. EDGE OF PAVEMENT
EX. BC
EX. 0.2ø TREE
EX. 0.3ø TREE
EX. 0.26ø TREE
EX. 375mmø SAN @ 0.47%
EX. 825mmø STM @ 0.45%
EX. CONCRETE SIDEWALK
EX. TRAFFIC BOX
EX. GV
EX. TL
EX. OVERHEAD HYDRO
EX. 250mmø WTM
EX. FH
EX. BIKE RACK
EX. BUS STOP
EX. CONC
EX. APP

202
0.005
100
0.90

EX. SAN MH T/G=102.80
N INV. 98.70
S INV. 98.69
EX. 250mmø SAN @ 1.06%
EX. CB T/G=102.70
N. INV=100.89±
S. INV=100.89±
EX. STM
EX. SAN MH T/G=102.85
N. INV. 98.55±
W. INV= 98.76±
E. INV=98.38±
EX. STM MH T/G=102.91
NW. INV=98.81±
NE. INV=98.81±
W. INV=98.41±
EX. 250mmø WTM

PLAINS ROAD WEST

LEGEND

201 14.60 77 0.75	DRAINAGE AREA I.D. DRAINAGE AREA (ha) PERCENT IMPERVIOUS RUNOFF COEFFICENT
	DRAINAGE BOUNDARY

POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:300

127 PLAINS ROAD WEST, BURLINGTON, ON
23082

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

10/18/2024 3:42:54 PM - Alyssa Stiletto

127 Plains Road West
Burlington, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	**95**
Area (m^2)	0.00709
Invert Elev. (m)	99.45
C/L Elev. (m)	99.50
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes						Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Additional Incremental Underground	Additional Incremental Surface m^3	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	99.99		0	0.0	0	0	0	0.000	0.000
Bottom of Tank	99.99	37	0	0.0	0	0	0	0.000	0.000
1/4 Depth	100.52	37	20	0.0	0	20	20	1.020	0.019
1/2 Depth	101.05	37	20	0.0	0	39	39	1.547	0.023
3/4 Depth	101.57	37	20	0.0	0	59	59	2.075	0.027
Top of Tank	102.10	37	20	0.0	0	78	78	2.602	0.030

```
2     Metric units
*#*************************************************************************|
*#  Project Name: 127 PLAINS ROAD WEST
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23082
*#       Date   : OCTOBER 2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23082.DAT
*#*************************************************************************|
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BUR6_002.stm
*
READ STORM          STORM_FILENAME "STORM.001"
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  TO PLAINS ROAD WEST
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.245](ha),
                    XIMP=[0.36], TIMP=[0.36], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[2.0](%),
                                         LGP=[15](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[5.0](%),
                                         LGI=[30](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%------------------|-------------------------------------------------------|
*# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
*
CALIB STANDHYD      ID=[2], NHYD=["EXT1"], DT=[1](min), AREA=[0.004](ha),
                    XIMP=[0.36], TIMP=[0.36], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[2.0](%),
                                         LGP=[15](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[30](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%------------------|-------------------------------------------------------|
*# CATCHMENT 102 -  TO HOWARD ROAD
*
CALIB STANDHYD      ID=[3], NHYD=["102"], DT=[1](min), AREA=[0.016](ha),
                    XIMP=[0.36], TIMP=[0.36], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[2.0](%),
                                         LGP=[15](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[7.0](%),
                                         LGI=[30](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%------------------|-------------------------------------------------------|
*# TOTAL TO PLAINS ROAD WEST
*
ADD HYD             IDsum=[4], NHYD=["101+EXT1"], IDs to add=[1+2]
*%------------------|-------------------------------------------------------|
*# CHECK
*
ADD HYD             IDsum=[5], NHYD=["CHECK"], IDs to add=[1+2+3]
*%------------------|-------------------------------------------------------|
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
*
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1](min), AREA=[0.256](ha),
                    XIMP=[0.88], TIMP=[0.88], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[4.0](%),
                                         LGP=[20](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[30](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%------------------|-------------------------------------------------------|
ROUTE RESERVOIR     IDout=[2],   NHYD=["201 ORIFICE"],  IDin=[1],
                    RDT=[1](min)
                          TABLE of ( OUTFLOW-STORAGE ) values
                                (cms) - (ha-m)
                               [   0.0 ,  0.0 ]
                               [   0.0190 , 0.0020  ]
                               [   0.0230 , 0.0039  ]
                               [   0.0270 , 0.0059  ]
                               [   0.0300 , 0.0078  ]
                               [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[3], NHYDovf=["OVF"]
*%------------------|-------------------------------------------------------|
*# CATCHMENT EXT1 -  TO NORTH LANDS
*
CALIB NASHYD        ID=[4], NHYD=["203"], DT=[1]min, AREA=[0.004](ha),
                    DWF=[0](cms),  CN/C=[75], IA=[8.47](mm),
                    N=[3], TP=[0.15]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%------------------|-------------------------------------------------------|
*# CATCHMENT 202 -  TO HOWARD ROAD
*
CALIB STANDHYD      ID=[5], NHYD=["202"], DT=[1](min), AREA=[0.005](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[2.0](%),
                                         LGP=[7](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[30](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%------------------|-------------------------------------------------------|
*# CHECK
*
ADD HYD             IDsum=[6], NHYD=["CHECK"], IDs to add=[2+3+4+5]
*%------------------|-------------------------------------------------------|
**#************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BUR6_002.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    BUR6_005.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
                    BUR6_010.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    BUR6_025.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    BUR6_050.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    BUR6_100.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[200]
                    hazel.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[225]
                    25MM.stm
*%------------------|-------------------------------------------------------|
FINISH
```

```
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 M 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: 2024-10-18     TIME: 11:36:40     RUN COUNTER: 001059         *
00039> ********************************************************************************
00040> * Input   filename: T:\PROJECTS\23082\SWMHYMO\23082.dat                        *
00041> * Output  filename: T:\PROJECTS\23082\SWMHYMO\23082.out                        *
00042> * Summary filename: T:\PROJECTS\23082\SWMHYMO\23082.sum                        *
00043> * User comments:                                                              *
00044> * 1:_____________________________________________________________________     *
00045> * 2:_____________________________________________________________________     *
00046> * 3:_____________________________________________________________________     *
00047> ********************************************************************************
00048>
00049> --------------------------------------------------------------------------------
00050> 001:0001--------------------------------------------------------------------------
00051> *#*****************************************************************************|
00052> *#  Project Name: 127 PLAINS ROAD WEST
00053> *#               BURLINGTON, ONTARIO
00054> *#  JOB NUMBER  : 23082
00055> *#       Date   : OCTOBER 2024
00056> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00057> *#       File   : 23082.DAT
00058> *#*****************************************************************************|
00059> *
00060>   ** END OF RUN :   1
00061>
00062> ********************************************************************************
00063>
00064>
00065>
00066>
00067>
00068> --------------------
00069> | START              |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
00070> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
00071>     TZERO =   .00 hrs on      0
00072>     METOUT=   2 (output = METRIC)
00073>     NRUN  = 002
00074>     NSTORM=   1
00075>               #  1=BUR6_002.stm
00076> --------------------------------------------------------------------------------
00077> 002:0002--------------------------------------------------------------------------
00078> *#*****************************************************************************|
00079> *#  Project Name: 127 PLAINS ROAD WEST
00080> *#               BURLINGTON, ONTARIO
00081> *#  JOB NUMBER  : 23082
00082> *#       Date   : OCTOBER 2024
00083> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00084> *#       File   : 23082.DAT
00085> *#*****************************************************************************|
00086> *
00087> --------------------------------------------------------------------------------
00088> 002:0002--------------------------------------------------------------------------
00089> *
00090> --------------------
00091> | READ STORM        |    Filename: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00092> | Ptotal=  40.93 mm|    Comments: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00093> --------------------
00094>              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00095>               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00096>               .17   1.715 |   1.67   8.325 |   3.17   4.467 |   4.67   2.213
00097>               .33   1.858 |   1.83  19.646 |   3.33   3.978 |   4.83   2.105
00098>               .50   2.032 |   2.00  78.391 |   3.50   3.595 |   5.00   2.008
00099>               .67   2.247 |   2.17  25.776 |   3.67   3.286 |   5.17   1.920
00100>               .83   2.522 |   2.33  13.777 |   3.83   3.030 |   5.33   1.841
00101>              1.00   2.888 |   2.50   9.511 |   4.00   2.815 |   5.50   1.769
00102>              1.17   3.399 |   2.67   7.331 |   4.17   2.632 |   5.67   1.703
00103>              1.33   4.172 |   2.83   6.005 |   4.33   2.474 |   5.83   1.642
00104>              1.50   5.492 |   3.00   5.111 |   4.50   2.335 |   6.00   1.586
00105>
00106> --------------------------------------------------------------------------------
00107> 002:0003--------------------------------------------------------------------------
00108> *
00109> *#*****************************************************************************|
00110> *#
00111> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00112> *#        ==============================================
00113> *#
00114> *#*****************************************************************************|
00115> *# CATCHMENT 101 -  TO PLAINS ROAD WEST
00116> *
00117> ----------------------
00118> | CALIB STANDHYD     |   Area    (ha)=     .25
00119> | 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00120> ----------------------
00121>                                IMPERVIOUS    PERVIOUS (i)
00122>      Surface Area     (ha)=        .09          .16
00123>      Dep. Storage     (mm)=       1.00         8.47
00124>      Average Slope     (%)=       5.00         2.00
00125>      Length            (m)=      30.00        15.00
00126>      Mannings n             =       .013         .250
00127>
00128>      Max.eff.Inten.(mm/hr)=      78.39        12.07
00129>                over (min)        1.00        10.00
00130>      Storage Coeff.  (min)=        .84 (ii)    9.97 (ii)
00131>      Unit Hyd. Tpeak (min)=       1.00        10.00
00132>      Unit Hyd. peak  (cms)=       1.18          .11
00133>                                                          *TOTALS*
00134>      PEAK FLOW       (cms)=        .02          .00          .021 (iii)
00135>      TIME TO PEAK    (hrs)=       2.00         2.15         2.000
00136>      RUNOFF VOLUME   (mm)=       39.93         9.00        20.134
00137>      TOTAL RAINFALL  (mm)=       40.93        40.93        40.933
00138>      RUNOFF COEFFICIENT  =         .98          .22          .492
00139>
00140>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00141>            CN* =  75.0    Ia = Dep. Storage  (Above)
00142>         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00143>              THAN THE STORAGE COEFFICIENT.
00144>        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00145>
00146> --------------------------------------------------------------------------------
00147> 002:0004--------------------------------------------------------------------------
00148> *# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
00149> *
00150> ----------------------
00151> | CALIB STANDHYD     |   Area    (ha)=     .00
00152> | 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00153> ----------------------
00154>                                IMPERVIOUS    PERVIOUS (i)
00155>      Surface Area     (ha)=        .00          .00
00156>      Dep. Storage     (mm)=       1.00         8.47
00157>      Average Slope     (%)=       2.00         2.00
00158>      Length            (m)=      30.00        15.00
00159>      Mannings n             =       .013         .250
00160>
00161>      Max.eff.Inten.(mm/hr)=      78.39        12.07
00162>                over (min)        1.00        10.00
00163>      Storage Coeff.  (min)=       1.11 (ii)   10.24 (ii)
00164>      Unit Hyd. Tpeak (min)=       1.00        10.00
00165>      Unit Hyd. peak  (cms)=       1.01          .11
00166>                                                          *TOTALS*
00167>      PEAK FLOW       (cms)=        .00          .00          .000 (iii)
00168>      TIME TO PEAK    (hrs)=       1.98         2.15         2.000
00169>      RUNOFF VOLUME   (mm)=       39.93         9.00        20.134
00170>      TOTAL RAINFALL  (mm)=       40.93        40.93        40.933
00171>      RUNOFF COEFFICIENT  =         .98          .22          .492
00172>
00173>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00174>            CN* =  75.0    Ia = Dep. Storage  (Above)
00175>         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00176>              THAN THE STORAGE COEFFICIENT.
00177>        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00178>
00179> --------------------------------------------------------------------------------
00180> 002:0005--------------------------------------------------------------------------
00181> *# CATCHMENT 102 -  TO HOWARD ROAD
00182> *
00183> ----------------------
00184> | CALIB STANDHYD     |   Area    (ha)=     .02
00185> | 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00186> ----------------------
00187>                                IMPERVIOUS    PERVIOUS (i)
00188>      Surface Area     (ha)=        .01          .01
00189>      Dep. Storage     (mm)=       1.00         8.47
00190>      Average Slope     (%)=       7.00         2.00
00191>      Length            (m)=      30.00        15.00
00192>      Mannings n             =       .013         .250
00193>
00194>      Max.eff.Inten.(mm/hr)=      78.39        12.07
00195>                over (min)        1.00        10.00
00196>      Storage Coeff.  (min)=        .76 (ii)    9.89 (ii)
00197>      Unit Hyd. Tpeak (min)=       1.00        10.00
00198>      Unit Hyd. peak  (cms)=       1.24          .11
00199>                                                          *TOTALS*
00200>      PEAK FLOW       (cms)=        .00          .00          .001 (iii)
00201>      TIME TO PEAK    (hrs)=       1.97         2.15         2.000
00202>      RUNOFF VOLUME   (mm)=       39.93         9.00        20.133
00203>      TOTAL RAINFALL  (mm)=       40.93        40.93        40.933
00204>      RUNOFF COEFFICIENT  =         .98          .22          .492
00205>
00206>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00207>            CN* =  75.0    Ia = Dep. Storage  (Above)
00208>         (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00209>              THAN THE STORAGE COEFFICIENT.
00210>        (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00211>
00212> --------------------------------------------------------------------------------
00213> 002:0006--------------------------------------------------------------------------
00214> *# TOTAL TO PLAINS ROAD WEST
00215> *
00216> ------------------------
00217> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00218> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
00219>                        ID1 01:101           .25     .021    2.00  20.13    .000
00220>                      +ID2 02:EXT1           .00     .000    2.00  20.13    .000
00221>                        ========================================================
00222>                        SUM 04:101+EXT1      .25     .021    2.00  20.13    .000
00223>
00224>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00225>
00226> --------------------------------------------------------------------------------
00227> 002:0007--------------------------------------------------------------------------
00228> *# CHECK
00229> *
00230> ------------------------
00231> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00232> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
00233>                        ID1 01:101           .25     .021    2.00  20.13    .000
00234>                      +ID2 02:EXT1           .00     .000    2.00  20.13    .000
00235>                      +ID3 03:102            .02     .001    2.00  20.13    .000
00236>                        ========================================================
00237>                        SUM 05:CHECK         .27     .022    2.00  20.13    .000
00238>
00239>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00240>
00241> --------------------------------------------------------------------------------
00242> 002:0008--------------------------------------------------------------------------
00243> *#*****************************************************************************|
00244> *#
00245> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00246> *#        ==============================================
00247> *#
00248> *#*****************************************************************************|
00249> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
00250> *
00251> ----------------------
00252> | CALIB STANDHYD     |   Area    (ha)=     .26
00253> | 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
00254> ----------------------
00255>                                IMPERVIOUS    PERVIOUS (i)
00256>      Surface Area     (ha)=        .23          .03
00257>      Dep. Storage     (mm)=       1.00         8.47
00258>      Average Slope     (%)=       2.00         4.00
00259>      Length            (m)=      30.00        20.00
00260>      Mannings n             =       .013         .250
00261>
00262>      Max.eff.Inten.(mm/hr)=      78.39        12.07
00263>                over (min)        1.00        10.00
00264>      Storage Coeff.  (min)=       1.11 (ii)    9.92 (ii)
00265>      Unit Hyd. Tpeak (min)=       1.00        10.00
00266>      Unit Hyd. peak  (cms)=       1.01          .11
00267>                                                          *TOTALS*
00268>      PEAK FLOW       (cms)=        .05          .00          .049 (iii)
00269>      TIME TO PEAK    (hrs)=       2.00         2.15         2.000
00270>      RUNOFF VOLUME   (mm)=       39.93         9.00        36.220
```

```
00271>      TOTAL RAINFALL   (mm)=      40.93        40.93         40.933
00272>      RUNOFF COEFFICIENT   =        .98          .22           .885
00273>
00274>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00275>            CN* =  75.0    Ia = Dep. Storage  (Above)
00276>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00277>            THAN THE STORAGE COEFFICIENT.
00278>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00279>
00280> ---------------------------------------------------------------------------
00281> 002:0009----------------------------------------------------------------------
00282> --------------------
00283> | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
00284> |  IN>01:(201   )   |
00285> | OUT<02:(201 OR)   |    =========  OUTLFOW STORAGE TABLE  =========
00286> --------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
00287>                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
00288>                           .000  .0000E+00    |     .027  .5900E-02
00289>                           .019  .2000E-02    |     .030  .7800E-02
00290>                           .023  .3900E-02    |     .000  .0000E+00
00291>
00292>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
00293>      ---------------            (ha)     (cms)     (hrs)       (mm)
00294>      INFLOW >01: (201   )        .26      .049     2.000      36.220
00295>      OUTFLOW<02: (201 OR)        .26      .020     2.033      36.220
00296>     OVERFLOW<03: (OVF   )        .00      .000      .000        .000
00297>
00298>                     TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
00299>                     CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
00300>                     PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
00301>
00302>
00303>                     PEAK   FLOW   REDUCTION [Qout/Qin](%)=   41.506
00304>                     TIME SHIFT OF PEAK FLOW         (min)=     2.00
00305>                     MAXIMUM  STORAGE   USED       (ha.m.)=.2703E-02
00306>
00307> ---------------------------------------------------------------------------
00308> 002:0010----------------------------------------------------------------------
00309> *# CATCHMENT EXT1 -  TO NORTH LANDS
00310> *
00311> ----------------------
00312> | CALIB NASHYD      |   Area    (ha)=     .00   Curve Number   (CN)=75.00
00313> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
00314> ----------------------   U.H. Tp(hrs)=    .150
00315>
00316>      Unit Hyd Qpeak  (cms)=     .001
00317>
00318>      PEAK FLOW       (cms)=     .000 (i)
00319>      TIME TO PEAK    (hrs)=    2.183
00320>      RUNOFF VOLUME    (mm)=    8.838
00321>      TOTAL RAINFALL   (mm)=   40.933
00322>      RUNOFF COEFFICIENT   =     .216
00323>
00324>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00325>
00326> ---------------------------------------------------------------------------
00327> 002:0011----------------------------------------------------------------------
00328> *# CATCHMENT 202 -  TO HOWARD ROAD
00329> *
00330> ----------------------
00331> | CALIB STANDHYD     |   Area    (ha)=     .00
00332> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00333> ----------------------
00334>                                IMPERVIOUS    PERVIOUS (i)
00335>      Surface Area     (ha)=        .00          .00
00336>      Dep. Storage     (mm)=       1.00         8.47
00337>      Average Slope     (%)=       2.00         2.00
00338>      Length            (m)=      30.00         7.00
00339>      Mannings n             =      .013         .250
00340>
00341>      Max.eff.Inten.(mm/hr)=     78.39        15.21
00342>                  over (min)        1.00         6.00
00343>      Storage Coeff.  (min)=       1.11 (ii)    6.38 (ii)
00344>      Unit Hyd. Tpeak (min)=       1.00         6.00
00345>      Unit Hyd. peak  (cms)=       1.01          .22
00346>                                                          *TOTALS*
00347>      PEAK FLOW       (cms)=        .00          .00          .001 (iii)
00348>      TIME TO PEAK    (hrs)=       2.00         2.07         2.000
00349>      RUNOFF VOLUME    (mm)=      39.93         9.00        39.618
00350>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00351>      RUNOFF COEFFICIENT   =        .98          .22          .968
00352>
00353>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00354>            CN* =  75.0    Ia = Dep. Storage  (Above)
00355>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00356>            THAN THE STORAGE COEFFICIENT.
00357>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00358>
00359> ---------------------------------------------------------------------------
00360> 002:0012----------------------------------------------------------------------
00361> *# CHECK
00362> *
00363> ------------------------
00364> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00365> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
00366>                       ID1 02:201 ORIFIC     .26      .020    2.03  36.22    .000
00367>                      +ID2 03:OVF            .00      .000     .00    .00    .000
00368>                      +ID3 04:203            .00      .000    2.18   8.84    .000
00369>                      +ID4 05:202            .00      .001    2.00  39.62    .000
00370>                       ========================================================
00371>                       SUM 06:CHECK          .27      .021    2.00  35.87    .000
00372>
00373>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00374>
00375> ---------------------------------------------------------------------------
00376> 002:0013----------------------------------------------------------------------
00377> **#*************************************************************************|
00378> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
00379> *
00380> ---------------------------------------------------------------------------
00381> 002:0002----------------------------------------------------------------------
00382> *
00383>   ** END OF RUN :   4
00384>
00385> ***************************************************************************
00386>
00387>
00388>
00389>
00390>
00391> --------------------
00392> | START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
00393> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
00394>     TZERO =   .00 hrs on        0
00395>     METOUT=   2 (output = METRIC)
00396>     NRUN  = 005
00397>     NSTORM=   1
00398>               #  1=BUR6_005.stm
00399> ---------------------------------------------------------------------------
00400> 005:0002----------------------------------------------------------------------
00401> *#*************************************************************************|
00402> *#  Project Name: 127 PLAINS ROAD WEST
00403> *#               BURLINGTON, ONTARIO
00404> *#  JOB NUMBER  : 23082
00405> *#       Date   : OCTOBER 2024
00406> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00407> *#       File   : 23082.DAT
00408> *#*************************************************************************|
00409> *
00410> ---------------------------------------------------------------------------
00411> 005:0002----------------------------------------------------------------------
00412> *
00413> --------------------
00414> | READ STORM        |    Filename: Burlington 5-yr 6hr CHICAGO    (A=802.04
00415> | Ptotal=  53.05 mm|    Comments: Burlington 5-yr 6hr CHICAGO    (A=802.04
00416> --------------------
00417>               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
00418>               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
00419>                .17   2.348 |  1.67  10.690 |  3.17   5.897 |  4.67   3.004
00420>                .33   2.537 |  1.83  24.479 |  3.33   5.279 |  4.83   2.862
00421>                .50   2.766 |  2.00 101.312 |  3.50   4.790 |  5.00   2.734
00422>                .67   3.048 |  2.17  31.941 |  3.67   4.394 |  5.17   2.619
00423>                .83   3.407 |  2.33  17.333 |  3.83   4.065 |  5.33   2.514
00424>               1.00   3.881 |  2.50  12.145 |  4.00   3.788 |  5.50   2.419
00425>               1.17   4.539 |  2.67   9.469 |  4.17   3.550 |  5.67   2.331
00426>               1.33   5.523 |  2.83   7.826 |  4.33   3.344 |  5.83   2.251
00427>               1.50   7.185 |  3.00   6.709 |  4.50   3.164 |  6.00   2.176
00428>
00429> ---------------------------------------------------------------------------
00430> 005:0003----------------------------------------------------------------------
00431> *
00432> *#*************************************************************************|
00433> *#
00434> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00435> *#        ==============================================
00436> *#
00437> *#*************************************************************************|
00438> *# CATCHMENT 101 -  TO PLAINS ROAD WEST
00439> *
00440> ----------------------
00441> | CALIB STANDHYD     |   Area    (ha)=     .25
00442> | 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00443> ----------------------
00444>                                IMPERVIOUS    PERVIOUS (i)
00445>      Surface Area     (ha)=        .09          .16
00446>      Dep. Storage     (mm)=       1.00         8.47
00447>      Average Slope     (%)=       5.00         2.00
00448>      Length            (m)=      30.00        15.00
00449>      Mannings n             =      .013         .250
00450>
00451>      Max.eff.Inten.(mm/hr)=     101.31        26.81
00452>                  over (min)        1.00         7.00
00453>      Storage Coeff.  (min)=        .76 (ii)    7.40 (ii)
00454>      Unit Hyd. Tpeak (min)=       1.00         7.00
00455>      Unit Hyd. peak  (cms)=       1.24          .16
00456>                                                          *TOTALS*
00457>      PEAK FLOW       (cms)=        .02          .01          .030 (iii)
00458>      TIME TO PEAK    (hrs)=       2.00         2.08         2.000
00459>      RUNOFF VOLUME    (mm)=      52.05        15.38        28.581
00460>      TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
00461>      RUNOFF COEFFICIENT   =        .98          .29          .539
00462>
00463>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00464>            CN* =  75.0    Ia = Dep. Storage  (Above)
00465>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00466>            THAN THE STORAGE COEFFICIENT.
00467>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00468>
00469> ---------------------------------------------------------------------------
00470> 005:0004----------------------------------------------------------------------
00471> *# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
00472> *
00473> ----------------------
00474> | CALIB STANDHYD     |   Area    (ha)=     .00
00475> | 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00476> ----------------------
00477>                                IMPERVIOUS    PERVIOUS (i)
00478>      Surface Area     (ha)=        .00          .00
00479>      Dep. Storage     (mm)=       1.00         8.47
00480>      Average Slope     (%)=       2.00         2.00
00481>      Length            (m)=      30.00        15.00
00482>      Mannings n             =      .013         .250
00483>
00484>      Max.eff.Inten.(mm/hr)=     101.31        25.43
00485>                  over (min)        1.00         8.00
00486>      Storage Coeff.  (min)=        1.00 (ii)    7.78 (ii)
00487>      Unit Hyd. Tpeak (min)=       1.00         8.00
00488>      Unit Hyd. peak  (cms)=       1.07          .14
00489>                                                          *TOTALS*
00490>      PEAK FLOW       (cms)=        .00          .00          .000 (iii)
00491>      TIME TO PEAK    (hrs)=       1.97         2.10         2.000
00492>      RUNOFF VOLUME    (mm)=      52.05        15.38        28.581
00493>      TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
00494>      RUNOFF COEFFICIENT   =        .98          .29          .539
00495>
00496>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00497>            CN* =  75.0    Ia = Dep. Storage  (Above)
00498>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00499>            THAN THE STORAGE COEFFICIENT.
00500>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00501>
00502> ---------------------------------------------------------------------------
00503> 005:0005----------------------------------------------------------------------
00504> *# CATCHMENT 102 -  TO HOWARD ROAD
00505> *
00506> ----------------------
00507> | CALIB STANDHYD     |   Area    (ha)=     .02
00508> | 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00509> ----------------------
00510>                                IMPERVIOUS    PERVIOUS (i)
00511>      Surface Area     (ha)=        .01          .01
00512>      Dep. Storage     (mm)=       1.00         8.47
00513>      Average Slope     (%)=       7.00         2.00
00514>      Length            (m)=      30.00        15.00
00515>      Mannings n             =      .013         .250
00516>
00517>      Max.eff.Inten.(mm/hr)=     101.31        26.81
00518>                  over (min)        1.00         7.00
00519>      Storage Coeff.  (min)=        .69 (ii)    7.32 (ii)
00520>      Unit Hyd. Tpeak (min)=       1.00         7.00
00521>      Unit Hyd. peak  (cms)=       1.30          .16
00522>                                                          *TOTALS*
00523>      PEAK FLOW       (cms)=        .00          .00          .002 (iii)
00524>      TIME TO PEAK    (hrs)=       1.95         2.08         2.000
00525>      RUNOFF VOLUME    (mm)=      52.05        15.38        28.580
00526>      TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
00527>      RUNOFF COEFFICIENT   =        .98          .29          .539
00528>
00529>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00530>            CN* =  75.0    Ia = Dep. Storage  (Above)
00531>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00532>            THAN THE STORAGE COEFFICIENT.
00533>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00534>
00535> ---------------------------------------------------------------------------
00536> 005:0006----------------------------------------------------------------------
00537> *# TOTAL TO PLAINS ROAD WEST
00538> *
00539> ------------------------
00540> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
```

```
                                                (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101                  .25     .030    2.00  28.58    .000
                    +ID2 02:EXT1                 .00     .000    2.00  28.58    .000
                     ================================================================
                     SUM 04:101+EXT1             .25     .030    2.00  28.58    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

005:0007-------------------------------------------------------------------------------
*# CHECK
*
------------------------
| ADD HYD (CHECK     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:101                  .25     .030    2.00  28.58    .000
                    +ID2 02:EXT1                 .00     .000    2.00  28.58    .000
                    +ID3 03:102                  .02     .002    2.00  28.58    .000
                     ================================================================
                     SUM 05:CHECK                .27     .032    2.00  28.58    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

005:0008-------------------------------------------------------------------------------
*#*****************************************************************************|
*#
*#         POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#         ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .26
| 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .23          .03
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         4.00
      Length            (m)=      30.00        20.00
      Mannings n             =     .013         .250

      Max.eff.Inten.(mm/hr)=     101.31        26.81
                  over (min)        1.00         7.00
      Storage Coeff.  (min)=       1.00 (ii)    7.41 (ii)
      Unit Hyd. Tpeak (min)=       1.00         7.00
      Unit Hyd. peak  (cms)=       1.07          .16
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .06          .00          .064 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.08         2.000
      RUNOFF VOLUME    (mm)=      52.05        15.38        47.652
      TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
      RUNOFF COEFFICIENT   =        .98          .29          .898

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0009-------------------------------------------------------------------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201   )    |
| OUT<02:(201 OR)    |    =========  OUTLFOW STORAGE TABLE  =========
----------------------    OUTFLOW     STORAGE   |  OUTFLOW     STORAGE
                            (cms)      (ha.m.)   |    (cms)     (ha.m.)
                             .000  .0000E+00    |     .027  .5900E-02
                             .019  .2000E-02    |     .030  .7800E-02
                             .023  .3900E-02    |     .000  .0000E+00

      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
      ---------------            (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (201   )        .26      .064     2.000     47.652
      OUTFLOW<02: (201 OR)        .26      .023     2.067     47.652
     OVERFLOW<03: (OVF   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   34.980
                    TIME SHIFT OF PEAK FLOW          (min)=     4.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.3678E-02

005:0010-------------------------------------------------------------------------------
*# CATCHMENT EXT1 -  TO NORTH LANDS
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
| 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
----------------------  U.H. Tp(hrs)=    .150

      Unit Hyd Qpeak  (cms)=     .001

      PEAK FLOW       (cms)=     .000 (i)
      TIME TO PEAK    (hrs)=    2.150
      RUNOFF VOLUME    (mm)=   15.250
      TOTAL RAINFALL   (mm)=   53.053
      RUNOFF COEFFICIENT   =     .287

      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0011-------------------------------------------------------------------------------
*# CATCHMENT 202 -  TO HOWARD ROAD
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .00
| 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .00          .00
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length            (m)=      30.00         7.00
      Mannings n             =     .013         .250

      Max.eff.Inten.(mm/hr)=     101.31        29.42
                  over (min)        1.00         5.00
      Storage Coeff.  (min)=       1.00 (ii)    5.05 (ii)
      Unit Hyd. Tpeak (min)=       1.00         5.00
      Unit Hyd. peak  (cms)=       1.07          .25
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .00          .00          .001 (iii)
      TIME TO PEAK    (hrs)=       1.98         2.05         2.000
      RUNOFF VOLUME    (mm)=      52.05        15.38        51.680
      TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
      RUNOFF COEFFICIENT   =        .98          .29          .974

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0012-------------------------------------------------------------------------------
*# CHECK
*
------------------------
| ADD HYD (CHECK     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 02:201 ORIFIC      .26     .023    2.07  47.65    .000
                     +ID2 03:OVF             .00     .000     .00    .00    .000
                     +ID3 04:203             .00     .000    2.15  15.25    .000
                     +ID4 05:202             .00     .001    2.00  51.68    .000
                      ================================================================
                      SUM 06:CHECK           .27     .023    2.00  47.24    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

005:0013-------------------------------------------------------------------------------
**#****************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
005:0002-------------------------------------------------------------------------------
*
005:0002-------------------------------------------------------------------------------
*
  ** END OF RUN :   9
*****************************************************************************
```

```
----------------------
| START              |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
----------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
             #  1=BUR6_010.stm

010:0002-------------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 127 PLAINS ROAD WEST
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23082
*#       Date   : OCTOBER 2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23082.DAT
*#*****************************************************************************|
*
010:0002-------------------------------------------------------------------------------
*
----------------------
| READ STORM         |    Filename: Burlington 10-yr 6hr CHICAGO     (A=918.
| Ptotal=  61.10 mm  |    Comments: Burlington 10-yr 6hr CHICAGO     (A=918.
----------------------
               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   2.714 |   1.67  12.326 |   3.17   6.808 |   4.67   3.472
               .33   2.933 |   1.83  28.176 |   3.33   6.095 |   4.83   3.308
               .50   3.197 |   2.00 116.310 |   3.50   5.532 |   5.00   3.161
               .67   3.523 |   2.17  36.748 |   3.67   5.075 |   5.17   3.027
               .83   3.937 |   2.33  19.967 |   3.83   4.696 |   5.33   2.907
              1.00   4.483 |   2.50  14.001 |   4.00   4.376 |   5.50   2.796
              1.17   5.242 |   2.67  10.921 |   4.17   4.102 |   5.67   2.695
              1.33   6.377 |   2.83   9.030 |   4.33   3.864 |   5.83   2.602
              1.50   8.291 |   3.00   7.743 |   4.50   3.656 |   6.00   2.516

010:0003-------------------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#         PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#         ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .09          .16
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       5.00         2.00
      Length            (m)=      30.00        15.00
      Mannings n             =     .013         .250

      Max.eff.Inten.(mm/hr)=     116.31        36.34
                  over (min)        1.00         7.00
      Storage Coeff.  (min)=        .72 (ii)    6.59 (ii)
      Unit Hyd. Tpeak (min)=       1.00         7.00
      Unit Hyd. peak  (cms)=       1.27          .17
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .03          .01          .036 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.08         2.000
      RUNOFF VOLUME    (mm)=      60.10        20.18        34.549
      TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
      RUNOFF COEFFICIENT   =        .98          .33          .565

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

010:0004-------------------------------------------------------------------------------
*# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .00
| 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .00          .00
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length            (m)=      30.00        15.00
      Mannings n             =     .013         .250

      Max.eff.Inten.(mm/hr)=     116.31        36.34
```

```
00811>                over (min)        1.00         7.00
00812>     Storage Coeff.  (min)=        .95 (ii)    6.82 (ii)
00813>     Unit Hyd. Tpeak (min)=       1.00         7.00
00814>     Unit Hyd. peak  (cms)=       1.11          .16
00815>                                                        *TOTALS*
00816>     PEAK FLOW       (cms)=        .00          .00          .001 (iii)
00817>     TIME TO PEAK    (hrs)=       2.00         2.08         2.000
00818>     RUNOFF VOLUME    (mm)=      60.10        20.18        34.549
00819>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00820>     RUNOFF COEFFICIENT   =        .98          .33          .565
00821>
00822>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00823>           CN* =  75.0    Ia = Dep. Storage  (Above)
00824>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00825>           THAN THE STORAGE COEFFICIENT.
00826>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00827>
00828> ------------------------------------------------------------------------------
00829> 010:0005------------------------------------------------------------------------
00830> *# CATCHMENT 102 -  TO HOWARD ROAD
00831> *
00832> ----------------------
00833> | CALIB STANDHYD     |   Area    (ha)=     .02
00834> | 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00835> ----------------------
00836>                              IMPERVIOUS    PERVIOUS (i)
00837>     Surface Area     (ha)=        .01          .01
00838>     Dep. Storage     (mm)=       1.00         8.47
00839>     Average Slope     (%)=       7.00         2.00
00840>     Length            (m)=      30.00        15.00
00841>     Mannings n            =       .013         .250
00842>
00843>     Max.eff.Inten.(mm/hr)=     116.31        37.93
00844>                over (min)        1.00         6.00
00845>     Storage Coeff.  (min)=        .65 (ii)    6.43 (ii)
00846>     Unit Hyd. Tpeak (min)=       1.00         6.00
00847>     Unit Hyd. peak  (cms)=       1.33          .18
00848>                                                        *TOTALS*
00849>     PEAK FLOW       (cms)=        .00          .00          .002 (iii)
00850>     TIME TO PEAK    (hrs)=       1.98         2.07         2.000
00851>     RUNOFF VOLUME    (mm)=      60.10        20.18        34.548
00852>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00853>     RUNOFF COEFFICIENT   =        .98          .33          .565
00854>
00855>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00856>           CN* =  75.0    Ia = Dep. Storage  (Above)
00857>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00858>           THAN THE STORAGE COEFFICIENT.
00859>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00860>
00861> ------------------------------------------------------------------------------
00862> 010:0006------------------------------------------------------------------------
00863> *# TOTAL TO PLAINS ROAD WEST
00864> *
00865> ------------------------
00866> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00867> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
00868>                        ID1 01:101          .25     .036    2.00  34.55    .000
00869>                       +ID2 02:EXT1         .00     .001    2.00  34.55    .000
00870>                        ========================================================
00871>                        SUM 04:101+EXT1      .25     .037    2.00  34.55    .000
00872>
00873>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00874>
00875> ------------------------------------------------------------------------------
00876> 010:0007------------------------------------------------------------------------
00877> *# CHECK
00878> *
00879> ------------------------
00880> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00881> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
00882>                        ID1 01:101          .25     .036    2.00  34.55    .000
00883>                       +ID2 02:EXT1         .00     .001    2.00  34.55    .000
00884>                       +ID3 03:102          .02     .002    2.00  34.55    .000
00885>                        ========================================================
00886>                        SUM 05:CHECK        .27     .039    2.00  34.55    .000
00887>
00888>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00889>
00890> ------------------------------------------------------------------------------
00891> 010:0008------------------------------------------------------------------------
00892> *#*****************************************************************************|
00893> *#
00894> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00895> *#        ==============================================
00896> *#
00897> *#*****************************************************************************|
00898> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
00899> *
00900> ----------------------
00901> | CALIB STANDHYD     |   Area    (ha)=     .26
00902> | 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
00903> ----------------------
00904>                              IMPERVIOUS    PERVIOUS (i)
00905>     Surface Area     (ha)=        .23          .03
00906>     Dep. Storage     (mm)=       1.00         8.47
00907>     Average Slope     (%)=       2.00         4.00
00908>     Length            (m)=      30.00        20.00
00909>     Mannings n            =       .013         .250
00910>
00911>     Max.eff.Inten.(mm/hr)=     116.31        36.34
00912>                over (min)        1.00         7.00
00913>     Storage Coeff.  (min)=        .95 (ii)    6.62 (ii)
00914>     Unit Hyd. Tpeak (min)=       1.00         7.00
00915>     Unit Hyd. peak  (cms)=       1.11          .17
00916>                                                        *TOTALS*
00917>     PEAK FLOW       (cms)=        .07          .00          .074 (iii)
00918>     TIME TO PEAK    (hrs)=       2.00         2.08         2.000
00919>     RUNOFF VOLUME    (mm)=      60.10        20.18        55.310
00920>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00921>     RUNOFF COEFFICIENT   =        .98          .33          .905
00922>
00923>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00924>           CN* =  75.0    Ia = Dep. Storage  (Above)
00925>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00926>           THAN THE STORAGE COEFFICIENT.
00927>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00928>
00929> ------------------------------------------------------------------------------
00930> 010:0009------------------------------------------------------------------------
00931> ----------------------
00932> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
00933> |  IN>01:(201   )    |
00934> | OUT<02:(201 OR)    |    =========  OUTLFOW STORAGE TABLE  =========
00935> ----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
00936>                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
00937>                             .000  .0000E+00    |     .027  .5900E-02
00938>                             .019  .2000E-02    |     .030  .7800E-02
00939>                             .023  .3900E-02    |     .000  .0000E+00
00940>
00941>     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
00942>     --------------------        (ha)     (cms)     (hrs)       (mm)
00943>     INFLOW >01: (201   )         .26      .074     2.000     55.310
00944>     OUTFLOW<02: (201 OR)         .26      .024     2.167     55.310
00945>    OVERFLOW<03: (OVF   )         .00      .000      .000       .000
00946>
00947>                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
00948>                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
00949>                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
00950>
00951>
00952>                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   32.318
00953>                  TIME SHIFT OF PEAK FLOW          (min)=   10.00
00954>                  MAXIMUM  STORAGE   USED       (ha.m.)=.4412E-02
00955>
00956> ------------------------------------------------------------------------------
00957> 010:0010------------------------------------------------------------------------
00958> *# CATCHMENT EXT1 -  TO NORTH LANDS
00959> *
00960> ----------------------
00961> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
00962> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
00963> ----------------------   U.H. Tp(hrs)=    .150
00964>
00965>     Unit Hyd Qpeak  (cms)=     .001
00966>
00967>     PEAK FLOW       (cms)=     .000 (i)
00968>     TIME TO PEAK    (hrs)=    2.150
00969>     RUNOFF VOLUME    (mm)=   20.065
00970>     TOTAL RAINFALL   (mm)=   61.101
00971>     RUNOFF COEFFICIENT   =     .328
00972>
00973>     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00974>
00975> ------------------------------------------------------------------------------
00976> 010:0011------------------------------------------------------------------------
00977> *# CATCHMENT 202 -  TO HOWARD ROAD
00978> *
00979> ----------------------
00980> | CALIB STANDHYD     |   Area    (ha)=     .00
00981> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00982> ----------------------
00983>                              IMPERVIOUS    PERVIOUS (i)
00984>     Surface Area     (ha)=        .00          .00
00985>     Dep. Storage     (mm)=       1.00         8.47
00986>     Average Slope     (%)=       2.00         2.00
00987>     Length            (m)=      30.00         7.00
00988>     Mannings n            =       .013         .250
00989>
00990>     Max.eff.Inten.(mm/hr)=     116.31        39.45
00991>                over (min)        1.00         5.00
00992>     Storage Coeff.  (min)=        .95 (ii)    4.55 (ii)
00993>     Unit Hyd. Tpeak (min)=       1.00         5.00
00994>     Unit Hyd. peak  (cms)=       1.11          .26
00995>                                                        *TOTALS*
00996>     PEAK FLOW       (cms)=        .00          .00          .002 (iii)
00997>     TIME TO PEAK    (hrs)=       2.00         2.03         2.000
00998>     RUNOFF VOLUME    (mm)=      60.10        20.18        59.698
00999>     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
01000>     RUNOFF COEFFICIENT   =        .98          .33          .977
01001>
01002>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01003>           CN* =  75.0    Ia = Dep. Storage  (Above)
01004>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01005>           THAN THE STORAGE COEFFICIENT.
01006>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01007>
01008> ------------------------------------------------------------------------------
01009> 010:0012------------------------------------------------------------------------
01010> *# CHECK
01011> *
01012> ------------------------
01013> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01014> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
01015>                        ID1 02:201 ORIFIC    .26     .024    2.17  55.31    .000
01016>                       +ID2 03:OVF           .00     .000     .00    .00    .000
01017>                       +ID3 04:203           .00     .000    2.15  20.07    .000
01018>                       +ID4 05:202           .00     .002    2.00  59.70    .000
01019>                        ========================================================
01020>                        SUM 06:CHECK         .27     .025    2.00  54.86    .000
01021>
01022>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01023>
01024> ------------------------------------------------------------------------------
01025> 010:0013------------------------------------------------------------------------
01026> *#*****************************************************************************|
01027> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
01028> *
01029> ------------------------------------------------------------------------------
01030> 010:0002------------------------------------------------------------------------
01031> *
01032> ------------------------------------------------------------------------------
01033> 010:0002------------------------------------------------------------------------
01034> *
01035> ------------------------------------------------------------------------------
01036> 010:0002------------------------------------------------------------------------
01037> *
01038>  ** END OF RUN :  24
01039>
01040> ******************************************************************************
01041>
01042>
01043>
01044>
01045>
01046> --------------------
01047> | START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
01048> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
01049>     TZERO =   .00 hrs on      0
01050>     METOUT=   2 (output = METRIC)
01051>     NRUN  = 025
01052>     NSTORM=   1
01053>               #  1=BUR6_025.stm
01054> ------------------------------------------------------------------------------
01055> 025:0002------------------------------------------------------------------------
01056> *#*****************************************************************************|
01057> *#  Project Name: 127 PLAINS ROAD WEST
01058> *#               BURLINGTON, ONTARIO
01059> *#  JOB NUMBER  : 23082
01060> *#       Date   : OCTOBER 2024
01061> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
01062> *#       File   : 23082.DAT
01063> *#*****************************************************************************|
01064> *
01065> ------------------------------------------------------------------------------
01066> 025:0002------------------------------------------------------------------------
01067> *
01068> --------------------
01069> | READ STORM        |    Filename: Burlington 25-yr 6hr CHICAGO      (A=106
01070> | Ptotal=  71.35 mm|    Comments: Burlington 25-yr 6hr CHICAGO      (A=106
01071> --------------------
01072>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
01073>               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
01074>               .17   3.182 |   1.67  14.410 |   3.17   7.968 |   4.67   4.068
01075>               .33   3.437 |   1.83  32.881 |   3.33   7.135 |   4.83   3.876
01076>               .50   3.746 |   2.00 135.380 |   3.50   6.477 |   5.00   3.704
01077>               .67   4.128 |   2.17  42.866 |   3.67   5.943 |   5.17   3.548
01078>               .83   4.612 |   2.33  23.321 |   3.83   5.499 |   5.33   3.407
01079>              1.00   5.251 |   2.50  16.365 |   4.00   5.125 |   5.50   3.278
01080>              1.17   6.138 |   2.67  12.771 |   4.17   4.805 |   5.67   3.160
```

```
              1.33   7.465 |   2.83  10.563 |   4.33   4.527 |   5.83   3.051
              1.50   9.700 |   3.00   9.061 |   4.50   4.284 |   6.00   2.950

--------------------------------------------------------------------------------
025:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       5.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        51.56
                  over (min)       1.00         6.00
     Storage Coeff.  (min)=        .68 (ii)    5.78 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.31          .19
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .03          .02          .046 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.05         2.000
     RUNOFF VOLUME    (mm)=      70.35        26.79        42.474
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .38          .595

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0004----------------------------------------------------------------------
*# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .00
| 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .00          .00
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        51.56
                  over (min)       1.00         6.00
     Storage Coeff.  (min)=        .89 (ii)    6.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.14          .19
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .001 (iii)
     TIME TO PEAK    (hrs)=       1.97         2.07         2.000
     RUNOFF VOLUME    (mm)=      70.34        26.80        42.471
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .38          .595

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0005----------------------------------------------------------------------
*# CATCHMENT 102 -  TO HOWARD ROAD
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .01          .01
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       7.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        51.56
                  over (min)       1.00         6.00
     Storage Coeff.  (min)=        .61 (ii)    5.72 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.37          .19
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .003 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.05         2.000
     RUNOFF VOLUME    (mm)=      70.35        26.80        42.474
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .38          .595

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0006----------------------------------------------------------------------
*# TOTAL TO PLAINS ROAD WEST
*
-------------------------
| ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------------------- (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:101           .25     .046    2.00  42.47    .000
                     +ID2 02:EXT1          .00     .001    2.00  42.47    .000
                      ================================================
                      SUM 04:101+EXT1      .25     .047    2.00  42.47    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
025:0007----------------------------------------------------------------------
*# CHECK
*
-------------------------
| ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------------------- (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:101           .25     .046    2.00  42.47    .000
                     +ID2 02:EXT1          .00     .001    2.00  42.47    .000
                     +ID3 03:102           .02     .003    2.00  42.47    .000
                      ================================================
                      SUM 05:CHECK         .27     .050    2.00  42.47    .000

01216>
01217>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01218>
01219> --------------------------------------------------------------------------------
01220> 025:0008----------------------------------------------------------------------
01221> *#*****************************************************************************|
01222> *#
01223> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
01224> *#        ==============================================
01225> *#
01226> *#*****************************************************************************|
01227> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
01228> *
01229> ----------------------
01230> | CALIB STANDHYD     |   Area    (ha)=     .26
01231> | 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
01232> ----------------------
01233>                               IMPERVIOUS    PERVIOUS (i)
01234>      Surface Area     (ha)=        .23          .03
01235>      Dep. Storage     (mm)=       1.00         8.47
01236>      Average Slope     (%)=       2.00         4.00
01237>      Length            (m)=      30.00        20.00
01238>      Mannings n            =       .013         .250
01239>
01240>      Max.eff.Inten.(mm/hr)=     135.38        51.56
01241>                   over (min)       1.00         6.00
01242>      Storage Coeff.  (min)=        .89 (ii)    5.82 (ii)
01243>      Unit Hyd. Tpeak (min)=       1.00         6.00
01244>      Unit Hyd. peak  (cms)=       1.14          .19
01245>                                                          *TOTALS*
01246>      PEAK FLOW       (cms)=        .08          .00          .087 (iii)
01247>      TIME TO PEAK    (hrs)=       2.00         2.05         2.000
01248>      RUNOFF VOLUME    (mm)=      70.35        26.80        65.120
01249>      TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
01250>      RUNOFF COEFFICIENT   =        .99          .38          .913
01251>
01252>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01253>            CN* =  75.0    Ia = Dep. Storage  (Above)
01254>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01255>            THAN THE STORAGE COEFFICIENT.
01256>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01257>
01258> --------------------------------------------------------------------------------
01259> 025:0009----------------------------------------------------------------------
01260> ----------------------
01261> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
01262> |  IN>01:(201    )   |
01263> | OUT<02:(201 OR)    |    =========  OUTFLOW STORAGE TABLE  =========
01264> ----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
01265>                             (cms)     (ha.m.)   |    (cms)    (ha.m.)
01266>                             .000  .0000E+00   |     .027  .5900E-02
01267>                             .019  .2000E-02   |     .030  .7800E-02
01268>                             .023  .3900E-02   |     .000  .0000E+00
01269>
01270>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
01271>      ---------------            (ha)     (cms)     (hrs)       (mm)
01272>      INFLOW >01: (201    )       .26      .087     2.000     65.120
01273>      OUTFLOW<02: (201 OR)        .26      .026     2.167     65.120
01274>     OVERFLOW<03: (OVF    )       .00      .000      .000       .000
01275>
01276>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
01277>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
01278>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
01279>
01280>
01281>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   29.839
01282>                    TIME SHIFT OF PEAK FLOW          (min)=    10.00
01283>                    MAXIMUM  STORAGE   USED       (ha.m.)=.5429E-02
01284>
01285> --------------------------------------------------------------------------------
01286> 025:0010----------------------------------------------------------------------
01287> *# CATCHMENT EXT1 -  TO NORTH LANDS
01288> *
01289> ----------------------
01290> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
01291> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
01292> ----------------------   U.H. Tp(hrs)=    .150
01293>
01294>      Unit Hyd Qpeak  (cms)=     .001
01295>
01296>      PEAK FLOW       (cms)=     .000 (i)
01297>      TIME TO PEAK    (hrs)=    2.133
01298>      RUNOFF VOLUME    (mm)=   26.689
01299>      TOTAL RAINFALL   (mm)=   71.347
01300>      RUNOFF COEFFICIENT   =     .374
01301>
01302>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01303>
01304> --------------------------------------------------------------------------------
01305> 025:0011----------------------------------------------------------------------
01306> *# CATCHMENT 202 -  TO HOWARD ROAD
01307> *
01308> ----------------------
01309> | CALIB STANDHYD     |   Area    (ha)=     .00
01310> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
01311> ----------------------
01312>                               IMPERVIOUS    PERVIOUS (i)
01313>      Surface Area     (ha)=        .00          .00
01314>      Dep. Storage     (mm)=       1.00         8.47
01315>      Average Slope     (%)=       2.00         2.00
01316>      Length            (m)=      30.00         7.00
01317>      Mannings n            =       .013         .250
01318>
01319>      Max.eff.Inten.(mm/hr)=     135.38        55.15
01320>                   over (min)       1.00         4.00
01321>      Storage Coeff.  (min)=        .89 (ii)    4.04 (ii)
01322>      Unit Hyd. Tpeak (min)=       1.00         4.00
01323>      Unit Hyd. peak  (cms)=       1.14          .29
01324>                                                          *TOTALS*
01325>      PEAK FLOW       (cms)=        .00          .00          .002 (iii)
01326>      TIME TO PEAK    (hrs)=       1.98         2.02         2.000
01327>      RUNOFF VOLUME    (mm)=      70.34        26.80        69.908
01328>      TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
01329>      RUNOFF COEFFICIENT   =        .99          .38          .980
01330>
01331>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01332>            CN* =  75.0    Ia = Dep. Storage  (Above)
01333>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01334>            THAN THE STORAGE COEFFICIENT.
01335>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01336>
01337> --------------------------------------------------------------------------------
01338> 025:0012----------------------------------------------------------------------
01339> *# CHECK
01340> *
01341> -------------------------
01342> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01343> -------------------------------------- (ha)     (cms)   (hrs)   (mm)   (cms)
01344>                       ID1 02:201 ORIFIC     .26      .026    2.17  65.12    .000
01345>                      +ID2 03:OVF            .00      .000     .00    .00    .000
01346>                      +ID3 04:203            .00      .000    2.13  26.69    .000
01347>                      +ID4 05:202            .00      .002    2.00  69.91    .000
01348>                       ================================================
01349>                       SUM 06:CHECK          .27      .027    2.00  64.63    .000
01350>
```

```
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
025:0013--------------------------------------------------------------------------
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
  ** END OF RUN :  49

*****************************************************************************
```

```
--------------------
| START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
             #  1=BUR6_050.stm
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 127 PLAINS ROAD WEST
*#               BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23082
*#       Date   : OCTOBER 2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 23082.DAT
*#*************************************************************************|
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 50-yr 6hr CHICAGO     (A=1172
| Ptotal=  78.93 mm|    Comments: Burlington 50-yr 6hr CHICAGO     (A=1172
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	3.533	1.67	15.961	3.17	8.836	4.67	4.516
.33	3.817	1.83	36.356	3.33	7.913	4.83	4.304
.50	4.160	2.00	149.296	3.50	7.185	5.00	4.113
.67	4.582	2.17	47.374	3.67	6.593	5.17	3.940
.83	5.119	2.33	25.806	3.83	6.102	5.33	3.783
1.00	5.827	2.50	18.121	4.00	5.688	5.50	3.640
1.17	6.809	2.67	14.149	4.17	5.333	5.67	3.509
1.33	8.278	2.83	11.707	4.33	5.025	5.83	3.388
1.50	10.753	3.00	10.045	4.50	4.755	6.00	3.277

```
--------------------------------------------------------------------------------
050:0003--------------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .16
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       5.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        64.31
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .65 (ii)    5.33 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.33          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .02          .055 (iii)
     TIME TO PEAK    (hrs)=       1.98         2.03         2.000
     RUNOFF VOLUME    (mm)=      77.93        32.00        48.539
     TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
     RUNOFF COEFFICIENT   =        .99          .41          .615

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0004--------------------------------------------------------------------------
*# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .00
| 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .00          .00
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        62.27
                   over (min)        1.00         6.00
     Storage Coeff.  (min)=        .86 (ii)    5.59 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.17          .20
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .001 (iii)
     TIME TO PEAK    (hrs)=       1.97         2.05         2.000
     RUNOFF VOLUME    (mm)=      77.93        32.01        48.536
     TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
     RUNOFF COEFFICIENT   =        .99          .41          .615

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0005--------------------------------------------------------------------------
*# CATCHMENT 102 -  TO HOWARD ROAD
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .02
| 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .01          .01
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       7.00         2.00
     Length            (m)=      30.00        15.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        64.31
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .59 (ii)    5.26 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.39          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .00          .00          .004 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03         2.000
     RUNOFF VOLUME    (mm)=      77.93        32.01        48.539
     TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
     RUNOFF COEFFICIENT   =        .99          .41          .615

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0006--------------------------------------------------------------------------
*# TOTAL TO PLAINS ROAD WEST
*
------------------------
| ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:101          .25     .055    2.00  48.54    .000
                       +ID2 02:EXT1         .00     .001    2.00  48.54    .000
                        ==========================================================
                        SUM 04:101+EXT1     .25     .055    2.00  48.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
050:0007--------------------------------------------------------------------------
*# CHECK
*
------------------------
| ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:101          .25     .055    2.00  48.54    .000
                       +ID2 02:EXT1         .00     .001    2.00  48.54    .000
                       +ID3 03:102          .02     .004    2.00  48.54    .000
                        ==========================================================
                        SUM 05:CHECK        .27     .059    2.00  48.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
050:0008--------------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .26
| 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .03
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         4.00
     Length            (m)=      30.00        20.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        64.31
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .86 (ii)    5.37 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.17          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .09          .00          .097 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.03         2.000
     RUNOFF VOLUME    (mm)=      77.93        32.01        72.421
     TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
     RUNOFF COEFFICIENT   =        .99          .41          .918

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
050:0009--------------------------------------------------------------------------
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201    )   |
| OUT<02:(201 OR)   |    =========  OUTFLOW STORAGE TABLE  =========
----------------------    OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)    |    (cms)    (ha.m.)
                            .000  .0000E+00     |     .027  .5900E-02
                            .019  .2000E-02     |     .030  .7800E-02
                            .023  .3900E-02     |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .26      .097    2.000      72.421
     OUTFLOW<02: (201 OR)        .26      .027    2.183      72.421
    OVERFLOW<03: (OVF   )        .00      .000     .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   28.308
                    TIME SHIFT OF PEAK FLOW       (min)=    11.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.6191E-02

--------------------------------------------------------------------------------
050:0010--------------------------------------------------------------------------
*# CATCHMENT EXT1 -  TO NORTH LANDS
*
```

```
01621> ----------------------
01622> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
01623> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
01624> ----------------------   U.H. Tp(hrs)=    .150
01625>
01626>      Unit Hyd Qpeak  (cms)=     .001
01627>
01628>      PEAK FLOW       (cms)=     .000 (i)
01629>      TIME TO PEAK    (hrs)=    2.133
01630>      RUNOFF VOLUME    (mm)=   31.898
01631>      TOTAL RAINFALL   (mm)=   78.932
01632>      RUNOFF COEFFICIENT   =     .404
01633>
01634>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01635>
01636> ------------------------------------------------------------------------------
01637> 050:0011-------------------------------------------------------------------------
01638> *# CATCHMENT 202 -  TO HOWARD ROAD
01639> *
01640> ----------------------
01641> | CALIB STANDHYD     |   Area    (ha)=     .00
01642> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
01643> ----------------------
01644>                              IMPERVIOUS    PERVIOUS (i)
01645>      Surface Area     (ha)=       .00          .00
01646>      Dep. Storage     (mm)=      1.00         8.47
01647>      Average Slope     (%)=      2.00         2.00
01648>      Length            (m)=     30.00         7.00
01649>      Mannings n            =      .013         .250
01650>
01651>      Max.eff.Inten.(mm/hr)=    149.30        66.26
01652>                    over (min)       1.00         4.00
01653>      Storage Coeff.  (min)=       .86 (ii)    3.78 (ii)
01654>      Unit Hyd. Tpeak (min)=      1.00         4.00
01655>      Unit Hyd. peak  (cms)=      1.17          .31
01656>                                                          *TOTALS*
01657>      PEAK FLOW       (cms)=       .00          .00          .002 (iii)
01658>      TIME TO PEAK    (hrs)=      1.98         2.02         2.000
01659>      RUNOFF VOLUME    (mm)=     77.93        32.01        77.471
01660>      TOTAL RAINFALL   (mm)=     78.93        78.93        78.932
01661>      RUNOFF COEFFICIENT   =       .99          .41          .981
01662>
01663>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01664>            CN* =  75.0    Ia = Dep. Storage  (Above)
01665>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01666>            THAN THE STORAGE COEFFICIENT.
01667>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01668>
01669> ------------------------------------------------------------------------------
01670> 050:0012-------------------------------------------------------------------------
01671> *# CHECK
01672> *
01673> ------------------------
01674> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01675> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
01676>                       ID1 02:201 ORIFIC     .26     .027    2.18  72.42    .000
01677>                      +ID2 03:OVF            .00     .000     .00    .00    .000
01678>                      +ID3 04:203            .00     .000    2.13  31.90    .000
01679>                      +ID4 05:202            .00     .002    2.00  77.47    .000
01680>                       ========================================================
01681>                       SUM 06:CHECK          .27     .028    2.17  71.90    .000
01682>
01683>   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01684>
01685> ------------------------------------------------------------------------------
01686> 050:0013-------------------------------------------------------------------------
01687> **#*****************************************************************************|
01688> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
01689> *
01690> ------------------------------------------------------------------------------
01691> 050:0002-------------------------------------------------------------------------
01692> *
01693> ------------------------------------------------------------------------------
01694> 050:0002-------------------------------------------------------------------------
01695> *
01696> ------------------------------------------------------------------------------
01697> 050:0002-------------------------------------------------------------------------
01698> *
01699> ------------------------------------------------------------------------------
01700> 050:0002-------------------------------------------------------------------------
01701> *
01702> ------------------------------------------------------------------------------
01703> 050:0002-------------------------------------------------------------------------
01704> *
01705>   ** END OF RUN :  99
01706>
01707> ******************************************************************************
01708>
01709>
01710>
01711>
01712>
01713> --------------------
01714> | START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
01715> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
01716>     TZERO =   .00 hrs on        0
01717>     METOUT=   2 (output = METRIC)
01718>     NRUN  = 100
01719>     NSTORM=   1
01720>              #  1=BUR6_100.stm
01721> ------------------------------------------------------------------------------
01722> 100:0002-------------------------------------------------------------------------
01723> *#*****************************************************************************|
01724> *#  Project Name: 127 PLAINS ROAD WEST
01725> *#               BURLINGTON, ONTARIO
01726> *#  JOB NUMBER  : 23082
01727> *#       Date   : OCTOBER 2024
01728> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
01729> *#       File   : 23082.DAT
01730> *#*****************************************************************************|
01731> *
01732> ------------------------------------------------------------------------------
01733> 100:0002-------------------------------------------------------------------------
01734> *
01735> --------------------
01736> | READ STORM       |    Filename: Burlington 100-yr 6hr CHICAGO        (A=
01737> | Ptotal=  86.27 mm|    Comments: Burlington 100-yr 6hr CHICAGO        (A=
01738> --------------------
01739>                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
01740>                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
01741>                 .17   3.862 |  1.67  17.445 |  3.17   9.657 |  4.67   4.936
01742>                 .33   4.172 |  1.83  39.736 |  3.33   8.649 |  4.83   4.704
01743>                 .50   4.546 |  2.00 163.177 |  3.50   7.853 |  5.00   4.495
01744>                 .67   5.008 |  2.17  51.779 |  3.67   7.206 |  5.17   4.306
01745>                 .83   5.595 |  2.33  28.205 |  3.83   6.670 |  5.33   4.135
01746>                1.00   6.369 |  2.50  19.806 |  4.00   6.217 |  5.50   3.979
01747>                1.17   7.443 |  2.67  15.465 |  4.17   5.829 |  5.67   3.835
01748>                1.33   9.048 |  2.83  12.795 |  4.33   5.492 |  5.83   3.703
01749>                1.50  11.752 |  3.00  10.979 |  4.50   5.197 |  6.00   3.581
01750>
01751> ------------------------------------------------------------------------------
01752> 100:0003-------------------------------------------------------------------------
01753> *
01754> *#*****************************************************************************|
01755> *#
01756> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
01757> *#        ==============================================
01758> *#
01759> *#*****************************************************************************|
01760> *# CATCHMENT 101 -  TO PLAINS ROAD WEST
01761> *
01762> ----------------------
01763> | CALIB STANDHYD     |   Area    (ha)=     .25
01764> | 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
01765> ----------------------
01766>                              IMPERVIOUS    PERVIOUS (i)
01767>      Surface Area     (ha)=       .09          .16
01768>      Dep. Storage     (mm)=      1.00         8.47
01769>      Average Slope     (%)=      5.00         2.00
01770>      Length            (m)=     30.00        15.00
01771>      Mannings n            =      .013         .250
01772>
01773>      Max.eff.Inten.(mm/hr)=    163.18        75.58
01774>                    over (min)       1.00         5.00
01775>      Storage Coeff.  (min)=       .63 (ii)    5.01 (ii)
01776>      Unit Hyd. Tpeak (min)=      1.00         5.00
01777>      Unit Hyd. peak  (cms)=      1.35          .23
01778>                                                          *TOTALS*
01779>      PEAK FLOW       (cms)=       .04          .02          .062 (iii)
01780>      TIME TO PEAK    (hrs)=      1.98         2.03         2.000
01781>      RUNOFF VOLUME    (mm)=     85.27        37.26        54.542
01782>      TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
01783>      RUNOFF COEFFICIENT   =       .99          .43          .632
01784>
01785>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01786>            CN* =  75.0    Ia = Dep. Storage  (Above)
01787>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01788>            THAN THE STORAGE COEFFICIENT.
01789>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01790>
01791> ------------------------------------------------------------------------------
01792> 100:0004-------------------------------------------------------------------------
01793> *# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
01794> *
01795> ----------------------
01796> | CALIB STANDHYD     |   Area    (ha)=     .00
01797> | 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
01798> ----------------------
01799>                              IMPERVIOUS    PERVIOUS (i)
01800>      Surface Area     (ha)=       .00          .00
01801>      Dep. Storage     (mm)=      1.00         8.47
01802>      Average Slope     (%)=      2.00         2.00
01803>      Length            (m)=     30.00        15.00
01804>      Mannings n            =      .013         .250
01805>
01806>      Max.eff.Inten.(mm/hr)=    163.18        75.58
01807>                    over (min)       1.00         5.00
01808>      Storage Coeff.  (min)=       .83 (ii)    5.21 (ii)
01809>      Unit Hyd. Tpeak (min)=      1.00         5.00
01810>      Unit Hyd. peak  (cms)=      1.19          .22
01811>                                                          *TOTALS*
01812>      PEAK FLOW       (cms)=       .00          .00          .001 (iii)
01813>      TIME TO PEAK    (hrs)=      1.97         2.03         2.000
01814>      RUNOFF VOLUME    (mm)=     85.27        37.26        54.540
01815>      TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
01816>      RUNOFF COEFFICIENT   =       .99          .43          .632
01817>
01818>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01819>            CN* =  75.0    Ia = Dep. Storage  (Above)
01820>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01821>            THAN THE STORAGE COEFFICIENT.
01822>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01823>
01824> ------------------------------------------------------------------------------
01825> 100:0005-------------------------------------------------------------------------
01826> *# CATCHMENT 102 -  TO HOWARD ROAD
01827> *
01828> ----------------------
01829> | CALIB STANDHYD     |   Area    (ha)=     .02
01830> | 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
01831> ----------------------
01832>                              IMPERVIOUS    PERVIOUS (i)
01833>      Surface Area     (ha)=       .01          .01
01834>      Dep. Storage     (mm)=      1.00         8.47
01835>      Average Slope     (%)=      7.00         2.00
01836>      Length            (m)=     30.00        15.00
01837>      Mannings n            =      .013         .250
01838>
01839>      Max.eff.Inten.(mm/hr)=    163.18        75.58
01840>                    over (min)       1.00         5.00
01841>      Storage Coeff.  (min)=       .57 (ii)    4.95 (ii)
01842>      Unit Hyd. Tpeak (min)=      1.00         5.00
01843>      Unit Hyd. peak  (cms)=      1.41          .23
01844>                                                          *TOTALS*
01845>      PEAK FLOW       (cms)=       .00          .00          .004 (iii)
01846>      TIME TO PEAK    (hrs)=      1.95         2.03         2.000
01847>      RUNOFF VOLUME    (mm)=     85.27        37.26        54.542
01848>      TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
01849>      RUNOFF COEFFICIENT   =       .99          .43          .632
01850>
01851>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01852>            CN* =  75.0    Ia = Dep. Storage  (Above)
01853>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01854>            THAN THE STORAGE COEFFICIENT.
01855>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01856>
01857> ------------------------------------------------------------------------------
01858> 100:0006-------------------------------------------------------------------------
01859> *# TOTAL TO PLAINS ROAD WEST
01860> *
01861> ------------------------
01862> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01863> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
01864>                       ID1 01:101            .25     .062    2.00  54.54    .000
01865>                      +ID2 02:EXT1           .00     .001    2.00  54.54    .000
01866>                       ========================================================
01867>                       SUM 04:101+EXT1       .25     .063    2.00  54.54    .000
01868>
01869>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01870>
01871> ------------------------------------------------------------------------------
01872> 100:0007-------------------------------------------------------------------------
01873> *# CHECK
01874> *
01875> ------------------------
01876> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01877> ------------------------                  (ha)     (cms)   (hrs)   (mm)    (cms)
01878>                       ID1 01:101            .25     .062    2.00  54.54    .000
01879>                      +ID2 02:EXT1           .00     .001    2.00  54.54    .000
01880>                      +ID3 03:102            .02     .004    2.00  54.54    .000
01881>                       ========================================================
01882>                       SUM 05:CHECK          .27     .067    2.00  54.54    .000
01883>
01884>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01885>
01886> ------------------------------------------------------------------------------
01887> 100:0008-------------------------------------------------------------------------
01888> *#*****************************************************************************|
01889> *#
01890> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
```

```
01891> *#        ================================================
01892> *#
01893> *#*****************************************************************************|
01894> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
01895> *
01896> ----------------------
01897> | CALIB STANDHYD     |   Area    (ha)=     .26
01898> | 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
01899> ----------------------
01900>                              IMPERVIOUS    PERVIOUS (i)
01901>      Surface Area     (ha)=        .23          .03
01902>      Dep. Storage     (mm)=       1.00         8.47
01903>      Average Slope     (%)=       2.00         4.00
01904>      Length            (m)=      30.00        20.00
01905>      Mannings n             =       .013         .250
01906>
01907>      Max.eff.Inten.(mm/hr)=     163.18        75.58
01908>                   over (min)        1.00         5.00
01909>      Storage Coeff.  (min)=        .83 (ii)    5.06 (ii)
01910>      Unit Hyd. Tpeak (min)=       1.00         5.00
01911>      Unit Hyd. peak  (cms)=       1.19          .22
01912>                                                          *TOTALS*
01913>      PEAK FLOW       (cms)=        .10          .00          .106 (iii)
01914>      TIME TO PEAK    (hrs)=       2.00         2.03         2.000
01915>      RUNOFF VOLUME    (mm)=      85.27        37.26        79.509
01916>      TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
01917>      RUNOFF COEFFICIENT   =        .99          .43          .922
01918>
01919>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01920>            CN* =  75.0    Ia = Dep. Storage  (Above)
01921>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01922>            THAN THE STORAGE COEFFICIENT.
01923>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01924>
01925> -------------------------------------------------------------------------------
01926> 100:0009----------------------------------------------------------------------
01927> ----------------------
01928> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
01929> |  IN>01:(201   )    |
01930> | OUT<02:(201 OR)    |    =========  OUTLFOW STORAGE TABLE  =========
01931> ----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
01932>                             (cms)     (ha.m.)   |    (cms)    (ha.m.)
01933>                              .000  .0000E+00    |     .027  .5900E-02
01934>                              .019  .2000E-02    |     .030  .7800E-02
01935>                              .023  .3900E-02    |     .000  .0000E+00
01936>
01937>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
01938>      --------------------       (ha)     (cms)     (hrs)       (mm)
01939>      INFLOW >01: (201   )        .26      .106     2.000     79.509
01940>      OUTFLOW<02: (201 OR)        .26      .029     2.183     79.509
01941>     OVERFLOW<03: (OVF   )        .00      .000      .000       .000
01942>
01943>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
01944>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
01945>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
01946>
01947>
01948>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.935
01949>                    TIME SHIFT OF PEAK FLOW         (min)=    11.00
01950>                    MAXIMUM  STORAGE   USED       (ha.m.)=.6962E-02
01951>
01952> -------------------------------------------------------------------------------
01953> 100:0010----------------------------------------------------------------------
01954> *# CATCHMENT EXT1 -  TO NORTH LANDS
01955> *
01956> ----------------------
01957> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number    (CN)=75.00
01958> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
01959> ----------------------   U.H. Tp(hrs)=    .150
01960>
01961>      Unit Hyd Qpeak  (cms)=     .001
01962>
01963>      PEAK FLOW       (cms)=     .000 (i)
01964>      TIME TO PEAK    (hrs)=    2.133
01965>      RUNOFF VOLUME    (mm)=   37.151
01966>      TOTAL RAINFALL   (mm)=   86.271
01967>      RUNOFF COEFFICIENT   =     .431
01968>
01969>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01970>
01971> -------------------------------------------------------------------------------
01972> 100:0011----------------------------------------------------------------------
01973> *# CATCHMENT 202 -  TO HOWARD ROAD
01974> *
01975> ----------------------
01976> | CALIB STANDHYD     |   Area    (ha)=     .00
01977> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
01978> ----------------------
01979>                              IMPERVIOUS    PERVIOUS (i)
01980>      Surface Area     (ha)=        .00          .00
01981>      Dep. Storage     (mm)=       1.00         8.47
01982>      Average Slope     (%)=       2.00         2.00
01983>      Length            (m)=      30.00         7.00
01984>      Mannings n             =       .013         .250
01985>
01986>      Max.eff.Inten.(mm/hr)=     163.18        77.71
01987>                   over (min)        1.00         4.00
01988>      Storage Coeff.  (min)=        .83 (ii)    3.57 (ii)
01989>      Unit Hyd. Tpeak (min)=       1.00         4.00
01990>      Unit Hyd. peak  (cms)=       1.19          .32
01991>                                                          *TOTALS*
01992>      PEAK FLOW       (cms)=        .00          .00          .002 (iii)
01993>      TIME TO PEAK    (hrs)=       1.98         2.02         2.000
01994>      RUNOFF VOLUME    (mm)=      85.27        37.26        84.789
01995>      TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
01996>      RUNOFF COEFFICIENT   =        .99          .43          .983
01997>
01998>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01999>            CN* =  75.0    Ia = Dep. Storage  (Above)
02000>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02001>            THAN THE STORAGE COEFFICIENT.
02002>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02003>
02004> -------------------------------------------------------------------------------
02005> 100:0012----------------------------------------------------------------------
02006> *# CHECK
02007> *
02008> -------------------------
02009> | ADD HYD (CHECK     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
02010> -------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
02011>                      ID1 02:201 ORIFIC      .26     .029    2.18  79.51    .000
02012>                     +ID2 03:OVF             .00     .000     .00    .00    .000
02013>                     +ID3 04:203             .00     .000    2.13  37.15    .000
02014>                     +ID4 05:202             .00     .002    2.00  84.79    .000
02015>                      ===========================================================
02016>                      SUM 06:CHECK            .27     .030    2.17  78.97    .000
02017>
02018>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02019>
02020> -------------------------------------------------------------------------------
02021> 100:0013----------------------------------------------------------------------
02022> **#*****************************************************************************|
02023> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
02024> *
02025> -------------------------------------------------------------------------------
02026> 100:0002----------------------------------------------------------------------
02027> *
02028> -------------------------------------------------------------------------------
02029> 100:0002----------------------------------------------------------------------
02030> *
02031> -------------------------------------------------------------------------------
02032> 100:0002----------------------------------------------------------------------
02033> *
02034> -------------------------------------------------------------------------------
02035> 100:0002----------------------------------------------------------------------
02036> *
02037> -------------------------------------------------------------------------------
02038> 100:0002----------------------------------------------------------------------
02039> *
02040> -------------------------------------------------------------------------------
02041> 100:0002----------------------------------------------------------------------
02042> *
02043>   ** END OF RUN : 199
02044>
02045> *****************************************************************************
02046>
02047>
02048>
02049>
02050>
02051> --------------------
02052> | START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
02053> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
02054>     TZERO =   .00 hrs on       0
02055>     METOUT=   2 (output = METRIC)
02056>     NRUN  = 200
02057>     NSTORM=   1
02058>               #  1=hazel.stm
02059> -------------------------------------------------------------------------------
02060> 200:0002----------------------------------------------------------------------
02061> *#*****************************************************************************|
02062> *#  Project Name: 127 PLAINS ROAD WEST
02063> *#               BURLINGTON, ONTARIO
02064> *#  JOB NUMBER  : 23082
02065> *#       Date   : OCTOBER 2024
02066> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
02067> *#       File   : 23082.DAT
02068> *#*****************************************************************************|
02069> *
02070> -------------------------------------------------------------------------------
02071> 200:0002----------------------------------------------------------------------
02072> *
02073> --------------------
02074> | READ STORM       |    Filename: Regional - Hurricane Hazel
02075> | Ptotal= 284.97 mm|    Comments: Regional - Hurricane Hazel
02076> --------------------
02077>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
02078>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
02079>               1.00   2.027 |  13.00   2.027 |  25.00   2.027 |  37.00   6.000
02080>               2.00   2.027 |  14.00   2.027 |  26.00   2.027 |  38.00   4.000
02081>               3.00   2.027 |  15.00   2.027 |  27.00   2.027 |  39.00   6.000
02082>               4.00   2.027 |  16.00   2.027 |  28.00   2.027 |  40.00  13.000
02083>               5.00   2.027 |  17.00   2.027 |  29.00   2.027 |  41.00  17.000
02084>               6.00   2.027 |  18.00   2.027 |  30.00   2.027 |  42.00  13.000
02085>               7.00   2.027 |  19.00   2.027 |  31.00   2.027 |  43.00  23.000
02086>               8.00   2.027 |  20.00   2.027 |  32.00   2.027 |  44.00  13.000
02087>               9.00   2.027 |  21.00   2.027 |  33.00   2.027 |  45.00  13.000
02088>              10.00   2.027 |  22.00   2.027 |  34.00   2.027 |  46.00  53.000
02089>              11.00   2.027 |  23.00   2.027 |  35.00   2.027 |  47.00  38.000
02090>              12.00   2.027 |  24.00   2.027 |  36.00   2.027 |  48.00  13.000
02091>
02092> -------------------------------------------------------------------------------
02093> 200:0003----------------------------------------------------------------------
02094> *
02095> *#*****************************************************************************|
02096> *#
02097> *#         PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
02098> *#         ==============================================
02099> *#
02100> *#*****************************************************************************|
02101> *# CATCHMENT 101 -  TO PLAINS ROAD WEST
02102> *
02103> ----------------------
02104> | CALIB STANDHYD     |   Area    (ha)=     .25
02105> | 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02106> ----------------------
02107>                              IMPERVIOUS    PERVIOUS (i)
02108>      Surface Area     (ha)=        .09          .16
02109>      Dep. Storage     (mm)=       1.00         8.47
02110>      Average Slope     (%)=       5.00         2.00
02111>      Length            (m)=      30.00        15.00
02112>      Mannings n             =       .013         .250
02113>
02114>      Max.eff.Inten.(mm/hr)=      53.00        48.98
02115>                   over (min)        1.00         6.00
02116>      Storage Coeff.  (min)=        .99 (ii)    6.20 (ii)
02117>      Unit Hyd. Tpeak (min)=       1.00         6.00
02118>      Unit Hyd. peak  (cms)=       1.08          .18
02119>                                                          *TOTALS*
02120>      PEAK FLOW       (cms)=        .01          .02          .034 (iii)
02121>      TIME TO PEAK    (hrs)=      45.45        46.00        46.000
02122>      RUNOFF VOLUME    (mm)=     283.97       211.67       237.710
02123>      TOTAL RAINFALL   (mm)=     284.97       284.97       284.973
02124>      RUNOFF COEFFICIENT   =       1.00          .74          .834
02125>
02126>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02127>            CN* =  75.0    Ia = Dep. Storage  (Above)
02128>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02129>            THAN THE STORAGE COEFFICIENT.
02130>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02131>
02132> -------------------------------------------------------------------------------
02133> 200:0004----------------------------------------------------------------------
02134> *# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
02135> *
02136> ----------------------
02137> | CALIB STANDHYD     |   Area    (ha)=     .00
02138> | 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02139> ----------------------
02140>                              IMPERVIOUS    PERVIOUS (i)
02141>      Surface Area     (ha)=        .00          .00
02142>      Dep. Storage     (mm)=       1.00         8.47
02143>      Average Slope     (%)=       2.00         2.00
02144>      Length            (m)=      30.00        15.00
02145>      Mannings n             =       .013         .250
02146>
02147>      Max.eff.Inten.(mm/hr)=      53.00        48.97
02148>                   over (min)        1.00         7.00
02149>      Storage Coeff.  (min)=       1.30 (ii)    6.51 (ii)
02150>      Unit Hyd. Tpeak (min)=       1.00         7.00
02151>      Unit Hyd. peak  (cms)=        .91          .17
02152>                                                          *TOTALS*
02153>      PEAK FLOW       (cms)=        .00          .00          .001 (iii)
02154>      TIME TO PEAK    (hrs)=      45.45        46.00        46.000
02155>      RUNOFF VOLUME    (mm)=     283.94       211.68       237.697
02156>      TOTAL RAINFALL   (mm)=     284.97       284.97       284.973
02157>      RUNOFF COEFFICIENT   =       1.00          .74          .834
02158>
02159>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02160>            CN* =  75.0    Ia = Dep. Storage  (Above)
```

```
02161>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02162>            THAN THE STORAGE COEFFICIENT.
02163>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02164>
02165> ---------------------------------------------------------------------------
02166> 200:0005-----------------------------------------------------------------
02167> *# CATCHMENT 102 -  TO HOWARD ROAD
02168> *
02169> ----------------------
02170> | CALIB STANDHYD     |   Area    (ha)=     .02
02171> | 03:102     DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02172> ----------------------
02173>                              IMPERVIOUS    PERVIOUS (i)
02174>      Surface Area     (ha)=        .01          .01
02175>      Dep. Storage     (mm)=       1.00         8.47
02176>      Average Slope     (%)=       7.00         2.00
02177>      Length            (m)=      30.00        15.00
02178>      Mannings n            =       .013         .250
02179>
02180>      Max.eff.Inten.(mm/hr)=      53.00        48.98
02181>                    over (min)       1.00         6.00
02182>      Storage Coeff.  (min)=        .89 (ii)    6.10 (ii)
02183>      Unit Hyd. Tpeak (min)=       1.00         6.00
02184>      Unit Hyd. peak  (cms)=       1.15          .19
02185>                                                          *TOTALS*
02186>      PEAK FLOW       (cms)=        .00          .00          .002 (iii)
02187>      TIME TO PEAK    (hrs)=      45.45        46.00        46.000
02188>      RUNOFF VOLUME    (mm)=     283.97       211.68       237.705
02189>      TOTAL RAINFALL   (mm)=     284.97       284.97       284.973
02190>      RUNOFF COEFFICIENT   =       1.00          .74          .834
02191>
02192>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02193>            CN* =  75.0    Ia = Dep. Storage  (Above)
02194>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02195>            THAN THE STORAGE COEFFICIENT.
02196>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02197>
02198> ---------------------------------------------------------------------------
02199> 200:0006-----------------------------------------------------------------
02200> *# TOTAL TO PLAINS ROAD WEST
02201> *
02202> ------------------------
02203> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02204> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02205>                        ID1 01:101          .25      .034   46.00 237.71    .000
02206>                       +ID2 02:EXT1         .00      .001   46.00 237.70    .000
02207>                        ========================================================
02208>                        SUM 04:101+EXT1      .25      .035   46.00 237.71    .000
02209>
02210>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02211>
02212> ---------------------------------------------------------------------------
02213> 200:0007-----------------------------------------------------------------
02214> *# CHECK
02215> *
02216> ------------------------
02217> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02218> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02219>                        ID1 01:101          .25      .034   46.00 237.71    .000
02220>                       +ID2 02:EXT1         .00      .001   46.00 237.70    .000
02221>                       +ID3 03:102          .02      .002   46.00 237.71    .000
02222>                        ========================================================
02223>                        SUM 05:CHECK         .27      .037   46.00 237.71    .000
02224>
02225>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02226>
02227> ---------------------------------------------------------------------------
02228> 200:0008-----------------------------------------------------------------
02229> *#*************************************************************************|
02230> *#
02231> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
02232> *#        ===============================================
02233> *#
02234> *#*************************************************************************|
02235> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
02236> *
02237> ----------------------
02238> | CALIB STANDHYD     |   Area    (ha)=     .26
02239> | 01:201     DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
02240> ----------------------
02241>                              IMPERVIOUS    PERVIOUS (i)
02242>      Surface Area     (ha)=        .23          .03
02243>      Dep. Storage     (mm)=       1.00         8.47
02244>      Average Slope     (%)=       2.00         4.00
02245>      Length            (m)=      30.00        20.00
02246>      Mannings n            =       .013         .250
02247>
02248>      Max.eff.Inten.(mm/hr)=      53.00        48.98
02249>                    over (min)       1.00         6.00
02250>      Storage Coeff.  (min)=       1.30 (ii)    6.33 (ii)
02251>      Unit Hyd. Tpeak (min)=       1.00         6.00
02252>      Unit Hyd. peak  (cms)=        .91          .18
02253>                                                          *TOTALS*
02254>      PEAK FLOW       (cms)=        .03          .00          .037 (iii)
02255>      TIME TO PEAK    (hrs)=      45.45        46.00        46.000
02256>      RUNOFF VOLUME    (mm)=     283.97       211.68       275.299
02257>      TOTAL RAINFALL   (mm)=     284.97       284.97       284.973
02258>      RUNOFF COEFFICIENT   =       1.00          .74          .966
02259>
02260>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02261>            CN* =  75.0    Ia = Dep. Storage  (Above)
02262>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02263>            THAN THE STORAGE COEFFICIENT.
02264>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02265>
02266> ---------------------------------------------------------------------------
02267> 200:0009-----------------------------------------------------------------
02268> --------------------
02269> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
02270> |  IN>01:(201   )    |
02271> | OUT<02:(201 OR)    |    =========  OUTLFOW STORAGE TABLE  =========
02272> --------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
02273>                           (cms)     (ha.m.)   |    (cms)    (ha.m.)
02274>                           .000  .0000E+00     |     .027  .5900E-02
02275>                           .019  .2000E-02     |     .030  .7800E-02
02276>                           .023  .3900E-02     |     .000  .0000E+00
02277>
02278>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
02279>      --------------------       (ha)     (cms)     (hrs)       (mm)
02280>      INFLOW >01: (201   )        .26      .037    46.000    275.299
02281>      OUTFLOW<02: (201 OR)        .26      .027    46.117    275.298
02282>     OVERFLOW<03: (OVF   )        .00      .000      .000       .000
02283>
02284>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
02285>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
02286>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
02287>
02288>
02289>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   73.460
02290>                    TIME SHIFT OF PEAK FLOW          (min)=     7.00
02291>                    MAXIMUM  STORAGE   USED       (ha.m.)=.6169E-02
02292>
02293> ---------------------------------------------------------------------------
02294> 200:0010-----------------------------------------------------------------
02295> *# CATCHMENT EXT1 -  TO NORTH LANDS
02296> *
02297> ----------------------
02298> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
02299> | 04:203     DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
02300> ----------------------   U.H. Tp(hrs)=    .150
02301>
02302>      Unit Hyd Qpeak  (cms)=     .001
02303>
02304>      PEAK FLOW       (cms)=     .001 (i)
02305>      TIME TO PEAK    (hrs)=   46.000
02306>      RUNOFF VOLUME    (mm)=  211.601
02307>      TOTAL RAINFALL   (mm)=  284.973
02308>      RUNOFF COEFFICIENT   =     .743
02309>
02310>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02311>
02312> ---------------------------------------------------------------------------
02313> 200:0011-----------------------------------------------------------------
02314> *# CATCHMENT 202 -  TO HOWARD ROAD
02315> *
02316> ----------------------
02317> | CALIB STANDHYD     |   Area    (ha)=     .00
02318> | 05:202     DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
02319> ----------------------
02320>                              IMPERVIOUS    PERVIOUS (i)
02321>      Surface Area     (ha)=        .00          .00
02322>      Dep. Storage     (mm)=       1.00         8.47
02323>      Average Slope     (%)=       2.00         2.00
02324>      Length            (m)=      30.00         7.00
02325>      Mannings n            =       .013         .250
02326>
02327>      Max.eff.Inten.(mm/hr)=      53.00        48.99
02328>                    over (min)       1.00         5.00
02329>      Storage Coeff.  (min)=       1.30 (ii)    4.60 (ii)
02330>      Unit Hyd. Tpeak (min)=       1.00         5.00
02331>      Unit Hyd. peak  (cms)=        .91          .24
02332>                                                          *TOTALS*
02333>      PEAK FLOW       (cms)=        .00          .00          .001 (iii)
02334>      TIME TO PEAK    (hrs)=      45.45        46.00        46.000
02335>      RUNOFF VOLUME    (mm)=     283.95       211.68       283.244
02336>      TOTAL RAINFALL   (mm)=     284.97       284.97       284.973
02337>      RUNOFF COEFFICIENT   =       1.00          .74          .994
02338>
02339>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02340>            CN* =  75.0    Ia = Dep. Storage  (Above)
02341>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02342>            THAN THE STORAGE COEFFICIENT.
02343>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02344>
02345> ---------------------------------------------------------------------------
02346> 200:0012-----------------------------------------------------------------
02347> *# CHECK
02348> *
02349> ------------------------
02350> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02351> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02352>                        ID1 02:201 ORIFIC    .26      .027   46.12 275.30    .000
02353>                       +ID2 03:OVF           .00      .000     .00    .00    .000
02354>                       +ID3 04:203           .00      .001   46.00 211.60    .000
02355>                       +ID4 05:202           .00      .001   46.00 283.24    .000
02356>                        ========================================================
02357>                        SUM 06:CHECK         .27      .029   46.00 274.49    .000
02358>
02359>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02360>
02361> ---------------------------------------------------------------------------
02362> 200:0013-----------------------------------------------------------------
02363> **#************************************************************************|
02364> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
02365> *
02366> ---------------------------------------------------------------------------
02367> 200:0002-----------------------------------------------------------------
02368> *
02369> ---------------------------------------------------------------------------
02370> 200:0002-----------------------------------------------------------------
02371> *
02372> ---------------------------------------------------------------------------
02373> 200:0002-----------------------------------------------------------------
02374> *
02375> ---------------------------------------------------------------------------
02376> 200:0002-----------------------------------------------------------------
02377> *
02378> ---------------------------------------------------------------------------
02379> 200:0002-----------------------------------------------------------------
02380> *
02381> ---------------------------------------------------------------------------
02382> 200:0002-----------------------------------------------------------------
02383> *
02384> ---------------------------------------------------------------------------
02385> 200:0002-----------------------------------------------------------------
02386> *
02387>   ** END OF RUN : 224
02388>
02389> ***************************************************************************
02390>
02391>
02392>
02393>
02394>
02395> --------------------
02396> | START            |  Project  dir.: T:\PROJECTS\23082\SWMHYMO\
02397> --------------------  Rainfall dir.: T:\PROJECTS\23082\SWMHYMO\
02398>     TZERO =   .00 hrs on      0
02399>     METOUT=   2 (output = METRIC)
02400>     NRUN  = 225
02401>     NSTORM=   1
02402>               #  1=25MM.stm
02403> ---------------------------------------------------------------------------
02404> 225:0002-----------------------------------------------------------------
02405> *#************************************************************************|
02406> *#  Project Name: 127 PLAINS ROAD WEST
02407> *#               BURLINGTON, ONTARIO
02408> *#  JOB NUMBER  : 23082
02409> *#       Date   : OCTOBER 2024
02410> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
02411> *#       File   : 23082.DAT
02412> *#************************************************************************|
02413> *
02414> ---------------------------------------------------------------------------
02415> 225:0002-----------------------------------------------------------------
02416> *
02417> --------------------
02418> | READ STORM        |    Filename: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
02419> | Ptotal=  25.27 mm|    Comments: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
02420> --------------------
02421>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
02422>               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
02423>               .17   1.491 |   1.17  13.390 |   2.17   3.748 |   3.17   1.810
02424>               .33   1.720 |   1.33  58.584 |   2.33   3.156 |   3.33   1.675
02425>               .50   2.045 |   1.50  17.849 |   2.50   2.734 |   3.50   1.560
02426>               .67   2.542 |   1.67   9.118 |   2.67   2.417 |   3.67   1.460
02427>               .83   3.408 |   1.83   6.129 |   2.83   2.170 |   3.83   1.374
02428>              1.00   5.319 |   2.00   4.638 |   3.00   1.973 |   4.00   1.299
02429>
02430> ---------------------------------------------------------------------------
```

```
02431> 225:0003--------------------------------------------------------------------------------
02432> *
02433> *#*****************************************************************************|
02434> *#
02435> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
02436> *#        ==============================================
02437> *#
02438> *#*****************************************************************************|
02439> *# CATCHMENT 101 -  TO PLAINS ROAD WEST
02440> *
02441> ----------------------
02442> | CALIB STANDHYD     |   Area    (ha)=     .25
02443> | 01:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02444> ----------------------
02445>                              IMPERVIOUS    PERVIOUS (i)
02446>      Surface Area     (ha)=       .09          .16
02447>      Dep. Storage     (mm)=      1.00         8.47
02448>      Average Slope     (%)=      5.00         2.00
02449>      Length            (m)=     30.00        15.00
02450>      Mannings n             =     .013         .250
02451>
02452>      Max.eff.Inten.(mm/hr)=     58.58         3.44
02453>                  over (min)        1.00        16.00
02454>      Storage Coeff.  (min)=       .95 (ii)   16.03 (ii)
02455>      Unit Hyd. Tpeak (min)=      1.00        16.00
02456>      Unit Hyd. peak  (cms)=      1.11          .07
02457>                                                          *TOTALS*
02458>      PEAK FLOW       (cms)=       .01          .00          .014 (iii)
02459>      TIME TO PEAK    (hrs)=      1.33         1.72         1.333
02460>      RUNOFF VOLUME    (mm)=     24.27         2.78        10.516
02461>      TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
02462>      RUNOFF COEFFICIENT   =       .96          .11          .416
02463>
02464>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02465>            CN* =  75.0    Ia = Dep. Storage  (Above)
02466>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02467>            THAN THE STORAGE COEFFICIENT.
02468>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02469>
02470> --------------------------------------------------------------------------------
02471> 225:0004--------------------------------------------------------------------------------
02472> *# CATCHMENT EXT1 -  TO PLAINS ROAD WEST
02473> *
02474> ----------------------
02475> | CALIB STANDHYD     |   Area    (ha)=     .00
02476> | 02:EXT1   DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02477> ----------------------
02478>                              IMPERVIOUS    PERVIOUS (i)
02479>      Surface Area     (ha)=       .00          .00
02480>      Dep. Storage     (mm)=      1.00         8.47
02481>      Average Slope     (%)=      2.00         2.00
02482>      Length            (m)=     30.00        15.00
02483>      Mannings n             =     .013         .250
02484>
02485>      Max.eff.Inten.(mm/hr)=     58.58         3.44
02486>                  over (min)        1.00        16.00
02487>      Storage Coeff.  (min)=      1.25 (ii)   16.33 (ii)
02488>      Unit Hyd. Tpeak (min)=      1.00        16.00
02489>      Unit Hyd. peak  (cms)=       .94          .07
02490>                                                          *TOTALS*
02491>      PEAK FLOW       (cms)=       .00          .00          .000 (iii)
02492>      TIME TO PEAK    (hrs)=      1.32         1.72         1.333
02493>      RUNOFF VOLUME    (mm)=     24.27         2.78        10.516
02494>      TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
02495>      RUNOFF COEFFICIENT   =       .96          .11          .416
02496>
02497>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02498>            CN* =  75.0    Ia = Dep. Storage  (Above)
02499>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02500>            THAN THE STORAGE COEFFICIENT.
02501>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02502>
02503> --------------------------------------------------------------------------------
02504> 225:0005--------------------------------------------------------------------------------
02505> *# CATCHMENT 102 -  TO HOWARD ROAD
02506> *
02507> ----------------------
02508> | CALIB STANDHYD     |   Area    (ha)=     .02
02509> | 03:102    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
02510> ----------------------
02511>                              IMPERVIOUS    PERVIOUS (i)
02512>      Surface Area     (ha)=       .01          .01
02513>      Dep. Storage     (mm)=      1.00         8.47
02514>      Average Slope     (%)=      7.00         2.00
02515>      Length            (m)=     30.00        15.00
02516>      Mannings n             =     .013         .250
02517>
02518>      Max.eff.Inten.(mm/hr)=     58.58         3.44
02519>                  over (min)        1.00        16.00
02520>      Storage Coeff.  (min)=       .86 (ii)   15.94 (ii)
02521>      Unit Hyd. Tpeak (min)=      1.00        16.00
02522>      Unit Hyd. peak  (cms)=      1.17          .07
02523>                                                          *TOTALS*
02524>      PEAK FLOW       (cms)=       .00          .00          .001 (iii)
02525>      TIME TO PEAK    (hrs)=      1.30         1.72         1.333
02526>      RUNOFF VOLUME    (mm)=     24.27         2.78        10.515
02527>      TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
02528>      RUNOFF COEFFICIENT   =       .96          .11          .416
02529>
02530>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02531>            CN* =  75.0    Ia = Dep. Storage  (Above)
02532>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02533>            THAN THE STORAGE COEFFICIENT.
02534>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02535>
02536> --------------------------------------------------------------------------------
02537> 225:0006--------------------------------------------------------------------------------
02538> *# TOTAL TO PLAINS ROAD WEST
02539> *
02540> ------------------------
02541> | ADD HYD (101+EXT1  ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02542> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02543>                       ID1 01:101           .25     .014    1.33  10.52    .000
02544>                      +ID2 02:EXT1          .00     .000    1.33  10.52    .000
02545>                       ========================================================
02546>                       SUM 04:101+EXT1      .25     .015    1.33  10.52    .000
02547>
02548>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02549>
02550> --------------------------------------------------------------------------------
02551> 225:0007--------------------------------------------------------------------------------
02552> *# CHECK
02553> *
02554> ------------------------
02555> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02556> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02557>                       ID1 01:101           .25     .014    1.33  10.52    .000
02558>                      +ID2 02:EXT1          .00     .000    1.33  10.52    .000
02559>                      +ID3 03:102           .02     .001    1.33  10.52    .000
02560>                       ========================================================
02561>                       SUM 05:CHECK         .27     .016    1.33  10.52    .000
02562>
02563>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02564>
02565> --------------------------------------------------------------------------------
02566> 225:0008--------------------------------------------------------------------------------
02567> *#*****************************************************************************|
02568> *#
02569> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
02570> *#        ===============================================
02571> *#
02572> *#*****************************************************************************|
02573> *# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD WEST
02574> *
02575> ----------------------
02576> | CALIB STANDHYD     |   Area    (ha)=     .26
02577> | 01:201    DT= 1.00 |   Total Imp(%)=   88.00   Dir. Conn.(%)=   88.00
02578> ----------------------
02579>                              IMPERVIOUS    PERVIOUS (i)
02580>      Surface Area     (ha)=       .23          .03
02581>      Dep. Storage     (mm)=      1.00         8.47
02582>      Average Slope     (%)=      2.00         4.00
02583>      Length            (m)=     30.00        20.00
02584>      Mannings n             =     .013         .250
02585>
02586>      Max.eff.Inten.(mm/hr)=     58.58         3.44
02587>                  over (min)        1.00        16.00
02588>      Storage Coeff.  (min)=      1.25 (ii)   15.80 (ii)
02589>      Unit Hyd. Tpeak (min)=      1.00        16.00
02590>      Unit Hyd. peak  (cms)=       .94          .07
02591>                                                          *TOTALS*
02592>      PEAK FLOW       (cms)=       .04          .00          .037 (iii)
02593>      TIME TO PEAK    (hrs)=      1.33         1.72         1.333
02594>      RUNOFF VOLUME    (mm)=     24.27         2.78        21.689
02595>      TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
02596>      RUNOFF COEFFICIENT   =       .96          .11          .858
02597>
02598>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02599>            CN* =  75.0    Ia = Dep. Storage  (Above)
02600>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02601>            THAN THE STORAGE COEFFICIENT.
02602>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02603>
02604> --------------------------------------------------------------------------------
02605> 225:0009--------------------------------------------------------------------------------
02606> ----------------------
02607> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
02608> |  IN>01:(201   )    |
02609> | OUT<02:(201 OR)    |    =========  OUTLFOW STORAGE TABLE  =========
02610> ----------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
02611>                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
02612>                              .000  .0000E+00    |     .027  .5900E-02
02613>                              .019  .2000E-02    |     .030  .7800E-02
02614>                              .023  .3900E-02    |     .000  .0000E+00
02615>
02616>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
02617>      ---------------            (ha)     (cms)     (hrs)       (mm)
02618>      INFLOW >01: (201   )        .26      .037     1.333     21.689
02619>      OUTFLOW<02: (201 OR)        .26      .018     1.367     21.689
02620>     OVERFLOW<03: (OVF   )        .00      .000      .000       .000
02621>
02622>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =       0
02623>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
02624>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
02625>
02626>
02627>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   49.079
02628>                    TIME SHIFT OF PEAK FLOW          (min)=     2.00
02629>                    MAXIMUM  STORAGE   USED       (ha.m.)=.1899E-02
02630>
02631> --------------------------------------------------------------------------------
02632> 225:0010--------------------------------------------------------------------------------
02633> *# CATCHMENT EXT1 -  TO NORTH LANDS
02634> *
02635> ----------------------
02636> | CALIB NASHYD       |   Area    (ha)=     .00   Curve Number   (CN)=75.00
02637> | 04:203    DT= 1.00 |   Ia      (mm)=   8.470   # of Linear Res.(N)= 3.00
02638> ----------------------   U.H. Tp(hrs)=    .150
02639>
02640>      Unit Hyd Qpeak  (cms)=     .001
02641>
02642>      PEAK FLOW       (cms)=     .000 (i)
02643>      TIME TO PEAK    (hrs)=    1.567
02644>      RUNOFF VOLUME    (mm)=    2.698
02645>      TOTAL RAINFALL   (mm)=   25.268
02646>      RUNOFF COEFFICIENT   =     .107
02647>
02648>      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02649>
02650> --------------------------------------------------------------------------------
02651> 225:0011--------------------------------------------------------------------------------
02652> *# CATCHMENT 202 -  TO HOWARD ROAD
02653> *
02654> ----------------------
02655> | CALIB STANDHYD     |   Area    (ha)=     .00
02656> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
02657> ----------------------
02658>                              IMPERVIOUS    PERVIOUS (i)
02659>      Surface Area     (ha)=       .00          .00
02660>      Dep. Storage     (mm)=      1.00         8.47
02661>      Average Slope     (%)=      2.00         2.00
02662>      Length            (m)=     30.00         7.00
02663>      Mannings n             =     .013         .250
02664>
02665>      Max.eff.Inten.(mm/hr)=     58.58         3.82
02666>                  over (min)        1.00        10.00
02667>      Storage Coeff.  (min)=      1.25 (ii)   10.40 (ii)
02668>      Unit Hyd. Tpeak (min)=      1.00        10.00
02669>      Unit Hyd. peak  (cms)=       .94          .21
02670>                                                          *TOTALS*
02671>      PEAK FLOW       (cms)=       .00          .00          .001 (iii)
02672>      TIME TO PEAK    (hrs)=      1.33         1.48         1.333
02673>      RUNOFF VOLUME    (mm)=     24.27         2.78        24.053
02674>      TOTAL RAINFALL   (mm)=     25.27        25.27        25.268
02675>      RUNOFF COEFFICIENT   =       .96          .11          .952
02676>
02677>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
02678>            CN* =  75.0    Ia = Dep. Storage  (Above)
02679>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
02680>            THAN THE STORAGE COEFFICIENT.
02681>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
02682>
02683> --------------------------------------------------------------------------------
02684> 225:0012--------------------------------------------------------------------------------
02685> *# CHECK
02686> *
02687> ------------------------
02688> | ADD HYD (CHECK     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
02689> ------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
02690>                       ID1 02:201 ORIFIC    .26     .018    1.37  21.69    .000
02691>                      +ID2 03:OVF           .00     .000     .00    .00    .000
02692>                      +ID3 04:203           .00     .000    1.57   2.70    .000
02693>                      +ID4 05:202           .00     .001    1.33  24.05    .000
02694>                       ========================================================
02695>                       SUM 06:CHECK         .27     .018    1.35  21.45    .000
02696>
02697>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
02698>
02699> --------------------------------------------------------------------------------
02700> 225:0013--------------------------------------------------------------------------------
```

```
02701> **#*************************************************************************|
02702> * RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
02703> *
02704> --------------------------------------------------------------------------------
02705> 225:0002--------------------------------------------------------------------------
02706> *
02707> --------------------------------------------------------------------------------
02708> 225:0002--------------------------------------------------------------------------
02709> *
02710> --------------------------------------------------------------------------------
02711> 225:0002--------------------------------------------------------------------------
02712> *
02713> --------------------------------------------------------------------------------
02714> 225:0002--------------------------------------------------------------------------
02715> *
02716> --------------------------------------------------------------------------------
02717> 225:0002--------------------------------------------------------------------------
02718> *
02719> --------------------------------------------------------------------------------
02720> 225:0002--------------------------------------------------------------------------
02721> *
02722> --------------------------------------------------------------------------------
02723> 225:0002--------------------------------------------------------------------------
02724> *
02725> --------------------------------------------------------------------------------
02726> 225:0002--------------------------------------------------------------------------
02727>       FINISH
02728> --------------------------------------------------------------------------------
02729> ********************************************************************************
02730>      WARNINGS / ERRORS / NOTES
02731>      ------------------------
02732>    Simulation ended on 2024-10-18     at 11:36:42
02733> ================================================================================
02734>
```

APPENDIX B

QUALITY CONTROL INFORMATION

Hydroworks Sizing Summary

127 Plains Road West

Burlington, ON

10-18-2024

Recommended Size: HydroFilter HF10

Hydroworks Sizing Program Version 5.8.5

A HydroFilter HF10 is recommended to provide 80 % annual TSS removal based on a drainage area of 0.256 (ha) with an imperviousness of 88 % and Hamilton RBG, Ontario rainfall for the ETV particle size distribution.

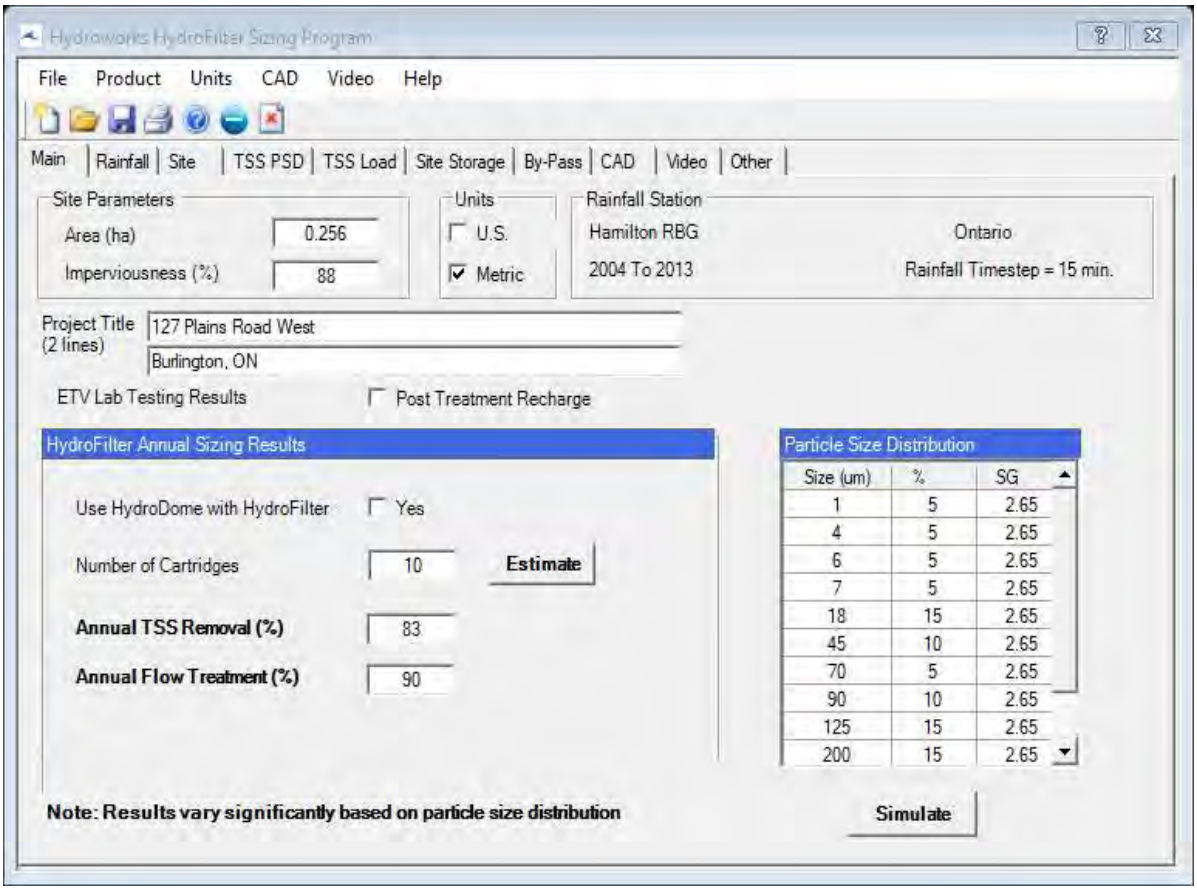
The recommended HydroFilter HF10 treats 90 % of the annual runoff and provides 83 % annual TSS removal for the Hamilton RBG rainfall records and ETV particle size distribution.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

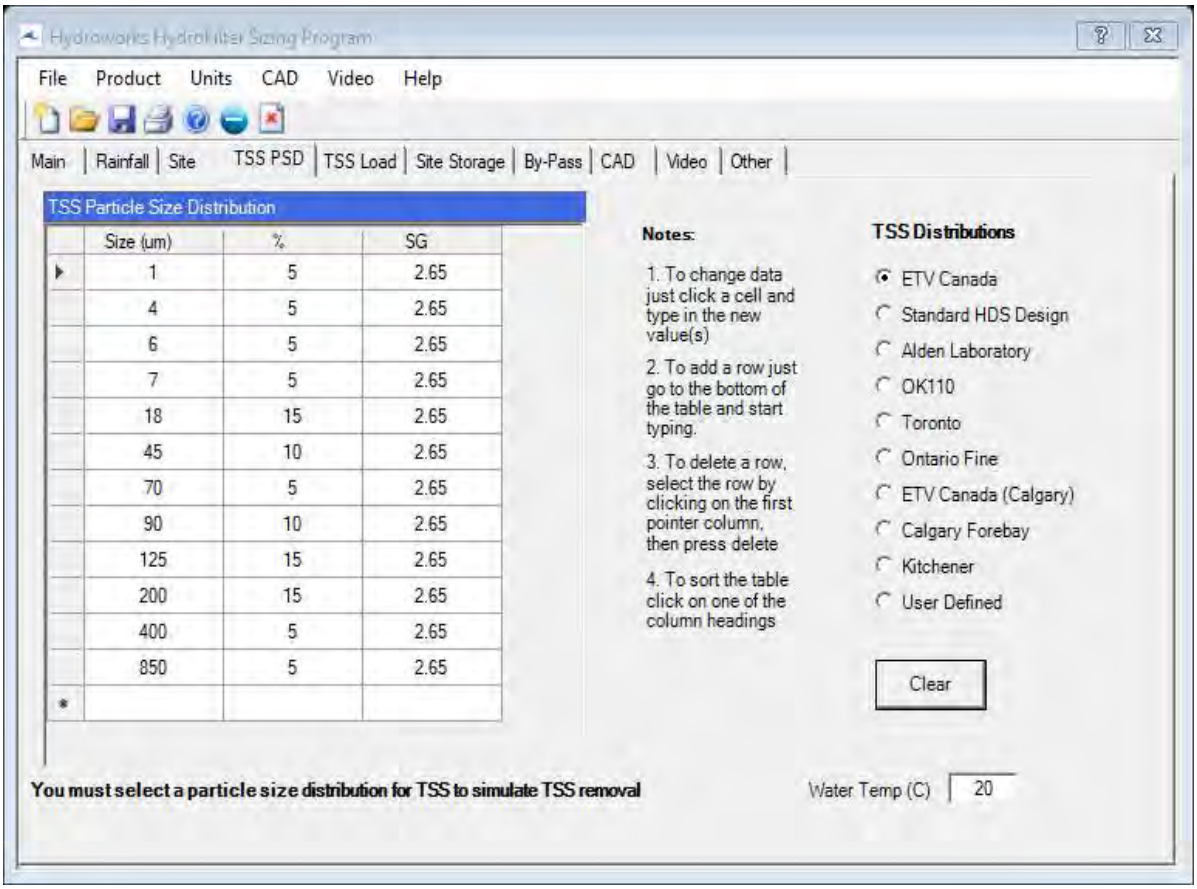
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroFilter .

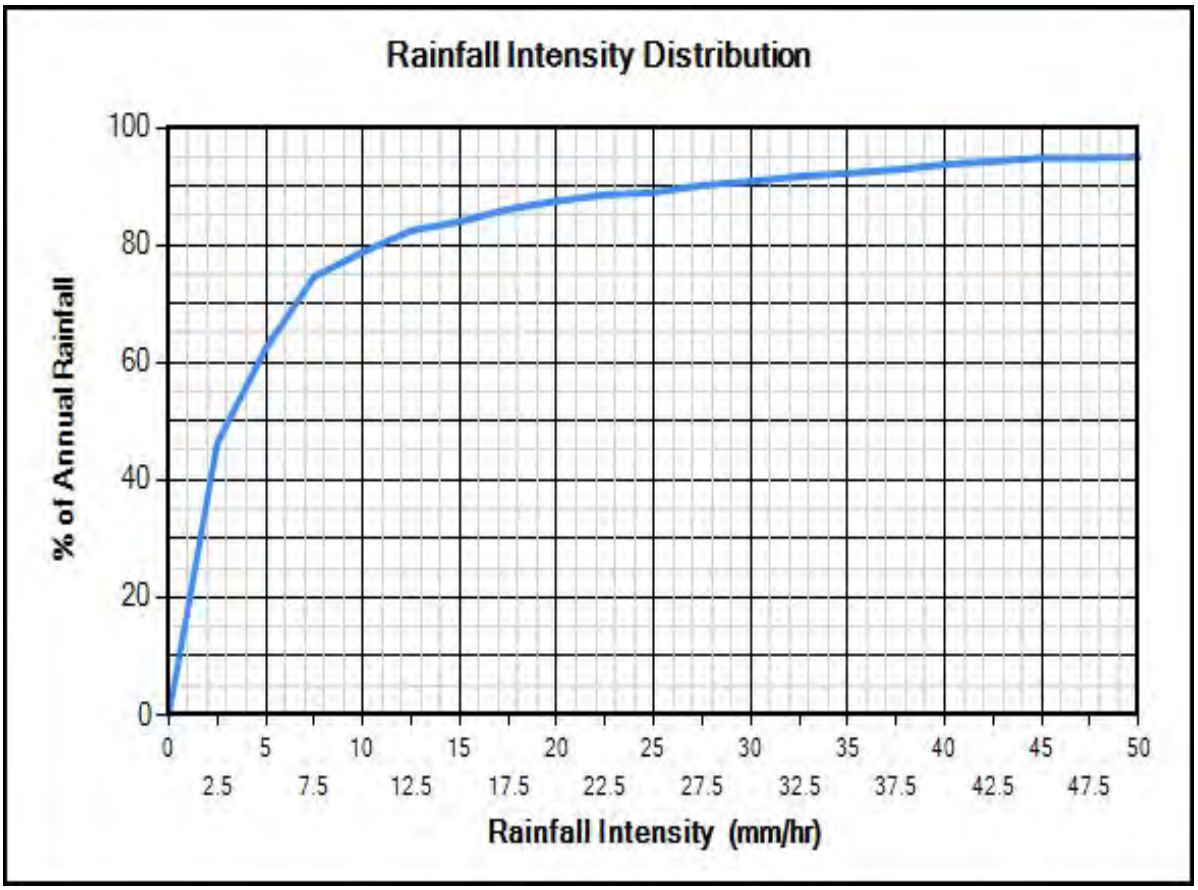
TSS Removal Sizing Summary



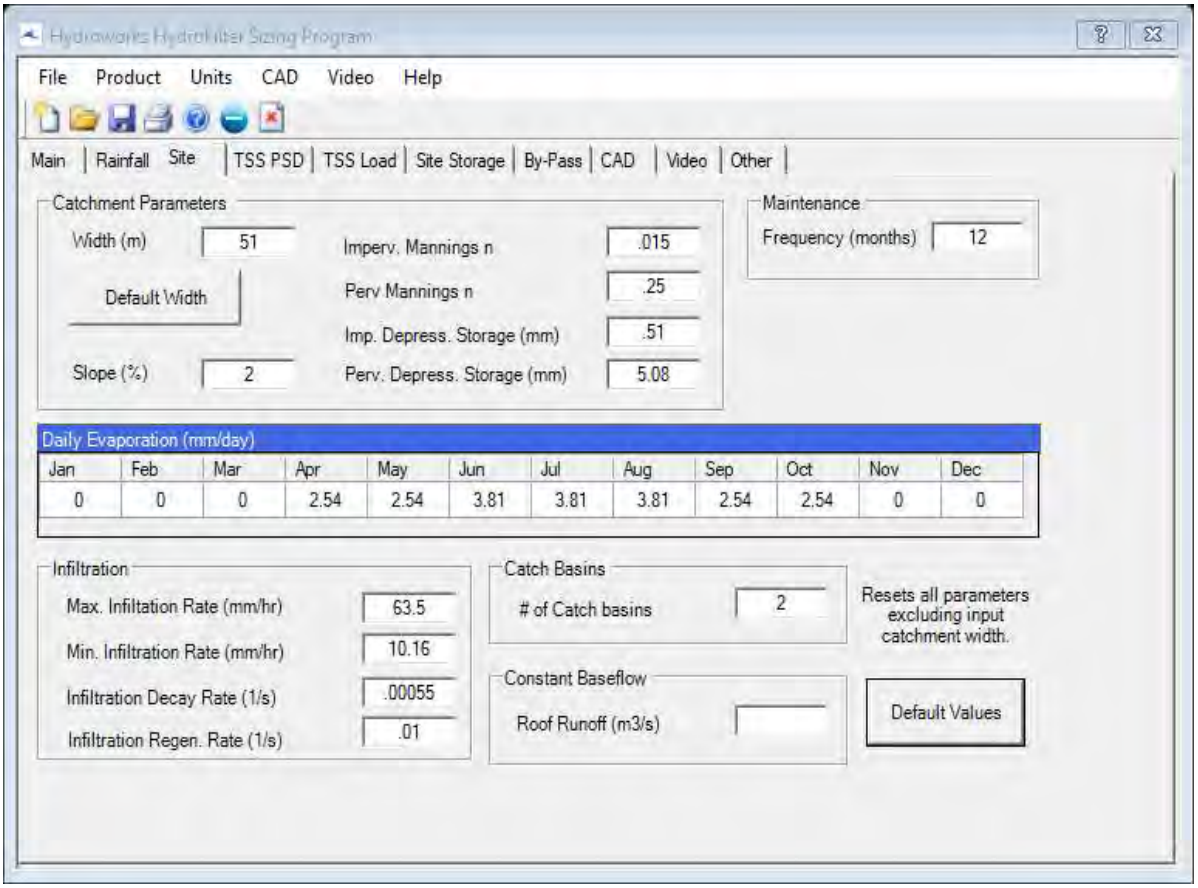
TSS Particle Size Distribution



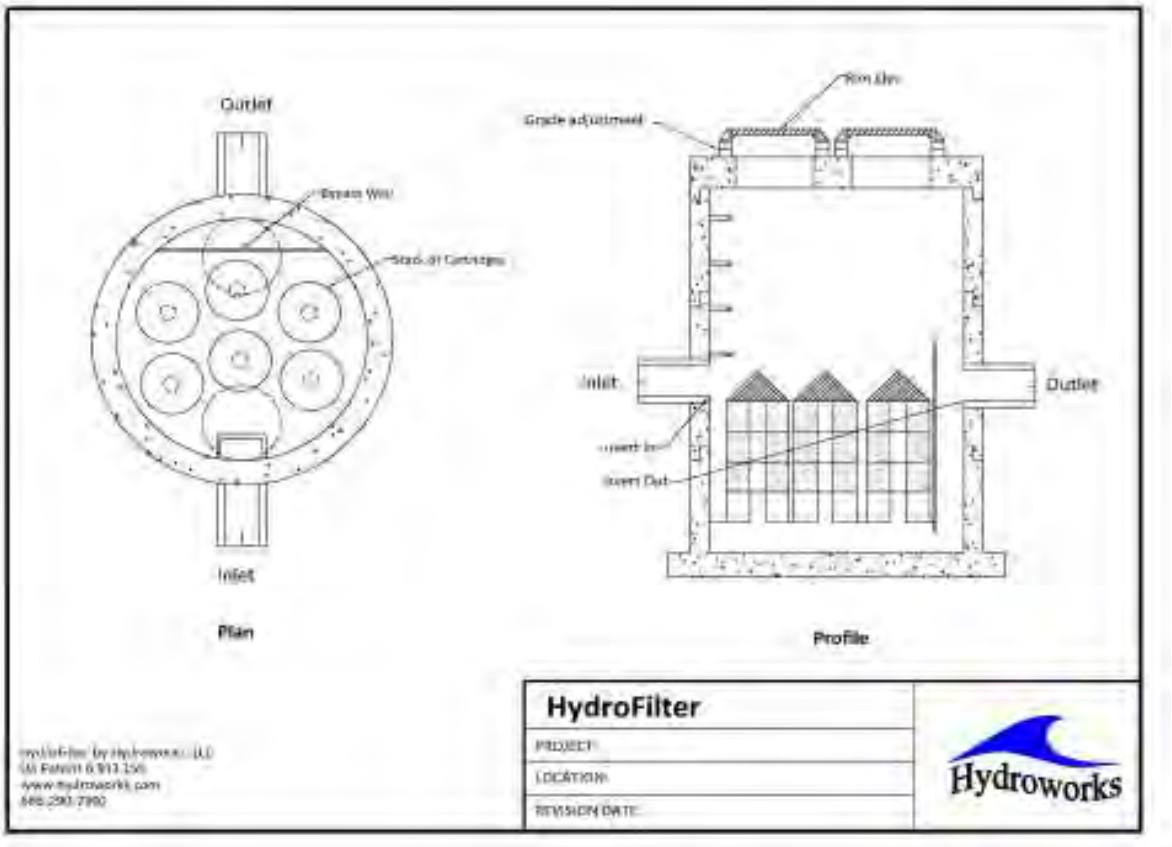
Rainfall Station - Hamilton RBG, Ontario(2004 To 2013)



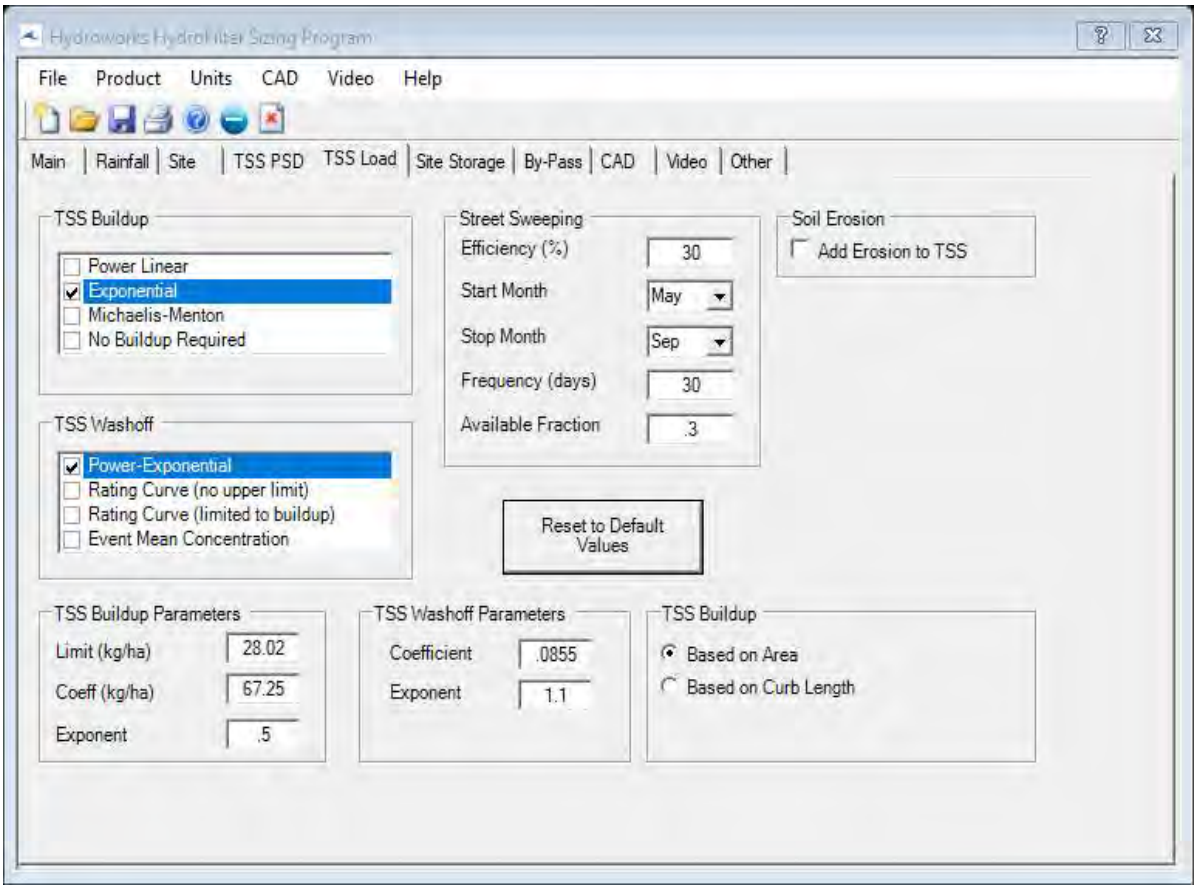
Site Physical Characteristics



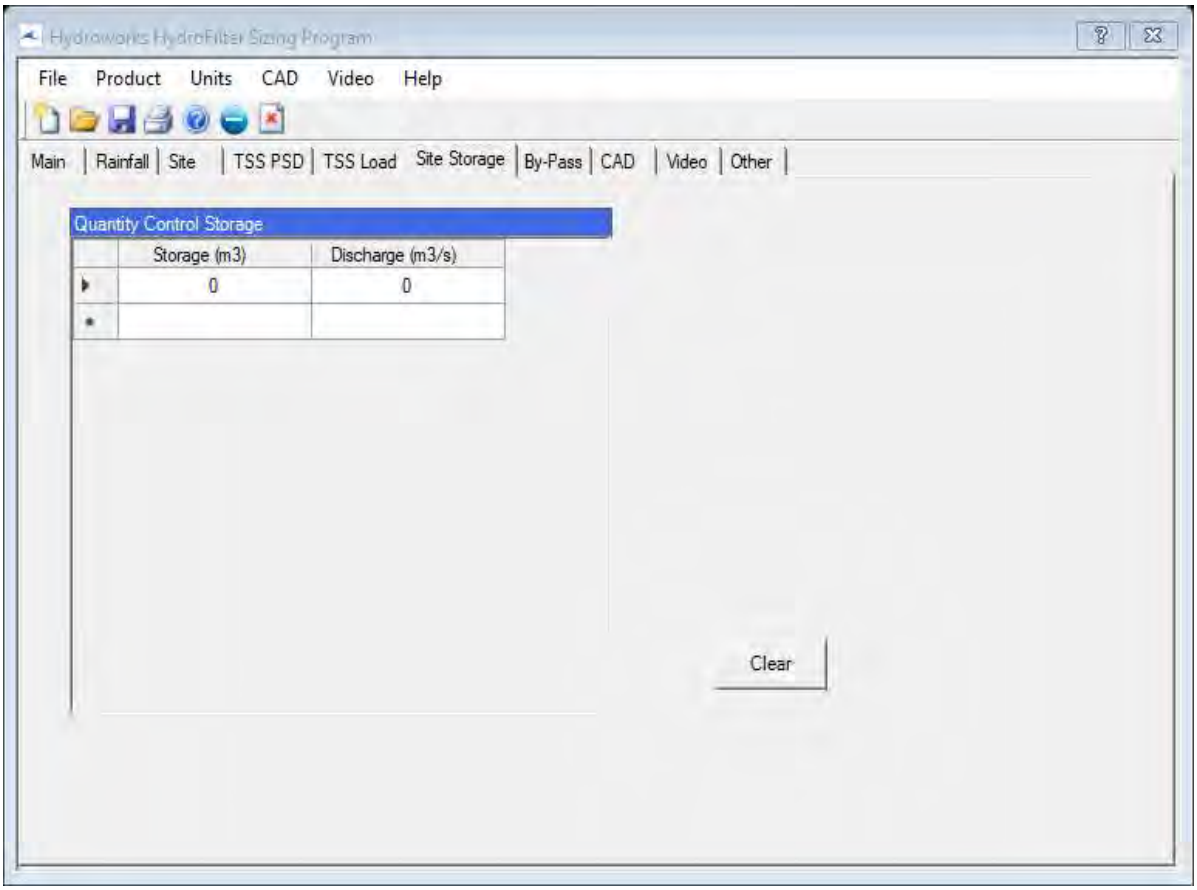
Generic HF10 CAD Drawing



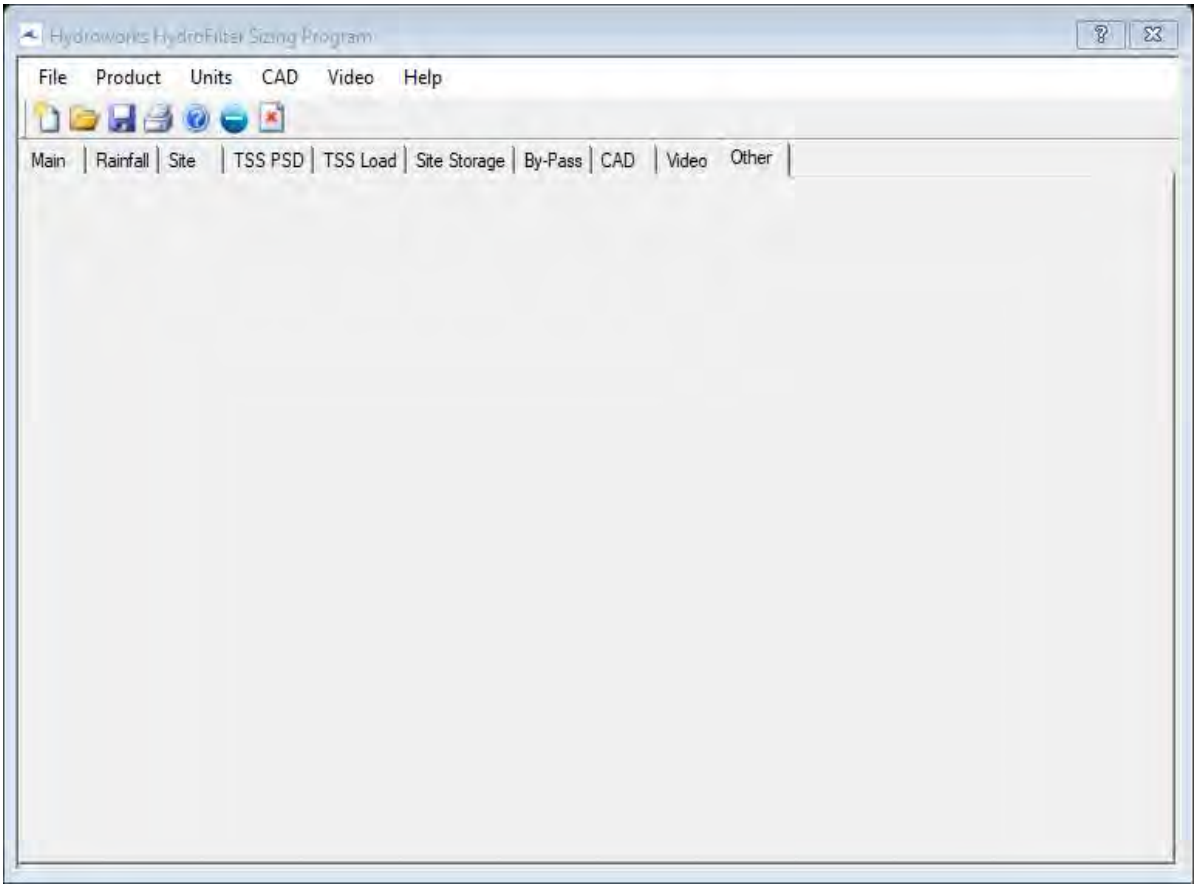
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.8.5
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1-800-290-7900
www.hydroworks.com

Verification Statement



Hydroworks HydroFilter HF2i
Registration number: (V-2024-02-01)
Date of issue: 2024-February-22

Technology type	Stormwater Filtration Device		
Application	Technology to treat stormwater and facilitate its infiltration into the ground.		
Company	Hydroworks, LLC.		
Address	257 Cox St., Roselle, NJ 07203 USA	**Phone**	+1-888-290-7900
Website	https://hydroworks.com	**E-mail**	gbryant@hydroworks.com

Verified Performance Claims for the HydroFilter HF2i

The Hydroworks HydroFilter HF2i was tested by Alden Research Laboratory, Holden, Massachusetts, USA in 2020. The performance test results were verified by the Sir Sandford Fleming College of Applied Arts and Technology's Centre for Advancement of Water and Wastewater Technologies (CAWT) following the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The following performance claims were verified:

Sediment Removal: The Hydroworks HydroFilter HF2i (two-cartridge 'dry' filter system) removed at least 84.6% of cumulative TSS, based on a 95% confidence level, with a particle size distribution of 1-1000 µm and an inlet test sediment concentration of 200 mg/L at a flow rate of 1.58 L/s (0.79 L/s per cartridge) based on 20 runs performed under controlled conditions during laboratory testing.

Maximum Treatment Flow Rate (MTFR): The Hydroworks HydroFilter two cartridge filter system has an MTFR of 25 gpm (0.06 cfs; 94.6 lpm) and an effective filtration treatment area (EFTA) of 12.57 ft^2 (1.17 m^2) (loading rate = 2.0 gpm/ft^2, 81.5 lpm/m^2).

Hydraulic Losses: The maximum driving head, which was recorded at the end of run 20, was 1.96 ft (60 cm), which correlates to 0.08 ft (2.4 cm) below bypass.

Technology Application

HydroFilter is a stormwater management device designed to both treat stormwater and facilitate its infiltration into the ground. The infiltration portion of HydroFilter is a removable component, which allows the HydroFilter to serve as either solely a filter or a filter with recharge capability for maintenance of the hydrologic cycle (i.e., groundwater/aquifer recharging and flood risk mitigation). This verification is specific to total suspended solids (TSS) removal.

Technology Description

Under normal or low flows, water enters the HydroFilter through a grate or horizontal inlet pipe. Incoming water builds up around the filters and creates a pressure head to drive water radially into the filter cartridges from the outside through to the centre of the cartridge. There is a 6” (150 mm) diameter opening in the centre that is contiguous through the centre of each cartridge. Water reaching the centre of each cartridge falls by gravity into the base plug and is transported out of the structure by a standard storm drain and/or recharge pipes into the surrounding soil.

A solid high deflection cone 24” (61 cm) diameter by approximately 12” (30.5 cm) height with a check valve is located on top of the top filter cartridge to prevent incoming water from entering the 6” (15.2 cm) diameter opening, while still allowing air to escape from the centre of the cartridges as water enters the filters. High flows are bypassed through a high pipe in the HydroFilter.

A schematic of the Hydroworks HydroFilter is shown in Figure 1.

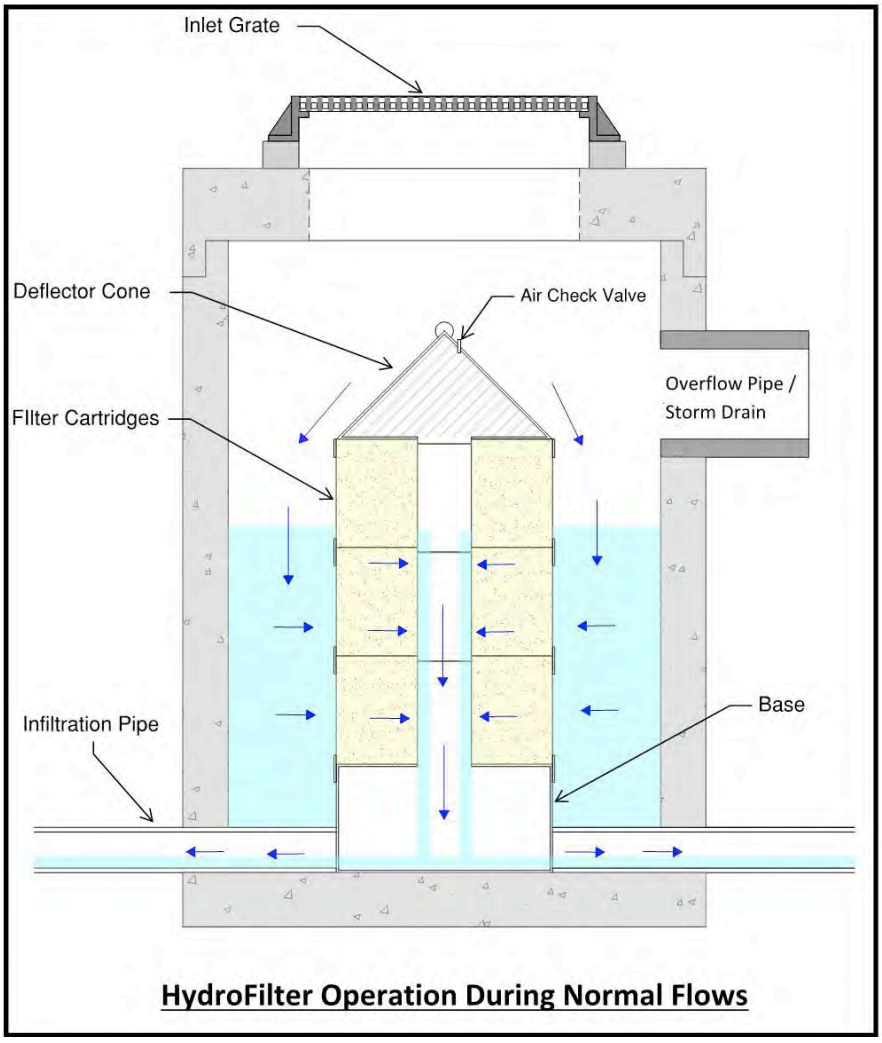


Figure 1: Schematic of the Hydroworks HydroFilter

Description of Test Procedure

Performance testing of the Hydroworks HydroFilter HF2i by Alden Laboratories was based on a "dry" filter, where the discharge point is below the cartridges such that it operates without the benefit of pre-treatment in a permanent pool. This differs from the "wet" configuration, which uses a weir wall to create a pre-treatment pool around the cartridges and allows for discharge above the cartridges by the head differential created by the weir wall.

The tested treatment filter (HF2i) was comprised of two (2) 24" (61 cm)-diameter x 12" (30.5 cm) high stacked interlocking filter cartridges installed inside a 3-ft diameter tank. Each cartridge contained a proprietary filter media. The inner and outer flow surfaces of the cartridges were perforated. The filter assembly was installed on a 24" (61 cm) diameter by 12" (30.5 cm) high base pedestal, which was sealed to the tank floor.

Water was transported into the tank by means of an 8" (20.3 cm) diameter inlet pipe, which discharged onto a sloped inlet containing a 24" (61 cm) storm grate. The flow was deflected around the annular space between the filter and tank, by the cone on top of the filters, and was transported radially through the cartridges.

A 6" (15.2 cm) centre opening transported the treated flow down into the base pedestal and into a 6" (15.2 cm) outlet pipe located at the bottom of the tank. The pipe was sealed to the pedestal and tank wall. A 6" (15.2 cm) bypass pipe was installed with the invert elevation at 3.04 ft (0.93 m). The pipe was connected to a tee in the outlet pipe upstream of the sampling point.

The annular area around the base pedestal (3.93 ft^2, 0.36m^2) was designed as a settling area for larger particles. A series of anti-scour pads were installed at the height of the pedestal to protect the captured sediment from scour.

Verification Results

A Verification Plan for the Hydroworks HydroFilter HF2i was prepared to guide the verification process based on the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol.

The CAWT verified the performance test data and other information pertaining to the Hydroworks HydroFilter HF2i based on performance testing conducted at Alden Labs, which followed the requirements outlined in the "*New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, January 25, 2013".* The intent of this protocol is to ensure that filtration manufactured treatment devices (MTDs) are tested under controlled conditions in a consistent, verifiable manner.

The HydroFilter HF2i technology performance claims verified by the CAWT are as follows:

Sediment Removal	The Hydroworks HydroFilter HF2i (two-cartridge 'dry' filter system) removed at least 84.6% of cumulative TSS, based on a 95% confidence level, with a particle size distribution of 1-1000 µm and an inlet test sediment concentration of 200 mg/L at a flow rate of 1.58 L/s (0.79 L/s per cartridge) based on 20 runs performed under controlled conditions during laboratory testing.
Maximum Treatment Flow Rate (MTFR)	The Hydroworks HydroFilter two cartridge filter system has an MTFR of 25 gpm (0.06 cfs, 94.6 lpm) and an effective filtration treatment area (EFTA) of 12.57 ft^2 (1.17 m^2) (loading rate = 2.0 gpm/ft^2, 81.5 lpm/m^2).
Hydraulic Losses	The maximum driving head, which was recorded at the end of run 20, was 1.96 ft (60 cm), which correlates to 0.08 ft (2.4 cm) below bypass.

Removal efficiency is based on the ability of the filtration MTD to reduce the influent TSS concentration. TSS removal efficiency was established by the Effluent Sampling Test Method. As indicated in Table 1, the test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution (PSD) specified in

the *"New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, January 25, 2013".* The protocol requires that the three-sample average of the test sediment PSD meet the specified PSD. The allowable tolerance of 2% variation from the specified PSD curve was met at each discrete particle size tested and the d50 was finer than 75 µm.

Table 1 – Test Sediment Particle Size Distribution

Particle Size (Microns)	Target Minimum % Less Than*
1,000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5

**A measured value may be lower than a target minimum % less than value by up to two percentage points (e.g., at least 3% of the particles must be less than 2 microns in size [target is 5%]), provided the measured d50 value does not exceed 75 microns.*

Laboratory testing of filters for TSS removal requires the use of a consistent PSD, which permits direct comparisons of filter products and a benchmark for filter design. The prescribed NJDEP PSD for filter testing (commonly referred to as the NJDEP PSD), is used by NJDEP for laboratory testing of both separators and filters.[1]

Figure 2 provides a comparison of average test sediment PSD to the PSD specified by NJDEP, indicating that the test sediment used for the removal test met the above-mentioned requirements. The median particle size (D_{50}) was 60 µm. In addition, samples from test sediment batches used for each run met the specified PSD within the required tolerance thresholds.

The capacity of the device to remove sediment was quantified at the 100% MTFR of 25 gpm (94.6 lpm) for 2 filter cartridges based on the Effluent Sampling Test Method. This method involved calculating the TSS concentration of the injected sediment, based on the mass injected and the volume of flow during the test period, and sampling the effluent leaving HydroFilter for each test run and calculating the average cumulative TSS removal efficiency.

The target influent total sediment concentration was 200 mg/L (+/-20 mg/L) for all tests. The allowed Coefficient of Variance (COV) for the measured samples was 0.10. The temperature of the supply water was below 26.7°C (80°F).

Five (5) time-stamped effluent samples and three (3) background samples of the supply water were collected from the end of the outlet pipe during each run. At the conclusion of each run, two (2) volume-based, evenly-spaced effluent samples were collected from the pipe during drawdown.

Table 2 provides the percent removal of cumulative TSS by the Hydroworks HydroFilter HF2i.

[1] Note: The NJDEP PSD is the same as the PSD specified for testing oil/grit separators under the *"Procedure for Laboratory Testing of Oil/Grit Separators"* (TRCA, 2014), which some jurisdictions in Canada call the Canadian ETV PSD.

Figure 2 – Average particle size distribution (PSD) of the 1-1000 micron test sediment used for the sediment removal test compared to the specified PSD (NJDEP specifications)

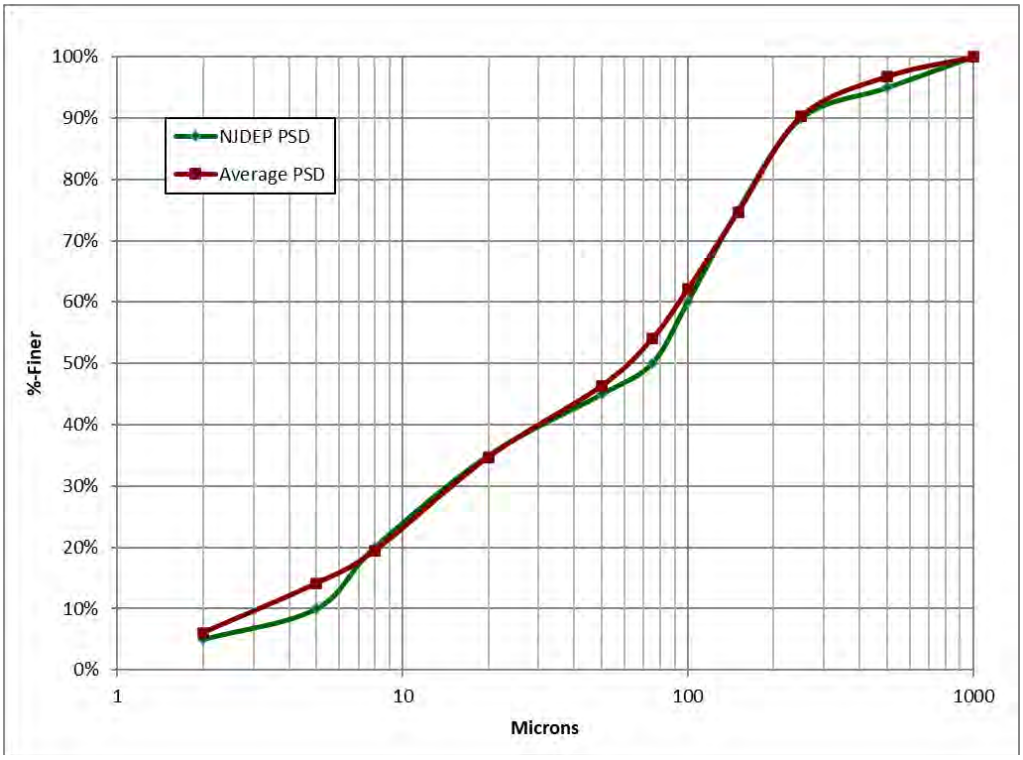


Table 2 – Removal efficiency summary (Source: Alden Report No.: 1182HF2i-R1)

Run #	Average Influent Concentration	Average Adjusted Effluent Concentration	Average Adjusted Drawdown Concentration	Influent Volume	Effluent Volume	Drawdown Volume	Removal Efficiency	Cumulative Average
	mg/L	mg/L	mg/L	L	L	L		
1	203	27.6	19.3	3353	3253	100	**86.5%**	**86.5%**
2	202	28.8	16.6	3350	3238	113	**86.0%**	**86.2%**
3	202	31.4	23.1	3352	3226	126	**84.6%**	**85.7%**
4	200	46.4	21.7	3364	3229	135	**77.3%**	**83.6%**
5	203	35.1	22.0	3360	3216	144	**83.0%**	**83.5%**
6	200	24.2	13.9	3361	3211	150	**88.1%**	**84.2%**
7	202	22.9	16.5	3356	3199	157	**88.8%**	**84.9%**
8	202	30.7	22.6	3357	3193	164	**85.0%**	**84.9%**
9	203	33.0	17.6	3547	3375	171	**84.1%**	**84.8%**
10	200	24.7	15.6	3548	3369	178	**87.9%**	**85.1%**
11	203	24.7	15.8	3538	3356	182	**88.0%**	**85.4%**
12	201	26.8	21.0	3561	3374	187	**86.8%**	**85.5%**
13	202	35.7	17.9	3543	3351	192	**82.8%**	**85.3%**
14	203	31.0	18.2	3545	3348	196	**85.1%**	**85.3%**
15	201	26.2	19.7	3547	3348	199	**87.1%**	**85.4%**
16	202	37.4	19.1	3554	3349	205	**82.0%**	**85.2%**
17	202	27.6	13.8	3557	3351	206	**86.7%**	**85.3%**
18	201	27.5	22.4	3553	3342	211	**86.5%**	**85.3%**
19	202	32.6	18.0	3545	3333	212	**84.3%**	**85.3%**
20	202	27.4	23.7	3548	3333	215	**86.5%**	**85.3%**

Scour testing was done after the sediment removal tests based on the sediment collected in the sump. Subsequent tests with and without the scour pads indicated acceptable scour (average TSS <2mg/l) in both cases, suggesting that the anti-scour pads have minimal impact on preventing sediment scour. HydroFilter can be used online based on current regulatory standards as long as the maximum conveyance rate of the drainage system does not exceed the maximum conveyance rate used for scour testing *("New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device", NJDEP, 2023*).

Quality Assurance

A number of Quality Assurance (QA)/Quality Control (QC) measures are documented in the *"New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, January 25, 2013"* to ensure results are accurate and precise, and that tests conducted by multiple vendors of the same category of technology are employing the same test method. The QA/QC measures include the use of certified laboratories, established test methods, calibration of equipment, tolerance limits for results variation, data checks during testing, and stringent documentation requirements.

The verifier, the CAWT, has confirmed that quality assurance requirements were addressed throughout the HydroFilter performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity. QA/QC parameters reviewed and validated by the verifier are summarized in Table 3, including the acceptance criteria for particle size distribution, solids concentration in test water, water temperature, flow measurement equipment, flow rate variation, head measurement equipment, sediment feed, sediment moisture content, and sample analysis.

Table 3 - Validation of QA/QC Procedures

QC Parameter	Acceptance Criteria
Particle Size Distribution	Analyzed by a certified laboratory (GeoTesting Express) in accordance with ASTM D422-63(2007)e1. The particle size utilized for testing was the NJDEP particle size distribution (Table 1). The allowable tolerance of 2% variation from the specified PSD curve was met at each discrete particle size tested and the d50 was finer than 75 µm.
Solids concentration in test water	Total suspended solids (TSS) concentration of test water (background TSS) of less than 20 mg/L. TSS analyzed in accordance with ASTM: D3977-97 (re-approval 2019).
Water temperature	Temperature of water less than 26.7ºC (80ºF)
Flow measurement equipment	Equipment calibration reports submitted to confirm that reported flow rate match actual flow rate. Flow rates from calibrated flow instruments recorded at no longer than 60 second intervals over the duration of the test.
Head measurement equipment	The water level recorded at a minimum of five-minute intervals. The minimum tolerance of the standpipe was within +/- 0.125 inches (0.32 cm).

Sediment feed	TSS concentration target = 200 mg/L with a tolerance limit of ±20 mg/L. The allowed Coefficient of Variance (COV) for the measured samples was 0.10.
Sediment moisture content	Determined by ASTM D4959-07 *"Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating".*
Sample analysis	Conducted by qualified laboratories using standard methods and meeting the requirements of ISO.

9. Verification Summary

In summary, the HydroFilter HF2i is a viable technology that, when sized appropriately, can be used to filter sediment from stormwater runoff.

Verification of performance claims for the Hydroworks HydroFilter was conducted by the CAWT based on independent third-party performance test results provided by Alden Research Laboratory, as well as additional information provided by Hydroworks on the operation of the technology. The verification follows the requirements outlined in the HydroFilter Verification Plan, which is based on the ISO 14034 ETV standard. The verified performance claims are provided in Table 4.

Table 4 - Verified Performance Claims for the HydroFilter HF2i

Parameter	Verified Claim	Accuracy
Sediment Removal	During the sediment removal efficiency test, the HydroFilter HF2i (two-cartridge 'dry' filter system) removed at least 84.6% of cumulative TSS, based on a 95% confidence level, with a particle size distribution of 1-1000 µm and an inlet test sediment concentration of 200 mg/L at a flow rate of 1.58 L/s (0.79 L/s per cartridge) based on 20 runs performed under controlled conditions during laboratory testing.	Sediment removal characteristics were quantified at the maximum treatment flow rate (MTFR) of 25 gallons per minute (gpm) (94.6 liters per minute (lpm)), with a particle size distribution (PSD) gradation of 1-1000 micron fractions. The target influent total sediment concentration was 200 mg/L (+/-20 mg/L) for all tests. The allowed Coefficient of Variance (COV) for the measured samples was 0.10. The temperature of the supply water was below 26.7 °C (80 °F). Five (5) time-stamped effluent samples and three (3) background samples of the supply water were collected from the end of the outlet pipe during each run. At the conclusion of each run, two (2) volume-based evenly-spaced effluent samples were collected from the pipe during drawdown. Collected samples were analyzed for Total Suspended Solids (TSS) concentration. The average cumulative TSS removal efficiencies were calculated using the injected influent sediment concentrations. Performance testing of the Hydroworks HydroFilter HF2i by Alden Laboratories was based on a "dry" filter, where the discharge point is below the cartridges such that it operates without the benefit of pre-treatment in a permanent pool. This differs from the "wet" configuration, which uses a weir wall to create a pre-treatment pool around the cartridges and allows for discharge above the cartridges by the head differential created by the weir wall.

Maximum Treatment Flow Rate (MTFR)	The HydroFilter two cartridge filter system has an MTFR of 25 gpm (0.06 cfs, 94.6 lpm) and an effective filtration treatment area (EFTA) of 12.57 ft^2 (1.17 m^2) (loading rate = 2.0 gpm/ft^2, 81.5 lpm/m^2).	Flow rates from calibrated flow instruments were recorded at no longer than 60 second intervals over the duration of the test. Instrument calibration reports were submitted with the final technical report. The accuracy of the flow measurement is ±1%.
Hydraulic Losses	The maximum driving head, which was recorded at the end of run 20, was 1.96 ft (60 cm), which correlates to 0.08 ft (2.4 cm) below bypass.	Accuracy of the readings was 0.3 mm.

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

For more information on the HydroFilter technology, contact:	For more information on VerifiGlobal, contact:
Hydroworks LLC. 257 Cox St., Roselle, NJ 07203 USA T: +1-888-290-7900 E: gbryant@hydroworks.com W: https://hydroworks.com	VerifiGlobal c/o ETA-Danmark A/S Göteborg Plads 1, DK-2150 Nordhaven T: +45 7224 5900 E: info@verifiglobal.com W: www.verifiglobal.com
Signed for Hydroworks: Graham Bryant Owner	Signed for VerifiGlobal: Thomas Bruun Managing Director John Neate Managing Director

NOTICE: Verifications are based on an evaluation of technology performance under specific, predetermined operational conditions and parameters and the appropriate quality assurance procedures. VerifiGlobal and the Verification Expert, the CAWT, make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable regulatory requirements. Mention of commercial product names does not imply endorsement.

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APPENDIX C

WATER ANALYSIS INFORMATION

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

Project Number: 23082
Project Name: 127 Plains Road West
Date: 18-Oct-24

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:

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

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for Type V wood frame construction (structure essentially all combustible)
= 0.8 for Type IV-A mass timber construction (encapsulated mass timber)
= 0.9 for Type IV-B mass timber construction (rated mass timber)
= 1.0 for Type IV-C mass timber construction (ordinary mass timber)
= 1.5 for Type IV-D mass timber construction (un-rated mass timber)
= 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

	Building Area				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
Building / Location	Footprint Area (m^2)	# 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)**
127 Plains Road West	varies (see below)	24	**5193.0**	**0.8**	13000	216.7	**-15**	-1950.0	**11050.0**	**-50**	-5525.0	**15**	1657.5	**7000**	**117**

Total Area Calculation:

Two largest ajoining floors plus 50% of any floors immediately above them up to eight floors

Floor	Area	Tot. Area	Cumm. Area
1	1018	1018	1018.0
2-5	958	2395	3413.0
6	720	360	3773.0
7-24	710	1420	5193.0

(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
> 30m	0%	exceed 75%

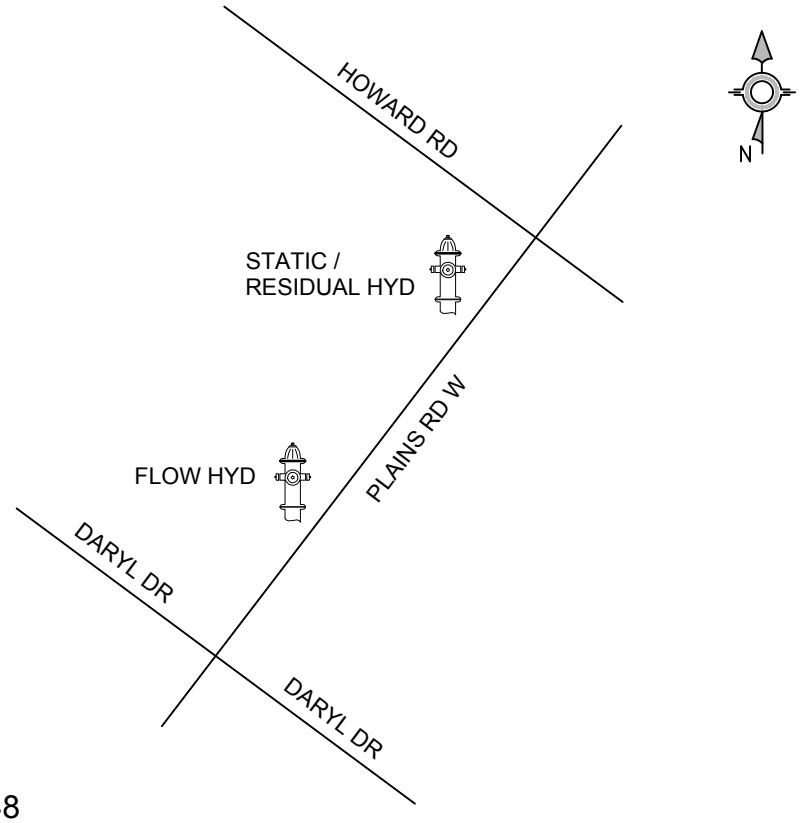
Side	Exposure (m)	Charge (%)
North =	**> 30**	**0**
South =	**> 30**	**0**
East =	**> 30**	**0**
West =	**17.6**	**15**
Total Expoure =		***15***

FLOW TEST RESULTS

DATE : OCTOBER 26, 2023 TIME : 9:30 AM

LOCATION : 127 PLAINS ROAD WEST
BURLINGTON, ONTARIO

TEST BY : VIPOND & P.U.C.



STATIC PRESSURE : 48

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	2-1/2"	42	30	920
2	2	2-1/2", 2-1/2"	39	18,18	1420

FIRST FOR FIRE PROTECTION

VIPOND INC

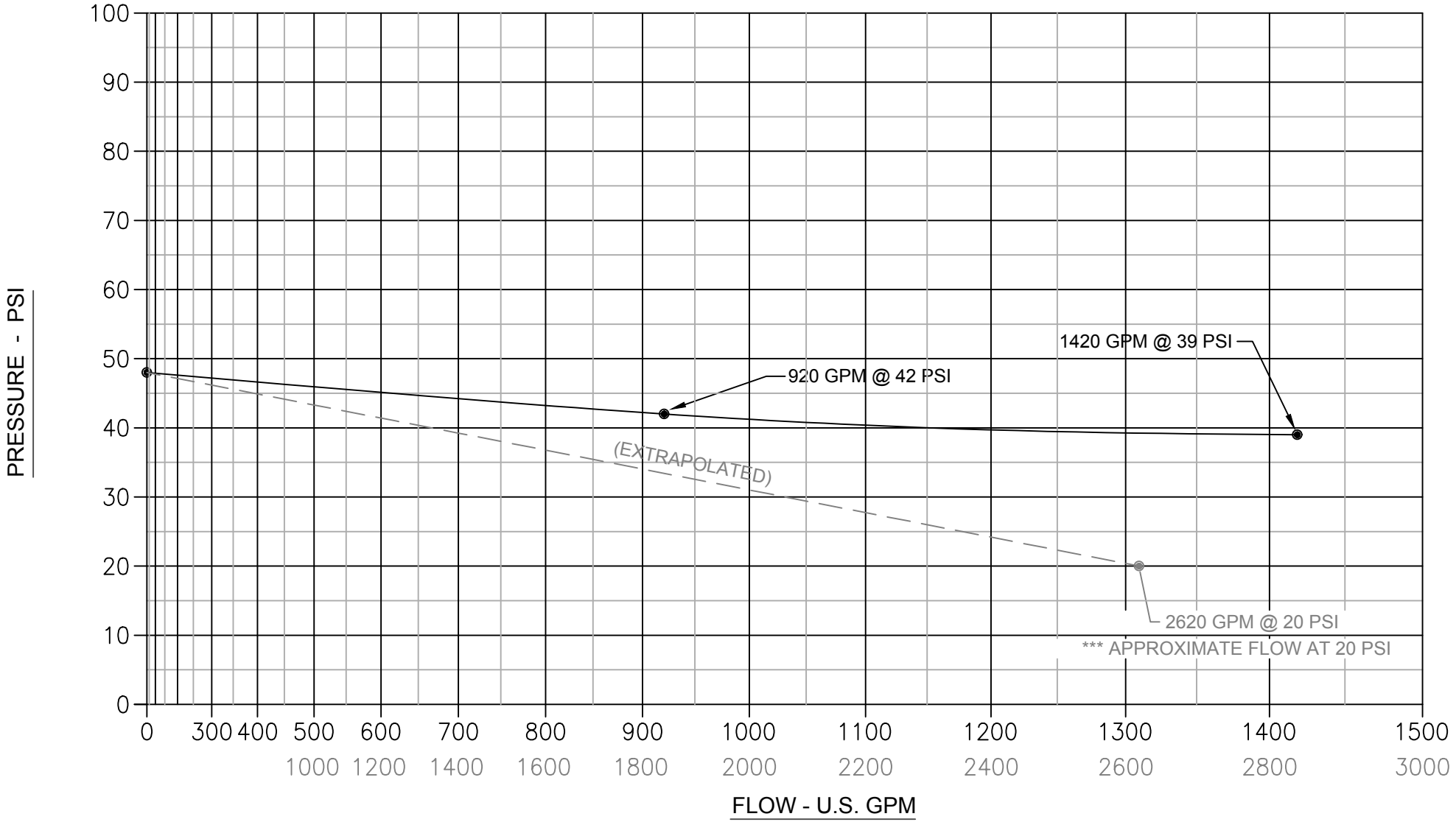
est. 1945

127 PLAINS ROAD WEST	PREPARED BY :	JOHN LUCES
BURLINGTON, ONTARIO	OFFICE :	STONEY CREEK
	TEST BY :	VIPOND & P.U.C.
	DATE :	OCTOBER 26, 2023 9:30 AM

STATIC : 48 PSI

42 PSI @ 920 GPM

39 PSI @ 1420 GPM



APPENDIX D

HYDROGEOLOGICAL INVESTIGATION

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

401 Grays Road · Hamilton, ON · L8E 2Z3

www.soil-mat.ca info@soil-mat.ca 905.318.7440 / 800.243.1922 (*toll free*) 905.318.7455

PROJECT NO.: SM 230581-EG June 10, 2024

LOSANI HOMES
430 McNeilly Road, Suite 203
Stoney Creek, Ontario
L8E 5E3

Attention: Daniel Borrelli
Planner and Project Coordinator

GEOTECHNICAL INVESTIGATION
PROPOSED 26-STOREY BUILDING
127 PLAINS ROAD WEST
BURLINGTON, ONTARIO

Dear Mr. Borrelli,

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 P230581 r1, dated July 11, 2023, and revised on February 14, 2024. Our comments and recommendations, based on our findings at the eight borehole locations, are presented herein.

1. INTRODUCTION

We understand that the proposed project will involve the construction of a 26-storey structure with up to four underground basement levels at the property, upon demolition of the existing structure located at 127 Plains Road West in Burlington, Ontario. The purpose of this geotechnical investigation work is to assess the subsurface soil and groundwater 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 eight [8] 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 14.0 to 32.1 metres below the existing grade on April 29 & 30, and May 1, 2, 3, 6, & 7, 2024. Upon completion of drilling all boreholes were outfitted with groundwater monitoring wells. 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.

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. Pocket penetrometer testing was performed on all cohesive samples recovered from the borings, routine moisture content tests were performed on all soil samples, and grain size analyses were performed on six [6] selected samples.

As noted above the boreholes were advanced with HQ diamond coring equipment where the power auger equipment encountered refusal on Shale Bedrock. Rock Quality Designation [RQD] was calculated for the recovered core samples, and 8 [eight] 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.

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 top of catch basin, located east of the tenant parking spaces, as illustrated on Drawing No. 1, Borehole Location Plan. This benchmark was noted to have a geodetic elevation of 102.89 metres on the survey provided to our office (A.T. McLaren Ltd. Drawing No. 30012-T, dated April 10, 2024).

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. 1A to 6, 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 as the exact depths of geological change.

It is understood that TerraDynamics Consulting Inc. have been retained to complete the Hydrogeological Assessment on the property based on the wells installed as part of this investigation. Their office was contacted for the completed static groundwater readings to allow for the relevant discussions in this report.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is currently occupied by commercial properties Ye Olde Squire Pub and Benjamin Moore Paints on the ground floor, with residential apartments above. The subject site beyond the footprint of the mixed-use building primarily consists of concrete and asphalt paved entryways and parking spaces, with a small landscaped area and sidewalk bordering the adjacent roadways. The site is bounded to the north by a commercial wholesaler, to the east by Howard Road, to the south by Plains Road West, and to the west by commercial properties. The site has relatively flat and even topography with the surrounding landscape.

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

Pavement Structure

All the boreholes were advanced through the existing pavement structure, which was found to consist of approximately 125 millimetres of asphaltic concrete overlying approximately 300 to 450 millimetres of granular base material. The pavement structure encountered at the borehole locations has been summarized as follows:

Table A – Pavement Structure

Borehole No.	Asphaltic Concrete (mm)	Granular Base (mm)
1A / 1B	125	450
2	125	450
3	125	450
4	125	300
5A / 5B	125	450
6	125	450

Sand and Gravel Fill

Sand and gravel fill material was encountered below the pavement structure at Borehole Nos. 2, 3, 4, and 6. The granular fill material was brown in colour, typically containing trace to some silt, occasional to moderate cobbles, occasionally exhibited clayey seams in the lower levels, and was generally found to be in a very loose to dense state. The granular fill encountered was proven to depths of between approximately 2.3 to 4.7 metres below the existing ground surface. Given the granular nature of the fill, the transition from fill materials to native sand and gravel was somewhat indistinct. As such, material identified as sand and gravel fill material may in fact be native sand and gravel.

Sand Fill

Sand fill was encountered below the pavement structure and in Borehole Nos. 1A/1B & 5A/5B. The granular fill material was brown in colour, contained traces of, to some, silt and gravel, and was noted to be in a very loose to compact state. The granular fill encountered was proven to depths of between approximately 2.1 to 2.2 metres below the existing ground surface.

Sand and Gravel

Native sand and gravel material was encountered immediately beneath the fill material at all borehole locations. The granular material was brown in colour, with varying gravel content throughout, typically containing traces of silt and clay, occasional to frequent cobbles, contained a seam of reddish-brown silty clay/clayey silt in Borehole Nos. 1A/1B, and was generally found to be in a compact to very dense state. The native material was proven to depths of between approximately 4.1 to 10.3 metres below the existing ground surface. As noted above, given the granular nature of the fill overburden, the transition from fill materials to native sand and gravel was somewhat indistinct. As such, material identified as native sand and gravel may in fact be fill material.

Sand

Native sand material was encountered immediately beneath the native silty clay/clayey silt in Borehole No. 4, and beneath the native sand and gravel at all remaining Borehole locations. The granular material was brown in colour, typically containing trace to some silt and gravel, occasionally exhibiting silty layers in the lower levels, and was generally found to be in a compact to very dense state. The native material was proven to depths of between approximately 14.0 to 17.9 metres below the existing ground surface.

Silty Clay/Clayey Silt

Native silty clay/clayey silt soil was beneath the native sand and gravel in Borehole No. 6, and beneath the native sand in Borehole Nos. 1A and 5A. The silty clay/clayey silt

was reddish-brown in colour in Borehole No. 6, and grey in Borehole No. 1A and 5A, contained traces of, to some, sand, trace gravel in the upper levels, and was generally in a very soft state in Borehole No. 6, while exhibiting a stiff to very stiff state in Borehole Nos. 1A and 5A. The fine-grained native soil was proven to depths of between approximately 7.1 to 22.4 metres below the existing ground surface.

Sandy and Silty Gravel

Native sandy and silty gravel material was encountered beneath the silty clay/clayey silt in Borehole Nos. 1A and 5A. The native material was red to reddish grey in colour, with a high gravel content in the upper levels, containing traces of clay increasing with depth, and was generally in a very dense state. The cohesive material was proven to depths of between approximately 25.6 to 27.5 metres below the existing ground surface.

Queenston Shale

Queenston Shale was encountered beneath the native sandy and silty gravel at Borehole Nos. 1A and 5A. 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. 1A and 5A using Hq size diamond core barrel equipment. The Rock Quality Designation [RQD] of the recovered rock cores was determined to range from approximately 0 to 95 per cent, generally increasing with depth, indicative of a sound quality rock mass. The results of the rock coring are summarized in the following table.

Table B - Bedrock Core Data

Core ID		Depth (m)	Recovery (%)	RQD (%)
Borehole No. 1A	Run 1	27.5 – 29.0	88%	82%
	Run 2	29.0 – 30.5	95%	89%
	Run 3	30.5 – 32.0	95%	90%
Borehole No. 5A	Run 1	25.6 – 26.0	38%	0%
	Run 2	26.0 – 27.6	95%	86%
	Run 3	27.6 – 29.2	90%	76%
	Run 4	29.2 – 30.6	98%	95%

Compressive strength testing was carried out on eight [8] core samples, yielding strengths in the range of approximately 47.5 to 80.5 MPa [6890 to 11670 psi], with an average of 53.2 MPa [7710 psi], summarised as follows.

Table C - Bedrock Compressive Strength Data

Core ID		Depth (m)	Unconfined Compressive Strength q_u (MPa)
Borehole No. 1A	Run 1	28.3	55.7
	Run 2	29.4	58.5
	Run 2	30.2	56.5
	Run 3	31.7	63.9
Borehole No. 5A	Run 2	26.4	58.4
	Run 2	27.3	80.5
	Run 3	29.0	57.5
	Run 4	30.3	47.5

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicates the surficial geology of the subject site to consist of Pleistocene deposits of sand and gravel, 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 by SOIL-MAT ENGINEERS with the following results:

Table C - Ground Water Level Measurements

Borehole No.	Ground Surface Elev. [m]	May 3, 2024		May 7, 2024		May 30, 2024	
		Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)	Ground Water Depth (m)	Ground Water Elev. (m)
1A	103.07	14.80	88.27	-	-	15.15	88.55
1B	103.08	13.19	89.89	-	-	13.15	89.93
2	103.12	-	-	13.10	90.02	13.07	90.05
3	103.15	-	-	12.93	90.22	12.90	90.25
4	103.26	-	-	-	-	12.95	90.31
5A	103.19	-	-	14.19	89.00	15.16	88.03
5B	103.23	-	-	12.84	90.36	13.19	90.04
6	103.31	13.09	90.22	-	-	13.07	90.24

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 88 to 91 metres. The groundwater elevation was observed at a depth of approximately 13 metres below the exiting grade, with some deeper aquifers encountered from the bedrock wells installed. It is noted that the groundwater level would be subject to seasonal variation due to prevailing weather conditions. As noted above, it is understood a more thorough hydrogeological assessment is being completed by Terra-Dynamics, which will speak further to the hydrogeological setting.

4. GEOTECHNICAL LABORATORY TESTING

As noted above, four [4] selected samples of the recovered soil were subjected to grain size analyses including sieve and hydrometer tests. The results of these grain size analyses have been summarised in Table C as follows:

Table D - Grain Size Analyses Summary

Sample	Sample Depth [m]	Clay [%]	Silt [%]	Sand [%]	Gravel [%]	Effective Diameter [mm]	Estimated Permeability [cm/sec]
BH1A SS17	19.8	48	52	0	0	0.0004	10^{-7}
BH1A SS20	24.4	9	21	34	36	0.003	10^{-6}
BH2 SS13	13.7	4	9	87	0	0.034	10^{-3}
BH4 SS12	12.2	6	14	80	0	0.010	10^{-3}
BH5A SS15	18.3	48	51	1	0	0.0004	10^{-7}
BH6 SS12	12.2	3	10	87	0	0.034	10^{-3}

The results outlined above indicate Sand with some silt and a trace of clay in Samples BH2 SS13, BH4 SS12, and BH6 SS12. According to the Unified Soil Classification System these soil samples are generally classified as S.M. – Sand-silt mixtures, to S.C. – Sand-clay mixtures. Samples BH1A SS17 and BH5A SS15 generally indicate Silt and Clay. According to the Unified Soil Classification System these soil samples are classified as M.L. – Inorganic silts to C.L. – Inorganic clays of low to medium plasticity. These results are consistent with our observations of the sand soils encountered within shallower depths, and silt/clay mixtures encountered in the lower levels across the site during drilling, our visual assessment of the recovered samples, as well as our experience in the area. It is noted that there is some variation in the overall permeability of the native soils, as a function of natural variation within the soil layers.

5. FOUNDATION CONSIDERATIONS

5.1 SHALLOW FOUNDATIONS

As noted above, it is understood that the proposed development will be a twenty-six-storey structure with up to four basement levels. As such, it would be anticipated that the structure is founded approximately 12 to 16 metres below the existing ground surface. Spread footings found within the native sand soils at this depth are considered suitable in terms of support conditions for the proposed structure. The spread footings may be designed considering Ultimate Limit State [ULS] bearing values of 225 kPa [~4,500 psf], and Serviceability Limit State [SLS] bearing values of 150 kPa [~3,000 psf], based on the total and differential settlements not exceeding 25 and 20 millimetres, respectively. Alternatively, the native sand soils are considered capable of supporting the structure on a raft slab foundation. The raft slab may similarly be designed considering design bearing values of 225 kPa [~4,500 psf] ULS and 150 kPa [~3,00 psf] SLS.

In the event that fewer basement levels are considered, and the structure is founded approximately 5 to 10 metres below the existing ground surface within the native sand and gravel, an increased bearing capacity of 450 kPa [~9,000 psf] ULS and 300 kPa [~6,000 psf] SLS may be considered for raft slab and spread footing foundations.

5.2 CAISSONS

The proposed 26-storey building may be supported on caisson foundations extending into the underlying Queenston Shale bedrock, and may be conservatively designed considering the bearing capacity as follows:

SLS = ULS = 2,000 kPa [~40,000 psf]

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. Where caissons extend through the upper weathered rock and into more sound bedrock [a minimum of 1.5 metres or more] it would be feasible to design caissons to also take advantage of skin friction within the rock. A unit skin friction resistance of ULS = SLS = 250 kPa [~5,000 psf] may be considered. Higher bearing and skin friction values may be available; however, these increased values would need to be confirmed through additional investigation including bedrock coring. Uplift capacity could be readily achieved with the skin friction on deeper caissons.

5.3 GENERAL FOUNDATION CONSIDERATIONS

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable deflection [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. There is no direct relationship between ULS and SLS; rather they are a function of the soil type and the tolerable deflections for serviceability, respectively. Evidently, the bearing capacity values would be lower for very settlement sensitive structure and larger for more flexible buildings.

The support conditions afforded by the founding soils are usually not uniform across the site, neither are the loads on the various foundation elements. It is therefore recommended that the footings and foundation walls be structurally reinforced to account for potential variable support and loading conditions.

In areas where it will be necessary to provide adjacent footings at different founding elevations, the lower footing should be constructed before the higher footing is constructed, 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.

All footings, grade beams, etc. exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost damage. This frost protection would also be required if construction were undertaken during the winter months. All footings and foundations should be designed and constructed in accordance with the current Ontario Building Code.

With foundations designed as outlined above and as required by the Building Code, and with careful attention paid to construction detail, total and differential settlements should be well within normally tolerated limits of 25 and 20 millimetres, respectively, for the type of building and occupancy expected.

It is noted that the performance of deep foundation schemes is greatly dependent on the method, equipment, and workmanship utilised during construction. It is therefore essential that installation procedures for such foundations be monitored/evaluated by SOIL-MAT ENGINEERS.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation 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.

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 D – Stiff Soil, 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	0.0290	0.0068	0.0027	0.172	0.102

7. LATERAL EARTH PRESSURE

The lateral earth pressures on basement walls and excavation support systems can be estimated on the basis of the following soil parameters. Any additional pressures due to surcharge loading, such as adjacent structures, roadways, parked vehicles, floor slab loading, etc. must be included in the design.

Table E – Lateral Earth Pressure Parameters

Soil Strata	Soil Unit Weight, γ [kN/m^3]	Angle of Internal Friction, θ [^{o}]	Coefficient of Active Earth Pressure, K_a	Coefficient of At Rest Earth Pressure, K_o	Coefficient of Passive Earth Pressure, K_p
Sand and Gravel	21	35	0.27	0.43	3.69
Sand	20	30	0.33	0.5	3.0
Silty Clay / Clayey Silt	19	25	0.41	0.58	2.46

8. EXCAVATIONS AND EXCAVATION SUPPORT CONSIDERATIONS

Excavations for the installation of building foundations and underground services are generally expected to extend to depths of approximately 12 to 16 metres below the existing grade. Excavations through any fill material and native sand / sand and gravel granular material would be expected to remain stable for the short construction period at slopes of up to 45 degrees to the horizontal while above the groundwater elevation. Excavations through the native silty clay/clayey silt soils should be relatively

straightforward, with the sides remaining stable for the short construction period at slopes of up to 60 degrees to the horizontal, while above the groundwater elevation. Where wet seams are encountered, or during periods of extended precipitation, or where excavations extend below the static groundwater level, the sides of excavations should be expected to 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter. Notwithstanding the foregoing, however, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper than those required in the Safety Act must be supported and a senior geotechnical engineer from this office should monitor the work.

EXCAVATION SUPPORT

It is anticipated that the new structure will approach the property limits and existing structures. As such it is anticipated that the excavations will require some level of excavation support, which may be accomplished in a number of methods, including 'soldier' pile and timber lagging, or continuous caisson wall. This will be especially prudent where existing structures are founded in close proximity to the excavations. It is noted that a preconstruction survey of adjacent above- and below-grade structures should be conducted to establish a baseline condition.

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. Where no lateral movements are acceptable the shoring should be designed considering an 'at rest' lateral earth pressure coefficient as noted in Table E above. Where small lateral movements can be tolerated an 'active' earth pressure coefficient should be considered, and can also be found in Table E above.

The caissons/soldier piles should be provided with lateral bracing, either by using a waler beam and raker supports, or with soil anchors. From a contractor's point of view, soil 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 there is a potential for significant movements of the shoring system 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 rakers can begin to carry load. If used, the rakers should be provided with a mechanism for 'jacking-in' preloads.

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.

It should be noted that excavations above but approaching the static groundwater level may encounter localized instability when the base of the excavation is exposed to heavy construction equipment loads, due to the 'pumping' of groundwater by fine-grained soils. Heavy construction vehicles should not travel on soils below 3 metres above the excavation base elevation. Consideration should be given to providing a concrete 'mud mat' 50 to 75 millimetres in thickness on top of the excavation base immediately after the soils have been exposed and evaluated by a representative from this office. Such a mud mat protects the excavation base soils from damage by construction equipment and foot traffic, and provides a clean surface for the construction of reinforcing steel cages, etc.

GROUNDWATER CONTROL

As noted above the static groundwater levels in the monitoring wells have been measured at depths as shallow as approximately 12 metres below the existing grade. Evidently excavations to the planned depths will extend below the static groundwater level and thus will experience groundwater infiltration through the soils below the static groundwater level and from perched water in more permeable soil seams at shallower depths. For excavations extending to 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, native sand or sand and gravel, 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 soil 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.

As noted above, 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 speak further to the anticipated pumping rates.

9. FLOOR SLAB AND PERMANENT DRAINAGE/WATERPROOFING CONSIDERATIONS

Depending on the final design, it is anticipated that the basement floor slab will be constructed either using conventional slab-on-grade techniques on a prepared subgrade, or on top of a raft slab foundation. As with all concrete floor slabs, there is a tendency for the slab to develop cracks. The slab thickness, concrete mix design, the amount of steel and/or fibre reinforcement and/or wire mesh placed into the concrete

slab, if any, will therefore be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend to a minimum depth of 1/3 of the thickness of the slab.

A moisture barrier will be required under the floor slabs such as the placement of at least 200 millimetres of well-compacted 20-millimetre clear crushed stone. At a minimum the moisture barrier material should contain no more than 10 per cent passing the No. 4 sieve. Where a 'non-damp' floor slab is required, as for instance under sheet vinyl floor coverings, etc., extra efforts will be required to damp proof the floor slab, as with the additional provision of a heavy 'poly' sheet, damp proofing sprays/membranes, drainage board products, etc. Where 'poly' sheets are used care should be taken to prevent puncturing and tearing and/or sufficiently heavy gauge sheeting specified. Alternatively, a proprietary product such as Delta-MS Underslab or WR Meadows membrane may be considered in lieu of the 'poly' sheets.

Curing of the slab must be carefully specified to ensure that slab curl is minimised. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

It is important that the concrete mix design provide a limiting water/cement ratio and total cement content, which will mitigate moisture related problems with low permeance floor coverings, such as debonding of vinyl and ceramic tile. It is equally important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage cracking and curling of the slab.

As noted above, the proposed basement levels may extend below the measured static groundwater level. As such it is recommended 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. Elevator pits extending below the general basement floor level should also be designed to be continuously water-tight with the surrounding structure.

While not strictly required for watertight systems, consideration may be given to addressing the potential for the build-up of groundwater beneath the basement floor slabs should any leaks in the waterproofing develop in the long-term, in addition to under-slab damp proofing measures recommended previously, through the means of

under-floor drainage. Under-floor drains may consist of 150-millimetre diameter perforated pipe, with a geofabric sock, placed in the clear stone beneath the floor slabs on nominal 4 to 6 metre centres. It is noted that the under-floor and perimeter drainage systems should have separate piping, i.e. piping from perimeter system does not connect to the under-floor system, in order to prevent surcharging of the under-floor system. They may outlet into a common sump-pit, though separate systems would be preferred. The need for such under-floor drainage would be best to be further assessed based on the final design slab elevation and the established seasonal high groundwater level.

10. 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 native granular soils are considered suitable for use as backfill in service trenches, etc. provided they are free of organics or any other deleterious material.

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 occasionally 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.

11. 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 F 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 fifteen to twenty-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 F - 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	40 millimetres	40 millimetres
Binder Course OPSS HL 8	92 per cent Marshall MRD	50 millimetres	80 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.

Depending on the anticipated traffic, a reduced light duty asphalt structure consisting of 65 millimetres of HL3 surface course may also perform sufficiently. This would be reasonable in areas subjected only to light vehicles such as cars for parking. Such a structure may have a reduced lifespan if subjected to heavier vehicles, and would also not allow for 'mill and pave' type operations for future rehabilitation.

Where asphalt pavement is to be constructed above the roof deck of the below grade parking level, the granular base layers recommended for the light duty pavement structure recommended above may be considered for both light duty and heavy-duty areas. It is noted that in such cases the roof deck slab should be sufficiently sloped and/or provided with suitable subdrains, in order to promote rapid drainage of water from beneath the pavement. As well the roof slab should be provided with a suitable water proofing system.

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.

12. 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.

Bennett Sabourin, B.Eng.
Junior Engineer

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

LICENSED PROFESSIONAL ENGINEER
JUNE 10/24
S. R. SEARS
PROVINCE OF ONTARIO

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 6, inclusive
Compressive Strength Test Results
Grain Size Analyses
Drawing No. 2, Slab-on-Grade with Perimeter Drainage

Distribution: Losani Homes [1, plus pdf]



LEGEND

- Bedrock Monitoring Well (BH#)
- Groundwater Monitoring Well (BH#)
- Temporary Benchmark (BM) — Top of catchbasin with geodetic elevation of 102.89m

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 230581-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Residential Development
127 Plains Road West
Burlington, Ontario

Preliminary Borehole Location Plan

Project No. SM 230581-G

Date: May 2024

Drawn: BS

Checked: AR

Drawing No. 1

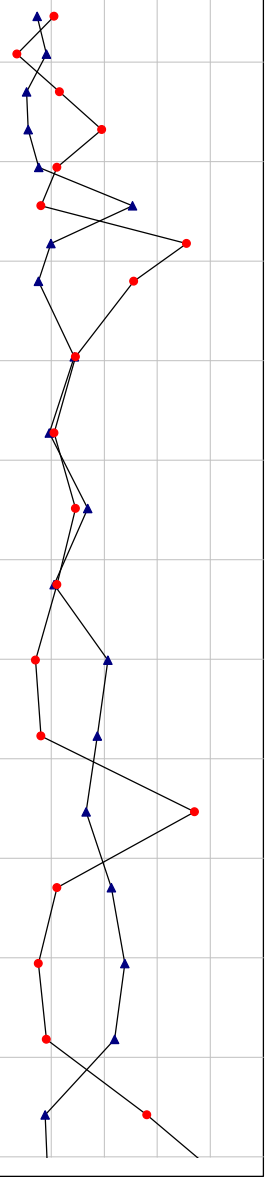
Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.07	Ground Surface							
0–3 / 0–1	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
3–6 / 1–2	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.	SS	1	8,12,9,6	21			
			SS	2	4,4,3,3	7			
6–9 / 2–3			SS	3	6,8,15,29	23			
9–14 / 3–4			SS	4	12,14,25,25	39			
14 / 4	98.60	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	5	5,10,12,15	22			
14–17 / 4–5			SS	6	2,3,13,25	16		1.5	
17–20 / 5–6			SS	7	20,33,38,35	71			
20–23 / 6–7			SS	8	19,27,24,26	51			
23–26 / 7–8		Seam of reddish brown silty clay	SS	9	7,13,16,34	29			
26–33 / 8–10	92.90		SS	10	13,11,10,9	21			
33–36 / 10–11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,12,17,16	29			
36–43 / 11–13			SS	12	11,9,13,18	22			
43–46 / 13–14			SS	13	3,6,8,17 Wet spoon	14			
46–52 / 14–16			SS	14	6,7,9,5 Wet spoon	16			
52–56 / 16–17			SS	15	18,36,38,37	74			
56–59 / 17–18	85.20	**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, stiff to very stiff.	SS	16	6,10,12,14	22		2.0	
59–66 / 18–20			SS	17	5,7,8,10	15		1.0	
66–72 / 20–22			SS	18	3,8,10,28	18		3.0	
72–79 / 22–24	80.70		SS	19	14,27,29,20	56			

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



Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

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)
25			**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.		SS	20	18,31,59,41	90				
26					SS	21	27,50/5"	100				
27	75.60				SS	22	50/2"	100				
28			**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.		HQ	1	RQD = 82%					Compressive Strength 55.7 MPa
29					HQ	2	RQD = 89%					Compressive Strength 58.5 MPa
30					HQ	3	RQD = 90%					Compressive Strength 56.5 MPa
31	71.00											Compressive Strength 63.9 MPa
32			End of Borehole									
33			NOTES: 1. Borehole was advanced using hollow stem auger equipment on April 29, 2024 to termination at a depth of 27.5 metres. Bedrock was cored to a depth of 32.1 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 3, 2024 - 14.8 metres May 30, 2024 - 15.2 metres									
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												

Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 1B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795147
E: 592660

Depth (ft / m)	Elevation (m)	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)
0 m	103.08	Ground Surface									
0 – 1 m	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
1 – 2 m	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.									
3 – 4 m	98.60	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense. Seam of reddish brown silty clay									
9 – 10 m	92.90	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
14 – 15 m	87.80	End of Borehole									

Note: Soil stratums inferred from BH1A

NOTES:

1. Borehole was advanced using hollow stem auger equipment on April 30, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 3, 2024 - 13.2 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: April 30, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795158
E: 592674

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.12	Ground Surface							
0 / 0	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
3 / 1		**Sand and Gravel Fill** Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, loose to dense.	SS	1	8,18,11,8	29			
7 / 2			SS	2	3,2,2,1	4			
10 / 3			SS	3	14,17,14,12	31			
13 / 4			SS	4	9,10,6,6	16			
15 / 4	98.40		SS	5	1,8,24,20	32			
16 / 5			SS	6	6,20,36,38	56			
20 / 6		**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	6,32,20,18	52			
23 / 7			SS	8	10,24,26,29	50			
26 / 8			SS	9	6,11,11,10	22			
30 / 9			SS	10	12,16,14,10	30			
33 / 10	92.90								
36 / 11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,18,18,18	36			
40 / 12			SS	12	12,12,16,12	28			
46 / 14			SS	13	16,30,34,36 Wet spoon	64			
49 / 15	87.90								
		End of Borehole							

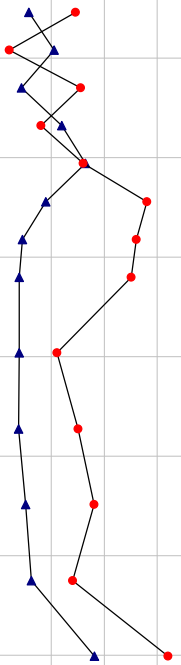
NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 13.1 metres
May 30, 2024 - 13.1 metres

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



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Checked by: AR
Sheet: 1 of 1

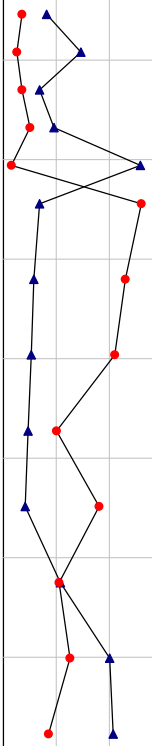
Log of Borehole No. 3

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795179
E: 592693

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.15	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
		Sand and Gravel Fill Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, very loose to loose.	SS	1	2,5,2,2	7			
			SS	2	2,3,2,16	5			
			SS	3	8,3,4,4	7			
			SS	4	5,4,6,7	10			
13 / 4	99.00		SS	5	1,1,2,9	3			
			SS	6	9,23,29,35	52			
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, very dense to compact.	SS	7	17,20,26,23	46			
			SS	8	15,19,23,21	42			
33 / 10	92.90		SS	9	8,11,9,11	20			
		Sand Brown, trace to some silt and gravel, dense to compact.	SS	10	17,20,16,17	36			
			SS	11	9,10,11,10	21			
			SS	12	9,10,15,27 Wet spoon	25			
51 / 16	87.30		SS	13	7,8,9,14 Wet spoon	17			
		End of Borehole NOTES: 1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.9 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 7, 2024 - 12.9 metres May 30, 2024 - 12.9 metres							

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



Drill Method: Hollow Stem Augers
Drill Date: May 6, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795187
E: 592682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.26	Ground Surface							
0 / 0	102.80	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 300 millimetres of compact granular base.							
6 / 2	100.70	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional cobbles, loose to compact	SS	1	4,7,6,3	13			
			SS	2	4,3,3,1	6			
			SS	3	1,3,3,2	6			
			SS	4	5,7,10,12	17			
13 / 4	99.20		SS	5	11,14,12,12	26			
			SS	6	1,1,0,1	1		<1.0	
16 / 5	97.70	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	1,1,1,1 Wet spoon	2		<1.0	
20 / 6			SS	8	7,17,13,15	30			
26 / 8		**Silty Clay/Clayey Silt** Reddish brown, trace to some sand, very soft.	SS	9	16,20,16,15	36			
33 / 10		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.	SS	10	24,18,16,14	34			
36 / 11			SS	11	10,12,12,16	24			
43 / 13			SS	12	8,11,11,16	22			
46 / 14			SS	13	7,18,11,11 Wet spoon	29			
51 / 16	87.40	End of Borehole	SS	14	2,6,17,24 Wet spoon	23			

NOTES:

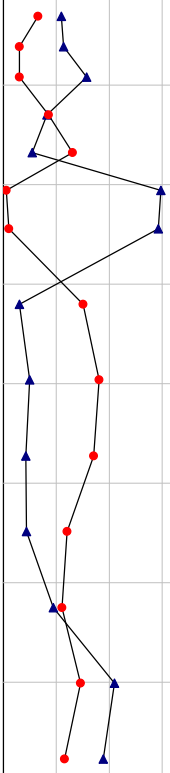
1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.8 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.0 metres

Moisture Content w% (10 20 30 40)

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



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

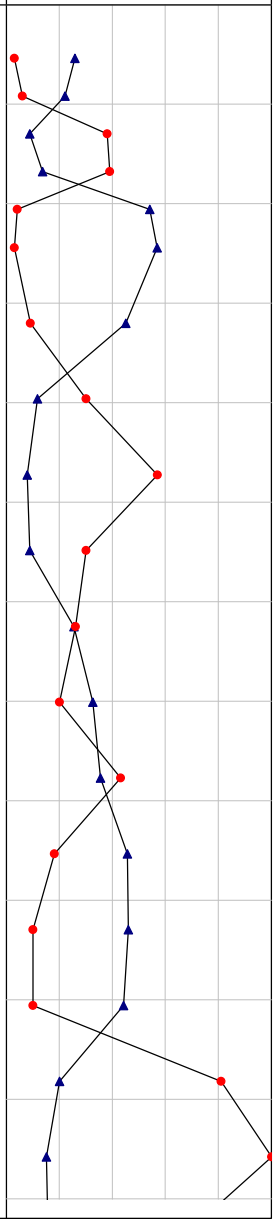
Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.19	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.	SS	1	1,2,1,1	3			
			SS	2	2,2,4,10	6			
			SS	3	9,18,20,27	38			
10 / 3	99.30		SS	4	16,19,20,18	39			
13 / 4		**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.	SS	5	4,2,2,2	4		<1.0	
16 / 5			SS	6	2,1,2,2	3		<1.0	
20 / 6			SS	7	2,4,5,9	9		1.0	
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.							
26 / 8		**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.	SS	8	9,15,15,19	30			
30 / 9			SS	9	9,35,22,25	57			
33 / 10	93.00		SS	10	10,14,16,21	30			
36 / 11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	10,12,14,14	26			
43 / 13			SS	12	6,10,10,12	20			
46 / 14			SS	13	7,14,29,39	43			
53 / 16	86.80	**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, very stiff to stiff.	SS	14	4,8,10,13	18		3.0	
56 / 17			SS	15	3,4,6,6	10		<1.0	
66 / 20			SS	16	4,4,6,8	10		<1.0	
69 / 21	82.30	**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.	SS	17	35,41,40,42	81			
76 / 23			SS	18	65,50/4"	100			
79 / 24									

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



Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

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)
25	77.60				SS	19	44,31,37,50/5	68				
					SS	20	50/4"	100				
26			**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.		HQ	1	RQD = 0%					
27					HQ	2	RQD = 86%					Compressive Strength 58.4 MPa Compressive Strength 80.5 MPa
28					HQ	3	RQD = 76%					Compressive Strength 57.5 MPa
29					HQ	4	RQD = 95%					Compressive Strength 47.5 MPa
30	72.60											
31			End of Borehole NOTES: 1. Borehole was advanced using hollow stem auger equipment on May 2, 2024 to termination at a depth of 25.6 metres. Bedrock was cored to a depth of 30.6 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 7, 2024 - 14.2 metres May 30, 2024 - 15.2 metres									
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 5B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795200
E: 592670

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	SAMPLE PP (kgf/cm2)	SAMPLE U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
0 / 0	103.23	Ground Surface									
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.									
13 / 4	99.30	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.									
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.									
33 / 10	93.00	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.									
45 / 14	89.20	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
		End of Borehole									

Note: Soil stratums inferred from BH5A

NOTES:

1. Borehole was advanced using solid stem auger equipment on May 3, 2024 to termination at a depth of 14.0 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 12.8 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795181
E: 592653

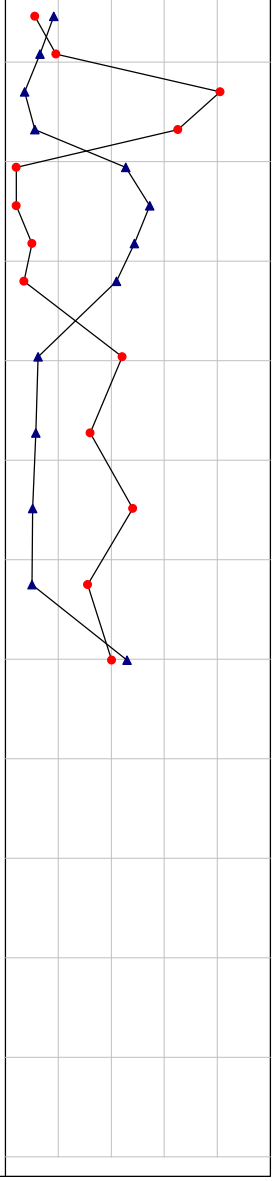
Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.31	Ground Surface								
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.								
6 / 2	101.10	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional to moderate cobbles, compact.		SS	1	6,6,5,2	11			
				SS	2	5,7,12,15	19			
				SS	3	18,46,35,63	81			
13 / 4	99.20			SS	4	16,30,35,21	65			
				SS	5	3,3,1,3	4		<1.0	
				SS	6	1,2,2,2	4		<1.0	
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.		SS	7	0,5,5,7	10		1.5	
23 / 7	96.20			SS	8	2,3,4,7	7		1.5	
		Silty Clay/Clayey Silt Reddish brown, trace to some sand, very soft.		SS	9	9,20,24,33	44			
33 / 10	93.10	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasional cobbles, dense.		SS	10	7,14,18,22	32			
				SS	11	31,26,22,21	48			
		Sand Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.		SS	12	9,14,17,20	31			
				SS	13	5,27,13,13 Wet spoon	40			
49 / 15	88.10	End of Borehole								

NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 1, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.1 metres



Drill Method: Hollow Stem Augers
Drill Date: May 1, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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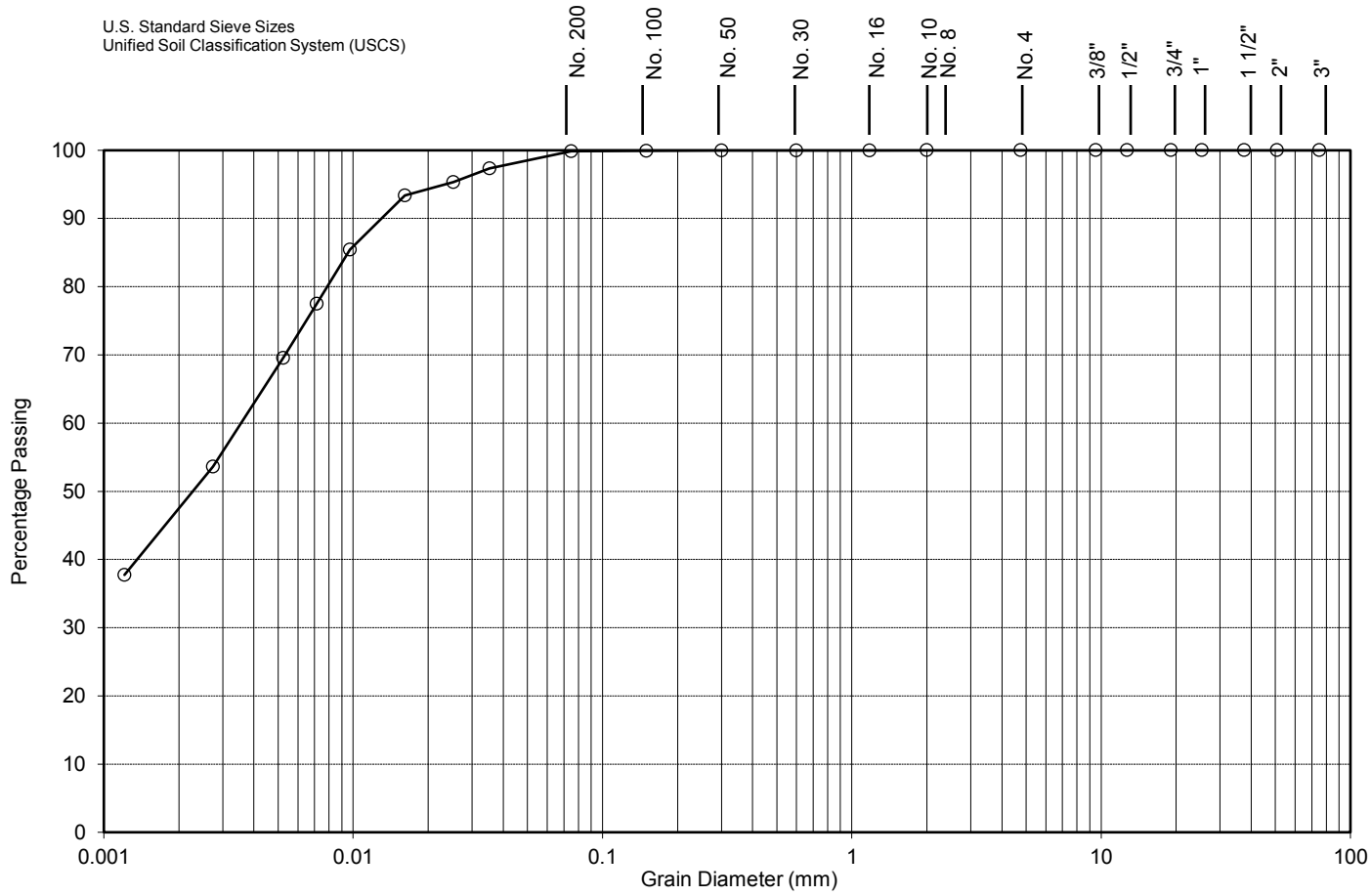
	Rock Core ID	Date Tested	Average Diameter D [mm]	Average Height H [mm]	Dry Weight (mass) [g]	Break Load Q_{ult} [lb]	Break Load Q_{ult} [N]	Aspect Ratio Factor C_F	Cross-Sectional Area A [m^2]	Calculated Volume V [m^3]	Calculated Unit Weight γ_{conc} [kN/m^3]	Calculated Density ρ_{conc} [kg/m^3]	Unconfined Compressive Strength [MPa]
1	1A1 (Run 1)	May-9-24	63.00	124.3	1028.2	39020	173561.0	1.00	0.00312	0.00039	26.0	2653.6	55.7
2	1A2 (Run2)	May-9-24	63.00	123.9	1013.5	40980	182279.0	1.00	0.00312	0.00039	25.7	2624.1	58.5
3	1A3 (Run 2)	May-9-24	63.00	129.8	1064.5	39590	176096.3	1.00	0.00312	0.00040	25.8	2630.9	56.5
4	1A4 (Run 3)	May-9-24	63.00	125.0	1028.4	44790	199225.9	1.00	0.00312	0.00039	25.9	2639.3	63.9
5	5A1 (Run 2)	May-9-24	63.00	108.0	885.8	41760	185748.5	0.98	0.00312	0.00034	25.8	2631.1	58.4
6	5A2 (Run 2)	May-9-24	63.00	111.0	912.5	57580	256115.8	0.98	0.00312	0.00035	25.9	2637.2	80.5
7	5A3 (Run 3)	May-9-24	63.00	127.8	1046.9	40280	179165.4	1.00	0.00312	0.00040	25.8	2627.9	57.5
8	5A4 (Run 4)	May-9-24	63.00	101.2	827.4	34290	152521.9	0.97	0.00312	0.00032	25.7	2622.8	47.5
	Date Cored:	April 29 - May 2, 2024											
	Date Received:	May 8, 2024											
	Project Name:	127 Plains Rd W, Burlington											

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

COMPRESSIVE STRENGTH TEST - ROCK CORE BREAK RESULTS

Project No.: 230581 **Lab Number: 24-598**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

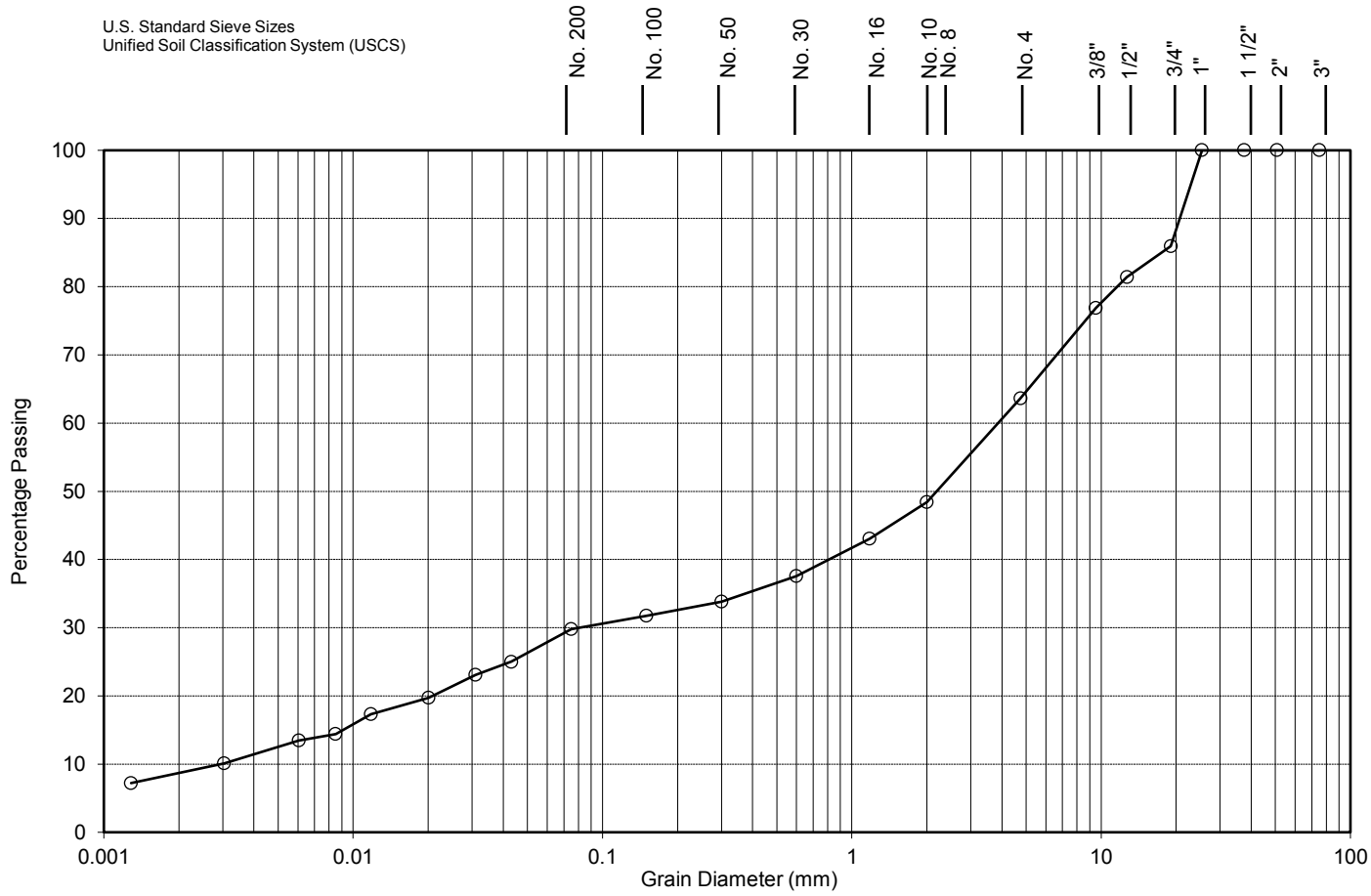
Lab No.:	**24-168**	Notes: Depth: 65'			
Borehole No.:	**1A**				
Sample No.:	**17**				
CLAY [%]:	**48**	Soil Description:	**Grey Silt and Clay**		
SILT [%]:	**52**		**M.L. - Inorganic silts to C.L. - Inorganic clays of low to medium plasticity**		
SAND [%]:	**0**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0004**	Coefficient of Uniformity C_U:	**9.0**	Coefficient of Curvature C_C:	**0.4**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 1**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

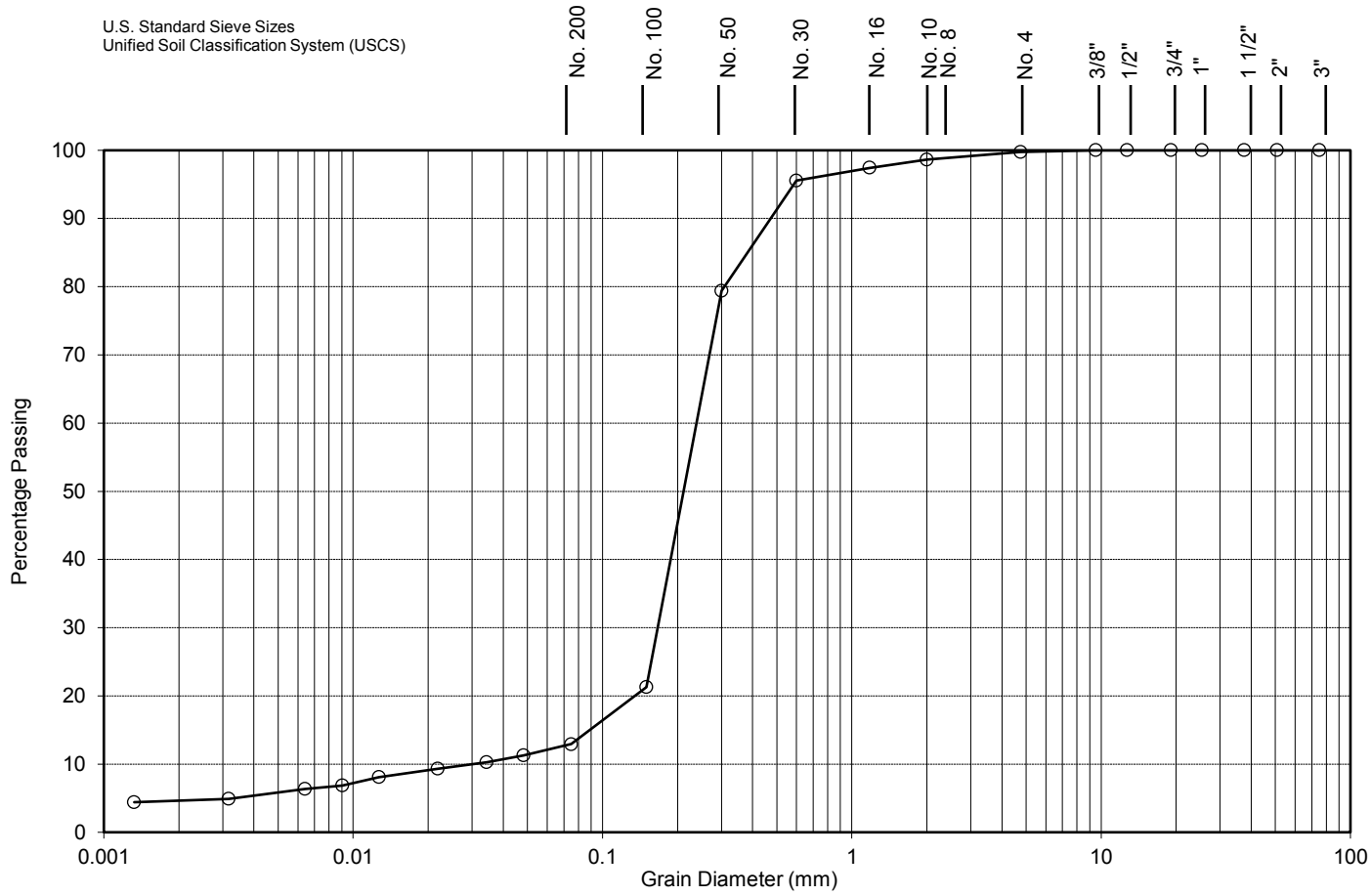
Lab No.:	**24-169**	Notes: Depth: 80'			
Borehole No.:	**1A**				
Sample No.:	**20**				
CLAY [%]:	**9**	Soil Description:	**Reddish Brown Sandy and Silty Gravel w/ a trace of Clay**		
SILT [%]:	**21**		**G.M. - Gravel-sand-silt mixtures, more than 12% fines to**		
SAND [%]:	**34**		**G.C. - Gravel-sand-clay mixtures, more than 12% fines**		
GRAVEL [%]:	**36**	Estimated Infiltration Rate [mm/hr] :	**25 to 30**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.003**	Coefficient of Uniformity C_U:	**1300.0**	Coefficient of Curvature C_C:	**0.7**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 2**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

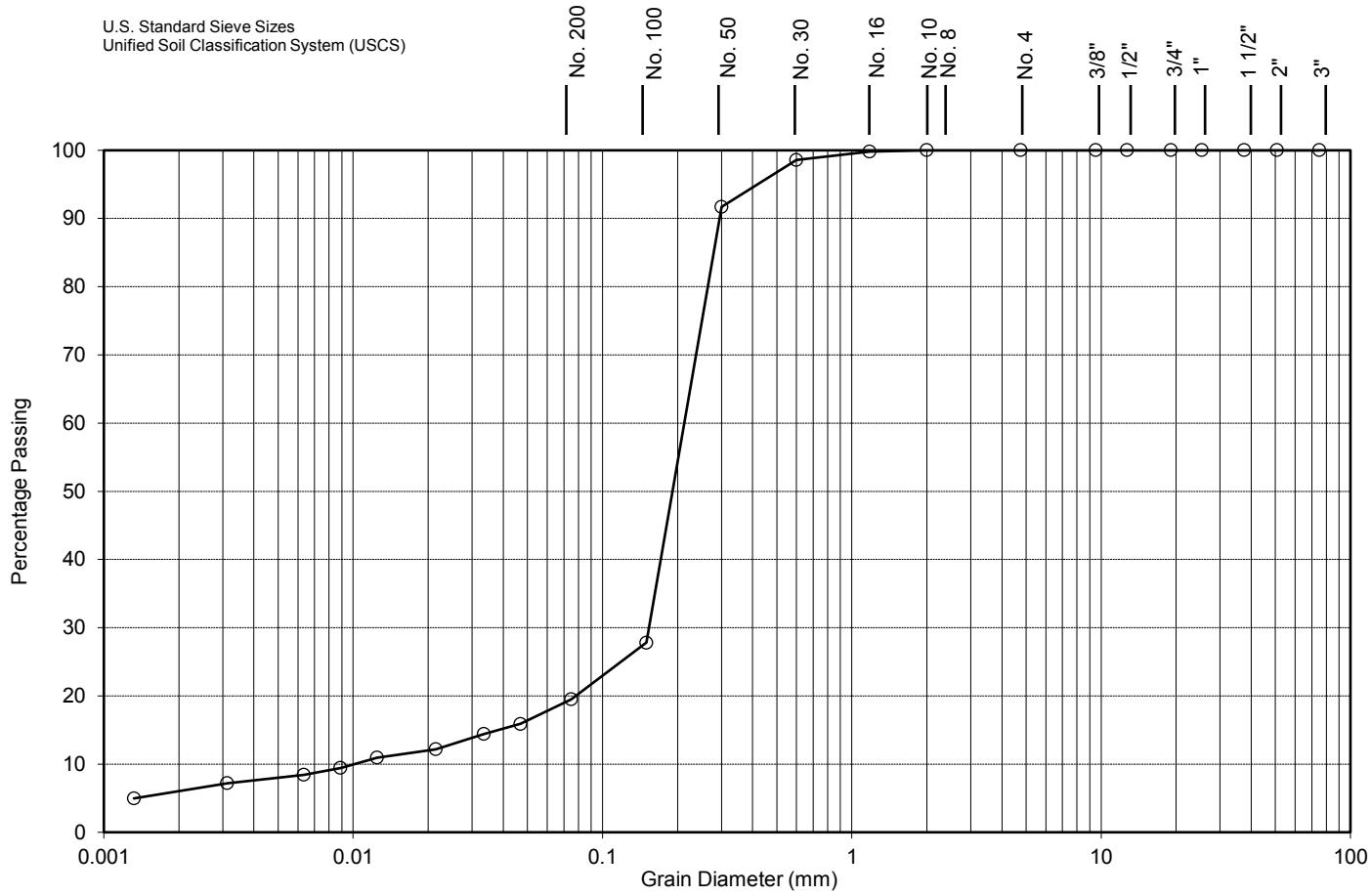
Lab No.:	**24-170**	Notes: Depth: 45'			
Borehole No.:	**2**				
Sample No.:	**13**				
CLAY [%]:	**4**	Soil Description:	**Reddish Brown Sand w/ traces of Silt and Clay**		
SILT [%]:	**9**		**S.M. - Silty sands, Sand-silt mixtures, more than 12% fines**		
SAND [%]:	**87**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**70 to 80**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.034**	Coefficient of Uniformity C_U:	**7.1**	Coefficient of Curvature C_C:	**3.5**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 3**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE

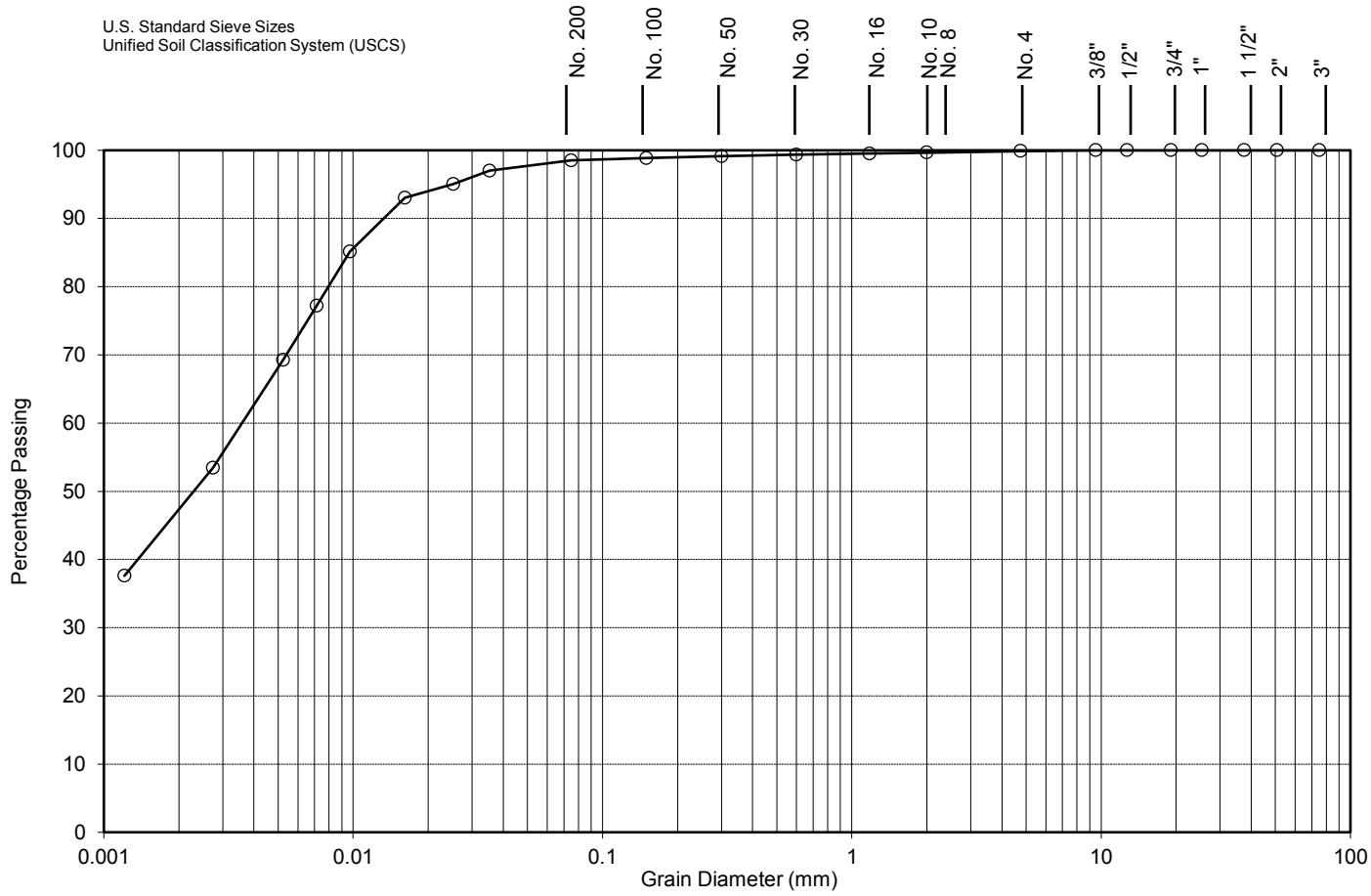
Lab No.:	**24-171**	Notes: Depth: 40'			
Borehole No.:	**4**				
Sample No.:	**12**				
CLAY [%]:	**6**	Soil Description:	**Reddish Brown Sand w/ some Silt and a trace of Clay**		
SILT [%]:	**14**		**S.M. - Sand-silt mixtures, more than 12% fines to**		
SAND [%]:	**80**		**S.C. - Sand-clay mixtures, more than 12% fines**		
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**45 to 55**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.010**	Coefficient of Uniformity C_U:	**21.9**	Coefficient of Curvature C_C:	**12.7**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 4**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

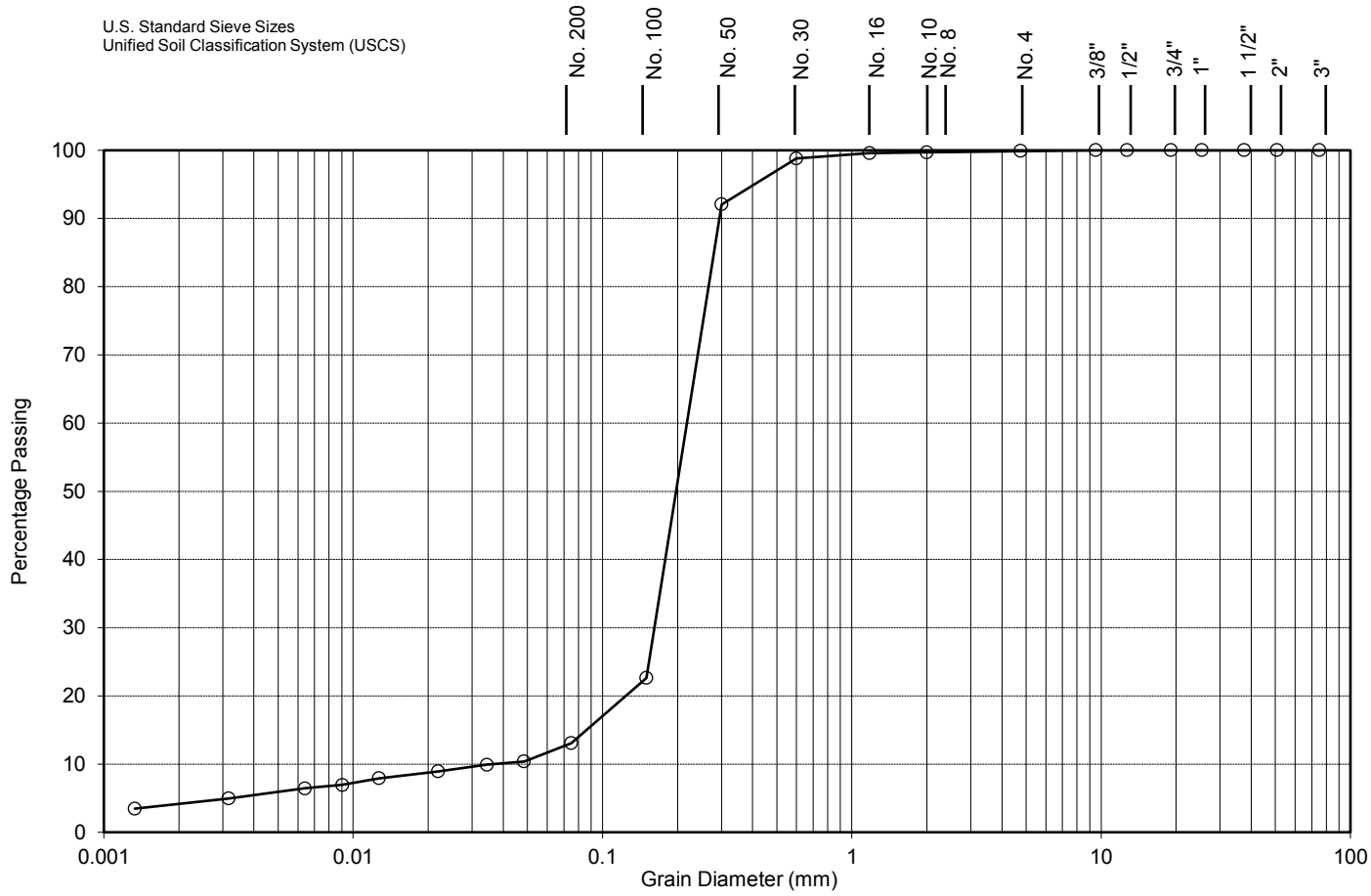
Lab No.:	**24-172**	Notes: Depth: 60'	
Borehole No.:	**5A**		
Sample No.:	**15**		
CLAY [%]:	**48**	Soil Description: **Grey Silt and Clay w/ a trace of Sand**	
SILT [%]:	**51**	**M.L. - Inorganic silts and very fine sands to C.L. - Inorganic clays of low to medium plasticity**	
SAND [%]:	**1**		
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] : **< 10**	Estimated Permeability, k [cm/s] **10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0004**	Coefficient of Uniformity C_U: **9.3**	Coefficient of Curvature C_C: **0.3**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 5**	**Project No.: SM 230581-T**

Mechanical & Hydrometer Analyses



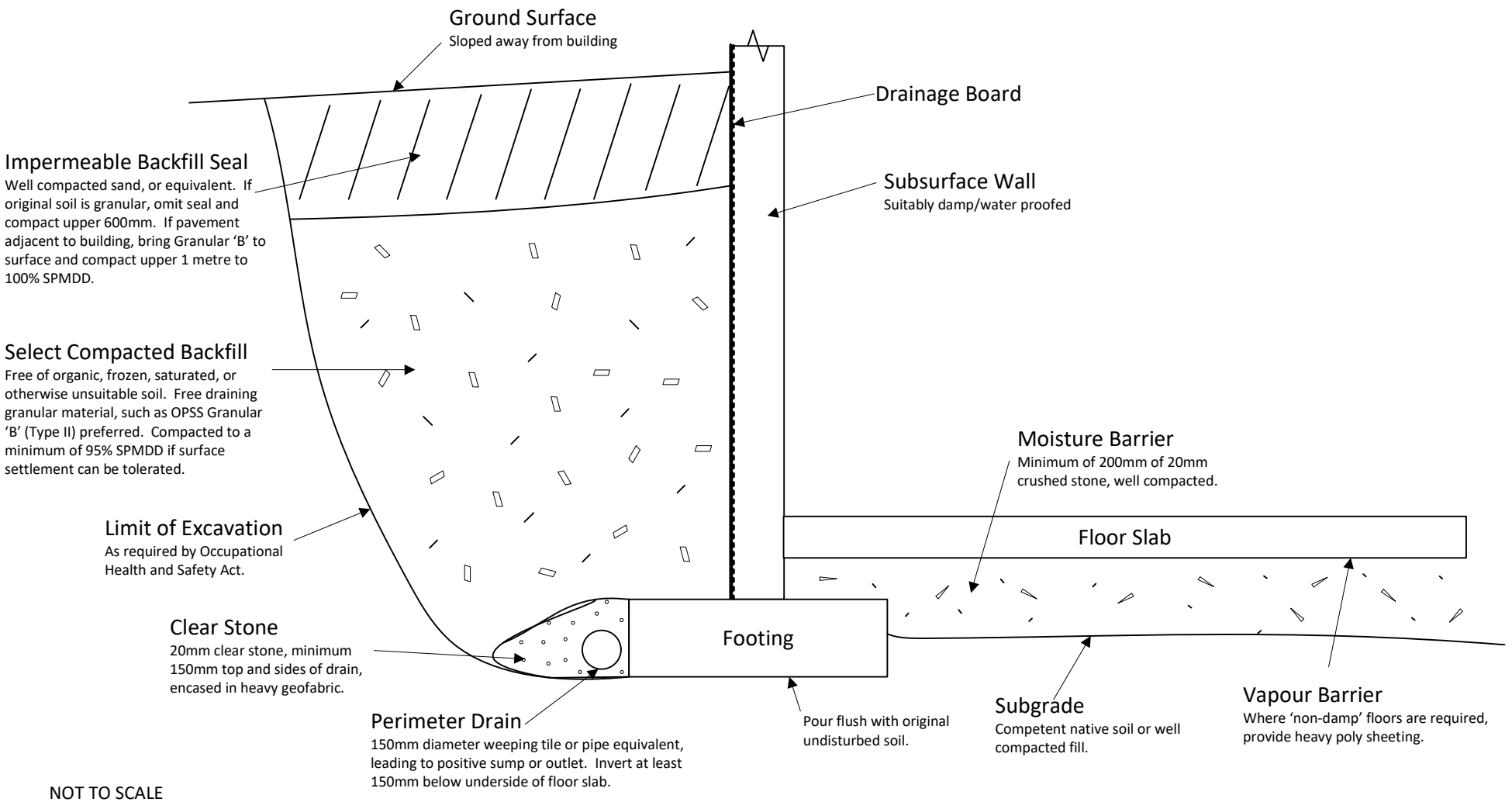
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	**24-173**	Notes: Depth: 40'			
Borehole No.:	**6**				
Sample No.:	**12**				
CLAY [%]:	**3**	Soil Description:	**Brown Sand w/ some Silt and a trace of Clay**		
SILT [%]:	**10**		**S.M. - Sand-silt mixtures, more than 12% fines**		
SAND [%]:	**87**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mm/hr] :	**70 to 80**	Estimated Permeability, k [cm/s]	**10^{-3}**
D_{10} (Effective Diam. in mm):	**0.034**	Coefficient of Uniformity C_U:	**6.5**	Coefficient of Curvature C_C:	**3.9**

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127 Plains Road West, Burlington ON

May 2024	**Grain Size Analysis No. 6**	**Project No.: SM 230581-T**



NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 230581-G
Date:	June 2024

Typical Design Requirements
Drainage and Backfill for Basement Walls

Drawing No. 2

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

July 10, 2024

Losani Homes
Attn: Daniel Borelli, M.PL.
430 McNeilly Road, Suite 203
Stoney Creek, ON L8E 5E3

Re: **Preliminary** Hydrogeological Assessment/Dewatering Study – 127 Plains Road West, Burlington, Region of Halton, ON

Dear Mr. Borelli,

1.0 Introduction, Background Information and Purpose

Terra-Dynamics Consulting Inc. (Terra-Dynamics) respectfully submits this **Preliminary** Hydrogeological Dewatering Study for re-development of 127 Plains Road West, Burlington (Site, Figure 1). It is our understanding that Losani Homes is planning to construct a 26-Story residential condominium building with up to four levels of underground parking (Chamberlain Architect Services Limited, 2022).

The City of Burlington (2023) have historically provided details of components to be included in the Hydrogeology Assessment/ Dewatering Study, and have included the following:

1. *Follows the terms of reference agreed upon by Conservation Halton, Region and City staff in advance of study commencement.*
2. *Indicates if a Permit to Take Water would be required during construction.*
3. *Includes testing of groundwater to ensure it meets municipal stormwater discharge criteria.*
4. *Provides sufficient monitoring data to address groundwater level seasonality.*

In other recent similar projects in the City of Burlington, the City has clarified that #4, "*sufficient monitoring data to address groundwater level seasonality",* indicated groundwater levels should be taken in all seasons and determine the estimated seasonably high groundwater level, i.e. a year of groundwater level monitoring was required. The seasonally high groundwater water table is typically during March and/or April in southwestern Ontario. This Preliminary Hydrogeological Assessment/Dewatering Study has been completed using preliminary information in support of an Official Plan Amendment/Zoning By-Law Amendment application.

2.0 Methodology

The following methodologies were used to investigate the Site:

A. Preparation of a Hydrogeological Assessment/Dewatering Study Terms of Reference for the City of Burlington (Appendix A);

B. Assessment of regional information including topography, overburden soils, bedrock and Ministry of the Environment, Conservation and Parks (MECP) water well records;

C. Review of geotechnical and environmental reporting for the Site including calculation of soil hydraulic conductivity via grain-size analyses (Soil-Mat Engineers & Consultants Ltd., 2024);

D. Investigation of Site conditions through (i) groundwater level monitoring from late-spring season of 2024, which will be continuing until June, 2025, (ii) groundwater sampling to conform with the City of Burlington Stormsewer By-law criteria (2022) and (iii) in-situ hydraulic conductivity testing of on-site monitoring wells to characterize the permeability of subsurface geologic materials;

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

F. Completion of a Groundwater Dewatering Assessment.

3.0 Physical Setting

The Site is municipally serviced (water and sewage) and within the City of Burlington and Halton Region.

The ground surface elevation is approximately between 102.5 and 103 metres above sea level (m ASL) (Figure 2, City of Burlington, 2021).

Conservation Halton (2019) have mapped a subwatershed divide through the Site, with most of the Site within (a) the West Aldershot Subwatershed of the Northshore Watershed Area and (b) a small portion of the western part of the Site within the Grindstone Creek Watershed #230 (Figure 1). The City of Burlington have mapped (a) the Aldershot watercourse as approximately 280 m west of the Site and (b) Grindstone Creek as 270 m northwest of the Site.

The Site is within Conservation Halton (CH), however no CH-mapped regulated vulnerable areas are located on-Site.

3.1 Regional Geology

The Site is located within the Iroquois Plain Physiographic Region (Chapman and Putnam, 1984) which is typically described as “covered in layers of fine silty sands” (Halton Region Source Protection Authority, 2022).

The regional surficial geology is mapped as a combination of beach gravel, and sand, in the western and eastern portions of the Site, respectively (Figure 2, OGS, 2003) and has been regionally estimated as about 23 metres thick (Charlesworth & Associates and SNC-Lavalin, 2006).

The underlying bedrock is 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 (Armstrong and Dodge, 2007). The bedrock regionally dips towards Lake Ontario and was regionally estimated as at about 80 m ASL (Charlesworth & Associates and SNC-Lavalin, 2006).

3.1.1 Site Geology

On April 29 to May 7, 2024, eight boreholes were completed by Soil-Mat to between 14 and 32 metres below ground surface (m BGS), and eight monitoring wells were constructed (Figures 2 and 3, Appendix B, Soil-Mat, 2024). The following summarizes the drilling program:

1. Boreholes were advanced in the overburden by hollow-stem augers and split-spoon sampling. Beneath pavement the soils were generally sand/sand and gravel fill, underlain by sand and gravel to about 17 m BGS (Figure 2, Appendix B). However, in some cases a 1 to 3 m thick silty clay layer is present within this upper sand and gravel between 4 and 7 m BGS. Overlying the bedrock are a silty clay and a sandy silty gravel layer. Shale bedrock was encountered between 25.6 to 27.5 metres below ground surface (m BGS), or a top of bedrock between 75.6 to 77.6 m ASL.

2. Bedrock boreholes were advanced in the shale using HQ coring (96 mm (2.5 inches) diameter). The shale bedrock was described as "*highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard*" (Soil-Mat, 2024). The calculated rock quality designation (RQD) was good (75-90%) to excellent (90-100%).

Geologic cross-sections were prepared using the above referenced borehole information to visualize the subsurface conditions (Figures 4, 5 and 6). Additional Ministry of the Environment, Conservation and Parks (MECP, 2024) monitoring well records were incorporated to the southwest to further characterize the physical setting (Figure 2, Appendix B).

3.1.2 Geologic Units to be Excavated

Excavation for four basement levels is calculated to proceed 14 m BGS, to an elevation of 89 m ASL within sand, based upon an average ground surface of 103 m ASL and 3.5 m depth per basement level (Figures 3, 4 and 5). The base of the sand unit was determined to be between 85.2 and 86.8 m ASL (Appendix B, Figures 3, 4 and 5), i.e. about 2 to 4 m below the estimated depth of excavation.

3.2 Groundwater

Eight groundwater monitoring wells were constructed to monitor two groundwater systems (Figure 3, Table 1), these are the:

a) Sand Water Table Monitoring Wells (constructed 11 to 16 m BGS): 1B, 2, 3, 4, 5B and 6; and
b) Shale Potentiometric Surface Monitoring Wells (28 to 32 m BGS): 1A and 5A.

Manual groundwater level measurements were collected three times in the late spring season of 2024 (Table 1), and manual measurements will continue to be collected every three months for a year. Water level dataloggers have also been installed and will be recording groundwater levels at a 15-minute interval at four locations: (a) Sand Water Table (1B, 3 and 6) and (b) Shale Potentiometric Surface (1A).

3.2.1 Preliminary Groundwater Levels

The Sand Water Table is monitored at six monitoring wells (MW1B, MW2, MW3, MW4, MW5B and MW6, Figure 2, Table 1). The depth to the water table was observed to be between 12.9 and 13.2 m BGS, or between 89.9 and 90.4 m ASL on June 20, 2024 (Table 1, Figure 7).

The Shale Potentiometric Surface is measured at two monitoring wells (MW-1A and MW-6A, Figure 2, Table 1). The groundwater level elevation of the potentiometric surface in the shale varied between 87.9 and 88.0 m ASL on June 20, 2024.

The vertical gradient between the Sand Water Table, and the Shale Potentiometric Surface was downwards on June 20, 2024 as compared at two locations: MW1B/MW1A and MW5B/MW5A. The downward vertical gradient indicates groundwater inflow to the excavation, when fully open, will be primarily through the sides. However, additional groundwater level data is required to confirm other seasonal conditions.

3.2.2 Groundwater Flow

Groundwater was observed to flow at a gradient of 0.009 m/m towards the south (Figure 3) in a similar direction to previous regional reporting (Charlesworth & Associates and SNC-Lavalin, 2006).

3.3 Hydraulic Conductivity Analyses

Two methods were used to determine on-site hydraulic conductivities:
(i) Laboratory grain size analyses and the Excel-tool HydrogeoSieveXL (Devlin, 2015, Table 2); and
(ii) In-situ hydraulic conductivity monitoring well testing (Figure 3, Table 3).

Table 2 – Grain-size Hydraulic Conductivity Analyses (Devlin, 2015)

Geologic Unit(s)	Location	Hydraulic Conductivity (m/s)	Depth (m BGS)
Poorly sorted sand with fines	BH2	$2x10^{-5}$	13.7
	BH4	$7x10^{-6}$	12.2
	BH6	$8x10^{-6}$	12.2
Geometric Mean		$1x10^{-5}$	
Poorly sorted clay with fines	BH1A	$1x10^{-9}$	19.8
	BH5A	$1x10^{-9}$	18.3
Poorly sorted sandy gravel with fines	BH1A	$2x10^{-6}$	24.4

Table 3 – In-situ Hydraulic Conductivity Analyses (Bouwer, 1989)

Geologic Unit	Location	Hydraulic Conductivity (m/s)	Depth (m BGS)
Sand	MW1B	$9x10^{-5}$	13.2-14.8
	MW2	$7x10^{-6}$	13.1-15.0
	MW3	$1x10^{-5}$	12.9-15.2
	MW4	$1x10^{-4}$	13.0-14.9
	MW5B	$3x10^{-6}$	12.9-13.9
	MW6	$6x10^{-5}$	13.1-14.4
Geometric Mean		$2x10^{-5}$	

The results are presented in Tables 2 and 3 and shown on the hydrogeologic cross-sections (Figures 4, 5 and 6) and the analyses provided in Appendix C. The geometric mean value of $2x10^{-5}$ m/s for the sand is a reasonable value for this geologic unit (Fetter, 1994), with a maximum calculated value of $1x10^{-4}$ m/s at MW4. In-situ hydraulic conductivity testing of the monitoring wells was completed using a rising-head approach and analyzed in Aqtesolv™ using the Bouwer and Rice solution (Bouwer, 1989) as recommended when the water level is within the monitoring well screened interval (Bair, 2005). Future reporting will also include in-situ hydraulic conductivity values for the shale from monitoring wells MW1A and MW5A.

3.4 Geologic Units to be Dewatered – Preliminary Estimate

It has been calculated that less than 2.2 m of saturated sand is expected to require dewatering if a fourth underground parking level is required. This is based upon: (i) a groundwater level 0.5 m higher than the average observed on June 20, 2024 (i.e. 0.5 m plus 90.16 m ASL), to account for a likely higher early spring water level, (ii) excavation to 89 m ASL (Section 3.1.2) and (iii) allowing for an additional 0.5 m of dewatering below the base of the excavation (Preene, 2023).

3.5 Groundwater Quality Analyses

Groundwater quality samples were collected June 20, 2024 from two sand water table monitoring wells: (i) MW-1B and (ii) MW-6. These groundwater samples were submitted to SGS Canada Inc. (an accredited Ontario laboratory) for laboratory analyses and comparison to the City of Burlington Sewer Use By-Law for Storm Sewer Discharge. Future reporting will include these results, including a discussion if treatment is required, to meet the City of Burlington Storm Sewer Discharge criteria.

3.6 Hydrogeologic Setting

The water table occurs within the sand and can be considered an unconfined unit. Excavation within the sand for a fourth underground parking level will involve some construction dewatering. Post-construction dewatering will also be required if the below grade structures (i.e. the underground parking garage) is not subject to water-tight construction.

4.0 Groundwater Dewatering Assessment

Dewatering flow rates were estimated for construction excavation dewatering. Post-construction dewatering rates will be completed for the final report if required, i.e. maintenance of dry conditions after construction is complete if below grade structures are not constructed water-tight.

The dewatering rates were estimated using an analytical equation for radial flow in a water table from Powers et al (2007). The average groundwater level for this assessment is 90.16 m ASL (June 20, 2024), however it is assumed as a factor of safety that the spring season high groundwater level may be additional 0.5 m higher (which will be confirmed after a year of monitoring) for a high groundwater level for the analyses of 90.66 m ASL. As the depth of excavation may extend to 89 m ASL (for four underground parking levels) and an additional 0.5 m of dewatering depth is a reasonable assumption for keeping an excavation dry (Preene, 2023), this requires a potential dewatering of 2.2 metres (Table D-1, Appendix D). An

excavation of 61 by 41 metres was used for this preliminary report approximating the dimensions of the Site.

The preliminary calculated construction dewatering rate was modelled to be less than 40,000 Litres/day (Table D-1, Appendix D).

As the calculated maximum dewatering rate is less than 50,000 L/day, a Ministry of the Environment, Conservation & Parks (MECP) Environmental Activity and Sector Registry (EASR) temporary 'Construction Site Dewatering' application should not be required, however a dewatering taking plan should be prepared for discharge to the City of Burlington storm sewer.

As the vertical gradient was downwards (Section 3.2.1) upwards groundwater inflow is not predicted to the constructed open excavation. However, the available groundwater levels for this analysis are preliminary, and additional water level data, during additional seasons, will be required to confirm this preliminary observation.

4.1 Dewatering Zone of Influence

A construction dewatering zone of influence in the sand was calculated as a radial distance of less than 10 metres based upon 6 months of dewatering (Table D-2, Appendix D), however if permanent dewatering was required to the same depth, the zone of influence could be expected to be on the order of 70 m (Table D-1, Appendix D).

4.2 Other Dewatering Considerations

Ministry of the Environment, Conservation and Parks (MECP, 2023) water well records within 200 m were reviewed and the oldest records were from 2011 and were for monitoring wells not for water supplies, consequently no private water supplies are suggested to exist within this municipally serviced area for consideration in the dewatering assessment.

Within 200 m of the Site, only construction dewatering Permits to Take Water (PTTW) and Environmental Activity and Sector Registries (EASRs) were listed by the MECP under Access Environment, i.e. no PTTW were listed within 200 m for water supplies that would be negatively affected by on-site construction dewatering.

5.0 Conclusions and Recommendations

5.1 Conclusions

The following preliminary conclusions are provided:

1. Construction of 4 basement parking levels is expected to be below the water table and require construction dewatering.

2. The water table at the Site is within an unconfined sand, observed to be about 13 metres below ground surface in June, 2024. The sand has an average hydraulic conductivity of $2x10^{-5}$ m/s.

3. Construction dewatering for underground parking may not require a Construction Dewatering EASR from the MECP with in-flows calculated as less than 40,000 Litres/day based upon preliminary groundwater levels. However, a dewatering taking plan should be prepared for discharge to the City of Burlington storm sewer; and

4. No negative effects are predicted to occur from dewatering takings, however a geotechnical engineer should be consulted with respect to the need for settlement monitoring of adjacent structures.

5.2 Recommendations

The following recommendations are provided for your consideration:

1. Submit the proposed Hydrogeologic Assessment/Dewatering Study Terms of Reference to the City of Burlington;

2. Continue the seasonal groundwater monitoring program to determine the variation in groundwater levels including the potential for upward gradients during excavation; and

3. Finalize this report following 1-year of groundwater level monitoring.

6.0 Limitations

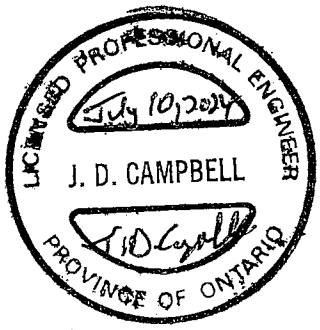
Subsurface dewatering assessments, by their nature, have inherent limitations and uncertainties primarily due to the heterogeneities in geologic conditions causing differences in hydraulic conductivity, hydraulic gradients and pressures in areas of a site not investigated by boreholes and/or monitoring wells. It is believed that these uncertainties have been addressed through conservative interpretation of other existing regional-based geologic conditions and site-specific data at the places investigated. 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 Losani Homes. The material in it reflects Terra-Dynamics' best judgment in light of the information available to Terra-Dynamics at the time of preparation of this report. 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. However that being said, a reliance letter will be provided with the final report that authorizes the City of Burlington to make reliance on the findings and recommendation outlined in 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 – Site Location
Figure 2 – Borehole/Monitoring Well Locations
Figure 3 – Site Details
Figure 4 – Hydrogeologic Cross Section A-A'
Figure 5 – Hydrogeologic Cross Section B-B'
Figure 6 – Hydrogeologic Cross Section C-C'
Table 1 – Manual Groundwater Levels
Appendix A – Terms of Reference
Appendix B –Borehole/Monitoring Well Logs
Appendix C – Hydraulic Conductivity Analyses
Appendix D – Dewatering Calculations

7.0 References

Armstrong, D.K., and Dodge, J.E.P., 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 219.

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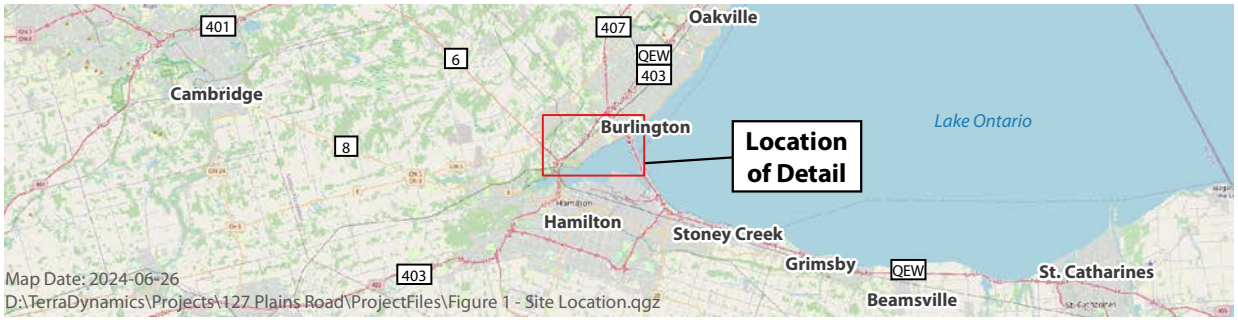
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Site — Burlington Creek Reaches — Conservation Halton Subwatersheds



Map Date: 2024-06-26
D:\TerraDynamics\Projects\127 Plains Road\ProjectFiles\Figure 1 - Site Location.qgz

Location of Site

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

Figure 1



- On-Site Boreholes
- MECP Water Well Records Used in Cross-Sections
- Site

Hydrogeologic Cross-Sections

- A-A'
- B-B'
- C-C'

Surficial Geology

- Gravel
- Sand

Borehole/Monitoring Well Locations

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

Prepared For:
Losani Homes

Figure 2

References: Ministry of Environment, Conservation and Parks: Drilled Water Wells, 2024. Ontario Geological Survey: Surficial Geology
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Map Date: 2024-07-03



On-Site Boreholes with Groundwater Water Levels

- Sand Water Table Monitoring Well
- Shale Monitoring Well
- Water Table Contours (mASL, June 20, 2024)
- Ground Surface Countours (0.5m)
- Site

Water Table Groundwater Flow Direction

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

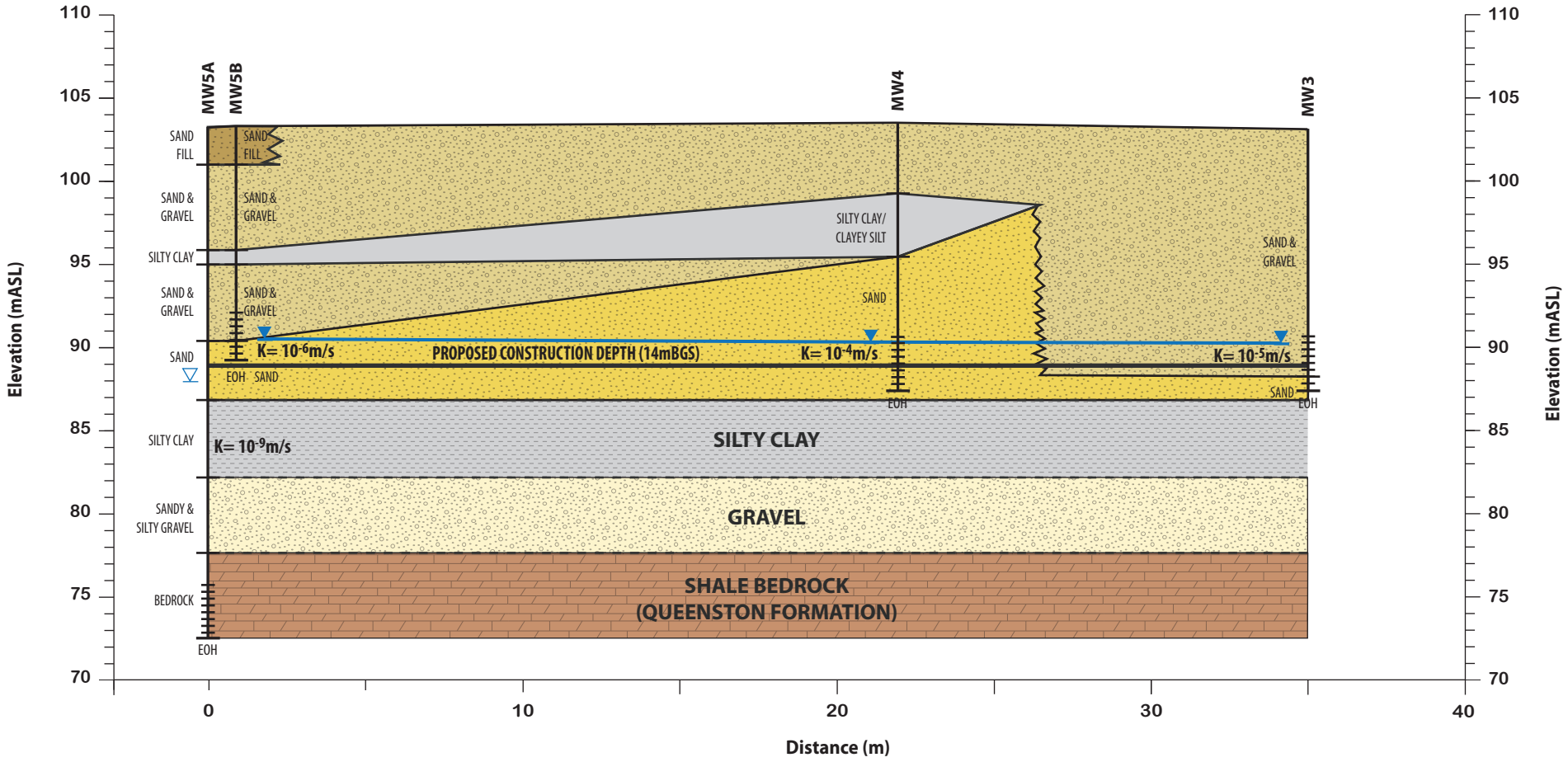
Prepared For:
Losani Homes

Figure 3

References: City of Burlington Open data: Contours at https://navburl-burlington.opendata.arcgis.com/datasets/Burlington::contours/explore
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Map Date: 2024-07-03

NORTHWEST A LOOKING NORTHEAST A′ SOUTHEAST



Groundwater Level June 20, 2024

- Water Table
- Potentiometric Surface
- Water Table
- EOH End of Hole
- K = Hydraulic Conductivity (m/s)

- Sand Fill
- Sand & Gravel
- Silty Clay/Clayey Silt
- Sand
- Silty Clay
- Gravel
- Shale Bedrock

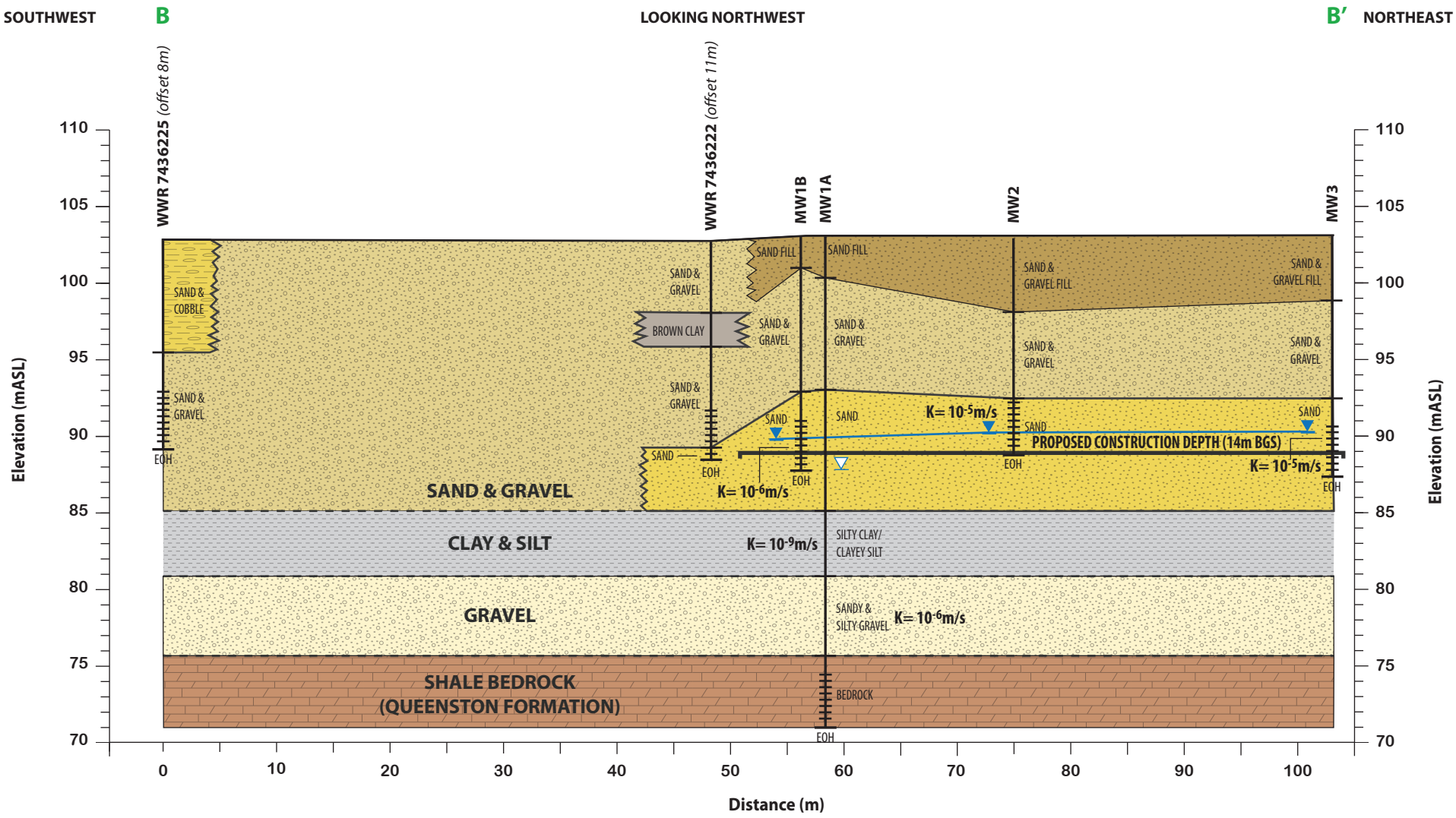
Hydrogeologic Cross-Section A-A′

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

Prepared For: Losani Homes | **Figure 4**

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Groundwater Level June 20, 2024

- Water Table
- Potentiometric Surface
- Water Table
- EOH End of Hole
- K = Hydraulic Conductivity (m/s)

- Sand & Cobble
- Sand & Sand/Gravel Fill
- Sand & Gravel
- Brown Clay
- Sand
- Silt & Clay
- Gravel
- Shale Bedrock

Hydrogeologic Cross-Section B-B'

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

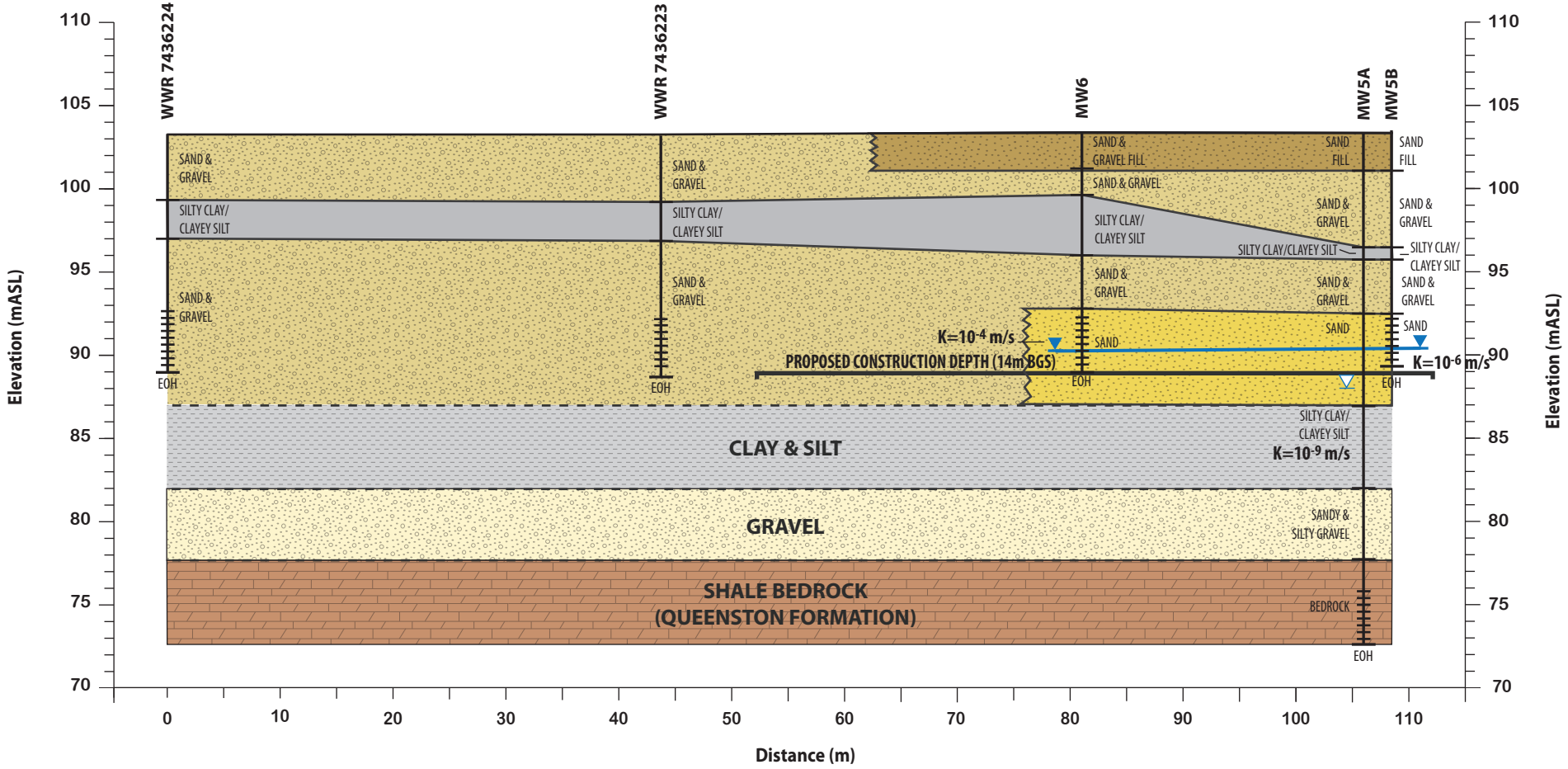
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Figure 5

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July 3, 2024

SOUTHWEST C LOOKING NORTHWEST C′ NORTHEAST



Groundwater Level June 20, 2024

- Water Table
- Potentiometric Surface
- Water Table
- EOH End of Hole
- K = Hydraulic Conductivity (m/s)

- Sand & Sand/Gravel Fill
- Sand & Gravel
- Silty Clay/Clayey Silt
- Sand

- Clay & Silt
- Gravel
- Shale Bedrock

Hydrogeologic Cross-Section C-C′

127 Plains Road West, Burlington, ON
Hydrogeological Assessment/Dewatering Study

Terra-Dynamics Consulting Inc.

Prepared For: Losani Homes | **Figure 6**

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Figure 7 - Manual Groundwater Levels

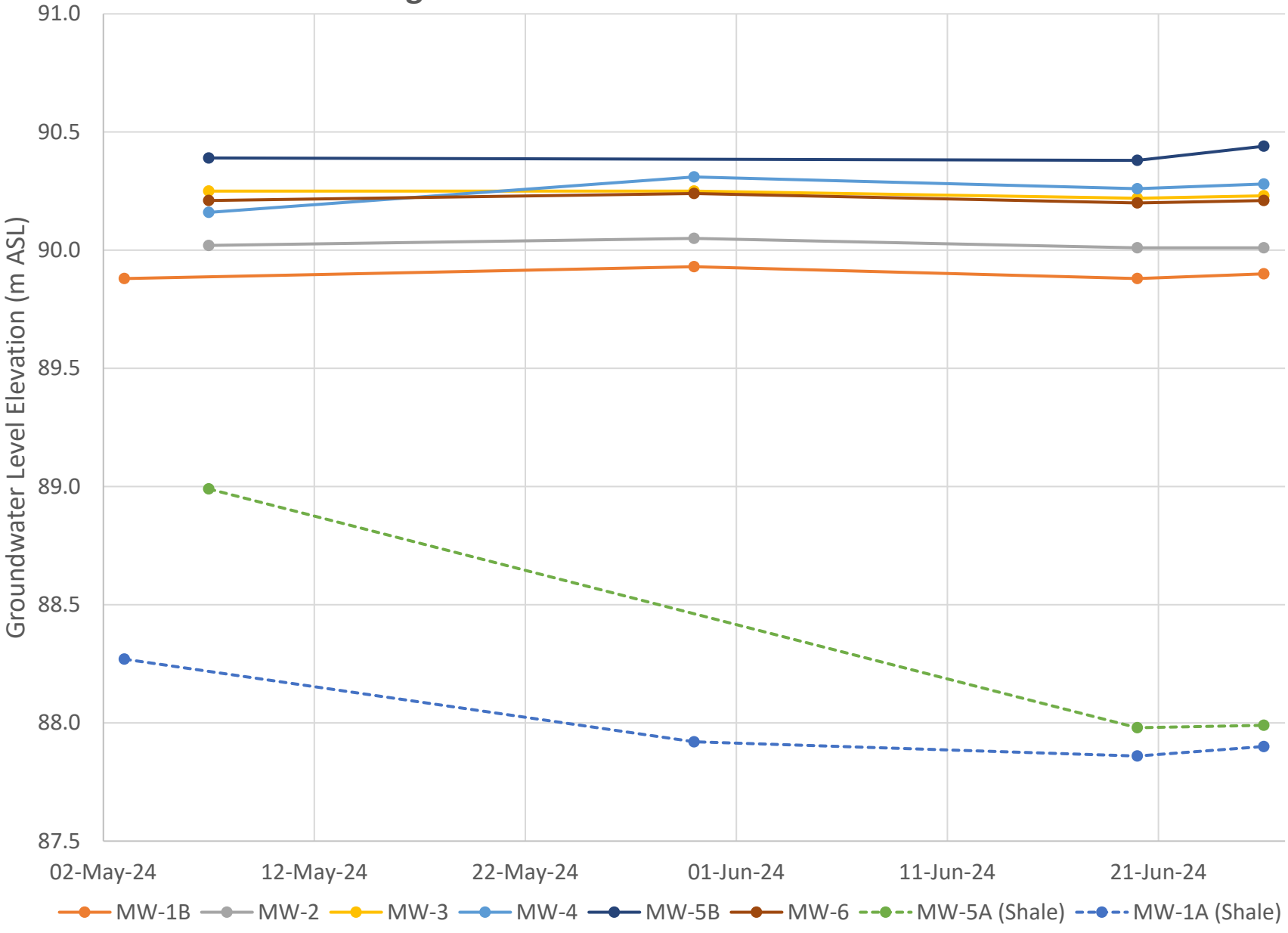


Table 1
Monitoring Location Details and Manual Water Levels

Well I.D.	Ground Elevation (m ASL)	Stick-Up (m)	TOC Elevation (m ASL)	Measured Well Depth Below TOC (m)	Well Depth below ground (m)	Date	Water level (m below TOC)	Water Level below ground (m)	Water Level Elevation (m ASL)
Water Table Sand									
MW-1B	103.08	-0.10	102.98	14.73	14.83	03-May-24	13.10	13.20	89.88
						30-May-24	13.05	13.15	89.93
						20-Jun-24	13.10	13.20	89.88
						26-Jun-24	13.08	13.18	89.90
MW-2	103.12	-0.08	103.04	14.87	14.95	07-May-24	13.02	13.10	90.02
						30-May-24	12.99	13.07	90.05
						20-Jun-24	13.03	13.11	90.01
						26-Jun-24	13.03	13.11	90.01
MW-3	103.15	-0.14	103.01	15.10	15.24	07-May-24	12.76	12.90	90.25
						30-May-24	12.76	12.90	90.25
						20-Jun-24	12.79	12.93	90.22
						26-Jun-24	12.78	12.92	90.23
MW-4	103.26	-0.09	103.17	14.79	14.88	07-May-24	13.01	13.10	90.16
						30-May-24	12.86	12.95	90.31
						20-Jun-24	12.91	13.00	90.26
						26-Jun-24	12.89	12.98	90.28
MW-5B	103.23	-0.06	103.17	13.84	13.90	07-May-24	12.78	12.84	90.39
						30-May-24	13.13	13.19	90.04*
						20-Jun-24	12.79	12.85	90.38
						26-Jun-24	12.73	12.79	90.44
MW-6	103.31	-0.11	103.20	14.31	14.42	07-May-24	12.99	13.10	90.21
						30-May-24	12.96	13.07	90.24
						20-Jun-24	13.00	13.11	90.20
						26-Jun-24	12.99	13.10	90.21
Potentiometric Surface Shale									
MW-1A	103.07	-0.11	102.96	32.10	32.21	03-May-24	14.69	14.80	88.27
						30-May-24	15.04	15.15	87.92
						20-Jun-24	15.10	15.21	87.86
						26-Jun-24	15.06	15.17	87.90
MW-5A	103.19	-0.09	103.10	30.60	30.69	07-May-24	14.11	14.20	88.99
						30-May-24	13.10	13.19	90.00*
						20-Jun-24	15.12	15.21	87.98
						26-Jun-24	15.11	15.20	87.99

Notes: MW=Monitoring well; TOC= Top of Casing; m ASL=metres above sea level;*-Values may not represent static conditions

Depth from Soil-Mat well logs

Appendix A

Terms of Reference

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

June 20, 2024

Losani Homes
c/o Daniel Borrelli, M.PL.
430 McNeilly Road, Suite 203
Stoney Creek, ON L8E 5E3

Re: Proposed Hydrogeologic Assessment/Dewatering Terms of Reference
127 Plains Road West, Burlington, ON

Dear Mr. Borrelli,

1.0 Introduction, Background Information and Purpose

Terra-Dynamics Consulting Inc. (Terra-Dynamics) respectfully submits this Proposed Terms of Reference to complete a Hydrogeology Assessment/Dewatering Study for 127 Plains Road, Burlington, ON (Site). It is our understanding that Losani Homes is planning to construct a 26-Story residential condominium building with up to four levels of underground parking (Chamberlain Architect Services Limited, 2022). Preliminary groundwater levels suggest a fourth underground parking level would be below the water table (Soil-Mat Engineers & Consultants Ltd. (Soil-Mat), 2024) and a depth of 3.5 m has been assumed per below grade parking level.

The City of Burlington (2023) have provided details of components to be included in the Hydrogeology Assessment/ Dewatering Study (Attachment A), and includes the following:

1. *Follows the terms of reference agreed upon by Conservation Halton, Region and City staff in advance of study commencement.*
2. *Indicates if a Permit to Take Water would be required during construction.*
3. *Includes testing of groundwater to ensure it meets municipal stormwater discharge criteria.*
4. *Provides sufficient monitoring data to address groundwater level seasonality.*

In other recent similar projects in the City of Burlington, the City has clarified that #4, "*sufficient monitoring data to address groundwater level seasonality",* meant groundwater levels should be taken in all seasons and determine the estimated seasonably high groundwater level, i.e. a year of groundwater level monitoring was required. The seasonally high groundwater water table is typically during March and/or April in southwestern Ontario.

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. This will include a review of nearby Provincial well records mapped out from the Ministry of the Environment, Conservation and Parks (MECP) and the Ontario Geological Survey (OGS), information from the regional groundwater study (Charlesworth & Associates and SNC-Lavalin, 2006), as well as the on-site

geotechnical investigation by Soil-Mat (2024). Information will be located on a site map, and well log information summarized and documented in the report, and geologic cross-sections prepared. Where grain-size analyses have been completed by Soil-Mat hydraulic conductivities will be calculated prior to field investigations.

2.2 Hydrogeological Field Investigation

2.2.1 Groundwater Level Monitoring

Manual groundwater levels will be manually measured every three months during site visits until a year of groundwater levels are collected meeting the City of Burlington requirements. Water level dataloggers will be installed in four of the eight groundwater monitoring wells to (i) capture the long-term trends, (ii) observe responses to precipitation events and (iii) any changes in the vertical gradient. It is proposed to install three dataloggers in the sand water table monitoring wells and a fourth in a deep shale monitoring well.

2.2.2 In-situ Hydraulic Conductivity Testing

The subject property will also be visited by Terra-Dynamics' staff to complete in-situ hydraulic conductivity testing of each of the monitoring wells constructed on-site. The testing will be completed using either bail-down, or falling head methods, with recovery monitoring completed using datalogging pressure transducers.

2.2.3 Groundwater Quality Testing

Following in-situ hydraulic conductivity testing, four groundwater samples will be collected for laboratory analysis of water quality from two monitoring wells, with two samples sent for laboratory analyses from each well, one unfiltered and one filtered for metals. These results will be compared to the City of Burlington's 2022 Stormsewer Discharge By-law Table 1 criteria (City of Burlington, 2022).

2.3 Dewatering Assessment

A conceptual model of groundwater flow will be prepared for the Site and include:

a) Measured groundwater levels;
b) Groundwater flow direction;
c) Vertical hydraulic gradients; and
d) Hydraulic conductivities per geologic unit.

These results will be used to calculate the (i) expected dewatering rates for construction conditions and (ii) the zone of influence during construction dewatering.

It is our current understanding that the dewatering assessment model inputs will include:

(a) Dewatering to 1 metre below the base of the fourth underground parking lot assumed to be 14 metres below ground surface for a total depth of 15 metres; and

(b) A 6-month duration of dewatering for the zone of influence.

As outlined in Section 2.2.3, the groundwater quality will be compared to the City of Burlington municipal stormsewer discharge criteria (2022) to identify any parameters requiring treatment before discharge, e.g. total suspended solids.

2.4 Reporting

Following a year of monitoring, a letter report documenting the construction dewatering assessment, incorporating the field investigations, will be prepared. The report will include dewatering recommendations including whether a Ministry of the Environment, Conservation and Parks (MECP) Environmental Activity and Sector Registry (EASR), or Permit to Take Water (PTTW) is required.

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 proposed Terms of Reference.

Yours truly,
TERRA-DYNAMICS CONSULTING INC.



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

cc. Stephanie Mirtitsch, MHBC

Attachments
A – Extracts from City of Burlington Pre-consultation

3.0 References

Chamberlain Architect Services Limited, 2022. 127 Plains Road, Burlington, Ontario, Project Stats.

Charlesworth & Associates and SNC-Lavalin, 2006. Hamilton Groundwater Resources Characterization and Wellhead Protection Partnership Study. Report to City of Hamilton.

City of Burlington, 2023. Development Application Pre-Consultation Form, 127 Plains Road West, Burlington, Ontario.

City of Burlington, 2022. By-law 59-2022, To Regulate the discharge of any matter into the Municipal Storm Sewers and to repeal By-law 86-2002, as amended.

Soil-Mat Engineers & Consultants Ltd., 2024. DRAFT Geotechnical Investigation Borehole Location Plan and Borehole logs, Proposed 26-Storey Building, 127 Plains Road W, Burlington, Ontario. Prepared for Losani Homes.

Attachment A

Extracts from City of

Burlington Pre-consultation

- Includes all traffic counts and modelling data in an Appendix and electronically
- Includes a multi-modal approach to transportation analysis
- Incorporates Travel Demand Measurement measures

15) Stormwater Management Report

- Please refer to the City of Burlington Stormwater Management Design Guidelines, approved by City Council on June 22, 2020, please be advised of new IDF curves for the City of Burlington: https://www.burlington.ca/en/services-for-you/Stormwater.asp
- Refers to the Ministry of the Environment "Stormwater Management Planning and Design Manual" and the TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide.
- Is prepared, signed and stamped by a Professional Engineer
- Includes pre and post development drainage area plans that are legible, plotted to an acceptable metric scale, plotted on 24" by 36" paper and plotted on a consistent base map layer
- Includes site grading and servicing plans that are legible, plotted to a metric scale of 1:200, 1:250, 1:300 or 1:500, plotted on 24" by 36" paper and plotted on a consistent base map layer
- Includes digital copies of modeling, modelling program acceptability to be confirmed with City Staff prior to use and prior to submission of report.
- Includes a list of all past reports and current technical documents that have been consulted.
- Includes all calculations, modelling, and parameters (as per City Standard Drawings S-IDF, S-2D, S-3D, etc., as amended)
- Includes clearly defined stormwater criteria for the site (including source) and demonstrates in report how these criteria will be satisfied.
- Addresses all interim conditions as well as the ultimate condition
- Contains engineering details and cross-sections showing existing utility locations if any temporary and/or permanent encroachments are proposed.
- Provide chemical analysis of groundwater to determine if it satisfies the City's storm sewer discharge criteria for water quality. (including documentation from the Geotechnical or Environmental Engineer in the appendix)
- If groundwater cannot be directly outletted to the municipal storm system, detail where it will outlet, i.e. treated then outlet to storm or outlet to the sanitary system.

- Provide an estimate of groundwater flow to be permanently managed in the site storm system (including documentation from the Geotechnical Engineer or Hydro-geologist in the appendix)
- Provide comment on whether or not it is anticipated a permit to take water would be necessary either temporarily during construction or permanently.

16) Grading and Servicing Plans

- Must be separate Plans
- Are stamped and signed by a Professional Engineer
- Contains legible drawings, plotted to a metric scale of 1:200, 1:250, 1:300 or 1:500, on 24" by 36" paper and plotted on a consistent base map layer
- Identifies property lines, dedications, easements, regulated areas, impermeable surfaces (including curbs, roads, driveways, sidewalks, etc.), buildings and entrances, and other information as needed
- Identifies the location of all underground, at grade and overhead utilities
- Identifies the location of all storm water management infrastructure, including swales, sub-drains, catch basins, pipes, and other quality and quantity controls as required
- Identifies Municipal Benchmark and Horizontal Control

17) Geotechnical Study (including Groundwater)

- Is prepared, signed and stamped by a Professional Engineer.
- Contains legible drawings
- Includes digital copies of models
- Includes all dimensions in metric, to scale, and on a consistent base map layer.
- Includes groundwater information (for example: dewatering during construction vs. permanent dewatering to be accommodated in a stormpond). Includes estimated volumes of groundwater to be permanently managed.
- Indicates if a Permit to Take Water would be required either during construction or permanently.
- Includes testing of groundwater to ensure it meets municipal stormwater discharge criteria. (City and Regional staff have been contacted if groundwater does not meet discharge criteria.)
- Contains sufficient quantity and distribution of boreholes to map soil and groundwater conditions for the soil type.
- Provides sufficient monitoring data to address groundwater level seasonality.

- Contains results of any geotechnical test completed.
- Discusses infiltration capabilities if Low Impact Development is proposed.
- Contains shoring and excavation details (for example: tiebacks, caissons, foundations, forming, piles) if underground parking or encroachments are proposed.
- Includes cross-sections, and dimensions from property lines and details of over-digging.
- Includes a stable slope assessment if required at the preconsultation stage. This study refers to the Ministry of Natural Resources and Forestry Technical Guidelines "Natural Hazards Manual Technical Guide – River and Stream Systems: Erosion Hazard Limit" and final topographical survey drawings with stable top of bank delineation signed and stamped by a Professional Engineer.
- Contains confirmation of the need for pre-construction surveys of surrounding buildings, to an extent determined by a Professional Engineer specializing in vibration, OR confirmation that pre-construction surveys are not warranted.

18) Environmental Site Assessment Report

- Completed in accordance with Ontario Regulation 153/04 as amended
- Regional Environmental Site Screen Questionnaire included
- Prepared, signed and stamped by a Qualified Person
- Letter of Reliance for City and Regional staff
- If the Phase One Study recommends a Phase Two Study, then the Phase Two is included with the submission
- If the Phase Two Study recommends site remediation, then the remediation plan is included to ensure that remediation feasibility has been considered.

19) Urban Design Brief:

- Contains a itemized and detailed analysis of how the proposed development meets the urban design objectives and policies of the Official Plan and any relevant approved urban design guidelines.
- Indicates how the proposed development responds to its surrounding context (both existing and planned).
- Provides a close examination and understanding of the surrounding area including blocks, streets, and buildings that could influence overall site and building design.
- Describes the overall architectural expression; building relationship to streetscape and adjacent properties; pedestrian, cycling, and transit connections; sustainable building elements; and other urban design features that ensure design excellence.

Appendix B

Soil-Mat and MECP Borehole/

Monitoring Well Logs



LEGEND

- Bedrock Monitoring Well (BH#)
- Groundwater Monitoring Well (BH#)
- Temporary Benchmark (BM) — Top of catchbasin with geodetic elevation of 102.89m

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 230581-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Residential Development
127 Plains Road West
Burlington, Ontario

Preliminary Borehole Location Plan

Project No. SM 230581-G

Date: May 2024

Drawn: BS

Checked: AR

Drawing No. 1

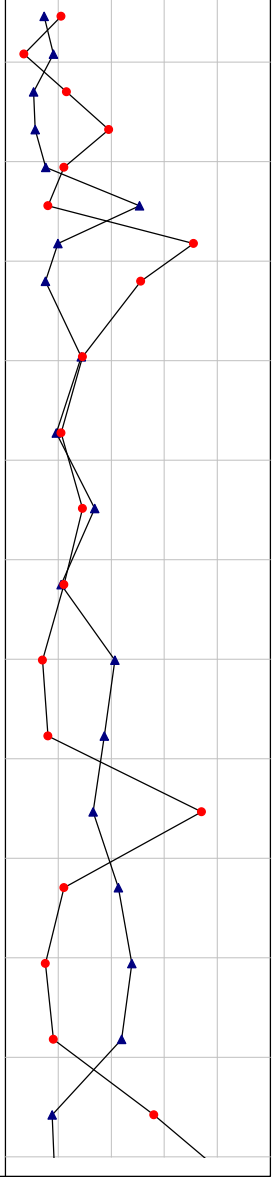
Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.07	Ground Surface							
0–2 / 0–1	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
2–10 / 1–3	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.	SS	1	8,12,9,6	21			
			SS	2	4,4,3,3	7			
			SS	3	6,8,15,29	23			
			SS	4	12,14,25,25	39			
10–14 / 3–4	98.60		SS	5	5,10,12,15	22			
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	6	2,3,13,25	16		1.5	
			SS	7	20,33,38,35	71			
			SS	8	19,27,24,26	51			
		Seam of reddish brown silty clay	SS	9	7,13,16,34	29			
32–33 / 9–10	92.90		SS	10	13,11,10,9	21			
33–56 / 10–17		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,12,17,16	29			
			SS	12	11,9,13,18	22			
			SS	13	3,6,8,17 Wet spoon	14			
			SS	14	6,7,9,5 Wet spoon	16			
			SS	15	18,36,38,37	74			
56–59 / 17–18	85.20								
59–72 / 18–22		**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, stiff to very stiff.	SS	16	6,10,12,14	22		2.0	
			SS	17	5,7,8,10	15		1.0	
			SS	18	3,8,10,28	18		3.0	
72–79 / 22–24	80.70		SS	19	14,27,29,20	56			

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



Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road · Hamilton, Ontario · L8E 2Z3
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www.soil-mat.ca · E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 1A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795146
E: 592661

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
25			**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.		SS	20	18,31,59,41	90			
26					SS	21	27,50/5"	100			
27	75.60				SS	22	50/2"	100			
28			**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.		HQ	1	RQD = 82%				
29					HQ	2	RQD = 89%				
30					HQ	3	RQD = 90%				
31	71.00										
32			End of Borehole								
33			NOTES: 1. Borehole was advanced using hollow stem auger equipment on April 29, 2024 to termination at a depth of 27.5 metres. Bedrock was cored to a depth of 32.1 metres. 2. Soil samples will be discarded after 3 months unless otherwise directed by our client. 3. A monitoring well was installed. The following free groundwater level readings have been measured: May 3, 2024 - 14.8 metres May 30, 2024 - 15.2 metres								
34											
35											
36											
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											

Moisture Content w%
10 20 30 40

Standard Penetration Test blows/300mm
20 40 60 80

Compressive Strength 55.7 MPa
Compressive Strength 58.5 MPa
Compressive Strength 56.5 MPa
Compressive Strength 63.9 MPa

Drill Method: Hollow Stem Augers
Drill Date: April 29, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 1B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795147
E: 592660

Depth (ft / m)	Elevation (m)	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)
0 m	103.08	Ground Surface									
0 – 1 m	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
1 – 2 m	100.90	**Sand Fill** Brown, trace to some silt and gravel, compact to loose.									
3 – 4 m	98.60	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense. Seam of reddish brown silty clay									
9 – 10 m	92.90	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
14 – 15 m	87.80	End of Borehole									

Note: Soil stratums inferred from BH1A

NOTES:

1. Borehole was advanced using hollow stem auger equipment on April 30, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 3, 2024 - 13.2 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: April 30, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795158
E: 592674

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.12	Ground Surface							
0 / 0	102.50	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
3 / 1		**Sand and Gravel Fill** Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, loose to dense.	SS	1	8,18,11,8	29			
7 / 2			SS	2	3,2,2,1	4			
10 / 3			SS	3	14,17,14,12	31			
13 / 4			SS	4	9,10,6,6	16			
15 / 4	98.40		SS	5	1,8,24,20	32			
16 / 5			SS	6	6,20,36,38	56			
20 / 6		**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	6,32,20,18	52			
23 / 7			SS	8	10,24,26,29	50			
26 / 8			SS	9	6,11,11,10	22			
30 / 9			SS	10	12,16,14,10	30			
33 / 10	92.90								
36 / 11		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	12,18,18,18	36			
40 / 12			SS	12	12,12,16,12	28			
46 / 14			SS	13	16,30,34,36 Wet spoon	64			
49 / 15	87.90								
		End of Borehole							

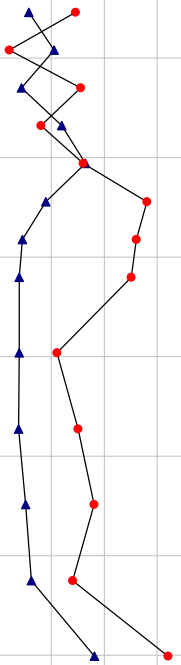
NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 13.1 metres
May 30, 2024 - 13.1 metres

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



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795179
E: 592693

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.15	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
		Sand and Gravel Fill Brown, varying gravel content throughout, occasional clayey seams in the lower levels, trace to some silt, occasional cobbles, very loose to loose.	SS	1	2,5,2,2	7			
			SS	2	2,3,2,16	5			
			SS	3	8,3,4,4	7			
			SS	4	5,4,6,7	10			
13 / 4	99.00		SS	5	1,1,2,9	3			
			SS	6	9,23,29,35	52			
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, very dense to compact.	SS	7	17,20,26,23	46			
			SS	8	15,19,23,21	42			
			SS	9	8,11,9,11	20			
33 / 10	92.90								
		Sand Brown, trace to some silt and gravel, dense to compact.	SS	10	17,20,16,17	36			
			SS	11	9,10,11,10	21			
			SS	12	9,10,15,27 Wet spoon	25			
51 / 16	87.30		SS	13	7,8,9,14 Wet spoon	17			
		End of Borehole							

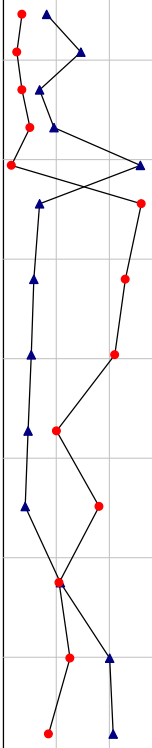
NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.9 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 12.9 metres
May 30, 2024 - 12.9 metres

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



Drill Method: Hollow Stem Augers
Drill Date: May 6, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

Soil-Mat Engineers & Consultants Ltd.
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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795187
E: 592682

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.26	Ground Surface							
0 / 0	102.80	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 300 millimetres of compact granular base.							
6 / 2	100.70	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional cobbles, loose to compact	SS	1	4,7,6,3	13			
			SS	2	4,3,3,1	6			
			SS	3	1,3,3,2	6			
			SS	4	5,7,10,12	17			
13 / 4	99.20		SS	5	11,14,12,12	26			
			SS	6	1,1,0,1	1		<1.0	
16 / 5	97.70	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.	SS	7	1,1,1,1 Wet spoon	2		<1.0	
20 / 6			SS	8	7,17,13,15	30			
26 / 8		**Silty Clay/Clayey Silt** Reddish brown, trace to some sand, very soft.	SS	9	16,20,16,15	36			
33 / 10		**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.	SS	10	24,18,16,14	34			
36 / 11			SS	11	10,12,12,16	24			
43 / 13			SS	12	8,11,11,16	22			
46 / 14			SS	13	7,18,11,11 Wet spoon	29			
51 / 16	87.40	End of Borehole	SS	14	2,6,17,24 Wet spoon	23			

NOTES:

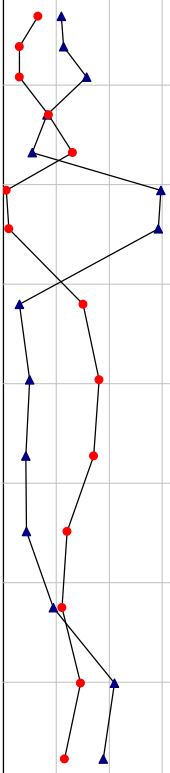
1. Borehole was advanced using hollow stem auger equipment on May 7, 2024 to termination at a depth of 15.8 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.0 metres

Moisture Content w% (10 20 30 40)

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



Drill Method: Hollow Stem Augers
Drill Date: May 7, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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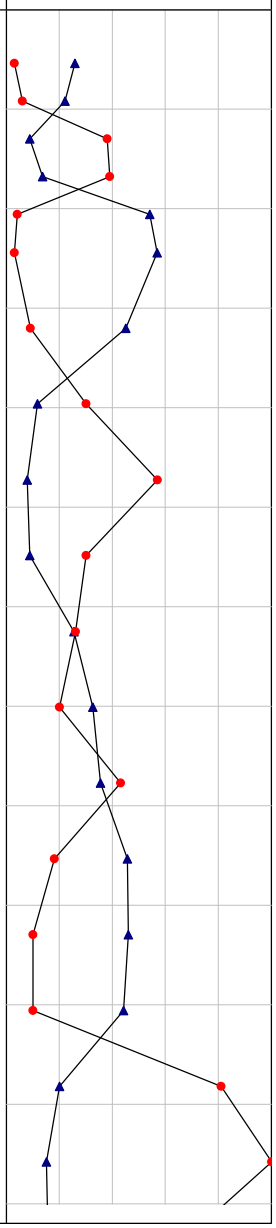
Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.19	Ground Surface							
0 / 0	102.60	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.							
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.	SS	1	1,2,1,1	3			
			SS	2	2,2,4,10	6			
			SS	3	9,18,20,27	38			
12 / 3	99.30	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.	SS	4	16,19,20,18	39			
			SS	5	4,2,2,2	4		<1.0	
			SS	6	2,1,2,2	3		<1.0	
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.	SS	7	2,4,5,9	9		1.0	
		Sand and Gravel Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.	SS	8	9,15,15,19	30			
			SS	9	9,35,22,25	57			
33 / 10	93.00		SS	10	10,14,16,21	30			
		Sand Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.	SS	11	10,12,14,14	26			
			SS	12	6,10,10,12	20			
			SS	13	7,14,29,39	43			
53 / 16	86.80	**Silty Clay/Clayey Silt** Grey, trace gravel in the upper levels, very stiff to stiff.	SS	14	4,8,10,13	18		3.0	
			SS	15	3,4,6,6	10		<1.0	
			SS	16	4,4,6,8	10		<1.0	
68 / 21	82.30	**Sandy and Silty Gravel** Red to reddish grey, high gravel content in the upper levels, trace clay increasing with depth, very dense.	SS	17	35,41,40,42	81			
			SS	18	65,50/4"	100			
79 / 24									



Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 2

Log of Borehole No. 5A

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795199
E: 592669

Depth	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
25	77.60		SS	19	44,31,37,50/5	68			
			SS	20	50/4"	100			
26		**Queenston Shale** Highly weathered in upper levels resembling a cohesive soil, becoming more sound with depth, hard.	HQ	1	RQD = 0%				
27			HQ	2	RQD = 86%				
28			HQ	3	RQD = 76%				
29									
30	72.60		HQ	4	RQD = 95%				
31		End of Borehole							
32		NOTES:							
33		1. Borehole was advanced using hollow stem auger equipment on May 2, 2024 to termination at a depth of 25.6 metres. Bedrock was cored to a depth of 30.6 metres.							
34		2. Soil samples will be discarded after 3 months unless otherwise directed by our client.							
35		3. A monitoring well was installed. The following free groundwater level readings have been measured: May 7, 2024 - 14.2 metres May 30, 2024 - 15.2 metres							
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									

Moisture Content w% (10 20 30 40)

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

Compressive Strength 58.4 MPa
Compressive Strength 80.5 MPa
Compressive Strength 57.5 MPa
Compressive Strength 47.5 MPa

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 2 of 2

Log of Borehole No. 5B

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795200
E: 592670

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	SAMPLE PP (kgf/cm2)	SAMPLE U.Wt.(kN/m3)	Moisture Content w% (10 20 30 40) / Standard Penetration Test blows/300mm (20 40 60 80)
0 / 0	103.23	Ground Surface									
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.									
6 / 2	101.00	**Sand Fill** Brown, trace to some silt and gravel, very loose to loose.									
13 / 4	99.30	**Sand and Gravel** Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, dense.									
23 / 7	96.00	**Silty Clay/Clayey Silt** Reddish brown, trace sand increasing with depth, soft to firm.									
33 / 10	93.00	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasionl to moderate cobbles, dense to very dense.									
45 / 14	89.20	**Sand** Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to very dense.									
		End of Borehole									

Note: Soil stratums inferred from BH5A

NOTES:

1. Borehole was advanced using solid stem auger equipment on May 3, 2024 to termination at a depth of 14.0 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 7, 2024 - 12.8 metres
May 30, 2024 - 13.2 metres

Drill Method: Hollow Stem Augers
Drill Date: May 2, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 230581-G
Project: Proposed 26-Storey Building
Location: 127 Plains Rd. W, Burlington
Client: Losani Homes

Project Manager: Adam Roemmele, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4795181
E: 592653

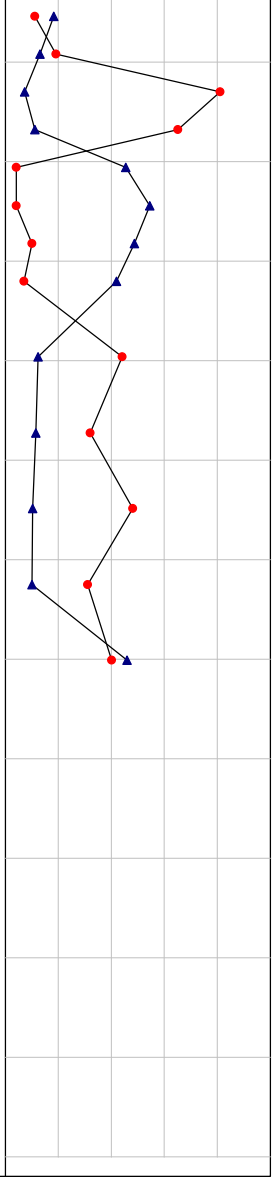
Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	103.31	Ground Surface								
0 / 0	102.70	**Pavement Structure** Approximately 125 millimetres of asphaltic concrete overlying 450 millimetres of compact granular base.								
6 / 2	101.10	**Sand and Gravel Fill** Brown, varying gravel content throughout, trace to some silt, occasional to moderate cobbles, compact.		SS	1	6,6,5,2	11			
				SS	2	5,7,12,15	19			
				SS	3	18,46,35,63	81			
13 / 4	99.20			SS	4	16,30,35,21	65			
				SS	5	3,3,1,3	4		<1.0	
				SS	6	1,2,2,2	4		<1.0	
		Sand and Gravel Brown, varying gravel content throughout, trace silt and clay, occasional to frequent cobbles, compact to very dense.		SS	7	0,5,5,7	10		1.5	
23 / 7	96.20			SS	8	2,3,4,7	7		1.5	
		Silty Clay/Clayey Silt Reddish brown, trace to some sand, very soft.		SS	9	9,20,24,33	44			
33 / 10	93.10	**Sand and Gravel** Brown, varying gravel content throughout, trace silt, occasional cobbles, dense.		SS	10	7,14,18,22	32			
				SS	11	31,26,22,21	48			
		Sand Brown, trace to some silt and gravel, with silty layers in the lower levels, compact to dense.		SS	12	9,14,17,20	31			
				SS	13	5,27,13,13 Wet spoon	40			
49 / 15	88.10	End of Borehole								

NOTES:

1. Borehole was advanced using hollow stem auger equipment on May 1, 2024 to termination at a depth of 15.2 metres.

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

3. A monitoring well was installed. The following free groundwater level readings have been measured:
May 30, 2024 - 13.1 metres



Drill Method: Hollow Stem Augers
Drill Date: May 1, 2024
Hole Size: 200 millimetres
Drilling Contractor: Davis Drilling Ltd.

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Datum: Geodetic
Field Logged by: BS
Checked by: AR
Sheet: 1 of 1

Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A366855

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name/Organization	E-mail Address	☐ Well Constructed by Well Owner
	2391798 Ontario Ltd.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3408 Lakeshore Rd.	Burlington	ON	L7N 1B3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
141 Plains Rd W.			

County/District/Municipality	City/Town/Village	Province	Postal Code
	Burlington	Ontario	L7T 1G1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	592662	4795132		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Fill	gravel	Dry	0	3
Brown	Sand	gravel/cobble	~~Cobble~~ Dry	3	14
Brown	Clay	silt	wet	14	20
Brown	Sand	gravel	Dry	20	40
Brown	Sand		wet	40	47

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	35	Bentonite	11.55
35	47	Sand	3.96

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify Auger

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
2	Plastic	.188	0	37

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
2.376	Plastic	10	37	47

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☑ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water	Hole Diameter Depth From	To	Diameter (cm/in)
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	0	47	8
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify			
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify			

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min/GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min/GPM)

Well production (l/min/GPM)

Disinfected? ☐ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Terra Firma Environmental Services Ltd.
Well Contractor's Licence No.: 6946
84 Martin Ross Ave. Toronto, ON M3J 2L4
Bus #: 416.450.6244, E: info@terrafirmaservices.com
Well Tech & Licence #: Gudkov, Sergey, #: 4182

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
4182		2022/11/30

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2022/11/30

Date Work Completed: 2022/11/17

Ministry Use Only

Audit No. Z400160

DEC 05 2022 Received

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Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A366273

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name/Organization	E-mail Address	☐ Well Constructed by Well Owner
	2381798 Ontario Ltd.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3408 Lakeshore Rd.	Burlington	ON	L7N 1B3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
141 Plains Rd W.			

County/District/Municipality	City/Town/Village	Province	Postal Code
	Burlington	Ontario	L7T 1G1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	592630	4791512		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	fill	gravel	Dry	0	3
Brown	Sand	gravel/cobble	Dry	3	14
Brown	Clay	silt	wet	14	20
Brown	Sand	gravel	Dry	20	40
Brown	Sand		Wet	40	47

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	35	Bentonite	11.55
35	47	Sand	3.96

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify Auger

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
2	Plastic	.188	0	37

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☑ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
2.376	Plastic	10	37	47

Water Details

Water found at Depth (m/ft)	Kind of Water	Water found at Depth (m/ft)	Kind of Water
	☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify		☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify
	☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify		☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	47	8

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: ___ hrs + ___ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min/GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min/GPM)

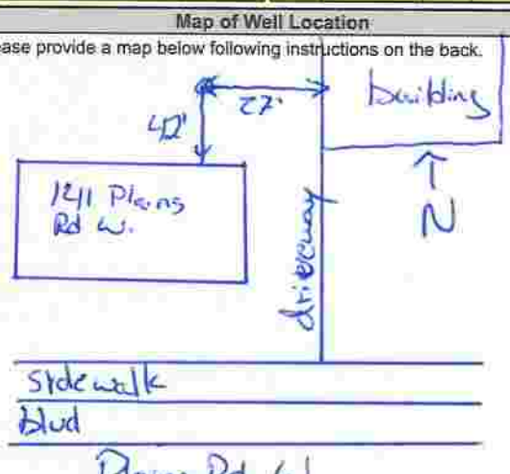
Well production (l/min/GPM)

Disinfected? ☐ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Terra Firma Environmental Services Ltd.
Well Contractor Licence #: 6946
84 Martin Ross Ave. Toronto, ON M3J 2L4
Bus #: 416.450.6244, E: info@terrafirmaservices.com
Well Tech & Licence #: Gudkov, Sergey, #: 4182

Well Contractor's Licence No.:

Well Technician's Licence No.: 4182

Signature of Technician and/or Contractor:

Date Submitted: 2022 11 30

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2022 11 30

Date Work Completed: 2022 11 01

Ministry Use Only

Audit No. Z400161

Received DEC 05 2022

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Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A366856

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name/Organization	E-mail Address	☐ Well Constructed by Well Owner
	2381798 Ontario Ltd.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3408 Lakeshore Rd.	Burlington	ON	L7N 1B3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
153 Plains Rd W			

County/District/Municipality	City/Town/Village	Province	Postal Code
	Burlington	Ontario	L7T 1G1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	592601	4795119		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	Fill	gravel	Dry	0	3
Brown	sand	gravel / cobble	Dry	3	14
Brown	Clay	Silt	wet	14	20
Brown	Sand	gravel	Dry	20	40
Brown	Sand		Wet	40	47

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	35	Bentonite	11.55
35	47	sand	3.96

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☑ Other, specify: Auger

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
2	Plastic	.188	0	37

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
2.376	Plastic	10	37	47

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☑ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min/GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min/GPM)

Well production (l/min/GPM)

Disinfected? ☐ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Water Details

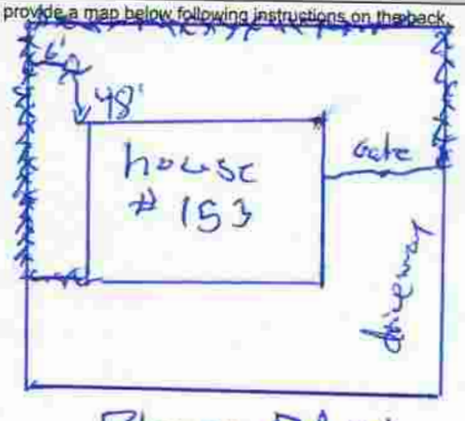
Water found at Depth (m/ft)	Kind of Water	
☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify
Water found at Depth (m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify
Water found at Depth (m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	47	8

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: **Terra Firma Environmental Services Ltd.**
Well Contractor Licence #: 6946
84 Martin Ross Ave. Toronto, ON M3J 2L4
Bus #: 416.450.6244, E: info@terrafirmaservices.com
Well Tech & Licence #: Gudkov, Sergey, #: 4182

Well Contractor's Licence No.

Well Technician's Licence No. 4182

Signature of Technician and/or Contractor

Date Submitted: 2022/11/30

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2022/11/30

Date Work Completed: 2022/11/12

Ministry Use Only

Audit No. Z400159

Received: DEC 05 2022

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Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A366272

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name/Organization	E-mail Address	☐ Well Constructed by Well Owner
	2381798 Ontario Ltd.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
3408 Lakeshore Rd.	Burlington	ON	L7N1B3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
153 Plains Rd W			

County/District/Municipality	City/Town/Village	Province	Postal Code
	Burlington	Ontario	L7T1G1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	592621	4795101		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	Fill	gravel	Dry	0	3
Brown	Sand	Cobble	Dry	3	20
Brown	Sand	gravel	Dry	20	45

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	33	Bentonite	10.89
33	45	Sand	3.96

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify Auger

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
2	Plastic	.188	0	35

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
2.38	Plastic	10	35	45

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☑ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water	
☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify
Water found at Depth (m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify
Water found at Depth (m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	45	8

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min/GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min/GPM)

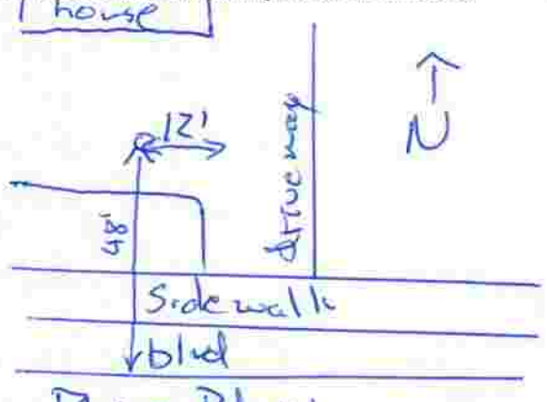
Well production (l/min/GPM)

Disinfected? ☐ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Terra Firma Environmental Services Ltd.
Well Contractor Licence #: 6946
84 Martin Ross Ave. Toronto, ON M3J 2L4
Bus #: 416.450.6244, E: info@terrafirmaservices.com
Well Tech & Licence #: Gudkov, Sergey, #: 4182

Well Contractor's Licence No.:

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
4182		2022/11/30

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2022/11/30

Date Work Completed: 2022/11/16

Ministry Use Only

Audit No. Z400162

DEC 05 2022

Received

Ministry's Copy

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Appendix C

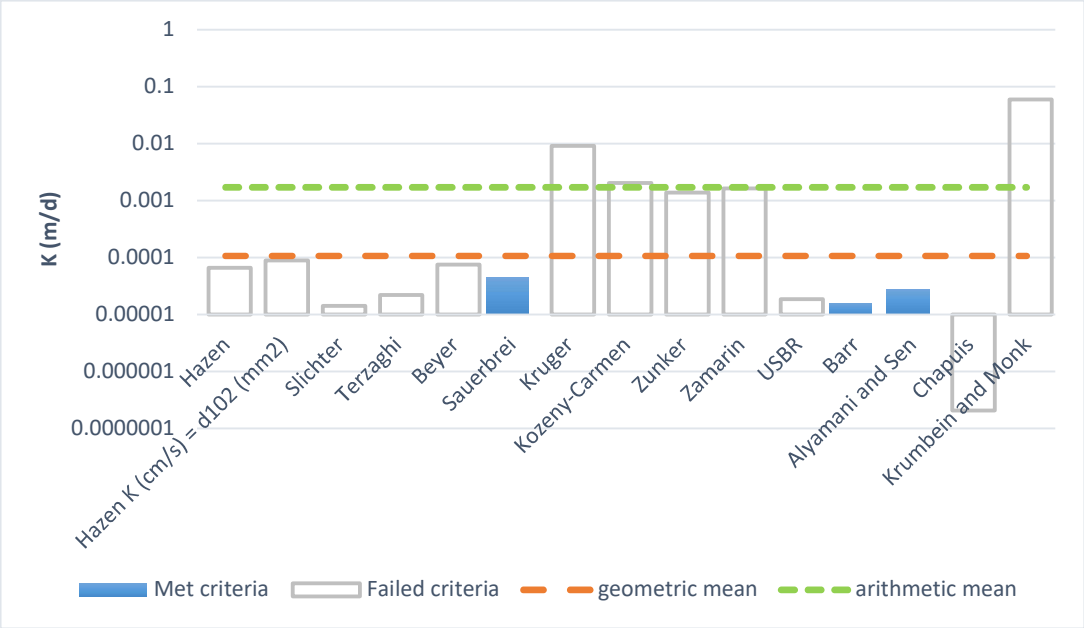
Hydraulic Conductivity Analyses

K from Grain Size Analysis Report Date: 13-May-24

Sample Name: BH-1A (65') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



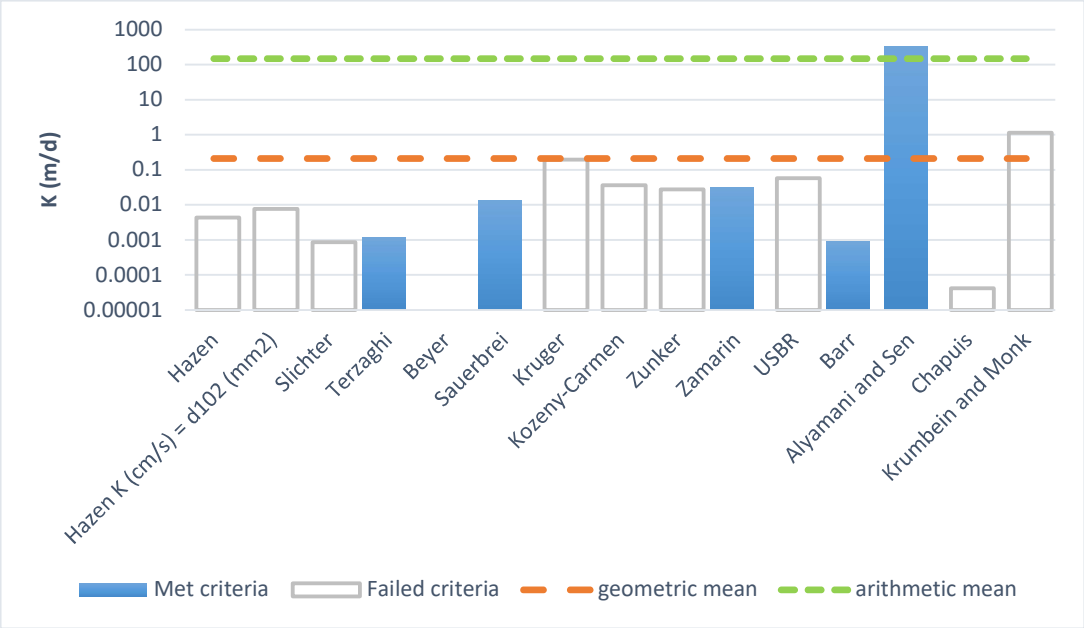
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.E-08	8.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-07	1.E-09	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	3.E-08	3.E-10	0.00	
Beyer	9.E-08	9.E-10	0.00	
Sauerbrei	5.E-08	5.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	3.E-08	3.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	7.E-05	7.E-07	0.06	
Shepherd	8.E-06	8.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 13-May-24

Sample Name: BH-1A (80') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted sandy gravel with fines



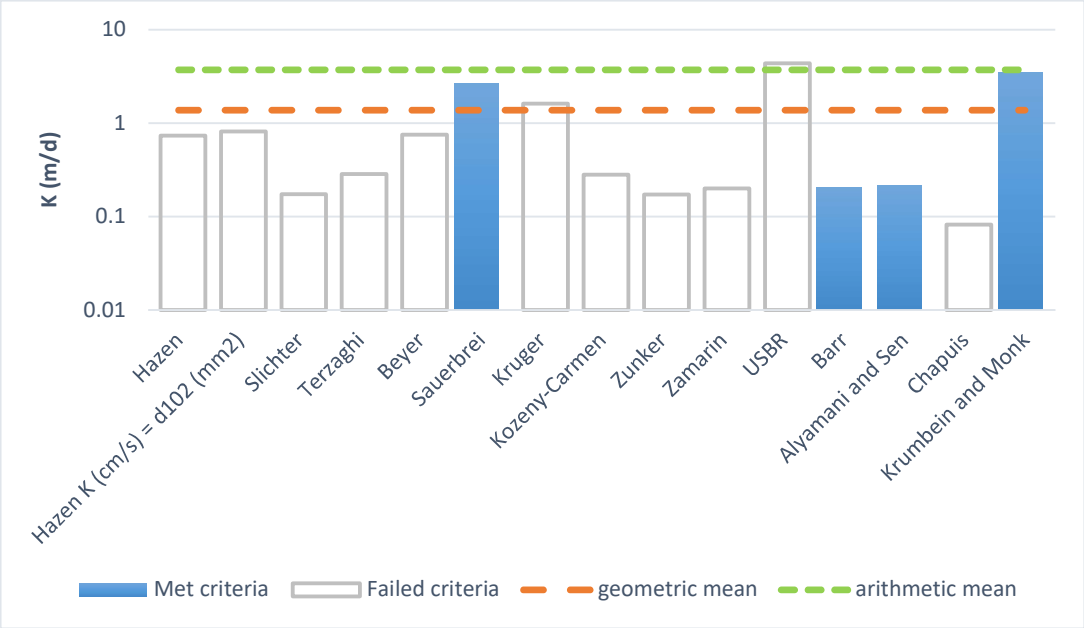
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.E-06	5.E-08	0.00	
Hazen K (cm/s) = d_{10} (mm)	9.E-06	9.E-08	0.01	
Slichter	1.E-06	1.E-08	0.00	
Terzaghi	1.E-06	1.E-08	0.00	
Beyer	-2.E-06	-2.E-08	0.00	
Sauerbrei	2.E-05	2.E-07	0.01	
Kruger	2.E-04	2.E-06	0.20	
Kozeny-Carmen	4.E-05	4.E-07	0.04	
Zunker	3.E-05	3.E-07	0.03	
Zamarin	4.E-05	4.E-07	0.03	
USBR	7.E-05	7.E-07	0.06	
Barr	1.E-06	1.E-08	0.00	
Alyamani and Sen	4.E-01	4.E-03	339.00	
Chapuis	5.E-08	5.E-10	0.00	
Krumbein and Monk	1.E-03	1.E-05	1.14	
Shepherd	6.E-01	6.E-03	558.63	
geometric mean	2.E-04	2.E-06	0.21	
arithmetic mean	2.E-01	2.E-03	149.61	

K from Grain Size Analysis Report Date: 13-May-24

Sample Name: BH-2 (45') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted sand low in fines



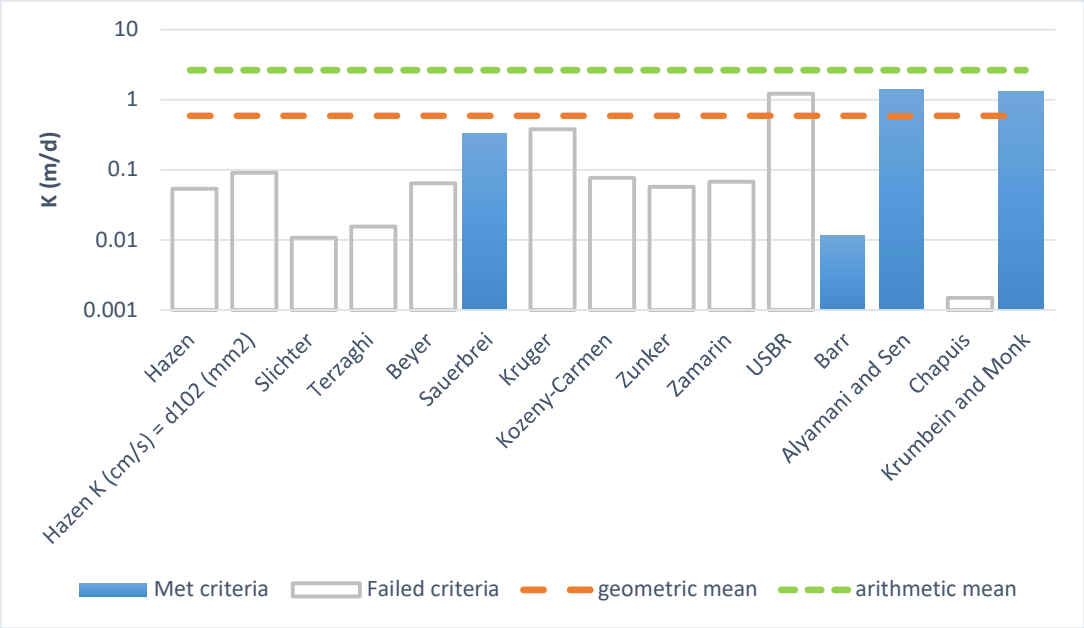
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.E-04	8.E-06	0.73	
Hazen K (cm/s) = d_{10} (mm)	9.E-04	9.E-06	0.81	
Slichter	2.E-04	2.E-06	0.17	
Terzaghi	3.E-04	3.E-06	0.28	
Beyer	9.E-04	9.E-06	0.75	
Sauerbrei	3.E-03	3.E-05	2.67	
Kruger	2.E-03	2.E-05	1.62	
Kozeny-Carmen	3.E-04	3.E-06	0.28	
Zunker	2.E-04	2.E-06	0.17	
Zamarin	2.E-04	2.E-06	0.20	
USBR	5.E-03	5.E-05	4.36	
Barr	2.E-04	2.E-06	0.21	
Alyamani and Sen	2.E-04	2.E-06	0.21	
Chapuis	9.E-05	9.E-07	0.08	
Krumbein and Monk	4.E-03	4.E-05	3.47	
Shepherd	1.E-02	1.E-04	12.11	
geometric mean	2.E-03	2.E-05	1.38	
arithmetic mean	4.E-03	4.E-05	3.73	

K from Grain Size Analysis Report Date: 13-May-24

Sample Name: BH-4 (40') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted sand low in fines



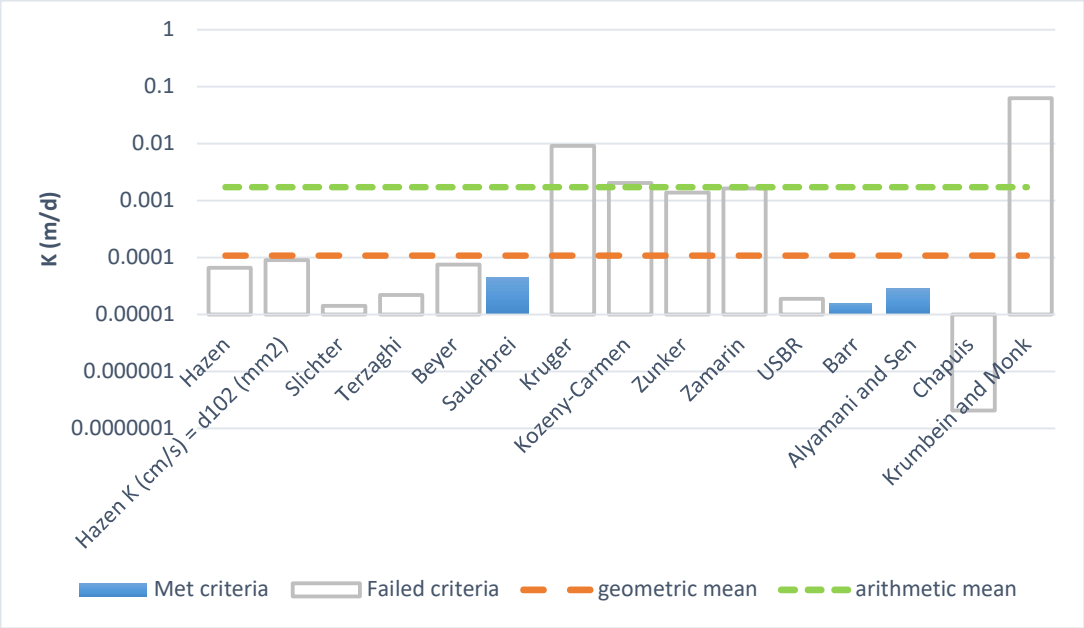
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	6.E-05	6.E-07	0.05	
Hazen K (cm/s) = d_{10} (mm)	1.E-04	1.E-06	0.09	
Slichter	1.E-05	1.E-07	0.01	
Terzaghi	2.E-05	2.E-07	0.02	
Beyer	7.E-05	7.E-07	0.06	
Sauerbrei	4.E-04	4.E-06	0.33	
Kruger	4.E-04	4.E-06	0.38	
Kozeny-Carmen	9.E-05	9.E-07	0.08	
Zunker	7.E-05	7.E-07	0.06	
Zamarin	8.E-05	8.E-07	0.07	
USBR	1.E-03	1.E-05	1.22	
Barr	1.E-05	1.E-07	0.01	
Alyamani and Sen	2.E-03	2.E-05	1.41	
Chapuis	2.E-06	2.E-08	0.00	
Krumbein and Monk	2.E-03	2.E-05	1.33	
Shepherd	1.E-02	1.E-04	10.21	
geometric mean	7.E-04	7.E-06	0.59	
arithmetic mean	3.E-03	3.E-05	2.66	

K from Grain Size Analysis Report Date: 13-May-24

Sample Name: BH-5A (60') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines



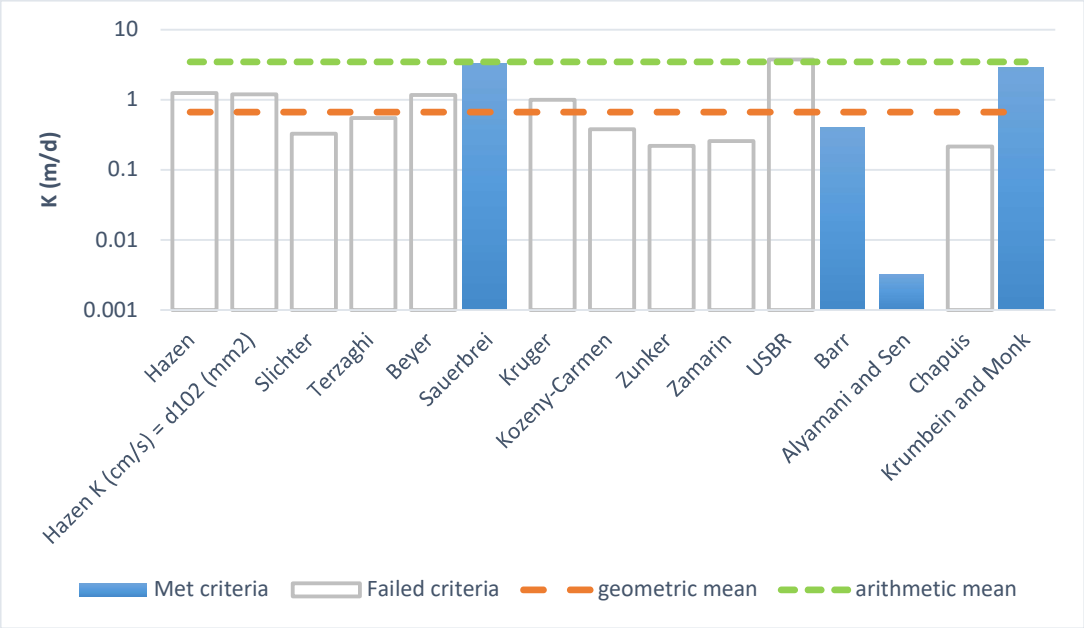
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.E-08	8.E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.E-07	1.E-09	0.00	
Slichter	2.E-08	2.E-10	0.00	
Terzaghi	3.E-08	3.E-10	0.00	
Beyer	9.E-08	9.E-10	0.00	
Sauerbrei	5.E-08	5.E-10	0.00	
Kruger	1.E-05	1.E-07	0.01	
Kozeny-Carmen	2.E-06	2.E-08	0.00	
Zunker	2.E-06	2.E-08	0.00	
Zamarin	2.E-06	2.E-08	0.00	
USBR	2.E-08	2.E-10	0.00	
Barr	2.E-08	2.E-10	0.00	
Alyamani and Sen	3.E-08	3.E-10	0.00	
Chapuis	2.E-10	2.E-12	0.00	
Krumbein and Monk	7.E-05	7.E-07	0.06	
Shepherd	8.E-06	8.E-08	0.01	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	2.E-06	2.E-08	0.00	

K from Grain Size Analysis Report Date: 13-May-24

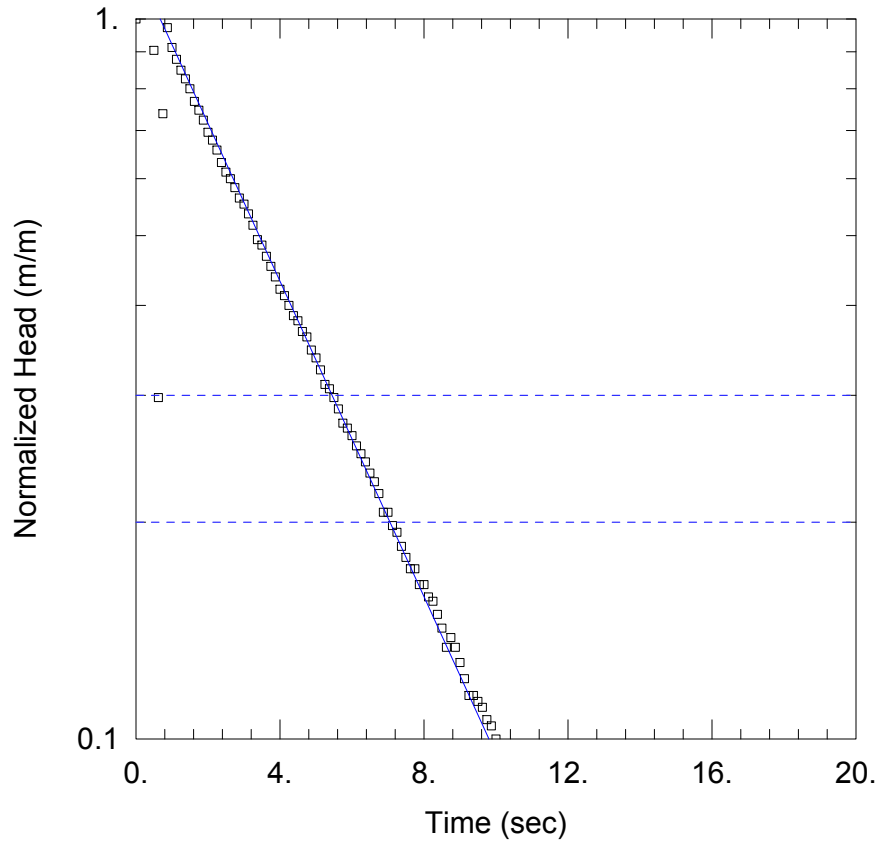
Sample Name: BH-6 (40') (127 Plains Rd West, Burlington ON)

Mass Sample (g): 100 T (oC) 20

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.E-03	1.E-05	1.24	
Hazen K (cm/s) = d_{10} (mm)	1.E-03	1.E-05	1.19	
Slichter	4.E-04	4.E-06	0.33	
Terzaghi	6.E-04	6.E-06	0.55	
Beyer	1.E-03	1.E-05	1.17	
Sauerbrei	4.E-03	4.E-05	3.24	
Kruger	1.E-03	1.E-05	1.00	
Kozeny-Carmen	4.E-04	4.E-06	0.38	
Zunker	3.E-04	3.E-06	0.22	
Zamarin	3.E-04	3.E-06	0.26	
USBR	4.E-03	4.E-05	3.75	
Barr	5.E-04	5.E-06	0.40	
Alyamani and Sen	4.E-06	4.E-08	0.00	
Chapuis	2.E-04	2.E-06	0.21	
Krumbein and Monk	3.E-03	3.E-05	2.90	
Shepherd	1.E-02	1.E-04	10.80	
geometric mean	8.E-04	8.E-06	0.67	
arithmetic mean	4.E-03	4.E-05	3.47	



WELL TEST ANALYSIS

Data Set: C:\...\MW1B.aqt
Date: 06/25/24 Time: 14:08:28

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-1B
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

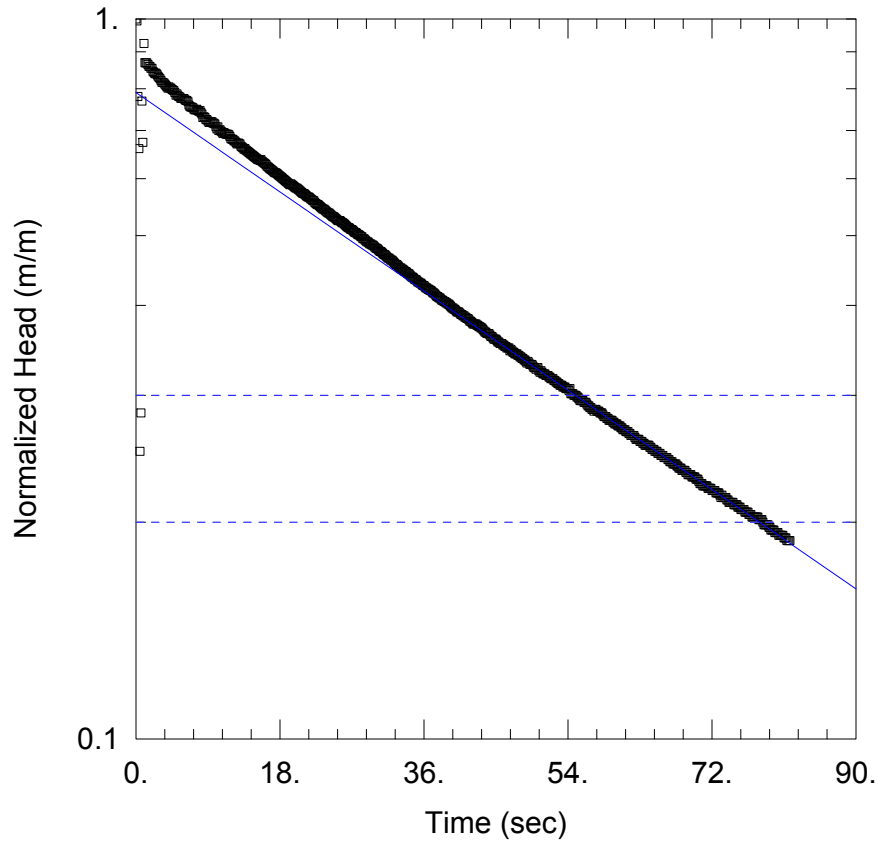
K = 8.753E-5 m/sec
y0 = 0.5572 m

AQUIFER DATA

Saturated Thickness: 2.34 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-3)

Initial Displacement: 0.47 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.34 m
Screen Length: 3.05 m
Well Radius: 0.1 m



WELL TEST ANALYSIS

Data Set: C:\...\MW2.aqt
Date: 06/25/24 Time: 14:27:23

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-2
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

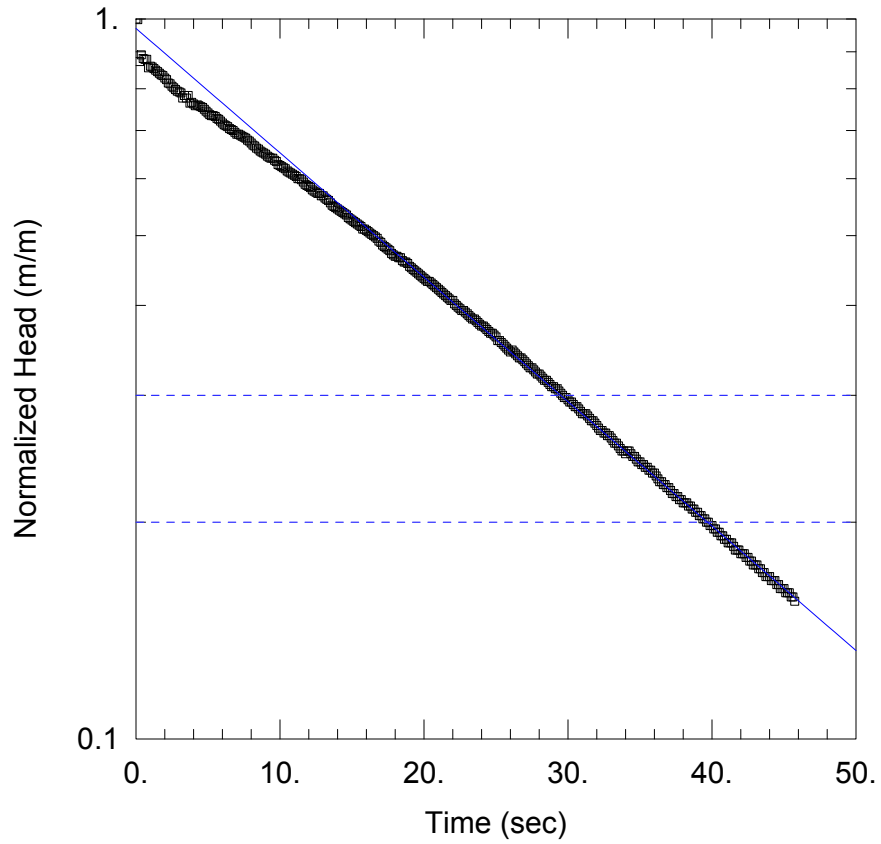
K = 7.482E-6 m/sec
y0 = 0.4819 m

AQUIFER DATA

Saturated Thickness: 1.86 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-2)

Initial Displacement: 0.61 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.86 m
Screen Length: 3.05 m
Well Radius: 0.1 m



WELL TEST ANALYSIS

Data Set: C:\...\MW3.aqt
Date: 06/25/24 Time: 13:59:31

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-3
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

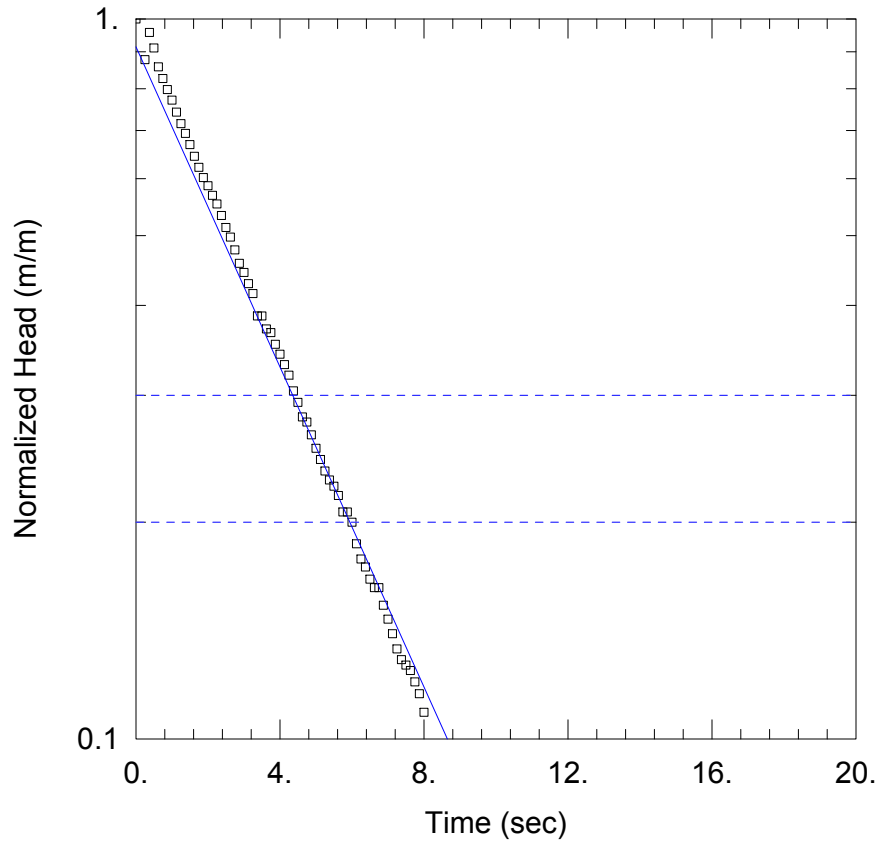
K = 1.381E-5 m/sec
y0 = 0.4559 m

AQUIFER DATA

Saturated Thickness: 2.34 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-3)

Initial Displacement: 0.47 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.34 m
Screen Length: 3.05 m
Well Radius: 0.1 m



WELL TEST ANALYSIS

Data Set: C:\...\MW4.aqt
Date: 06/25/24 Time: 13:51:12

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-4
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

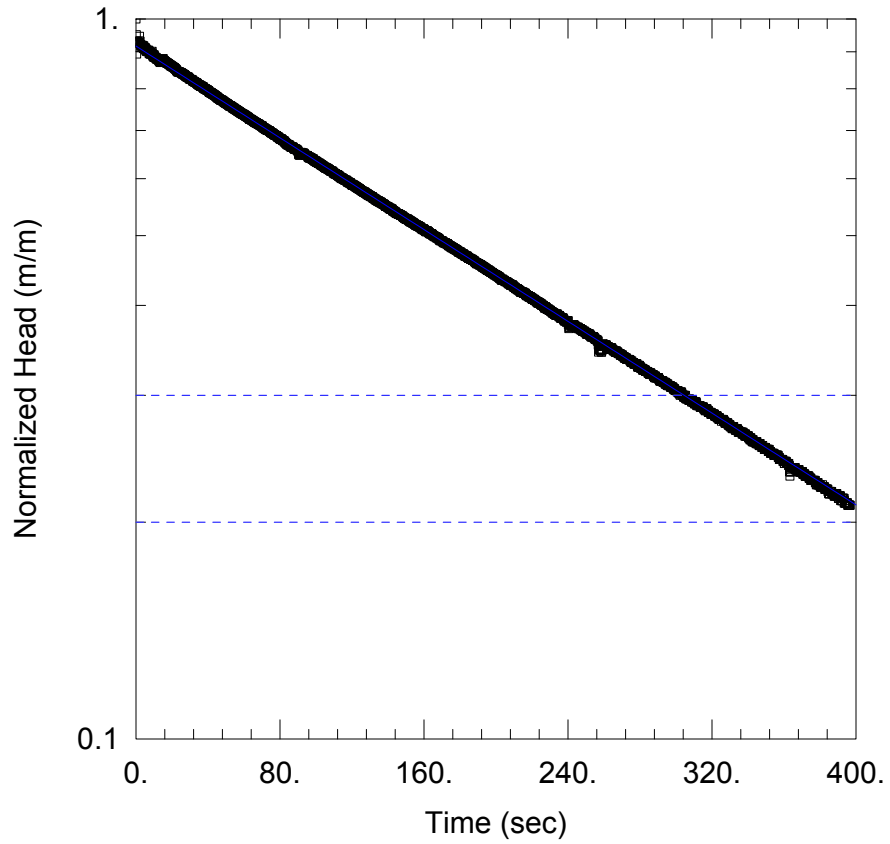
K = 0.0001188 m/sec
y0 = 0.4886 m

AQUIFER DATA

Saturated Thickness: 1.89 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-4)

Initial Displacement: 0.45 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.89 m
Screen Length: 3.05 m
Well Radius: 0.1 m



WELL TEST ANALYSIS

Data Set: C:\...\MW5B.aqt
Date: 06/25/24 Time: 14:35:21

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-5B
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

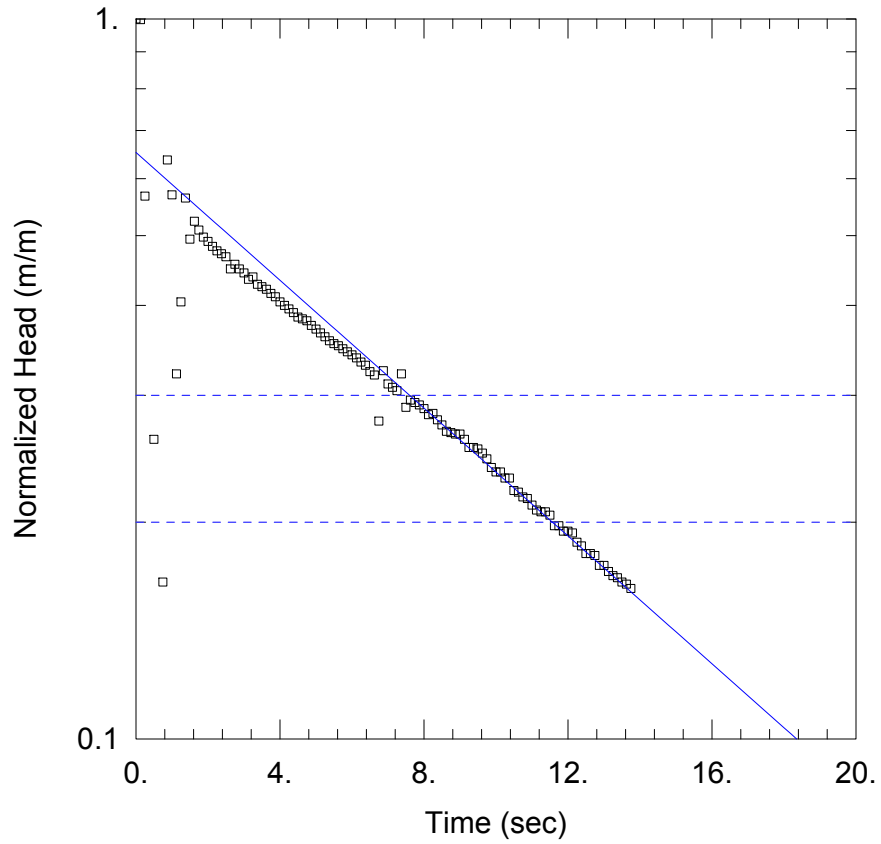
K = 2.524E-6 m/sec
y0 = 0.5776 m

AQUIFER DATA

Saturated Thickness: 1.05 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-5B)

Initial Displacement: 0.63 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.05 m
Screen Length: 3.05 m
Well Radius: 0.1 m



WELL TEST ANALYSIS

Data Set: C:\...\MW6.aqt
Date: 06/25/24 Time: 13:39:02

PROJECT INFORMATION

Company: Terra-Dynamics Consulting Inc.
Client: Losani Homes
Location: 127 Plains Rd W,Burlington,ON
Test Well: MW-6
Test Date: June 20, 2024

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.767E-5 m/sec
y0 = 0.5806 m

AQUIFER DATA

Saturated Thickness: 1.33 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-6)

Initial Displacement: 0.89 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.33 m
Screen Length: 3.05 m
Well Radius: 0.1 m

Appendix D

Dewatering Calculations

Table D-1

Horizontal Dewatering Calculation

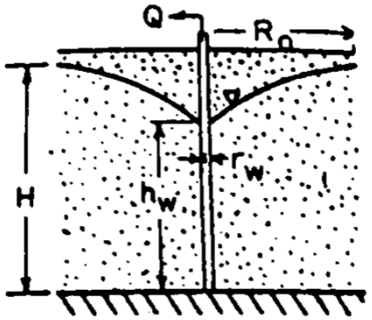
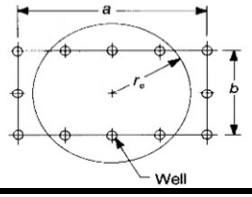
Radial flow, water table aquifer	Inputs	Comments
H=Initial saturated thickness (m)	2.2	
h_w=Remaining saturated thickness (m)	0	
K=Hydraulic Conductivity (m/s)	2.E-05	
a=Rectangular Excavation Length (m)	61	Requirement for a/b < 1.5
b=Rectangular Excavation Width (m)	41	
	Calculations	
R_w=Re=Effective radius Calc (m)	28	$r_e = \sqrt{\frac{ab}{\pi}}$
R_0=Radius of Influence Calc (Sichart & Kryieleis) (m)	58	$R_o = r_e + 3000(H - h_w)\sqrt{k}$
Q_w=Flow Rate (m^3/s)	0.000425	$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0 / r_w}$
Q_w=Flow Rate (m^3/day)	37	
Q_w=Flow Rate (L/day)	36,709	

Table D-2

Redius of Influence Calculation

Parameters	Values	Value Details
D (aquifer thickness, metres)	2.2	See Section 4.0
k (permeability, m/sec)	2.E-05	Average sand hydraulic conductivity of saturated sand portion
S (storage coefficient, dimensionless)	0.1	Cashman and Preene (2021) note equation can be used without significant error in unconfined aquifers where the drawdown is not a large proportion of the original saturated thickness. In this case a drawdown of 2.2 m, or 53% may be valid for application. "*For an unconfined aquifer, the storage coefficient is terms the specific yield, Sy* " (Cashman and Preene, 2021) Sand Sy 0.1-0.3
t (time since pumping began, seconds)	15,768,000	6 months estimate
Lo (distance of influence, metres)	9.6	Calculated

$$L_o = \sqrt{\frac{12kDt}{S}}$$

Table D-2
Redius of Influence Calculation

Other Equation Inputs

Months
6

APPENDIX E

MAINTENANCE MANUAL



Hydroworks® HydroFilter

Operations & Maintenance Manual

Standard Filter

Version 1.0

Introduction

The HydroFilter is a stormwater management device designed to both treat stormwater.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. This is especially true of any stormwater treatment practice that includes filtration such as HydroFilter. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroFilter is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroFilter.

Hydroworks® HydroFilter Operation

Hydroworks HF Operation

Under normal or low flows, water enters the structure through a grate or inlet pipe . Incoming water builds up around the filters and creates head to drive water radially into the filter cartridges from the outside through to the center of the cartridge. There is a 6" (150mm) diameter open center that runs through the center of each cartridge. Water reaching the center flows down into the base plug and is conveyed out of the structure by a pipe that conveys the treated flow behind a weir wall. The height of the weir wall provides the necessary head to push the inlet water through the filter and depends on the difference in elevation between the inlet and outlet pipe(s) (Figure 1).

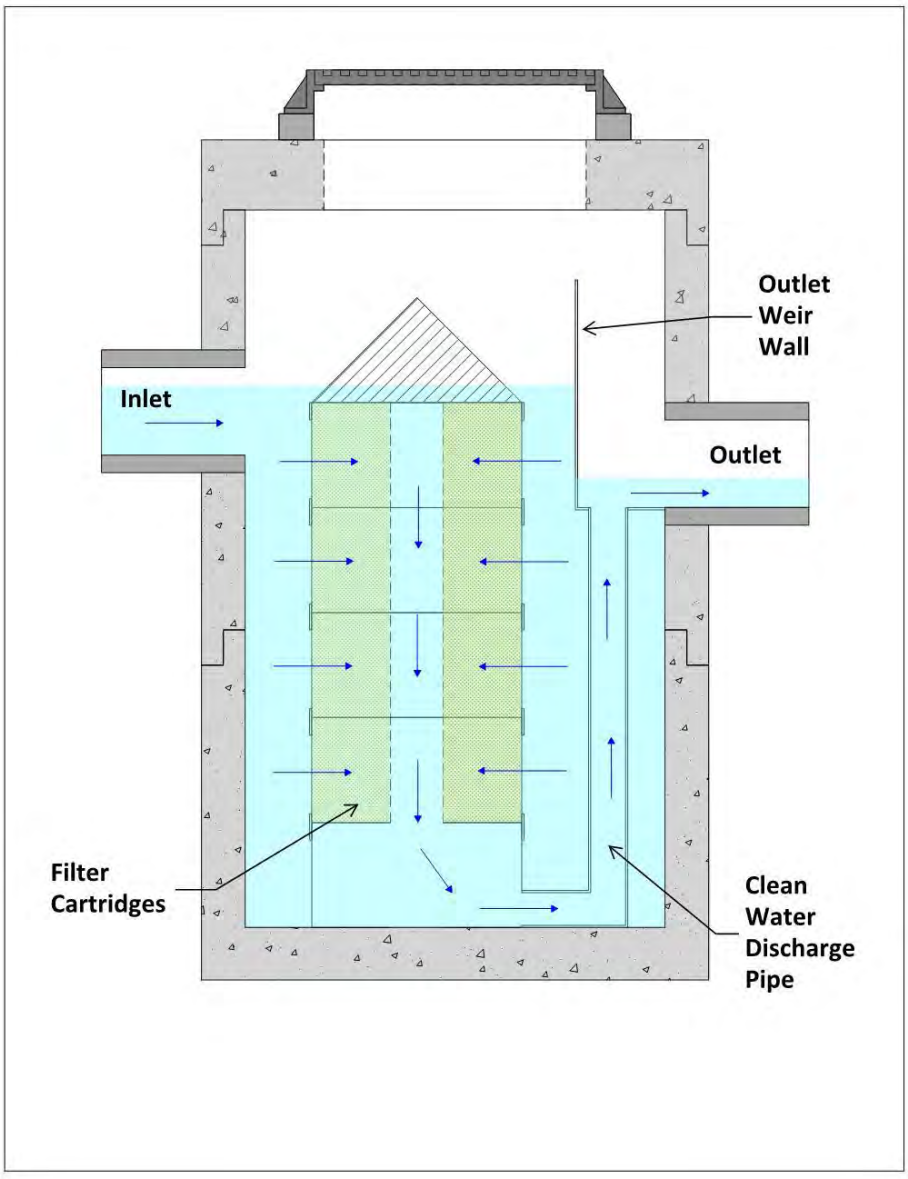


Figure 1. Hydroworks HydroFilter Operation – Standard Filter

A solid cone with a check valve is placed on top of the top filter cartridge to prevent incoming water from entering the 6" (150 mm) diameter opening while still allowing air to escape from the center of the cartridges as water enters the filter.

High flows are typically bypassed around the HydroFilter.

Inspection

Procedure

The HydroFilter should be inspected 24 hours after rainfall.

If the structure has not drained down to the outlet pipe within 24 hours of the last rainfall, the HydroFilter requires maintenance (i.e. water level on either side of the weir wall is the same).

Frequency

Construction Period

The filter cartridges **should not** be installed in the HydroFilter during the construction period since construction sediment will prematurely plug the cartridges requiring excessive maintenance during the construction period. A plate is installed in the base for the construction period to remind the contractor that the cartridges should only be installed for post construction operation. This plate needs to be removed when the cartridges are installed for post development operation.

If the HydroFilter is installed in an offline configuration, the cartridges in the HydroFilter can be installed prior to delivery of the structure during the construction period, however, the inlet and outlet from the HydroFilter structure must be plugged such that any sediment-laden water bypasses the HydroFilter. These plugs then have to be removed after the construction period to allow post construction operation of the HydroFilter.

Post-Construction Period

The Hydroworks HydroFilter should be inspected twice during the first year of operation for normal stabilized sites (no exposed soil or materials storage). The initial inspections will indicate the required future frequency of inspection and maintenance if the unit was maintained and put into service (filters installed) after the construction period.

It is anticipated that the filter cartridges will need to be replaced annually. However, this will depend on pollutant loadings on the site and off-site activities (nearby construction, etc.). Filters are different from separators in that sediment levels at the bottom of a filter do not dictate maintenance frequency.

A filter does not need to be maintained until its' rated treatment rate decreases to the point where it can no longer provide the required annual percentage of pollutant removal. This is a hydraulic requirement that will depend on the hydrology (rainfall intensity distribution) and characteristics of the site (imperviousness, area, pollutant loading) being designed. That is why the frequency of cleaning is based on the

presence of water after a storm since the flow rate is reduced indicating maintenance is required.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

1. Water/Sediment Removal

Maintenance involves removing the water and replacing the filter cartridges. In both cases, sediment that has been collected around the filter cartridges in the sump of the device must be removed first. This is typically done by vacuum truck.

It is important to remove all sediment and water from the structure before trying to remove and replace the filter cartridges.

2. Filter Cartridge Replacement

Replacement of filter cartridges is made easy due to the modular nature of each cartridge. The cartridges are stacked vertically on top of each other. Each cartridge has a sleeve such that they fit together.

A lifting bar is located In the center of the 6” hollow center of each cartridge near the top of the cartridge. The top cone has a lifting ring on the top of it. For shallow installations, vertical stacks of filters should have an access opening in the structure directly above them or close to being above them to facilitate maintenance.

A winch with a hook is lowered down to hook on to the cone lifting ring and the cone is winched out of the structure. Similarly, the winch is hooked under the lifting bar of each successive filter cartridge and they are winched out of the structure.

Fresh cartridges are similarly winched in stacking them as required ending each stack with a cone. Call Hydroworks at 888-290-7900 since we offer a cartridge exchange program.

The local municipality should be consulted for the allowable disposal options for both the water and sediments that are removed from the HydroFilter.

Filter Cartridge Replenishment

Small HydroFilter units may be able to be replenished to extend the frequency of replacement. Once the top cone is removed an inflatable pipe plug can be lowered through the central core created by the connected filters to the base and expanded at the bottom to seal the vertical core.

This vertical core or pipe can then be filled with clean water to backflush the filter forcing it to flow from the central core opening back through the filter to the outside of each filter cartridge. This backflush water can then be pumped or vacuumed from the structure with the central core still being full of water.

HYDROFILTER INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____
Depth of rainfall (last 24h) _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroFilter	**Yes**	**No**
Standing water (above outlet invert)	☐ *	☐
Missing internal components	☐ **	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the structure (oil, leaves, trash)	☐	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐

* Maintenance required
** Repairs required
*** Further investigation is required

Other Comments: _____

_____

_____

_____

_____

_____

_____

_____

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Hydroworks

Hydroworks® HydroFilter

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroFilter to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the filter has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 257 Cox St., Roselle, NJ 07203 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroFilter are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroFilter, or the cost of other goods or services related to the purchase and installation of the HydroFilter. For this Limited Warranty to apply, the HydroFilter must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroFilter arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroFilter, whether the claim is based upon contract, tort, or other legal basis.