S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing Report

789-795 Brant Street

CITY OF BURLINGTON

CAMARRO DEVELOPMENTS INC.

September 2022

SLA File: 22065

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Camarro Developments Inc. to provide Consulting Engineering services for the proposed development at 789-795 Brant Street in the City of Burlington, Region of Halton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of constructing a 31-storey mixed-use building including six levels of underground parking, an asphalt driveway, concrete sidewalk, and landscaped areas.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the Preliminary Engineering Plans prepared by S. Llewellyn & Associates Limited (see Appendix F) and the Site Plan prepared by RAW Design Inc. 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: City of Burlington Standard Drawings (City of Burlington, March 2014)

Ref. 3: Halton Region Water and Wastewater Linear Design Manual (Halton Region, May 2014)

Ref. 4: Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation Authority / Toronto and Region Conservation Authority, 2010)

Ref. 5: Stormwater Management Design Guidelines (City of Burlington, May 21, 2020)



Figure 1.0 – Location Plan

1.3 GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

Geotechnical and Hydrogeological Investigations were prepared by B.I.G Consulting Inc. dated July 29, 2021 and April 27, 2022 respectively. Five boreholes were drilled between June 10 and 19, 2021 to depths ranging between 19.8m and 24.8m below grade. Asphalt and topsoil were encountered at the surface of all boreholes and was underlain by granular material to depths ranging from 1.5m to 2.3m. An upper clayey silt layer was encountered below the granular material extending to depths of 3.1m to 6.1m. A silty sand was encountered below the clayey silt layer extending to depths of 3.2m to 4.6m. A Lower clayey silt layer was encountered below silty sand extending to depths of 6.1m. Shale was encountered beneath the overburden soils in all boreholes extending to depths of 11.9m to 24.8m.

The groundwater quality determined by laboratory analyses revealed compliance to Region of Halton parameters of the sanitary sewer limits. Given there is no chemical criteria for City of Burlington storm sewer, consultation with the City of Burlington is required prior to discharging any water to the storm sewer. Temporary construction dewatering will be required and the dewatering flowrates, taking into consideration precipitation volumes, are 151,000 L/day (1.75 l/s) (unfactored) and 378,000 L/day (4.38 l/s) (factored), which does not exceed the allowable discharge rates noted in Table 2.3 of this report. The estimated permanent drainage rate is 113,000 L/day (1.31 l/s) (safety factor of 1.5). Registration on the MECP Environmental Activity and Sector Registry for Water Taking will be required for construction since the temporary construction dewatering flow rate is more than 50,000 L/day. An application for permission to discharge to the storm sewer system will be required unless the subsurface structure of the building is designed as watertight or onsite disposal facilities are implemented.

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Burlington requirements:

Quantity Control

The post development flow rates will be controlled to pre-development flow rates for the 2-year to 100-year storm events. Additionally, the maximum pre-development imperviousness of 36% is to be used for the pre-development calculations, as per City of Burlington Standards.

Quality Control

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

2.1 EXISTING CONDITIONS

In the existing condition, the site consist of an existing 1-storey commercial building and a 2-storey commercial building with parking garage, associated asphalt parking lot and landscaped areas. The site is bounded by Prospect Street to the north, Brant Street to the west, existing residential lands to the east, and a future development to the south.

Two (2) catchment area, Catchment 101 and Catchment 102 have been identified in the existing condition. Catchment 101 represents the discharge to the existing 900mmø storm sewer along Prospect Street. Catchment 102 represents the discharge to the existing 1500mmø storm sewer along Brant Street. See Table 2.1 below and the Existing Conditions Storm Drainage Area Plan in Appendix A for details.

Table 2.1 – Existing Conditions Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
101	To Prospect Street	0.13	80%	0.78
102	To Brant Street	0.10	66%	0.69

The existing conditions discharge from the site was calculated using the SWMHYMO Hydrologic Modelling Program for the 2-year to 100-year City of Burlington design storms. A summary of the results can be found in Table 2.2.

Table 2.2 – Existing Condition Stormwater Discharge		
Storm Event	Catchment 101 Discharge (m^3/s)	Catchment 102 Discharge (m^3/s)
2-year	0.023	0.015
5-year	0.030	0.019
10-year	0.035	0.023
25-year	0.041	0.027
50-year	0.046	0.031
100-year	0.050	0.034

Allowable Discharge Rates

The post development flow rates shall be controlled to pre-development flow rates for the 2-year to 100-year storm events. However, the maximum pre-development imperviousness of 36% will be used for the pre-development calculations since the existing conditions site is greater than 36% impervious. The allowable discharge rates for the 2-year to 100-year storm events have been calculated using the SWMHYMO Hydrologic Modelling Program. A summary of the results can be found in Table 2.3

Table 2.3 – Allowable Discharge Rates	
Storm Event	Post-Development Allowable Discharge (m^3/s)
2-year	0.018
5-year	0.025
10-year	0.029
25-year	0.037
50-year	0.042
100-year	0.049

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 31-storey mixed-use building including six levels of underground parking, an asphalt driveway, concrete sidewalk, and landscaped areas. It is proposed to service the site with a 300mmø storm sewer, designed and constructed in accordance with the City of Burlington standards.

Two (2) catchment areas, Catchment 201 and 202 have been identified in the proposed condition. Catchment 201 represents controlled drainage from the site, which will be captured by the roof and proposed area drains and discharged to the existing 900mmø storm sewer along Prospect Street. Catchment 202 represents uncontrolled drainage from the site which will sheet drain to Prospect Street and Brant Street. See Table 2.4 below and the Post-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.4 – Proposed Condition Catchment Areas				
Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
201	Controlled drainage to Prospect Street	0.205	99%	0.95
202	Uncontrolled drainage to Prospect Street and Brant Street	0.025	99%	0.90

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 100mmø orifice pipe between MH1 and the proposed cast-in-place concrete storage tank. With the installation of quantity control measures for Catchment 201, it will be required to provide on-site stormwater storage. On-site storage will be provided by a cast-in-place concrete storage tank within the underground parking. See Table 2.5 and Appendix A for the stage-storage-discharge relationship of the orifice control and on-site storage.

Table 2.5 – Proposed Condition Stage-Storage-Discharge (Catchment 201)		
Elevation (m)	Storage (m^3)	Discharge (m^3/s)
90.60 (Orifice Invert)	0	0
90.90 (Overflow Weir flowing to the Bottom of Tank)	10	0.0124
88.50 (Bottom of Tank)	10	0.0124
89.00 (0.5m Deep)	30	0.0124
89.50 (1.0m Deep)	50	0.0124
90.00 (1.5m Deep)	70	0.0124
90.60 (Orifice Invert)	94	0.0124
91.05 (2.55m Deep)	102	0.0176
91.20 (Top of Tank)	108	0.0206

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-year to 100-year City of Burlington design storms. A summary of the results can be found in Table 2.6 and the detailed SWMHYMO input/output information can be found in Appendix B.

Table 2.6 – Proposed Condition Stormwater Discharge (To Prospect Street)					
Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
2-Yr	0.012	0.005	0.018	0.018	26.7
5-Yr	0.012	0.007	0.019	0.025	37.9
10-Yr	0.012	0.008	0.020	0.029	45.7
25-Yr	0.012	0.009	0.022	0.037	56.4
50-Yr	0.012	0.010	0.023	0.042	64.7
100-Yr	0.012	0.011	0.024	0.049	73.2

This analysis determined the following:

- The proposed condition discharge rates to Prospect Street will not exceed the maximum allowable discharge rates during all storm events, with the installation of a 100mmø orifice pipe.

- Catchment 201 will require 73.2m^3 of stormwater storage during the 100-year event, which can be accommodated by the proposed storage tank having a volume of 108m^3.

Water Quality Control

Water quality control will be achieved through a treatment train approach. See the Preliminary Servicing Plan prepared by S. Llewellyn & Associates Limited for details.

The proposed development is required to achieve an “Enhanced” (80% TSS removal) level of water quality protection. To achieve these criteria, discharge from the site will be subject to a treatment train that consists of ADS Flexstorm Pure Permanent Inlet Filters and a HydroStorm oil/grit separator before ultimately discharging to the existing 900mmø storm sewer along Prospect Street.

ADS Flexstorm Pure Permanent Inlet Filters have been proposed within the proposed area drains in the asphalt parking lot. The installation of the ADS Flexstorm Pure Permanent Inlet Filters will contribute to the removal of TSS and the capture of floatables within the area drains. The technical information regarding the ADS Flexstorm Pure Permanent Inlet Filters can be found in Appendix A.

The HydroStorm sizing software was used to determine the required size of the oil/grit separator unit for the site. It was determined that a HydroStorm HS5 will provide 80% TSS removal and 98% average annual runoff treatment for the ETV particle size distribution. See HydroStorm unit sizing procedures in Appendix A for details.

With the combination of the proposed HydroStorm Unit and the ADS Flexstorm Pure Permanent Inlet Filters, the requirements for an “Enhanced” level of quality control for the site will be satisfied.

HydroStorm units and ADS Inlet Filters require regular inspection and maintenance as per the manufacture's specifications to ensure the unit operates properly. See the Maintenance Manuals in Appendix A for details.

2.3 SEDIMENT AND EROSION CONTROL

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

- Install 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;
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.

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

2.4 FLOOD SPILL CONTROL

The City of Burlington will be completing a Phase 2 study intended to confirm the extent of the flood hazard within the site area and further discuss policy and mitigation measures in this area. Once this study is complete, the site will be reviewed to ensure all requirements with respect to the spill hazards are met.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

There is an existing 200mmø sanitary sewer, which flows west along Prospect Street and existing 450mmø and 300mmø sanitary sewers, which flow south along Brant Street.

3.2 SANITARY DEMAND

Sanitary discharge from the site was estimated in accordance with the Region of Halton Water and Wastewater Linear Design Manual. Table 3.1 summarizes the sanitary sewer discharge rate for the subject lands.

Table 3.1 - Post-Development Sanitary Sewer Discharge

Population [A]	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
577 persons	1.84	3.94	0.07	**7.32**

[A] Population = (354 units x 1.62 persons/unit) + (485m^2 commercial x 90 persons/hectare) = 577 persons
[B] Average demand = 275 l/cap/day x population
[C] Peaking Factor = $1+((14/(4+P^{0.5})))$ with P expressed in thousands Min=2.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Site Area (0.228 hectares)
[E] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed site will be serviced by a 200mmø sanitary sewer, designed and constructed in accordance with City of Burlington and Region of Halton standards. Drainage from this sewer will discharge to the existing 450mmø sanitary sewer fronting the site along Brant Street.

The minimum grade of the proposed 200mmø sanitary sewer will be 1.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.028 m^3/s (28 l/s). Therefore, the proposed 200mmø sanitary sewer at a minimum grade of 1.0% is adequately sized to service the proposed development.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 350mmø watermain along Prospect Street and existing 200mmø and 400mmø watermains along Brant Street. There is an existing fire hydrant adjacent to the site fronting 784 Brant Street which is connected to the existing 400mmø watermain.

4.2 DOMESTIC WATER DEMAND

Water demand for the site was estimated in accordance with the Halton Region Water and Wastewater Linear Design Manual. Tables 4.1 summarizes the domestic water demand requirements for the Average Daily, Maximum Daily and Peaking Hourly demand scenarios.

Table 4.1 - Post-Development Domestic Water Demand

Population [A*]	Average Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	**Max. Daily Demand [E] (l/s)**	**Max. Hourly Demand [F] (l/s)**
577 persons	1.84	2.25	4.0	**4.14**	**7.36**

[A] Population = (354 units x 1.62 persons/unit) + (485m^2 commercial x 90 persons/hectare) = 577 persons
[B] Average Daily Demand = 275 l/cap/day x population
[C] Max. Daily Peaking Factor = 2.25
[D] Max. Hourly Peaking Factor = 4.0
[E] Max. Daily Demand = Average Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Average Daily Demand x Max. Hourly Peaking Factor

4.3 FIRE FLOW DEMAND

Fire flow demands for the proposed development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA).

The 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: 5% correction (>30.1m to 45m)
South Face: 25% correction (0m to 3m)
East Face: 5% correction (30.1m to 45m)
West Face: 0% correction (>45m)

It is estimated that the required fire flow for the proposed development will be **367 l/s**. See the Fire Flow Demand Requirements in Appendix C for details.

The existing hydrant fronting the site on Brant Street is located within the 90m separation from the building face adjacent to a street (as per Sentence 3.2.5.7 of the 2020 Ontario Building Code), no additional private hydrants are proposed for this development. Hydrant flow test was performed by Jackson Waterworks on the existing 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 4.2 summarizes the hydrant flow data provided by Jackson Waterworks.

Table 4.2 – Hydrant Flow Test Data	
Hydrant ID	H20737
Location	786 Brant Street
Static Pressure	62 psi
Residual Pressure During Test Flow	57 psi
Test Flow Rate	2014 USGPM (127 l/s)
Theoretical Flow @ 20 psi	**7,355 USGPM (464 l/s)**

Based on the above hydrant flow test data, the theoretical maximum available flow rate from the hydrant is **464 l/s**, while the maximum required fire flow for the proposed development is only **367 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting two 150mmø watermains to the existing 350mmø watermain on Prospect Street. One of the 150mmø watermains will split at property line to provide two 150mmø fire water services and a 100mmø domestic water service for the proposed building. All proposed water services will be designed and constructed in accordance with City of Burlington and Region of Halton standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development at 789-795 Brant Street 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 Servicing and Preliminary Grading & Erosion Control Plan prepared by S. Llewellyn & Associates Limited;
- A 100mmø orifice pipe be installed as per the Preliminary Servicing Plan and this report to achieve effective stormwater quantity control;
- A cast-in-place concrete storage tank be installed as per the Preliminary Servicing Plan and this report to provide adequate stormwater storage;
- Erosion and sediment controls be installed as described in this report and shown on the Preliminary Grading & Erosion Control Plan prepared by S. Llewellyn & Associates Limited;
- The proposed sanitary and water servicing system be installed as per the Preliminary 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



Y. Moradiya, B.Eng.

S. Nelson, P.Eng.

APPENDIX A

STORMWATER MANAGEMENT INFORMATION

GRAHAMS LANE

BRANT STREET

PROSPECT STREET

ROBINSON STREET

EXISTING RESIDENTIAL LANDS

FUTURE DEVELOPMENT

101
0.13
80
0.78

102
0.10
66
0.69

LEGEND

101 0.125 80 0.78	DRAINAGE AREA I.D. DRAINAGE AREA (ha) PERCENT IMPERVIOUS RUNOFF COEFFICENT
	DRAINAGE BOUNDARY

EXISTING CONDITIONS
STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 789–795 BRANT STREET, BURLINGTON, ON
PROJECT No.: 22065

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GRAHAMS LANE

BRANT STREET

PROSPECT STREET

ROBINSON STREET

FUTURE DEVELOPMENT

EXISTING RESIDENTIAL LANDS

202
0.025
99%
0.90

201
0.205
99%
0.95

LIMIT OF UNDERGROUND

PROP. WALKWAY

BUILDING OVERHANG

PROPOSED 31-STOREY MIXED-USE BUILDING
FFE=92.60
P1=88.13
P2=85.43
P3=82.73
P4=80.03
P5=77.33
P6=74.63

AD2 (NYLOPLAST) (C/W FLEXSTORM INLET FILTER) T/G 92.15

AD3 (NYLOPLAST) (C/W FLEXSTORM INLET FILTER) T/G 92.10

AD1 (NYLOPLAST) T/G 92.25

PROP. STORMWATER STORAGE TANK (DESIGN BY OTHERS)
TOP OF TANK=91.20
BOTTOM OF TANK=88.50
STORAGE VOLUME=108m³

CONNECT PROP. 70.0m-300mmø STM @ 1.0% TO EX. STM MH PROP. INV=90.36

PROP. 2.0m-100mmø ORIFICE PIPE @ 2.0% INV=90.60

PROP. RETAINING WALL (DESIGN BY OTHERS)

PROP. CONCRETE RAMP (TO BE HEATED)

EX.2 STOREY BRICK BUILDING

EX.1 STOREY BRICK BUILDING

EX.APARTMENT BUILDING

EX. CURB (NOT SURVEYED)

EX. STM

EX.CB

EX.CBMH

EX.STM MH (NOT SURVEYED)
N.INV=89.07
S.INV=88.79
W.INV=89.07
E.INV=89.36

EX.900mmø STM @ 0.43%

EX.1500mmø STM @ 0.82%

EX.750mmø STM @ 0.44%

EX.600mmø STM @ 0.48%

EX.CB T/G=92.13

EX.CB T/G=91.81

EX.CB T/G=91.67

EX.CB T/G=91.95
N.INV=90.29
E.INV=90.34

EX.STM MH T/G=92.26
N.INV=90.61
E.INV=91.14

EX.CB T/G=92.21

LEGEND

201
0.205
99
0.95

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DRAINAGE BOUNDARY

EMERGENCY OVERLAND FLOW ROUTE

PROPOSED CONDITIONS
STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 789-795 BRANT STREET, BURLINGTON, ON
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Burlington, Ontario

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Orifice Pipe
Diameter (mm)	**100**
Area (m^2)	0.00785
Invert Elev. (m)	90.60
C/L Elev. (m)	90.65
Disch. Coeff. (C_d)	0.8
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	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	90.60	38.5	0.0	0	0.000	0.0000
Weir	90.85	38.5	9.6	10	0.200	0.0124
Bottom of Tank	88.50	40.0	0.0	10	0.200	0.0124
0.5m Deep	89.00	40.0	20.0	30	0.200	0.0124
1.0m Deep	89.50	40.0	20.0	50	0.200	0.0124
1.5m Deep	90.00	40.0	20.0	70	0.200	0.0124
Orifice Invert	90.60	40.0	24.0	94	0.200	0.0124
Weir	90.85	40.0	0.0	94	0.200	0.0124
2.55m Deep	91.05	40.0	8.0	102	0.400	0.0176
Top of Tank	91.20	40.0	6.0	108	0.550	0.0206

Hydroworks Sizing Summary

789-795 Brant Street

09-09-2022

Recommended Size: HydroStorm HS 5

A HydroStorm HS 5 is recommended to provide 80 % annual TSS removal based on a drainage area of 0.205 (ha) with an imperviousness of 99 % and Hamilton RBG, Ontario rainfall for the ETV Canada particle size distribution.

The recommended HydroStorm HS 5 treats 98 % of the annual runoff and provides 80 % annual TSS removal for the Hamilton RBG rainfall records and ETV Canada particle size distribution.

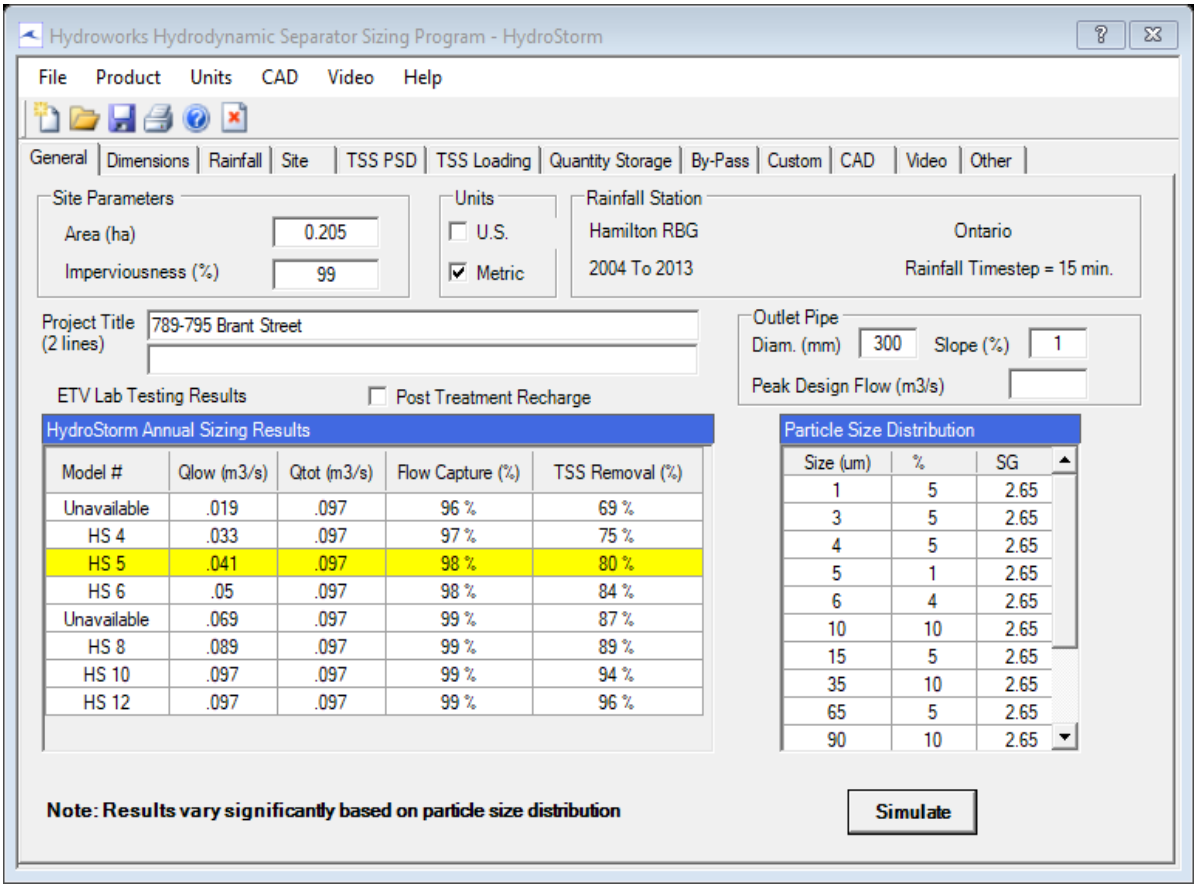
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .1 (m3/s) for the given 300 (mm) pipe diameter at 1% slope. The headloss was calculated to be 99 (mm) based on a flow depth of 300 (mm) (full pipe flow).

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.

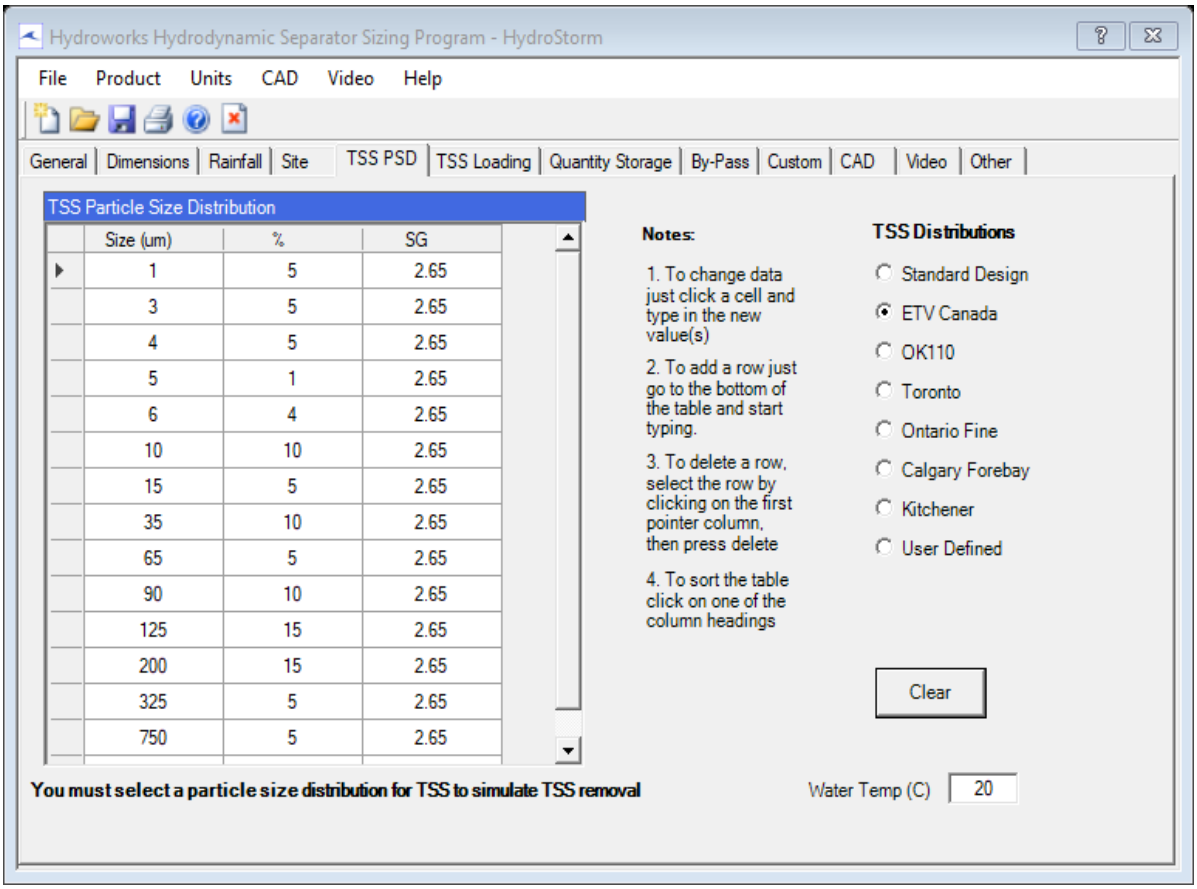
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 HydroStorm .

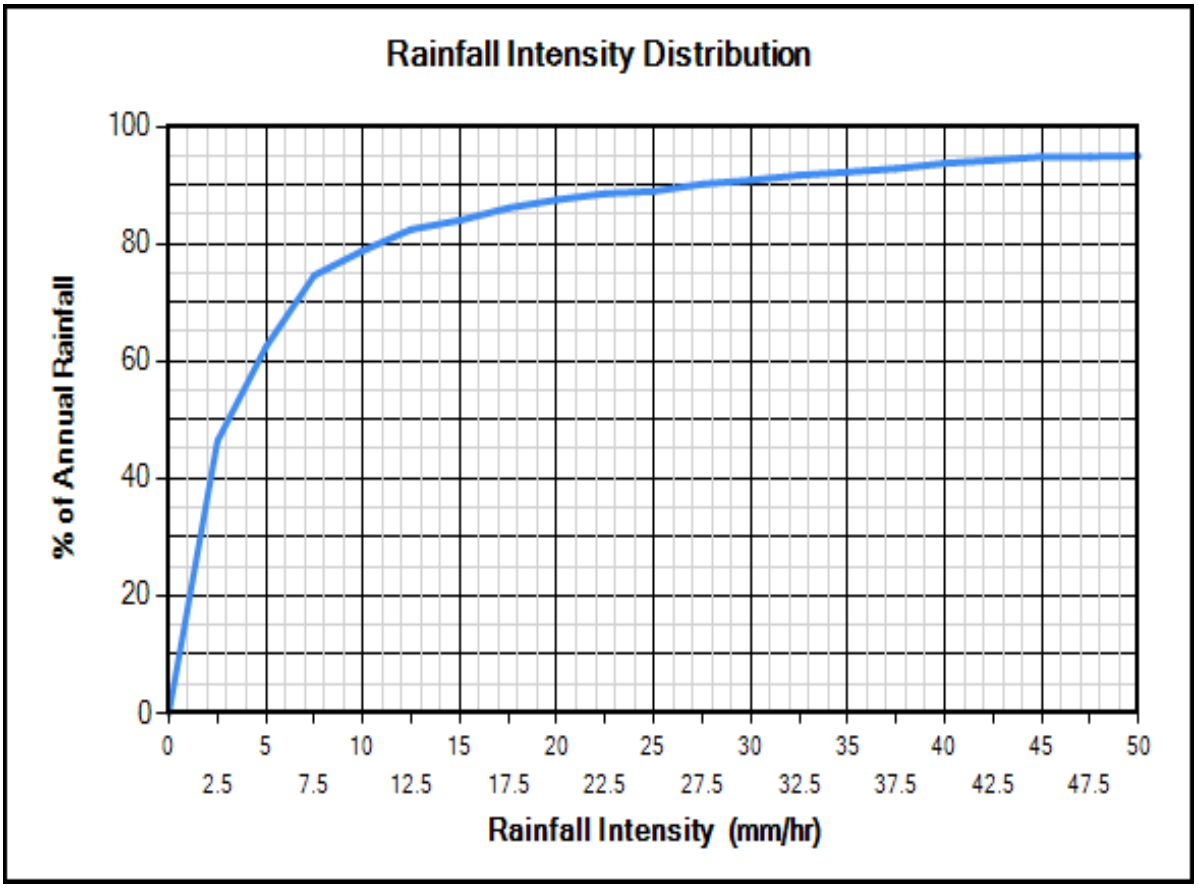
TSS Removal Sizing Summary



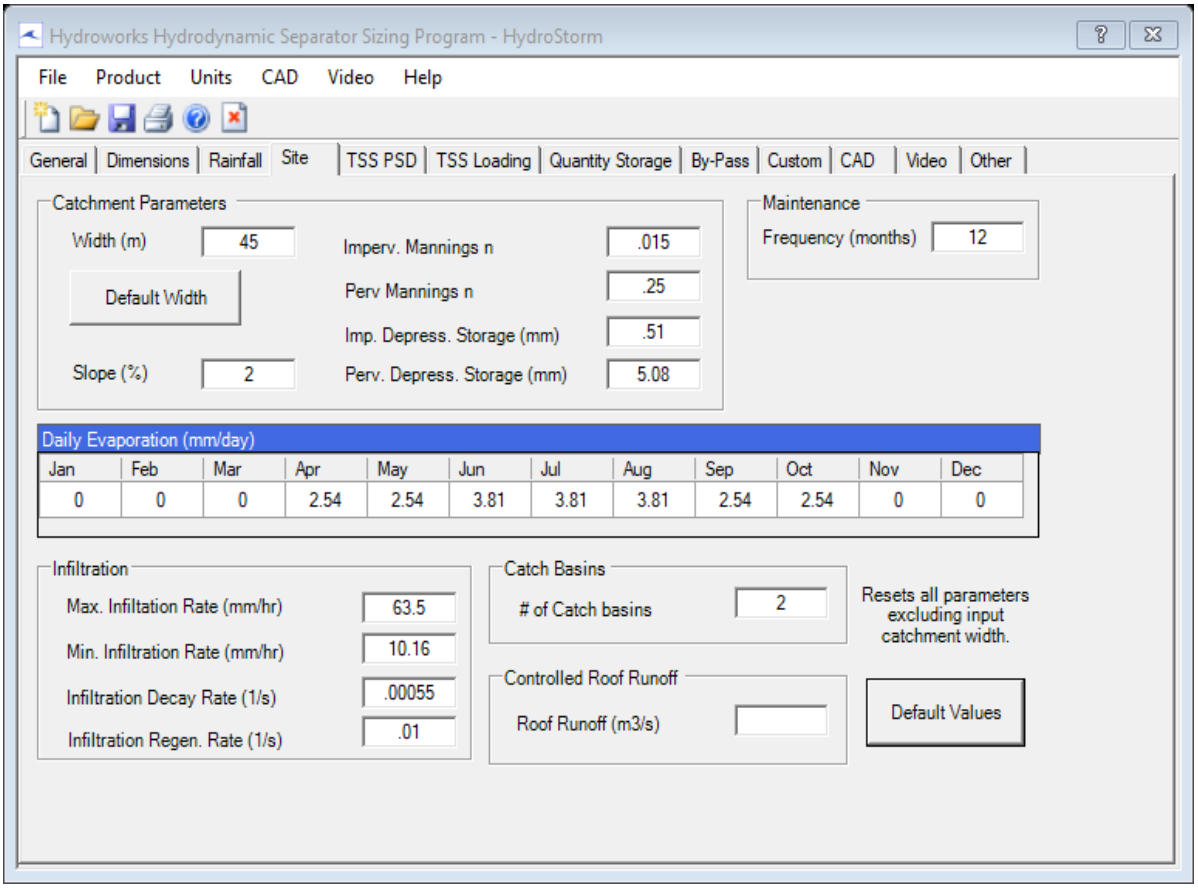
TSS Particle Size Distribution



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



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

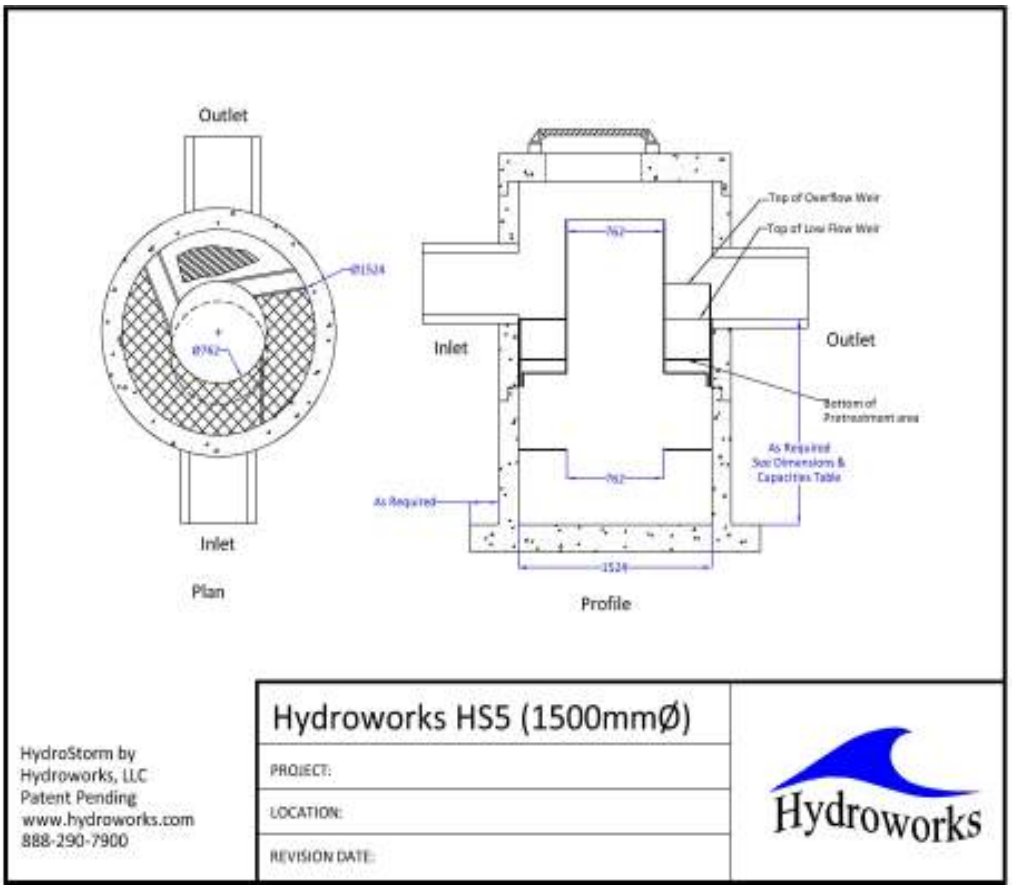
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

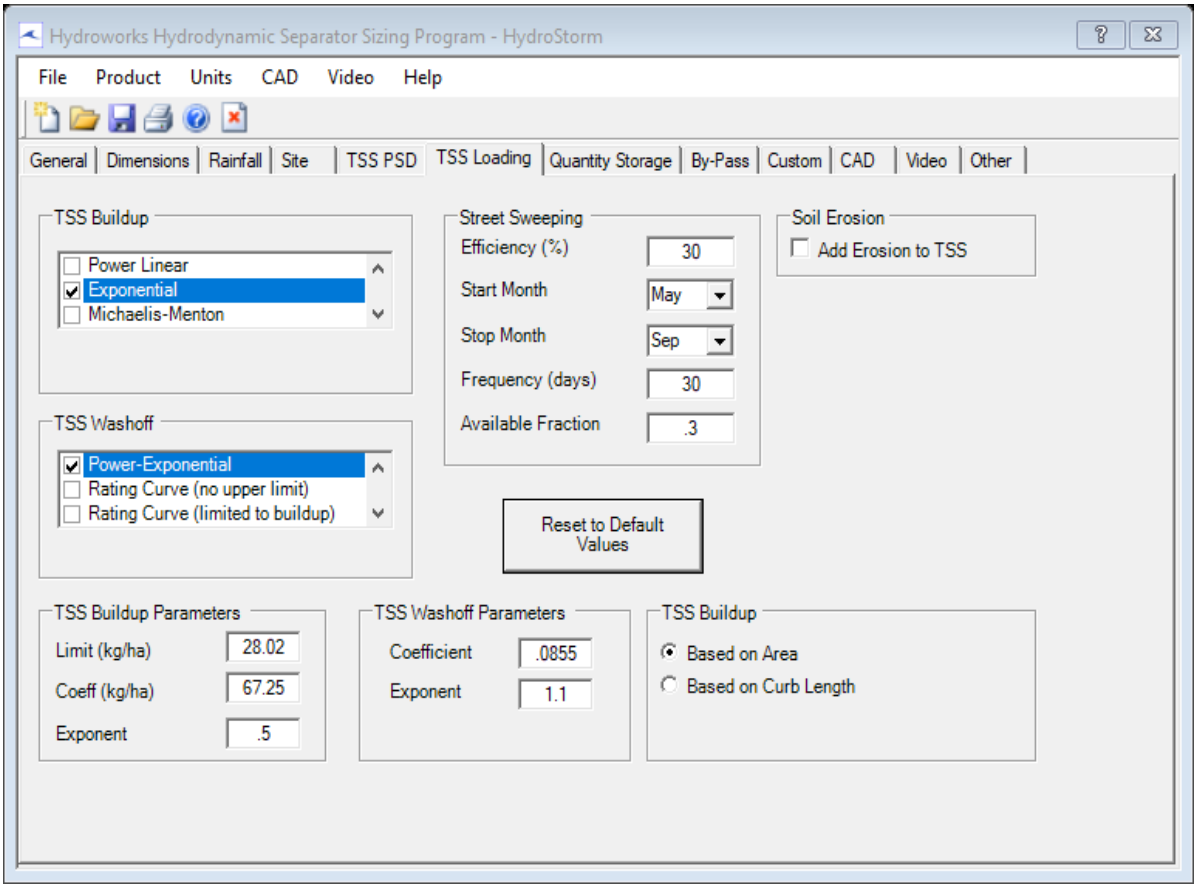
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

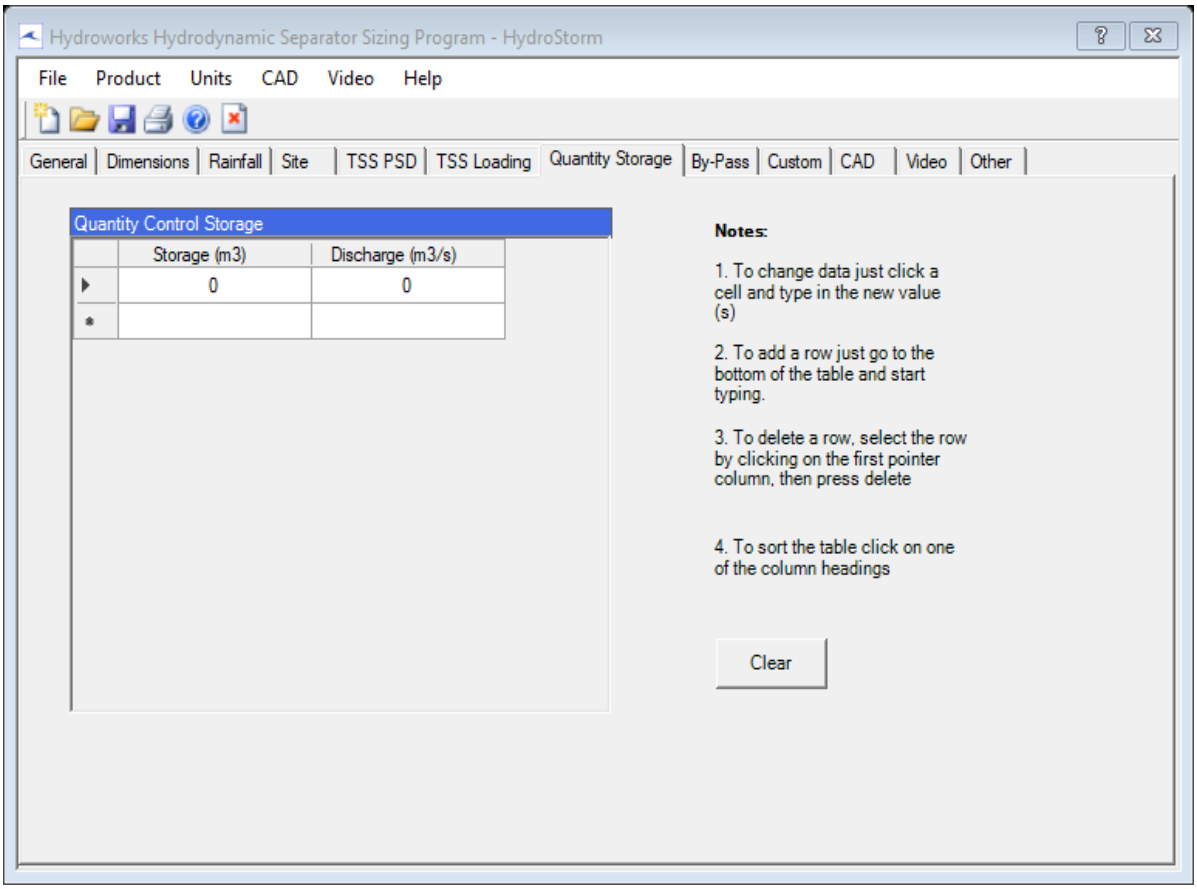
Generic HS 5 CAD Drawing



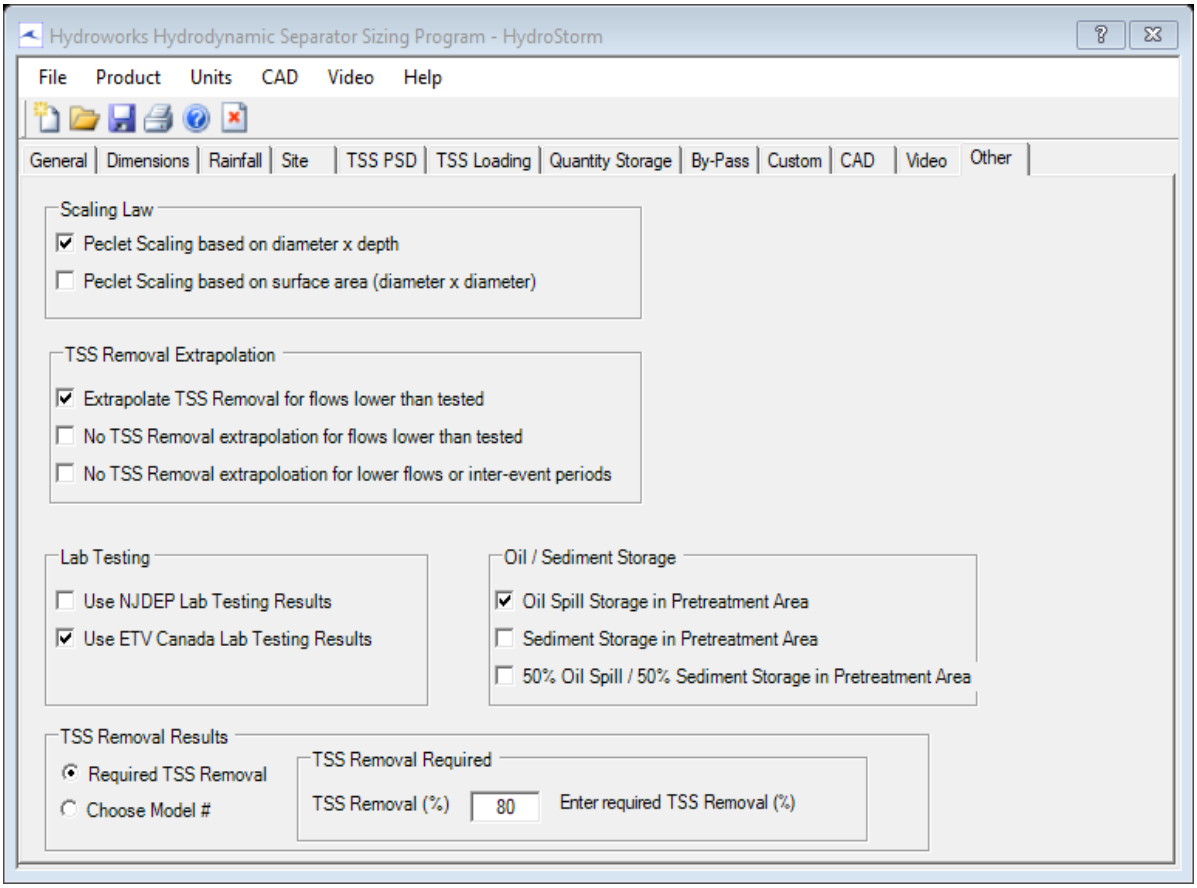
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.6
Copyright Hydroworks, LLC, 2022
1-800-290-7900
www.hydroworks.com



Hydroworks® HydroStorm

Operations & Maintenance Manual

Version 1.0

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.

Introduction

The HydroStorm is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. 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 HydroStorm 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 HydroStorm.

Hydroworks® HydroStorm Operation

The Hydroworks HydroStorm (HS) separator is a unique hydrodynamic by-pass separator. It incorporates a protected submerged pretreatment zone to collect larger solids, a treatment tank to remove finer solids, and a dual set of weirs to create a high flow bypass. High flows are conveyed directly to the outlet and do not enter the treatment area, however, the submerged pretreatment area still allows removal of coarse solids during high flows.

Under normal or low flows, water enters an inlet area with a horizontal grate. The area underneath the grate is submerged with openings to the main treatment area of the separator. Coarse solids fall through the grate and are either trapped in the pretreatment area or conveyed into the main treatment area depending on the flow rate. Fines are transported into the main treatment area. Openings and weirs in the pretreatment area allow entry of water and solids into the main treatment area and cause water to rotate in the main treatment area creating a vortex motion. Water in the main treatment area is forced to rise along the walls of the separator to discharge from the treatment area to the downstream pipe.

The vortex motion forces solids and floatables to the middle of the inner chamber. Floatables are trapped since the inlet to the treatment area is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while water must flow up the walls of the separator to discharge into the downstream pipe.

A set of high flow weirs near the outlet pipe create a high flow bypass over both the pretreatment area and main treatment chamber. The rate of flow into the treatment area is regulated by the number and size of openings into the treatment chamber and the height of by-pass weirs. High flows flow over the weirs directly to the outlet pipe preventing the scour and resuspension of any fines collected in the treatment chamber.

A central access tube is located in the structure to provide access for cleaning. The arrangement of the inlet area and bypass weirs near the outlet pipe facilitate the use of multiple inlet pipes.

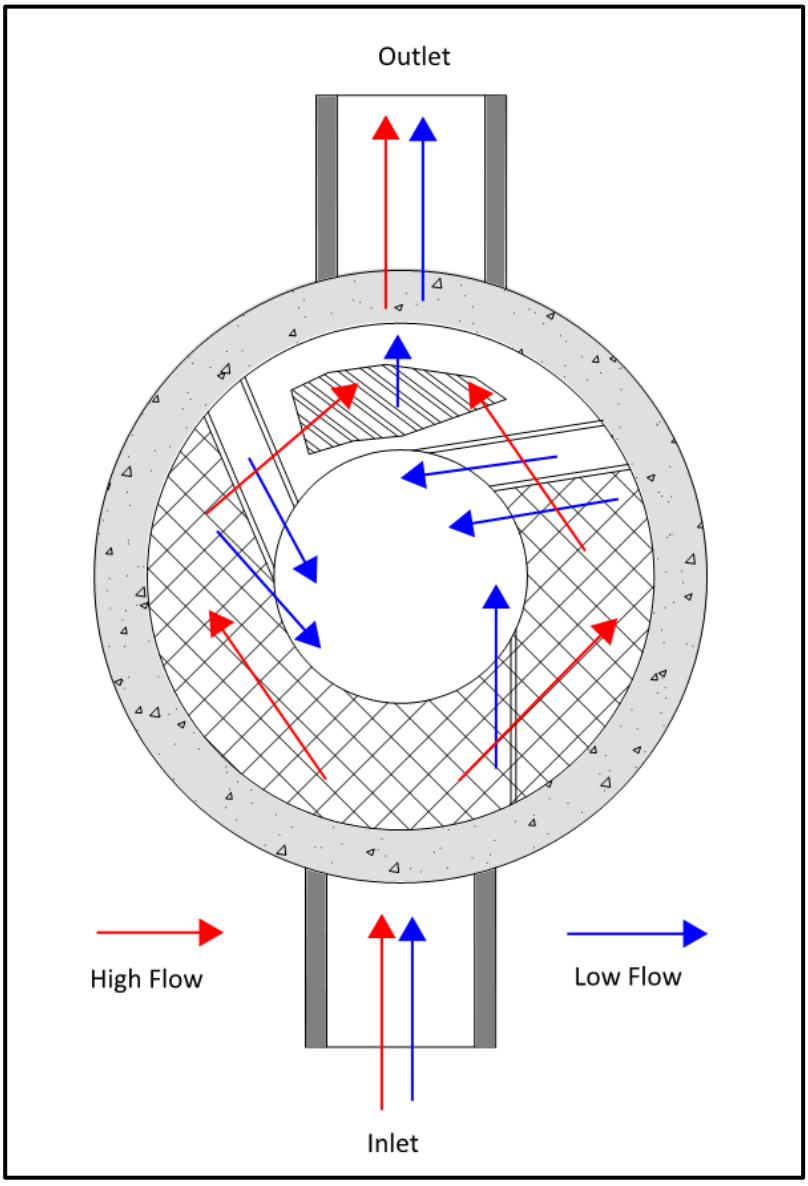


Figure 1. Hydroworks HydroStorm Operation – Plan View

Figure 2 is a profile view of the HydroStorm separator showing the flow patterns for low and high flows.

Hydroworks

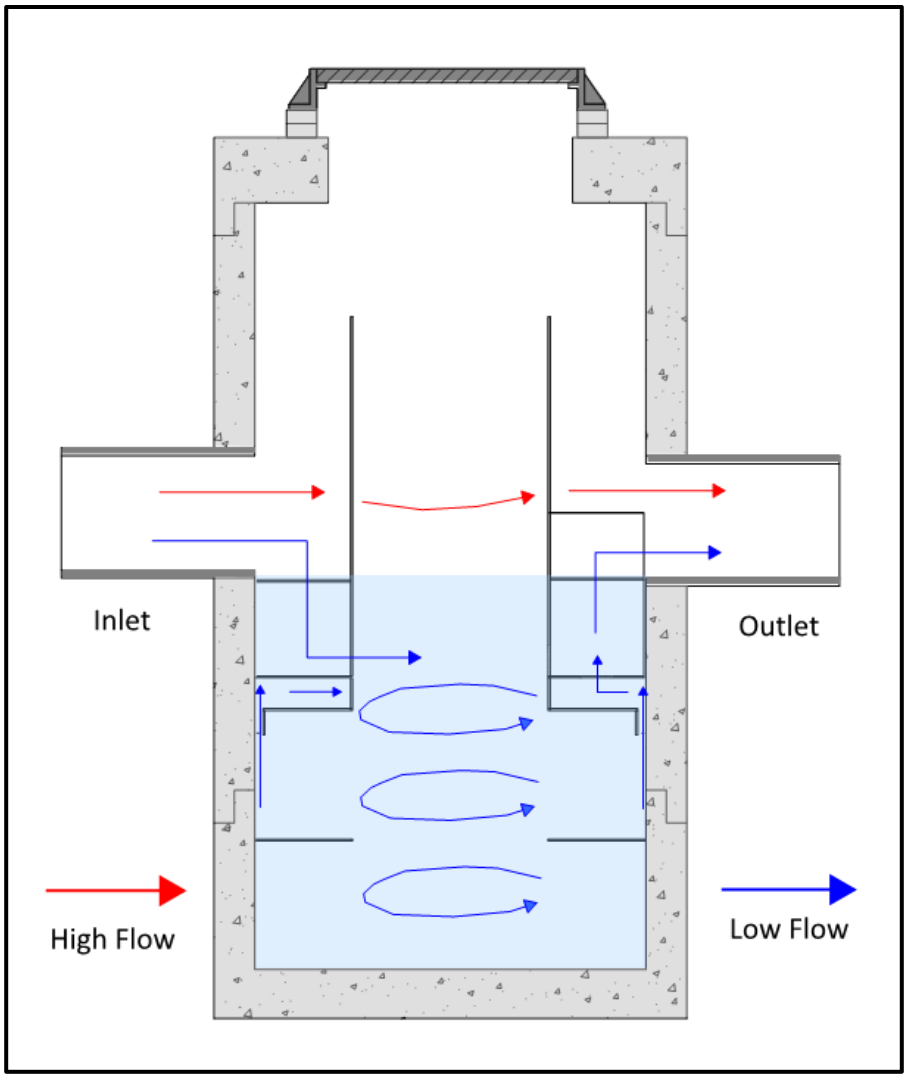


Figure 2. Hydroworks HydroStorm Operation – Profile View

The HS 4i is an inlet version of the HS 4 separator. There is a catch-basin grate on top of the HS 4i. A funnel sits sits underneath the grate on the frame and directs the water to the inlet side of the separator to ensure all lows flows are properly treated. The whole funnel is removed for inspection and cleaning.

Hydroworks

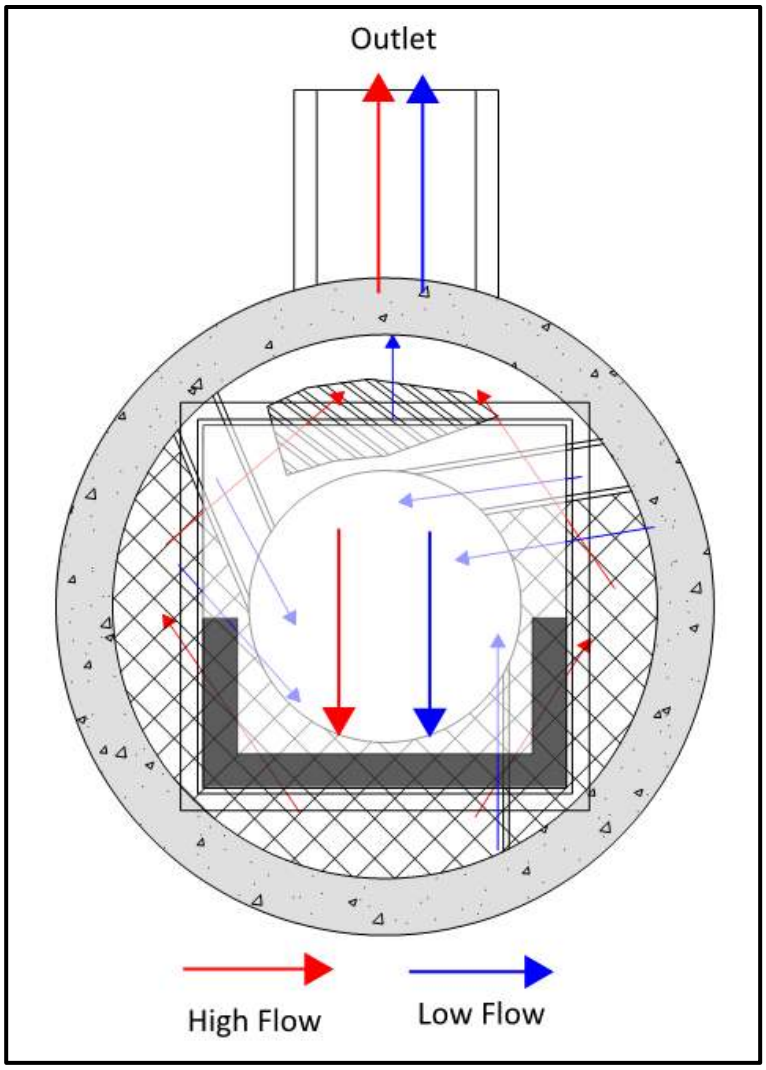


Figure 3. Hydroworks HS 4i Funnel

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the center access tube of the separator. Separators with an inlet grate (HS 4i or custom separator) will have a plastic funnel located under the grate that must be removed from the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

Hydroworks

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HydroStorm separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroStorm separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HydroStorm separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period.

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

The Hydroworks HydroStorm unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroStorm separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

A central access opening (24” or greater) is provided to the gain access to the lower treatment tank of the unit. This is the primary location to maintain by vacuum truck. The pretreatment area can also be vacuumed and/or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pretreatment floor.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature. Disposal of the water will depend on local requirements. Disposal options for the decanted water may include:

1. Discharge into a nearby sanitary sewer manhole
2. Discharge into a nearby LID practice (grassed swale, bioretention)
3. Discharge through a filter bag into a downstream storm drain connection

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HydroStorm unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

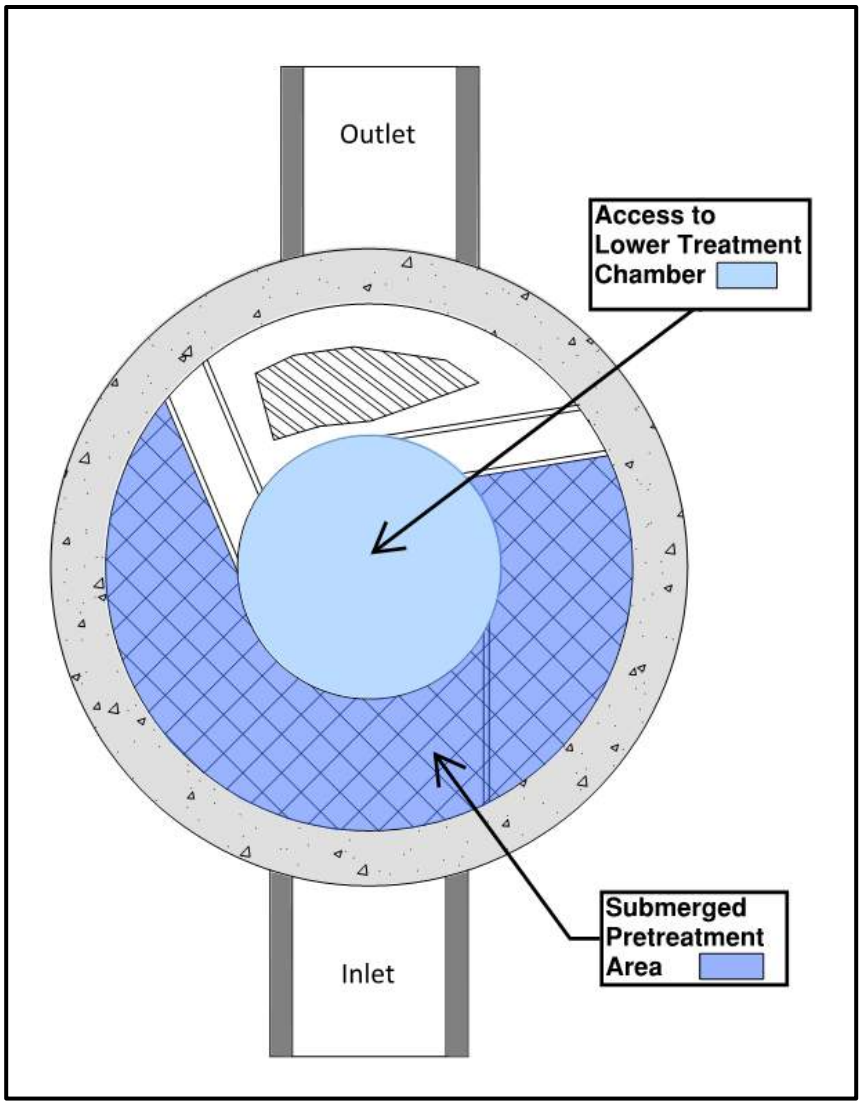


Figure 3. Maintenance Access

Frequency

Construction Period

A HydroStorm separator can fill with construction sediment quickly during the construction period. The HydroStorm must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroStorm separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroStorm was independently tested by Alden Research Laboratory in 2017. A HydroStorm HS 4 was tested for scour with a 50% sediment depth of 0.5 ft. Therefore, maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. A measurement of the total water depth in the separator through the central access tube should be taken and compared to water depth given in Table 1. The standard water depth from Table 1 should be subtracted from the measured water depth and the resulting extra depth should be added to the 1 ft to determine the site-specific sediment maintenance depth for that separator.

For example, if the measured water depth in the HS-7 is 7 feet, then the sediment maintenance depth for that HS-7 is 2 ft (= 1 + 7 – 6) and the separator does not need to be cleaned for sediment accumulation until the measure sediment depth is 2 ft.

The HydroStorm separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroStorm Models

Model	Diameter (ft)	Total Water Depth (ft)	Sediment Maintenance Depth for Table 1 Total Water Depth(ft)
HS-3	3	3	1
HS-4	4	4	1
HS-5	5	4	1
HS-6	6	4	1
HS-7	7	6	1
HS-8	8	7	1
HS-9	9	7.5	1
HS-10	10	8	1
HS-11	11	9	1
HS-12	12	9.5	1

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

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

HydroStorm	**Yes**	**No**
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____"

Routine Measurements

Floating debris depth	**< 0.5" (13mm)**	☐	**>0.5" 13mm)**	☐ *
Floating debris coverage	**< 50% of surface area**	☐	**> 50% surface area**	☐ *
Sludge depth	**< 12" (300mm)**	☐	**> 12" (300mm)**	☐ *****

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

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

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 HydroStorm 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 separator 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 136 Central Ave., Clark, NJ 07066 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 HydroStorm 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 HydroStorm, or the cost of other goods or services related to the purchase and installation of the HydroStorm. For this Limited Warranty to apply, the HydroStorm 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 HydroStorm 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 HydroStorm, whether the claim is based upon contract, tort, or other legal basis.

FLEXSTORM™ Inlet Filter Specifications and Work Instructions

Product: **FLEXSTORM Inlet Filters**

Manufacturer: **Inlet & Pipe Protection, Inc** www.inletfilters.com

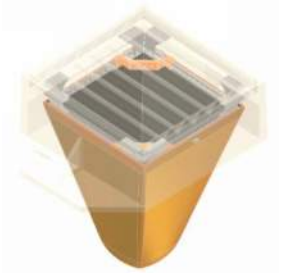
A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the Engineer. FLEXSTORM PURE, permanent filters, are capable of removing small particles, hydrocarbons, and other contaminants from drainage "hot spots".

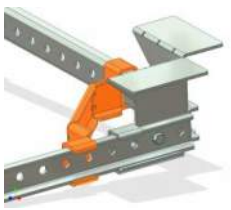
2.0 Material:

2.1 The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile sediment bag attached to the frame with a stainless steel locking band. The sediment bag hangs suspended from the rigid frame at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment.






2.2 The FLEXSTORM Inlet Filter frame includes lifting handles in addition to the standard overflow feature. A FLEXSTORM Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system on most rectangular designs is adjustable in ½" increments up to 5" per side should the casting or drainage structure have imperfections.


2.3 **FLEXSTORM CATCH-IT** Inlet Filters for temporary inlet protection: The FLEXSTORM CATCH-IT framing is galvanized or zinc plated for corrosion resistance. The **"FX"** Woven Polypropylene filter bag is the design standard, although the **"IL"** Nonwoven geotextile is also available if preferred by the engineer. These products are typically used for temporary inlet protection lasting 3 months (short term road work) to 5 years (residential developments).





2.4 **FLEXSTORM PURE** Inlet Filters for permanent inlet protection: The FLEXSTORM PURE framing is comprised of 304 stainless steel with a 25 year life rating. Multiple filter bags are available: **FX, FX+, PC, PC+, LL** and others. The Post Construction **"PC+"** is the design standard consisting of the **"FX"** Woven Polypropylene sediment bag lined with Adsorb-it filter fabric, which is made from recycled polyester fibers. The **"PC+"** includes a replaceable hydrocarbon skimmer pouch strapped to the bottom of the bag for advanced TPH removal.







3.0 Filter Bag Specifications and Capabilities:

3.1 Material Properties (taken from manufacturers average roll value):

FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/ Oil Skimmer	PCP	PCP-S	137	140
LL: Litter and Leaf Bag	LL	LL-S	High	3.5
IL: IDOT Non-Woven Bag	IL	IL-S	145	70

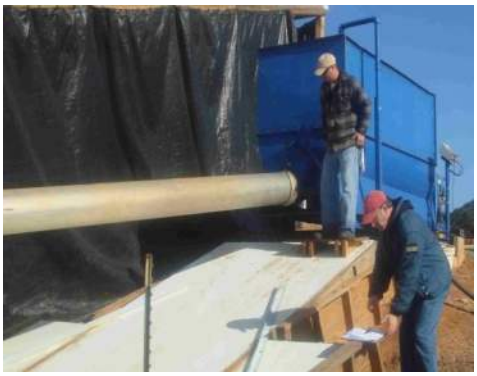
3.2 Standard Bag Sizes and Capabilities: Bag Sizes are determined by clear opening dimensions of the drainage structure. Once frame design size is confirmed, Small - XL bag ratings can be confirmed to meet design criteria. Ratings below are for standard 22" deep bags.

Standard Bag Size§	Solids Storage Capacity (CuFt)	Filtered Flow Rate at 50% Max (CFS)			Oil Retention (Oz)	
		FX	PC	IL	PC*	PCP**
Small	1.6	1.2	0.8	0.9	66	155
Medium	2.1	1.8	1.2	1.3	96	185
Large	3.8	2.2	1.5	1.6	120	209
XL	4.2	3.6	2.4	2.6	192	370

4.0 Tested Filtration Efficiency and Removal Rates: Filtration Efficiency, TSS, and TPH testing performed under large scale, real world conditions at accredited third party erosion and sediment control testing laboratory. (See Full Test Reports at www.inletfilters.com)



Inside View of Hopper Agitator



Hopper With Outlet Pipe Leading To Area Inlet



Area Inlet Simulated Showing Influent Discharge From Pipe

4.1 **FLEXSTORM "FX" Filtration Efficiency Test Results:** All testing performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination of Sediment Retention Device Effectiveness in Sheet Flow Application,* with flow diverted into an area inlet. Test Soil used as sediment had the following characteristics with a nominal 7% sediment to water concentration mix. This is representative of a heavy sediment load running off of a construction site.

Soil Characteristics	Test Method	Value		Filtration Efficiency of "FX" FLEXSTORM Bag
% Gravel	ASTM D 422	2		**82%**
% Sand		60		
% Silt		24		
% Clay		14		
Liquid Limit, %	ASTM D 4318	34		
Plasticity Index, %		9		
Soil Classification	USDA	Sandy Loam		
Soil Classification	USCS	Silty Sand (SM)		

4.2 **FLEXSTORM "PC" and "PC+" Test Results:** TSS measured on effluent samples in accordance with SM 2540D and TPH in accordance with EPA 1664A.

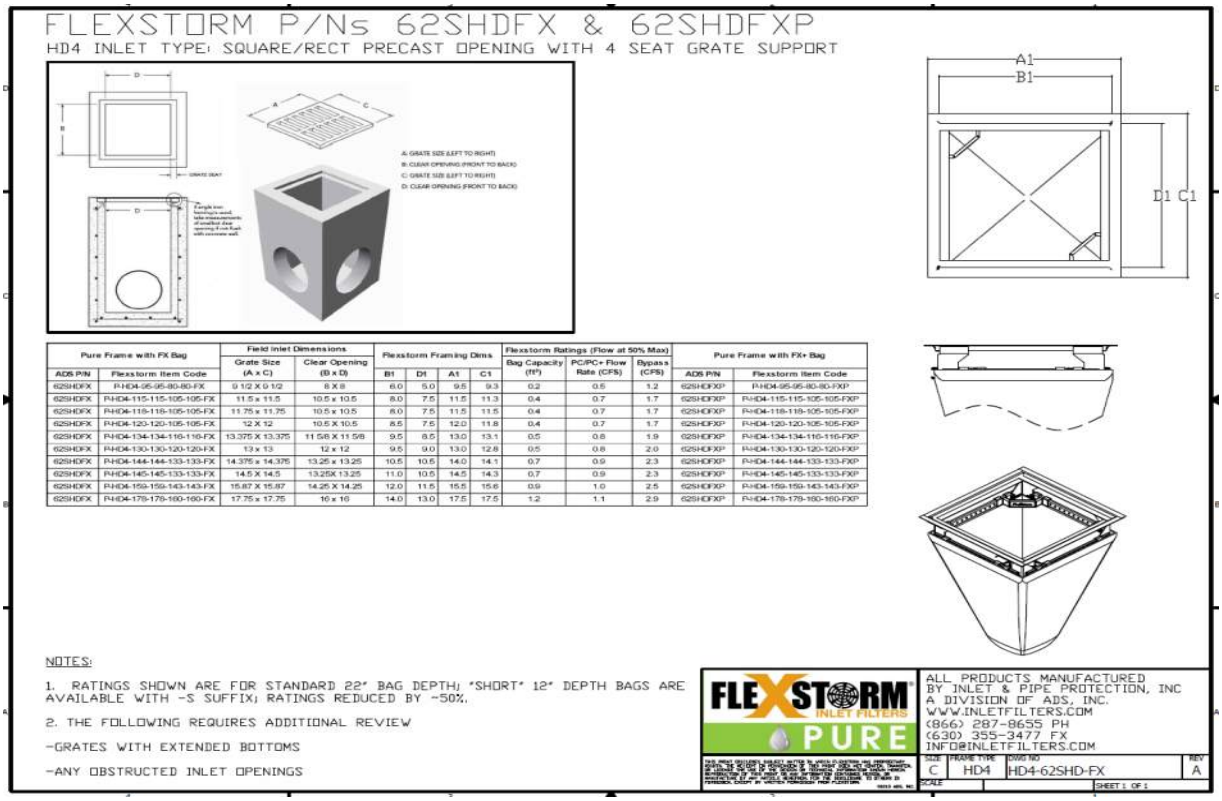
Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

Product Tested	Street Sweep Sediment Load	Particle Size of Sediment Load	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	2.5% = 100 lbs Sed / 4000 lbs water	.001 mm – 10.0 mm (median 200 micron)	**99.68%**	95.61%

Product Tested	Hydrocarbon Load	Ave Flow Rate GPM	% TPH Removal	Oil Retention Efficiency
FLEXSTORM PC+	243 mg/L using 750 mL (1.45 lb) used motor oil + lube oil and clean water	19	**99.04%**	97.22%
FLEXSTORM PC		20	**97.67%**	91.61%
FLEXSTORM PC+		92	**96.88%**	99.11%

5.0 Identification of Drainage Structures to Determine FLEXSTORM Item Codes:

5.1 The Installer (Contactor) shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number or the exact grate size and clear opening size will provide the information necessary to identify the required FLEXSTORM Inlet Filter part number. Inlet Filters are supplied to the field pre-configured to fit the specified drainage structure. Item Codes can be built using the FLEXSTORM Product Configurator at www.inletfilters.com. Detailed Submittal / Specification drawings are linked to each Item Code and available for download by engineers and contractors to include on plans and/or verify field inlet requirements. An example of a typical drawing is shown below.



Pure Frame with FX Bag		Field Inlet Dimensions		Flexstorm Framing Dims				Flexstorm Ratings (Flow at 50% Max)			Pure Frame with FX+ Bag	
ADS P/N	Flexstorm Item Code	Grate Size (A x C)	Clear Opening (B x D)	B1	D1	A1	C1	Bag Capacity (ft³)	PC/PC+ Flow Rate (CFS)	Bypass (CFS)	ADS P/N	Flexstorm Item Code
62SHDFX	FHD4-95-95-80-80-FX	9 1/2 X 9 1/2	8 X 8	6.0	5.0	9.5	9.3	0.2	0.5	1.2	62SHDFXP	FHD4-95-95-80-80-FXP
62SHDFX	FHD4-115-115-105-105-FX	11.5 x 11.5	10.5 x 10.5	8.0	7.5	11.5	11.3	0.4	0.7	1.7	62SHDFXP	FHD4-115-115-105-105-FXP
62SHDFX	FHD4-118-118-105-105-FX	11.75 x 11.75	10.5 x 10.5	8.0	7.5	11.5	11.5	0.4	0.7	1.7	62SHDFXP	FHD4-118-118-105-105-FXP
62SHDFX	FHD4-120-120-105-105-FX	12 X 12	10.5 X 10.5	8.5	7.5	12.0	11.8	0.4	0.7	1.7	62SHDFXP	FHD4-120-120-105-105-FXP
62SHDFX	FHD4-134-134-116-116-FX	13.375 X 13.375	11.58 X 11.58	9.5	8.5	13.0	13.1	0.5	0.8	1.9	62SHDFXP	FHD4-134-134-116-116-FXP
62SHDFX	FHD4-130-130-120-120-FX	13 x 13	12 x 12	9.5	9.0	13.0	12.8	0.5	0.8	2.0	62SHDFXP	FHD4-130-130-120-120-FXP
62SHDFX	FHD4-144-144-133-133-FX	14.375 x 14.375	13.25 x 13.25	10.5	10.5	14.0	14.1	0.7	0.9	2.3	62SHDFXP	FHD4-144-144-133-133-FXP
62SHDFX	FHD4-145-145-133-133-FX	14.5 X 14.5	13.25X 13.25	11.0	10.5	14.5	14.3	0.7	0.9	2.3	62SHDFXP	FHD4-145-145-133-133-FXP
62SHDFX	FHD4-159-159-143-143-FX	15.87 X 15.87	14.25 X 14.25	12.0	11.5	15.5	15.6	0.9	1.0	2.5	62SHDFXP	FHD4-159-159-143-143-FXP
62SHDFX	FHD4-178-178-160-160-FX	17.75 x 17.75	16 x 16	14.0	13.0	17.5	17.5	1.2	1.1	2.9	62SHDFXP	FHD4-178-178-160-160-FXP

6.0 Installation Into Standard Grated Drainage Structures:

6.1 Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drainage structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8", which is the thickness of the steel hangers. For Curb Box Inlet Filters: Insert FLEXSTORM CATCH IT Inlet Filter as described above, pull the rear curb guard flap up and over the open curb box until tight, align magnets to ensure firm attachment to the top portion of the curb box casting. If the curb back opening is not magnetic, slide a typical rock sack or 2 x 4 through the 2-ply rear curb box flap to create a dam which will direct runoff into the sediment bag.






7.0 Maintenance Guidelines: The frequency of maintenance will vary depending on the application (during construction, post construction, or industrial use), the area of installation (relative to grade and runoff exposure), and the time of year relative to the geographic location (infrequent rain, year round rain, rain and snow conditions). The FLEXSTORM Operation & Maintenance Plan (as shown in 7.5) or other maintenance log should be kept on file.

7.1 Frequency of Inspections: Construction site inspection should occur following each ½" or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with year round rainfall and three times per year (every three months) in areas with rainy seasons before and after snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

7.2 General Maintenance for standard sediment bags: Upon inspection, the FLEXSTORM Inlet Filter should be emptied if the sediment bag is more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift the FLEXSTORM Inlet Filter from the drainage structure. Machine assistance is not required. Dispose of the sediment or debris as directed by the Engineer. As an alternative, an industrial vacuum may be used to collect the accumulated sediment if available. Remove any caked on silt from the sediment bag and reverse flush the bag for optimal filtration. Replace the bag if the geotextile is torn or punctured to ½" diameter or greater on the lower half of the bag. If properly maintained, the Woven sediment bag will last a minimum of 4 years in the field.

7.3 Inspection and Handling of the FLEXSTORM PC / PC+ post construction sediment bag: The PC+ sediment bags will collect oil until saturated. Both the Adsorb-it filter liner and the skimmer pouch will retain oil. The volume of oils retained will depend on sediment bag size. Unlike other passive oil sorbent products, Adsorb-it filter fabric has the ability to remove hydrocarbons at high flow rates while retaining 10- 20 times its weight in oil (weight of fabric is 12.8 oz / sq yd). The average 2' x 2' PC Bag contains approx .8 sq yds, or 10 oz of fabric. At 50% saturation, the average Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil. Once the bag has become saturated with oils, it can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. If it is determined, per Maintenance Contracts or Engineering Instructions, that the saturated PC sediment bags will be completely replaced, it is the responsibility of the service technician to place the filter medium and associated debris in an approved container and dispose of in accordance with EPA regulations. Spent Adsorb-it can be recycled for its fuel value through waste to energy incineration with a higher BTU per pound value than coal. The oil skimmers start white in color and will gradually turn brown/black as they become saturated, indicating time for replacement. The average skimmer pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. To remove the pouch simply unclip it from the swivel strap sewn to the bottom of the bag. Dispose of all oil contaminated products in accordance to EPA guidelines. The ClearTec Rubberizer media used in the pouch, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

7.4 Sediment Bag Replacement: When replacing a Sediment Bag, remove the bag by loosening or cutting off the clamping band. Take the new sediment bag, which is equipped with a stainless steel worm drive clamping band, and use a drill or screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band. For Oil absorbent boom bags, simply replace the oil boom or pouch when saturated by sliding it through the mesh support sleeve.



7.5 Operation & Maintenance Plan. (Download at www.inletfilters.com or www.ads-pipe.com)

FLEXSTORM OPERATION AND MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Installation Instructions:

1. Remove grate from the drainage structure
2. Clean stone and dirt from ledge (lip) of drainage structure
3. Drop the FLEXSTORM inlet filter through the clear opening such that the hangers rest firmly on the lip of the structure.
4. Replace the grate and confirm it is not elevated more than 1/8", the thickness of the steel hangers.

Frequency of Inspections:

1. Inspection should occur following any rain event >½".
2. Post construction inspections should occur 4 times per year. In snowfall affected regions additional inspections should take place before and after snowfall season.
3. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than 3 times/year.

Maintenance Guidelines:

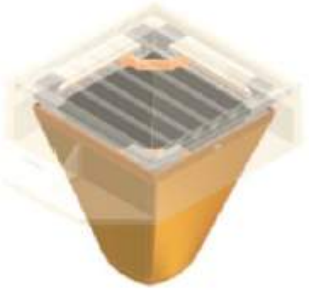
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial vacuum can be used to collect sediment.
5. Remove caked on silt from sediment bag and flush with Medium spray with optimal filtration.
6. Replace bag if torn or punctured to >½" diameter on lower half of bag.

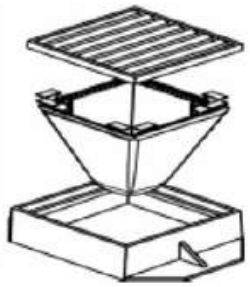
Post Construction PC Bag Maintenance:

1. At 50% saturation the average 2'x2' Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil and should be serviced. To recover the oils the filter can be centrifuged or passed through a wringer.
2. Oil skimmer pouches start to turn black when saturated, indicating time for replacement. Each ClearTec Rubberizer pouch will absorb ~62oz (4 lbs) of oil before needing replacement.
3. Dispose of all oil contaminated products in accordance with EPA guidelines. ClearTec Rubberizer, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

Sediment Bag Replacement:

1. Remove the bag by loosening or cutting off clamping bag.
2. Take new sediment bag and secure worm drive clamping band to the frame channel.
3. Ensure Bag is secure and there is no slack around perimeter.





STRUCTURE ID#/LOCATION:

DATE	TASK PERFORMED	INSPECTOR

APPENDIX B

SWMHYMO INPUT/OUTPUT INFORMATION

```
00001> 2     Metric units
00002> *#*************************************************************************|
00003> *#  Project Name: 789-795 BRANT STREET
00004> *#               BURLINGTON, OMTARIO
00005> *#  JOB NUMBER  : 22065
00006> *#       Date   : SEPTEMBER 2022
00007> *#    Revised   :
00008> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00009> *#       File   : 22065.DAT
00010> *#*************************************************************************|
00011> *
00012> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
00013>                     BUR6_002.stm
00014> *
00015> READ STORM          STORM_FILENAME "STORM.001"
00016> *
00017> *#*************************************************************************|
00018> *#
00019> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00020> *#        ============================================
00021> *#
00022> **#************************************************************************|
00023> *# CATCHMENT 101 - EXISTING CONDITIONS (To Prospect Street)
00024> CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.13](ha),
00025>                     XIMP=[0.80], TIMP=[0.80], DWF=[0](cms), LOSS=[2],
00026>                     SCS curve number CN=[70],
00027>                     Pervious   surfaces: IAper=[10.8](mm), SLPP=[2.0](%),
00028>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
00029>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
00030>                                          LGI=[10](m), MNI=[0.013], SCI=[0](min),
00031>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00032> *%-----------------|-------------------------------------------------------|
00033> *# CATCHMENT 102 - EXISTING CONDITIONS (To Brant Street)
00034> CALIB STANDHYD      ID=[2], NHYD=["102"], DT=[1](min), AREA=[0.10ha),
00035>                     XIMP=[0.66], TIMP=[0.66], DWF=[0](cms), LOSS=[2],
00036>                     SCS curve number CN=[70],
00037>                     Pervious   surfaces: IAper=[10.8](mm), SLPP=[2.0](%),
00038>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
00039>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
00040>                                          LGI=[10](m), MNI=[0.013], SCI=[0](min),
00041>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00042> *%-----------------|-------------------------------------------------------|
00043> *# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
00044> CALIB STANDHYD      ID=[3], NHYD=["101"], DT=[1](min), AREA=[0.23](ha),
00045>                     XIMP=[0.36], TIMP=[0.36], DWF=[0](cms), LOSS=[2],
00046>                     SCS curve number CN=[70],
00047>                     Pervious   surfaces: IAper=[10.8](mm), SLPP=[1.5](%),
00048>                                          LGP=[20](m), MNP=[0.250], SCP=[0](min),
00049>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.5](%),
00050>                                          LGI=[20](m), MNI=[0.013], SCI=[0](min),
00051>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00052> *%-----------------|-------------------------------------------------------|
00053>
00054> *#*************************************************************************|
00055> *#
00056> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00057> *#        =============================================
00058> *#
00059> **#************************************************************************|
00060> *# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
00061> CALIB STANDHYD      ID=[4], NHYD=["201"], DT=[1](min), AREA=[0.205](ha),
00062>                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
00063>                     SCS curve number CN=[70],
00064>                     Pervious   surfaces: IAper=[10.8](mm), SLPP=[2.0](%),
00065>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
```

```
00066>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
00067>                                          LGI=[10](m), MNI=[0.013], SCI=[0](min),
00068>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00069> *%-----------------|-------------------------------------------------------|
00070> *# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
00071> CALIB STANDHYD      ID=[5], NHYD=["202"], DT=[1](min), AREA=[0.025](ha),
00072>                     XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
00073>                     SCS curve number CN=[70],
00074>                     Pervious   surfaces: IAper=[10.8](mm), SLPP=[2.0](%),
00075>                                          LGP=[10](m), MNP=[0.250], SCP=[0](min),
00076>                     Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
00077>                                          LGI=[10](m), MNI=[0.013], SCI=[0](min),
00078>                     RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
00079> *%-----------------|-------------------------------------------------------|
00080> *# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
00081> *
00082> ROUTE RESERVOIR     IDout=[6],   NHYD=["201"],  IDin=[4],
00083>                     RDT=[1](min),
00084>                           TABLE of ( OUTFLOW-STORAGE ) values
00085>                                    (cms) - (ha-m)
00086>                                     0.0000 , 0.0000
00087>                                     0.0124 , 0.0010
00088>                                     0.0124 , 0.0010
00089>                                     0.0124 , 0.0030
00090>                                     0.0124 , 0.0050
00091>                                     0.0124 , 0.0070
00092>                                     0.0124 , 0.0094
00093>                                     0.0176 , 0.0102
00094>                                     0.0206 , 0.0108
00095>                                     -1  ,  -1    (max twenty pts)
00096>                           IDovf=[7], NHYDovf=["OVF"]
00097> *%-----------------|-------------------------------------------------------|
00098> ADD HYD             IDsum=[8], NHYD=["Total"], IDs to add=[5+6+7]
00099> *%-----------------|-------------------------------------------------------|
00100> * RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
00101> *
00102> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
00103>                     BUR6_005.stm
00104> *
00105> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
00106>                     BUR6_010.stm
00107> *
00108> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
00109>                     BUR6_025.stm
00110> *
00111> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
00112>                     BUR6_050.stm
00113> *
00114> START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
00115>                     BUR6_100.stm
00116> *
00117> *%-----------------|-------------------------------------------------------|
00118> FINISH
00119>
00120>
00121>
00122>
00123>
00124>
00125>
00126>
00127>
00128>
00129>
00130>
```

```
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   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> +++++++++                in any City          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: 2022-09-09     TIME: 11:38:41     RUN COUNTER: 000124          *
00039> ********************************************************************************
00040> * Input   filename: T:\PROJECTS\22065\SWMHYMO\22065.dat                        *
00041> * Output  filename: T:\PROJECTS\22065\SWMHYMO\22065.out                        *
00042> * Summary filename: T:\PROJECTS\22065\SWMHYMO\22065.sum                        *
00043> * User comments:                                                              *
00044> * 1:_____________________________________________________________________     *
00045> * 2:_____________________________________________________________________     *
00046> * 3:_____________________________________________________________________     *
00047> ********************************************************************************
00048>
00049> --------------------------------------------------------------------------------
00050> 001:0001--------------------------------------------------------------------------
00051> *#*****************************************************************************|
00052> *#  Project Name: 789-795 BRANT STREET
00053> *#               BURLINGTON, OMTARIO
00054> *#  JOB NUMBER  : 22065
00055> *#       Date   : SEPTEMBER 2022
00056> *#    Revised   :
00057> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00058> *#       File   : 22065.DAT
00059> *#*****************************************************************************|
00060> *
00061>   ** END OF RUN :   1
00062>
00063> ********************************************************************************
00064>
00065>
00066>
00067>
00068>
00069> --------------------
00070> | START            |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
00071> --------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
00072>     TZERO =   .00 hrs on       0
00073>     METOUT=   2 (output = METRIC)
00074>     NRUN  = 002
00075>     NSTORM=   1
00076>              #  1=BUR6_002.stm
00077> --------------------------------------------------------------------------------
00078> 002:0002--------------------------------------------------------------------------
00079> *#*****************************************************************************|
00080> *#  Project Name: 789-795 BRANT STREET
00081> *#               BURLINGTON, OMTARIO
00082> *#  JOB NUMBER  : 22065
00083> *#       Date   : SEPTEMBER 2022
00084> *#    Revised   :
00085> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00086> *#       File   : 22065.DAT
00087> *#*****************************************************************************|
00088> *
00089> --------------------------------------------------------------------------------
00090> 002:0002--------------------------------------------------------------------------
00091> *
00092> --------------------
00093> | READ STORM       |    Filename: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00094> | Ptotal=  40.93 mm|    Comments: Burlington 2-yr 6hr CHICAGO  (A=681.52,
00095> --------------------
00096>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00097>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00098>                .17   1.715 |   1.67   8.325 |   3.17   4.467 |   4.67   2.213
00099>                .33   1.858 |   1.83  19.646 |   3.33   3.978 |   4.83   2.105
00100>                .50   2.032 |   2.00  78.391 |   3.50   3.595 |   5.00   2.008
00101>                .67   2.247 |   2.17  25.776 |   3.67   3.286 |   5.17   1.920
00102>                .83   2.522 |   2.33  13.777 |   3.83   3.030 |   5.33   1.841
00103>               1.00   2.888 |   2.50   9.511 |   4.00   2.815 |   5.50   1.769
00104>               1.17   3.399 |   2.67   7.331 |   4.17   2.632 |   5.67   1.703
00105>               1.33   4.172 |   2.83   6.005 |   4.33   2.474 |   5.83   1.642
00106>               1.50   5.492 |   3.00   5.111 |   4.50   2.335 |   6.00   1.586
00107>
00108> --------------------------------------------------------------------------------
00109> 002:0003--------------------------------------------------------------------------
00110> *
00111> *#*****************************************************************************|
00112> *#
00113> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00114> *#        ==============================================
00115> *#
00116> **#****************************************************************************|
00117> *# CATCHMENT 101 - EXISTING CONDITIONS (To Prospect Street)
00118> ----------------------
00119> | CALIB STANDHYD     |   Area    (ha)=     .13
00120> | 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
00121> ----------------------
00122>                                IMPERVIOUS    PERVIOUS (i)
00123>      Surface Area     (ha)=        .10          .03
00124>      Dep. Storage     (mm)=       1.00        10.80
00125>      Average Slope     (%)=       2.00         2.00
00126>      Length            (m)=      10.00        10.00
00127>      Mannings n            =       .013         .250
00128>
00129>      Max.eff.Inten.(mm/hr)=      78.39         8.00
00130>                 over (min)        1.00         9.00
00131>      Storage Coeff.  (min)=        .57 (ii)    9.01 (ii)
00132>      Unit Hyd. Tpeak (min)=       1.00         9.00
00133>      Unit Hyd. peak  (cms)=       1.40          .13
00134>                                                          *TOTALS*
00135>      PEAK FLOW       (cms)=        .02          .00          .023 (iii)
00136>      TIME TO PEAK    (hrs)=       1.97         2.18         2.000
00137>      RUNOFF VOLUME    (mm)=      39.93         6.53        33.253
00138>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00139>      RUNOFF COEFFICIENT   =        .98          .16          .812
00140>
00141>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00142>            CN* =  70.0    Ia = Dep. Storage  (Above)
00143>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00144>            THAN THE STORAGE COEFFICIENT.
00145>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00146>
00147> --------------------------------------------------------------------------------
00148> 002:0004--------------------------------------------------------------------------
00149> *# CATCHMENT 102 - EXISTING CONDITIONS (To Brant Street)
00150> ----------------------
00151> | CALIB STANDHYD     |   Area    (ha)=     .10
00152> | 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
00153> ----------------------
00154>                                IMPERVIOUS    PERVIOUS (i)
00155>      Surface Area     (ha)=        .07          .03
00156>      Dep. Storage     (mm)=       1.00        10.80
00157>      Average Slope     (%)=       2.00         2.00
00158>      Length            (m)=      10.00        10.00
00159>      Mannings n            =       .013         .250
00160>
00161>      Max.eff.Inten.(mm/hr)=      78.39         8.00
00162>                 over (min)        1.00         9.00
00163>      Storage Coeff.  (min)=        .57 (ii)    9.01 (ii)
00164>      Unit Hyd. Tpeak (min)=       1.00         9.00
00165>      Unit Hyd. peak  (cms)=       1.40          .13
00166>                                                          *TOTALS*
00167>      PEAK FLOW       (cms)=        .01          .00          .015 (iii)
00168>      TIME TO PEAK    (hrs)=       1.97         2.18         2.000
00169>      RUNOFF VOLUME    (mm)=      39.93         6.53        28.577
00170>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00171>      RUNOFF COEFFICIENT   =        .98          .16          .698
00172>
00173>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00174>            CN* =  70.0    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> *# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
00182> ----------------------
00183> | CALIB STANDHYD     |   Area    (ha)=     .23
00184> | 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00185> ----------------------
00186>                                IMPERVIOUS    PERVIOUS (i)
00187>      Surface Area     (ha)=        .08          .15
00188>      Dep. Storage     (mm)=       1.00        10.80
00189>      Average Slope     (%)=       1.50         1.50
00190>      Length            (m)=      20.00        20.00
00191>      Mannings n            =       .013         .250
00192>
00193>      Max.eff.Inten.(mm/hr)=      78.39         6.94
00194>                 over (min)        1.00        16.00
00195>      Storage Coeff.  (min)=        .95 (ii)   15.71 (ii)
00196>      Unit Hyd. Tpeak (min)=       1.00        16.00
00197>      Unit Hyd. peak  (cms)=       1.11          .07
00198>                                                          *TOTALS*
00199>      PEAK FLOW       (cms)=        .02          .00          .018 (iii)
00200>      TIME TO PEAK    (hrs)=       2.00         2.35         2.000
00201>      RUNOFF VOLUME    (mm)=      39.93         6.53        18.557
00202>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00203>      RUNOFF COEFFICIENT   =        .98          .16          .453
00204>
00205>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00206>            CN* =  70.0    Ia = Dep. Storage  (Above)
00207>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00208>            THAN THE STORAGE COEFFICIENT.
00209>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00210>
00211> --------------------------------------------------------------------------------
00212> 002:0006--------------------------------------------------------------------------
00213> *#*****************************************************************************|
00214> *#
00215> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00216> *#        ===============================================
00217> *#
00218> **#****************************************************************************|
00219> *# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
00220> ----------------------
00221> | CALIB STANDHYD     |   Area    (ha)=     .20
00222> | 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00223> ----------------------
00224>                                IMPERVIOUS    PERVIOUS (i)
00225>      Surface Area     (ha)=        .20          .00
00226>      Dep. Storage     (mm)=       1.00        10.80
00227>      Average Slope     (%)=       2.00         2.00
00228>      Length            (m)=      10.00        10.00
00229>      Mannings n            =       .013         .250
00230>
00231>      Max.eff.Inten.(mm/hr)=      78.39         8.00
00232>                 over (min)        1.00         9.00
00233>      Storage Coeff.  (min)=        .57 (ii)    9.01 (ii)
00234>      Unit Hyd. Tpeak (min)=       1.00         9.00
00235>      Unit Hyd. peak  (cms)=       1.40          .13
00236>                                                          *TOTALS*
00237>      PEAK FLOW       (cms)=        .04          .00          .044 (iii)
00238>      TIME TO PEAK    (hrs)=       1.97         2.18         2.000
00239>      RUNOFF VOLUME    (mm)=      39.93         6.53        39.599
00240>      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
00241>      RUNOFF COEFFICIENT   =        .98          .16          .967
00242>
00243>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00244>            CN* =  70.0    Ia = Dep. Storage  (Above)
00245>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00246>            THAN THE STORAGE COEFFICIENT.
00247>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00248>
00249> --------------------------------------------------------------------------------
00250> 002:0007--------------------------------------------------------------------------
00251> *# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
00252> ----------------------
00253> | CALIB STANDHYD     |   Area    (ha)=     .03
00254> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00255> ----------------------
00256>                                IMPERVIOUS    PERVIOUS (i)
00257>      Surface Area     (ha)=        .02          .00
00258>      Dep. Storage     (mm)=       1.00        10.80
00259>      Average Slope     (%)=       2.00         2.00
00260>      Length            (m)=      10.00        10.00
00261>      Mannings n            =       .013         .250
00262>
00263>      Max.eff.Inten.(mm/hr)=      78.39         8.00
00264>                 over (min)        1.00         9.00
00265>      Storage Coeff.  (min)=        .57 (ii)    9.01 (ii)
00266>      Unit Hyd. Tpeak (min)=       1.00         9.00
00267>      Unit Hyd. peak  (cms)=       1.40          .13
00268>                                                          *TOTALS*
00269>      PEAK FLOW       (cms)=        .01          .00          .005 (iii)
00270>      TIME TO PEAK    (hrs)=       1.95         2.18         2.000
```

```
00271>      RUNOFF VOLUME    (mm)=      39.93         6.53         39.598
00272>      TOTAL RAINFALL   (mm)=      40.93        40.93         40.933
00273>      RUNOFF COEFFICIENT   =        .98          .16           .967
00274>
00275>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00276>            CN* =  70.0    Ia = Dep. Storage  (Above)
00277>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00278>            THAN THE STORAGE COEFFICIENT.
00279>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00280>
00281> ---------------------------------------------------------------------------
00282> 002:0008-----------------------------------------------------------------
00283> *# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
00284> *
00285> ---------------------
00286> | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
00287> |  IN>04:(201   )   |
00288> | OUT<06:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
00289> ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
00290>                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
00291>                             .000  .0000E+00   |     .012  .7000E-02
00292>                             .012  .1000E-02   |     .012  .9400E-02
00293>                             .012  .1000E-02   |     .018  .1020E-01
00294>                             .012  .3000E-02   |     .021  .1080E-01
00295>                             .012  .5000E-02   |     .000  .0000E+00
00296>
00297>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
00298>      --------------------       (ha)     (cms)     (hrs)       (mm)
00299>      INFLOW >04: (201   )        .20      .044     2.000     39.599
00300>      OUTFLOW<06: (201   )        .20      .012     1.883     39.599
00301>     OVERFLOW<07: (OVF   )        .00      .000      .000      .000
00302>
00303>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
00304>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
00305>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
00306>
00307>
00308>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   28.052
00309>                    TIME SHIFT OF PEAK FLOW         (min)=    -7.00
00310>                    MAXIMUM  STORAGE   USED       (ha.m.)=.2670E-02
00311>
00312> ---------------------------------------------------------------------------
00313> 002:0009-----------------------------------------------------------------
00314> ----------------------
00315> | ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00316> ----------------------------------         (ha)     (cms)   (hrs)   (mm)   (cms)
00317>                         ID1 05:202           .03      .005    2.00  39.60    .000
00318>                        +ID2 06:201           .20      .012    1.88  39.60    .000
00319>                        +ID3 07:OVF           .00      .000     .00    .00    .000
00320>                         ============================================================
00321>                         SUM 08:Total          .23      .018    2.00  39.60    .000
00322>
00323>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00324>
00325> ---------------------------------------------------------------------------
00326> 002:0010-----------------------------------------------------------------
00327> * RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
00328> *
00329>   ** END OF RUN :   4
00330>
00331> ***************************************************************************
00332>
00333>
00334>
00335>
00336>
00337> ---------------------
00338> | START             |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
00339> ---------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
00340>      TZERO =   .00 hrs on      0
00341>      METOUT=   2 (output = METRIC)
00342>      NRUN  = 005
00343>      NSTORM=   1
00344>             #  1=BUR6_005.stm
00345> ---------------------------------------------------------------------------
00346> 005:0002-----------------------------------------------------------------
00347> *#*************************************************************************|
00348> *#  Project Name: 789-795 BRANT STREET
00349> *#               BURLINGTON, OMTARIO
00350> *#  JOB NUMBER  : 22065
00351> *#       Date   : SEPTEMBER 2022
00352> *#    Revised   :
00353> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00354> *#       File   : 22065.DAT
00355> *#*************************************************************************|
00356> *
00357> ---------------------------------------------------------------------------
00358> 005:0002-----------------------------------------------------------------
00359> *
00360> --------------------
00361> | READ STORM        |    Filename: Burlington 5-yr 6hr CHICAGO    (A=802.04
00362> | Ptotal=  53.05 mm|    Comments: Burlington 5-yr 6hr CHICAGO    (A=802.04
00363> --------------------
00364>                TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00365>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00366>                 .17   2.348 |   1.67  10.690 |   3.17   5.897 |   4.67   3.004
00367>                 .33   2.537 |   1.83  24.479 |   3.33   5.279 |   4.83   2.862
00368>                 .50   2.766 |   2.00 101.312 |   3.50   4.790 |   5.00   2.734
00369>                 .67   3.048 |   2.17  31.941 |   3.67   4.394 |   5.17   2.619
00370>                 .83   3.407 |   2.33  17.333 |   3.83   4.065 |   5.33   2.514
00371>                1.00   3.881 |   2.50  12.145 |   4.00   3.788 |   5.50   2.419
00372>                1.17   4.539 |   2.67   9.469 |   4.17   3.550 |   5.67   2.331
00373>                1.33   5.523 |   2.83   7.826 |   4.33   3.344 |   5.83   2.251
00374>                1.50   7.185 |   3.00   6.709 |   4.50   3.164 |   6.00   2.176
00375>
00376> ---------------------------------------------------------------------------
00377> 005:0003-----------------------------------------------------------------
00378> *
00379> *#*************************************************************************|
00380> *#
00381> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00382> *#        ==============================================
00383> *#
00384> **#************************************************************************|
00385> *# CATCHMENT 101 - EXISTING CONDITIONS (To Prospect Street)
00386> ----------------------
00387> | CALIB STANDHYD     |   Area    (ha)=     .13
00388> | 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
00389> ----------------------
00390>                              IMPERVIOUS    PERVIOUS (i)
00391>      Surface Area     (ha)=        .10          .03
00392>      Dep. Storage     (mm)=       1.00        10.80
00393>      Average Slope     (%)=       2.00         2.00
00394>      Length             (m)=     10.00        10.00
00395>      Mannings n            =       .013         .250
00396>
00397>      Max.eff.Inten.(mm/hr)=     101.31        19.99
00398>                 over (min)        1.00         6.00
00399>      Storage Coeff.  (min)=         .52 (ii)    6.37 (ii)
00400>      Unit Hyd. Tpeak (min)=        1.00         6.00
00401>      Unit Hyd. peak  (cms)=        1.45          .18
00402>                                                          *TOTALS*
00403>      PEAK FLOW       (cms)=         .03          .00          .030 (iii)
00404>      TIME TO PEAK    (hrs)=        1.95         2.07         2.000
00405>      RUNOFF VOLUME    (mm)=       52.05        11.81         44.005
00406>      TOTAL RAINFALL   (mm)=       53.05        53.05         53.053
00407>      RUNOFF COEFFICIENT   =         .98          .22           .829
00408>
00409>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00410>            CN* =  70.0    Ia = Dep. Storage  (Above)
00411>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00412>            THAN THE STORAGE COEFFICIENT.
00413>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00414>
00415> ---------------------------------------------------------------------------
00416> 005:0004-----------------------------------------------------------------
00417> *# CATCHMENT 102 - EXISTING CONDITIONS (To Brant Street)
00418> ----------------------
00419> | CALIB STANDHYD     |   Area    (ha)=     .10
00420> | 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
00421> ----------------------
00422>                              IMPERVIOUS    PERVIOUS (i)
00423>      Surface Area     (ha)=        .07          .03
00424>      Dep. Storage     (mm)=       1.00        10.80
00425>      Average Slope     (%)=       2.00         2.00
00426>      Length             (m)=     10.00        10.00
00427>      Mannings n            =       .013         .250
00428>
00429>      Max.eff.Inten.(mm/hr)=     101.31        19.99
00430>                 over (min)        1.00         6.00
00431>      Storage Coeff.  (min)=         .52 (ii)    6.37 (ii)
00432>      Unit Hyd. Tpeak (min)=        1.00         6.00
00433>      Unit Hyd. peak  (cms)=        1.45          .18
00434>                                                          *TOTALS*
00435>      PEAK FLOW       (cms)=         .02          .00          .019 (iii)
00436>      TIME TO PEAK    (hrs)=        1.95         2.07         2.000
00437>      RUNOFF VOLUME    (mm)=       52.05        11.81        38.372
00438>      TOTAL RAINFALL   (mm)=       53.05        53.05        53.053
00439>      RUNOFF COEFFICIENT   =         .98          .22           .723
00440>
00441>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00442>            CN* =  70.0    Ia = Dep. Storage  (Above)
00443>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00444>            THAN THE STORAGE COEFFICIENT.
00445>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00446>
00447> ---------------------------------------------------------------------------
00448> 005:0005-----------------------------------------------------------------
00449> *# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
00450> ----------------------
00451> | CALIB STANDHYD     |   Area    (ha)=     .23
00452> | 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00453> ----------------------
00454>                              IMPERVIOUS    PERVIOUS (i)
00455>      Surface Area     (ha)=        .08          .15
00456>      Dep. Storage     (mm)=       1.00        10.80
00457>      Average Slope     (%)=       1.50         1.50
00458>      Length             (m)=     20.00        20.00
00459>      Mannings n            =       .013         .250
00460>
00461>      Max.eff.Inten.(mm/hr)=     101.31        14.65
00462>                 over (min)        1.00        12.00
00463>      Storage Coeff.  (min)=         .86 (ii)   11.80 (ii)
00464>      Unit Hyd. Tpeak (min)=        1.00        12.00
00465>      Unit Hyd. peak  (cms)=        1.17          .10
00466>                                                          *TOTALS*
00467>      PEAK FLOW       (cms)=         .02          .00          .025 (iii)
00468>      TIME TO PEAK    (hrs)=        2.00         2.18         2.000
00469>      RUNOFF VOLUME    (mm)=       52.05        11.81        26.300
00470>      TOTAL RAINFALL   (mm)=       53.05        53.05        53.053
00471>      RUNOFF COEFFICIENT   =         .98          .22           .496
00472>
00473>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00474>            CN* =  70.0    Ia = Dep. Storage  (Above)
00475>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00476>            THAN THE STORAGE COEFFICIENT.
00477>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00478>
00479> ---------------------------------------------------------------------------
00480> 005:0006-----------------------------------------------------------------
00481> *#*************************************************************************|
00482> *#
00483> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00484> *#        ==============================================
00485> *#
00486> **#************************************************************************|
00487> *# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
00488> ----------------------
00489> | CALIB STANDHYD     |   Area    (ha)=     .20
00490> | 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00491> ----------------------
00492>                              IMPERVIOUS    PERVIOUS (i)
00493>      Surface Area     (ha)=        .20          .00
00494>      Dep. Storage     (mm)=       1.00        10.80
00495>      Average Slope     (%)=       2.00         2.00
00496>      Length             (m)=     10.00        10.00
00497>      Mannings n            =       .013         .250
00498>
00499>      Max.eff.Inten.(mm/hr)=     101.31        19.99
00500>                 over (min)        1.00         6.00
00501>      Storage Coeff.  (min)=         .52 (ii)    6.37 (ii)
00502>      Unit Hyd. Tpeak (min)=        1.00         6.00
00503>      Unit Hyd. peak  (cms)=        1.45          .18
00504>                                                          *TOTALS*
00505>      PEAK FLOW       (cms)=         .06          .00          .057 (iii)
00506>      TIME TO PEAK    (hrs)=        1.97         2.07         2.000
00507>      RUNOFF VOLUME    (mm)=       52.05        11.81        51.651
00508>      TOTAL RAINFALL   (mm)=       53.05        53.05        53.053
00509>      RUNOFF COEFFICIENT   =         .98          .22           .974
00510>
00511>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00512>            CN* =  70.0    Ia = Dep. Storage  (Above)
00513>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00514>            THAN THE STORAGE COEFFICIENT.
00515>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00516>
00517> ---------------------------------------------------------------------------
00518> 005:0007-----------------------------------------------------------------
00519> *# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
00520> ----------------------
00521> | CALIB STANDHYD     |   Area    (ha)=     .03
00522> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00523> ----------------------
00524>                              IMPERVIOUS    PERVIOUS (i)
00525>      Surface Area     (ha)=        .02          .00
00526>      Dep. Storage     (mm)=       1.00        10.80
00527>      Average Slope     (%)=       2.00         2.00
00528>      Length             (m)=     10.00        10.00
00529>      Mannings n            =       .013         .250
00530>
00531>      Max.eff.Inten.(mm/hr)=     101.31        19.99
00532>                 over (min)        1.00         6.00
00533>      Storage Coeff.  (min)=         .52 (ii)    6.37 (ii)
00534>      Unit Hyd. Tpeak (min)=        1.00         6.00
00535>      Unit Hyd. peak  (cms)=        1.45          .19
00536>                                                          *TOTALS*
00537>      PEAK FLOW       (cms)=         .01          .00          .007 (iii)
00538>      TIME TO PEAK    (hrs)=        1.95         2.07         2.000
00539>      RUNOFF VOLUME    (mm)=       52.05        11.81        51.651
00540>      TOTAL RAINFALL   (mm)=       53.05        53.05        53.053
```

```
00541>     RUNOFF COEFFICIENT   =       .98         .22          .974
00542>
00543>       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00544>           CN* =  70.0    Ia = Dep. Storage  (Above)
00545>      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00546>           THAN THE STORAGE COEFFICIENT.
00547>     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00548>
00549> ------------------------------------------------------------------------------
00550> 005:0008-----------------------------------------------------------------------
00551> *# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
00552> *
00553> ---------------------
00554> | ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
00555> |  IN>04:(201   )   |
00556> | OUT<06:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
00557> ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
00558>                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
00559>                             .000  .0000E+00    |     .012  .7000E-02
00560>                             .012  .1000E-02    |     .012  .9400E-02
00561>                             .012  .1000E-02    |     .018  .1020E-01
00562>                             .012  .3000E-02    |     .021  .1080E-01
00563>                             .012  .5000E-02    |     .000  .0000E+00
00564>
00565>     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
00566>     --------------------       (ha)     (cms)     (hrs)       (mm)
00567>     INFLOW >04: (201   )        .20      .057     2.000     51.651
00568>     OUTFLOW<06: (201   )        .20      .012     1.867     51.651
00569>    OVERFLOW<07: (OVF   )        .00      .000      .000       .000
00570>
00571>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
00572>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
00573>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
00574>
00575>
00576>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.691
00577>                    TIME SHIFT OF PEAK FLOW         (min)=    -8.00
00578>                    MAXIMUM  STORAGE   USED       (ha.m.)=.3792E-02
00579>
00580> ------------------------------------------------------------------------------
00581> 005:0009-----------------------------------------------------------------------
00582> ----------------------
00583> | ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
00584> ----------------------- (ha)     (cms)   (hrs)   (mm)   (cms)
00585>                          ID1 05:202          .03     .007    2.00   51.65    .000
00586>                         +ID2 06:201          .20     .012    1.87   51.65    .000
00587>                         +ID3 07:OVF          .00     .000     .00     .00    .000
00588>                          ==========================================================
00589>                          SUM 08:Total         .23     .019    2.00   51.65    .000
00590>
00591>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
00592>
00593> ------------------------------------------------------------------------------
00594> 005:0010-----------------------------------------------------------------------
00595> * RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
00596> *
00597> ------------------------------------------------------------------------------
00598> 005:0002-----------------------------------------------------------------------
00599> *
00600>   ** END OF RUN :   9
00601>
00602> ********************************************************************************
00603>
00604>
00605>
00606>
00607>
00608> --------------------
00609> | START            |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
00610> --------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
00611>     TZERO =   .00 hrs on       0
00612>     METOUT=   2 (output = METRIC)
00613>     NRUN  = 010
00614>     NSTORM=   1
00615>              #  1=BUR6_010.stm
00616> ------------------------------------------------------------------------------
00617> 010:0002-----------------------------------------------------------------------
00618> *#*************************************************************************|
00619> *#  Project Name: 789-795 BRANT STREET
00620> *#               BURLINGTON, OMTARIO
00621> *#  JOB NUMBER  : 22065
00622> *#       Date   : SEPTEMBER 2022
00623> *#    Revised   :
00624> *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
00625> *#       File   : 22065.DAT
00626> *#*************************************************************************|
00627> *
00628> ------------------------------------------------------------------------------
00629> 010:0002-----------------------------------------------------------------------
00630> *
00631> --------------------
00632> | READ STORM        |    Filename: Burlington 10-yr 6hr CHICAGO     (A=918.
00633> | Ptotal=  61.10 mm|    Comments: Burlington 10-yr 6hr CHICAGO     (A=918.
00634> --------------------
00635>               TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
00636>                hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
00637>                .17   2.714 |   1.67  12.326 |   3.17   6.808 |   4.67   3.472
00638>                .33   2.933 |   1.83  28.176 |   3.33   6.095 |   4.83   3.308
00639>                .50   3.197 |   2.00 116.310 |   3.50   5.532 |   5.00   3.161
00640>                .67   3.523 |   2.17  36.748 |   3.67   5.075 |   5.17   3.027
00641>                .83   3.937 |   2.33  19.967 |   3.83   4.696 |   5.33   2.907
00642>               1.00   4.483 |   2.50  14.001 |   4.00   4.376 |   5.50   2.796
00643>               1.17   5.242 |   2.67  10.921 |   4.17   4.102 |   5.67   2.695
00644>               1.33   6.377 |   2.83   9.030 |   4.33   3.864 |   5.83   2.602
00645>               1.50   8.291 |   3.00   7.743 |   4.50   3.656 |   6.00   2.516
00646>
00647> ------------------------------------------------------------------------------
00648> 010:0003-----------------------------------------------------------------------
00649> *
00650> *#*************************************************************************|
00651> *#
00652> *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00653> *#        ==============================================
00654> *#
00655> **#************************************************************************|
00656> *# CATCHMENT 101 - EXISTING CONDITIONS (To Prospect Street)
00657> ---------------------
00658> | CALIB STANDHYD     |   Area    (ha)=     .13
00659> | 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
00660> ---------------------
00661>                                IMPERVIOUS    PERVIOUS (i)
00662>      Surface Area     (ha)=        .10          .03
00663>      Dep. Storage     (mm)=       1.00        10.80
00664>      Average Slope     (%)=       2.00         2.00
00665>      Length            (m)=      10.00        10.00
00666>      Mannings n             =       .013         .250
00667>
00668>      Max.eff.Inten.(mm/hr)=     116.31        28.14
00669>                   over (min)        1.00         6.00
00670>      Storage Coeff.  (min)=        .49 (ii)    5.59 (ii)
00671>      Unit Hyd. Tpeak (min)=       1.00         6.00
00672>      Unit Hyd. peak  (cms)=       1.48          .20
00673>                                                          *TOTALS*
00674>      PEAK FLOW       (cms)=        .03          .00          .035 (iii)
00675>      TIME TO PEAK    (hrs)=       1.98         2.07         2.000
00676>      RUNOFF VOLUME    (mm)=      60.10        15.90        51.260
00677>      TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00678>      RUNOFF COEFFICIENT   =        .98          .26          .839
00679>
00680>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00681>            CN* =  70.0    Ia = Dep. Storage  (Above)
00682>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00683>            THAN THE STORAGE COEFFICIENT.
00684>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00685>
00686> ------------------------------------------------------------------------------
00687> 010:0004-----------------------------------------------------------------------
00688> *# CATCHMENT 102 - EXISTING CONDITIONS (To Brant Street)
00689> ---------------------
00690> | CALIB STANDHYD     |   Area    (ha)=     .10
00691> | 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
00692> ---------------------
00693>                                IMPERVIOUS    PERVIOUS (i)
00694>      Surface Area     (ha)=        .07          .03
00695>      Dep. Storage     (mm)=       1.00        10.80
00696>      Average Slope     (%)=       2.00         2.00
00697>      Length            (m)=      10.00        10.00
00698>      Mannings n             =       .013         .250
00699>
00700>      Max.eff.Inten.(mm/hr)=     116.31        28.14
00701>                   over (min)        1.00         6.00
00702>      Storage Coeff.  (min)=        .49 (ii)    5.59 (ii)
00703>      Unit Hyd. Tpeak (min)=       1.00         6.00
00704>      Unit Hyd. peak  (cms)=       1.48          .20
00705>                                                          *TOTALS*
00706>      PEAK FLOW       (cms)=        .02          .00          .023 (iii)
00707>      TIME TO PEAK    (hrs)=       1.98         2.07         2.000
00708>      RUNOFF VOLUME    (mm)=      60.10        15.90        45.072
00709>      TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00710>      RUNOFF COEFFICIENT   =        .98          .26          .738
00711>
00712>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00713>            CN* =  70.0    Ia = Dep. Storage  (Above)
00714>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00715>            THAN THE STORAGE COEFFICIENT.
00716>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00717>
00718> ------------------------------------------------------------------------------
00719> 010:0005-----------------------------------------------------------------------
00720> *# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
00721> ---------------------
00722> | CALIB STANDHYD     |   Area    (ha)=     .23
00723> | 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
00724> ---------------------
00725>                                IMPERVIOUS    PERVIOUS (i)
00726>      Surface Area     (ha)=        .08          .15
00727>      Dep. Storage     (mm)=       1.00        10.80
00728>      Average Slope     (%)=       1.50         1.50
00729>      Length            (m)=      20.00        20.00
00730>      Mannings n             =       .013         .250
00731>
00732>      Max.eff.Inten.(mm/hr)=     116.31        22.46
00733>                   over (min)        1.00        10.00
00734>      Storage Coeff.  (min)=        .81 (ii)   10.04 (ii)
00735>      Unit Hyd. Tpeak (min)=       1.00        10.00
00736>      Unit Hyd. peak  (cms)=       1.20          .11
00737>                                                          *TOTALS*
00738>      PEAK FLOW       (cms)=        .03          .01          .029 (iii)
00739>      TIME TO PEAK    (hrs)=       2.00         2.15         2.000
00740>      RUNOFF VOLUME    (mm)=      60.10        15.90        31.811
00741>      TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00742>      RUNOFF COEFFICIENT   =        .98          .26          .521
00743>
00744>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00745>            CN* =  70.0    Ia = Dep. Storage  (Above)
00746>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00747>            THAN THE STORAGE COEFFICIENT.
00748>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00749>
00750> ------------------------------------------------------------------------------
00751> 010:0006-----------------------------------------------------------------------
00752> *#*************************************************************************|
00753> *#
00754> *#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
00755> *#        ===============================================
00756> *#
00757> **#************************************************************************|
00758> *# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
00759> ---------------------
00760> | CALIB STANDHYD     |   Area    (ha)=     .20
00761> | 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00762> ---------------------
00763>                                IMPERVIOUS    PERVIOUS (i)
00764>      Surface Area     (ha)=        .20          .00
00765>      Dep. Storage     (mm)=       1.00        10.80
00766>      Average Slope     (%)=       2.00         2.00
00767>      Length            (m)=      10.00        10.00
00768>      Mannings n             =       .013         .250
00769>
00770>      Max.eff.Inten.(mm/hr)=     116.31        28.14
00771>                   over (min)        1.00         6.00
00772>      Storage Coeff.  (min)=        .49 (ii)    5.59 (ii)
00773>      Unit Hyd. Tpeak (min)=       1.00         6.00
00774>      Unit Hyd. peak  (cms)=       1.48          .20
00775>                                                          *TOTALS*
00776>      PEAK FLOW       (cms)=        .07          .00          .066 (iii)
00777>      TIME TO PEAK    (hrs)=       1.97         2.07         2.000
00778>      RUNOFF VOLUME    (mm)=      60.10        15.90        59.659
00779>      TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
00780>      RUNOFF COEFFICIENT   =        .98          .26          .976
00781>
00782>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
00783>            CN* =  70.0    Ia = Dep. Storage  (Above)
00784>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
00785>            THAN THE STORAGE COEFFICIENT.
00786>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
00787>
00788> ------------------------------------------------------------------------------
00789> 010:0007-----------------------------------------------------------------------
00790> *# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
00791> ---------------------
00792> | CALIB STANDHYD     |   Area    (ha)=     .03
00793> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
00794> ---------------------
00795>                                IMPERVIOUS    PERVIOUS (i)
00796>      Surface Area     (ha)=        .02          .00
00797>      Dep. Storage     (mm)=       1.00        10.80
00798>      Average Slope     (%)=       2.00         2.00
00799>      Length            (m)=      10.00        10.00
00800>      Mannings n             =       .013         .250
00801>
00802>      Max.eff.Inten.(mm/hr)=     116.31        28.14
00803>                   over (min)        1.00         6.00
00804>      Storage Coeff.  (min)=        .49 (ii)    5.59 (ii)
00805>      Unit Hyd. Tpeak (min)=       1.00         6.00
00806>      Unit Hyd. peak  (cms)=       1.48          .20
00807>                                                          *TOTALS*
00808>      PEAK FLOW       (cms)=        .01          .00          .008 (iii)
00809>      TIME TO PEAK    (hrs)=       1.93         2.07         2.000
00810>      RUNOFF VOLUME    (mm)=      60.10        15.90        59.659
```

```
     TOTAL RAINFALL   (mm)=      61.10        61.10         61.101
     RUNOFF COEFFICIENT   =        .98          .26           .976

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

010:0008----------------------------------------------------------------------------
*# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>04:(201   )   |
| OUT<06:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .012  .7000E-02
                           .012  .1000E-02   |     .012  .9400E-02
                           .012  .1000E-02   |     .018  .1020E-01
                           .012  .3000E-02   |     .021  .1080E-01
                           .012  .5000E-02   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >04: (201   )        .20      .066     2.000     59.659
     OUTFLOW<06: (201   )        .20      .012     1.850     59.659
    OVERFLOW<07: (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](%)=   18.887
                    TIME SHIFT OF PEAK FLOW         (min)=    -9.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4573E-02

010:0009----------------------------------------------------------------------------
-----------------------
| ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------------------       (ha)     (cms)   (hrs)   (mm)    (cms)
                        ID1 05:202          .03      .008    2.00   59.66    .000
                       +ID2 06:201          .20      .012    1.85   59.66    .000
                       +ID3 07:OVF          .00      .000     .00     .00    .000
                        ==========================================================
                        SUM 08:Total        .23      .020    2.00   59.66    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

010:0010----------------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
*
----------------------------------------------------------------------------
010:0002----------------------------------------------------------------------------
*
----------------------------------------------------------------------------
010:0002----------------------------------------------------------------------------
*
  ** END OF RUN :  24

*****************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
--------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
             #  1=BUR6_025.stm
----------------------------------------------------------------------------
025:0002----------------------------------------------------------------------------
**************************************************************************|
*#  Project Name: 789-795 BRANT STREET
*#               BURLINGTON, OMTARIO
*#  JOB NUMBER  : 22065
*#       Date   : SEPTEMBER 2022
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 22065.DAT
**************************************************************************|
*
----------------------------------------------------------------------------
025:0002----------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 25-yr 6hr CHICAGO      (A=106
| Ptotal=  71.35 mm|    Comments: Burlington 25-yr 6hr CHICAGO      (A=106
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.182 |   1.67  14.410 |   3.17   7.968 |   4.67   4.068
               .33   3.437 |   1.83  32.881 |   3.33   7.135 |   4.83   3.876
               .50   3.746 |   2.00 135.380 |   3.50   6.477 |   5.00   3.704
               .67   4.128 |   2.17  42.866 |   3.67   5.943 |   5.17   3.548
               .83   4.612 |   2.33  23.321 |   3.83   5.499 |   5.33   3.407
              1.00   5.251 |   2.50  16.365 |   4.00   5.125 |   5.50   3.278
              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 - EXISTING CONDITIONS (To Prospect Street)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .10          .03
     Dep. Storage     (mm)=        1.00        10.80
     Average Slope     (%)=        2.00         2.00
     Length             (m)=      10.00        10.00
     Mannings n              =      .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        41.44
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .46 (ii)    4.83 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.50          .23

                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .041 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.05         2.000
     RUNOFF VOLUME    (mm)=      70.35        21.64        60.605
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .30          .849

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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 102 - EXISTING CONDITIONS (To Brant Street)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .10
| 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .07          .03
     Dep. Storage     (mm)=        1.00        10.80
     Average Slope     (%)=        2.00         2.00
     Length             (m)=      10.00        10.00
     Mannings n              =      .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        41.44
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .46 (ii)    4.83 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.50          .23

                                                      *TOTALS*
     PEAK FLOW       (cms)=        .02          .00          .027 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.05         2.000
     RUNOFF VOLUME    (mm)=      70.35        21.64        53.786
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .30          .754

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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----------------------------------------------------------------------------
*# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .08          .15
     Dep. Storage     (mm)=        1.00        10.80
     Average Slope     (%)=        1.50         1.50
     Length             (m)=      20.00        20.00
     Mannings n              =      .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        36.07
                   over (min)        1.00         8.00
     Storage Coeff.  (min)=        .76 (ii)    8.40 (ii)
     Unit Hyd. Tpeak (min)=       1.00         8.00
     Unit Hyd. peak  (cms)=       1.24          .14

                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .01          .037 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.10         2.000
     RUNOFF VOLUME    (mm)=      70.35        21.64        39.174
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .30          .549

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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----------------------------------------------------------------------------
*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .20
| 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .20          .00
     Dep. Storage     (mm)=        1.00        10.80
     Average Slope     (%)=        2.00         2.00
     Length             (m)=      10.00        10.00
     Mannings n              =      .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        41.44
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .46 (ii)    4.83 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.50          .23

                                                      *TOTALS*
     PEAK FLOW       (cms)=        .08          .00          .076 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.05         2.000
     RUNOFF VOLUME    (mm)=      70.35        21.64        69.860
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .30          .979

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

----------------------------------------------------------------------------
025:0007----------------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .02          .00
     Dep. Storage     (mm)=        1.00        10.80
     Average Slope     (%)=        2.00         2.00
     Length             (m)=      10.00        10.00
     Mannings n              =      .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        41.44
                   over (min)        1.00         5.00
     Storage Coeff.  (min)=        .46 (ii)    4.83 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.50          .23
```

```
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .01          .00           .009 (iii)
     TIME TO PEAK    (hrs)=       1.93         2.05          2.000
     RUNOFF VOLUME    (mm)=      70.35        21.64         69.859
     TOTAL RAINFALL   (mm)=      71.35        71.35         71.347
     RUNOFF COEFFICIENT   =        .99          .30           .979

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

-------------------------------------------------------------------------------
025:0008--------------------------------------------------------------------------
*# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>04:(201   )   |
| OUT<06:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |    (cms)     (ha.m.)
                           .000  .0000E+00    |     .012  .7000E-02
                           .012  .1000E-02    |     .012  .9400E-02
                           .012  .1000E-02    |     .018  .1020E-01
                           .012  .3000E-02    |     .021  .1080E-01
                           .012  .5000E-02    |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)        (mm)
     INFLOW >04: (201   )         .20      .076     2.000      69.860
     OUTFLOW<06: (201   )         .20      .012     1.833      69.860
     OVERFLOW<07: (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](%)=   16.216
                    TIME SHIFT OF PEAK FLOW         (min)=   -10.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5636E-02

-------------------------------------------------------------------------------
025:0009--------------------------------------------------------------------------
----------------------
| ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 05:202            .03     .009    2.00  69.86    .000
                       +ID2 06:201            .20     .012    1.83  69.86    .000
                       +ID3 07:OVF            .00     .000     .00    .00    .000
                        ========================================================
                        SUM 08:Total           .23     .022    2.00  69.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
025:0010--------------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
*
-------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
-------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
-------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*
  ** END OF RUN :  49

********************************************************************************
---------------------
| START             |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
---------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
           #  1=BUR6_050.stm
-------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 789-795 BRANT STREET
*#               BURLINGTON, OMTARIO
*#  JOB NUMBER   : 22065
*#       Date    : SEPTEMBER 2022
*#    Revised    :
*#    Company    : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File    : 22065.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    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   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 - EXISTING CONDITIONS (To Prospect Street)
----------------------
| CALIB STANDHYD    |   Area    (ha)=     .13
| 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .03
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        52.80
                  over (min)       1.00         4.00
     Storage Coeff.  (min)=        .44 (ii)    4.41 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.52          .26
                                                *TOTALS*
     PEAK FLOW       (cms)=        .04          .00           .046 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03          2.000
     RUNOFF VOLUME    (mm)=      77.93        26.23         67.591
     TOTAL RAINFALL   (mm)=      78.93        78.93         78.932
     RUNOFF COEFFICIENT   =        .99          .33           .856

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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 102 - EXISTING CONDITIONS (To Brant Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .10
| 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
---------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .07          .03
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        52.80
                  over (min)       1.00         4.00
     Storage Coeff.  (min)=        .44 (ii)    4.41 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.52          .26
                                                *TOTALS*
     PEAK FLOW       (cms)=        .03          .00           .031 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03          2.000
     RUNOFF VOLUME    (mm)=      77.93        26.23         60.352
     TOTAL RAINFALL   (mm)=      78.93        78.93         78.932
     RUNOFF COEFFICIENT   =        .99          .33           .765

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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--------------------------------------------------------------------------
*# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .15
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      20.00        20.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        44.84
                  over (min)       1.00         8.00
     Storage Coeff.  (min)=        .73 (ii)    7.73 (ii)
     Unit Hyd. Tpeak (min)=       1.00         8.00
     Unit Hyd. peak  (cms)=       1.26          .14
                                                *TOTALS*
     PEAK FLOW       (cms)=        .03          .01           .042 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.10          2.000
     RUNOFF VOLUME    (mm)=      77.93        26.23         44.841
     TOTAL RAINFALL   (mm)=      78.93        78.93         78.932
     RUNOFF COEFFICIENT   =        .99          .33           .568

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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--------------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .20
| 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        52.80
                  over (min)       1.00         4.00
     Storage Coeff.  (min)=        .44 (ii)    4.41 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.52          .26
                                                *TOTALS*
     PEAK FLOW       (cms)=        .08          .00           .084 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03          2.000
     RUNOFF VOLUME    (mm)=      77.93        26.23         77.415
     TOTAL RAINFALL   (mm)=      78.93        78.93         78.932
     RUNOFF COEFFICIENT   =        .99          .33           .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

-------------------------------------------------------------------------------
050:0007--------------------------------------------------------------------------
*# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .02          .00
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
```

```
     Mannings n          =       .013        .250

     Max.eff.Inten.(mm/hr)=     149.30       52.80
                   over (min)        1.00        4.00
     Storage Coeff.  (min)=        .44 (ii)    4.41 (ii)
     Unit Hyd. Tpeak (min)=       1.00        4.00
     Unit Hyd. peak  (cms)=       1.52         .27
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .01         .00          .010 (iii)
     TIME TO PEAK    (hrs)=       1.93        2.03         2.000
     RUNOFF VOLUME    (mm)=      77.93       26.23        77.415
     TOTAL RAINFALL   (mm)=      78.93       78.93        78.932
     RUNOFF COEFFICIENT  =        .99         .33          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

--------------------------------------------------------------------------------
050:0008--------------------------------------------------------------------------
*# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
*
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>04:(201   )   |
| OUT<06:(201   )   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .012  .7000E-02
                           .012  .1000E-02   |     .012  .9400E-02
                           .012  .1000E-02   |     .018  .1020E-01
                           .012  .3000E-02   |     .021  .1080E-01
                           .012  .5000E-02   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------         (ha)     (cms)     (hrs)       (mm)
     INFLOW >04: (201   )         .20      .084     2.000     77.415
     OUTFLOW<06: (201   )         .20      .012     1.800     77.415
    OVERFLOW<07: (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](%)=   14.697
                    TIME SHIFT OF PEAK FLOW        (min)=   -12.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.6474E-02

--------------------------------------------------------------------------------
050:0009--------------------------------------------------------------------------
------------------------
| ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------ ----------------- (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 05:202           .03      .010   2.00  77.41    .000
                       +ID2 06:201           .20      .012   1.80  77.42    .000
                       +ID3 07:OVF           .00      .000    .00    .00    .000
                        ========================================================
                        SUM 08:Total          .23      .023   2.00  77.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
050:0010--------------------------------------------------------------------------
* RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------------
*
  ** END OF RUN :  99

********************************************************************************




--------------------
| START             |  Project  dir.: T:\PROJECTS\22065\SWMHYMO\
-------------------  Rainfall dir.: T:\PROJECTS\22065\SWMHYMO\
    TZERO =    .00 hrs on      0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=BUR6_100.stm
--------------------------------------------------------------------------------
100:0002--------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 789-795 BRANT STREET
*#               BURLINGTON, OMTARIO
*#  JOB NUMBER  : 22065
*#       Date   : SEPTEMBER 2022
*#    Revised   :
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   : 22065.DAT
*#*************************************************************************|
*
--------------------------------------------------------------------------------
100:0002--------------------------------------------------------------------------
*
--------------------
| READ STORM        |    Filename: Burlington 100-yr 6hr CHICAGO        (A=
| Ptotal=  86.27 mm|    Comments: Burlington 100-yr 6hr CHICAGO        (A=
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   3.862 |   1.67  17.445 |   3.17   9.657 |   4.67   4.936
              .33   4.172 |   1.83  39.736 |   3.33   8.649 |   4.83   4.704
              .50   4.546 |   2.00 163.177 |   3.50   7.853 |   5.00   4.495
              .67   5.008 |   2.17  51.779 |   3.67   7.206 |   5.17   4.306
              .83   5.595 |   2.33  28.205 |   3.83   6.670 |   5.33   4.135
             1.00   6.369 |   2.50  19.806 |   4.00   6.217 |   5.50   3.979
             1.17   7.443 |   2.67  15.465 |   4.17   5.829 |   5.67   3.835
             1.33   9.048 |   2.83  12.795 |   4.33   5.492 |   5.83   3.703
             1.50  11.752 |   3.00  10.979 |   4.50   5.197 |   6.00   3.581

--------------------------------------------------------------------------------
100:0003--------------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#

**#*************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS (To Prospect Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 01:101    DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   80.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .03
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     163.18        62.91
                   over (min)        1.00         4.00
     Storage Coeff.  (min)=        .43 (ii)    4.13 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.53          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .050 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03         2.000
     RUNOFF VOLUME    (mm)=      85.27        30.90        74.397
     TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
     RUNOFF COEFFICIENT  =        .99          .36          .862

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

--------------------------------------------------------------------------------
100:0004--------------------------------------------------------------------------
*# CATCHMENT 102 - EXISTING CONDITIONS (To Brant Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .10
| 02:102    DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   66.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .07          .03
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     163.18        62.91
                   over (min)        1.00         4.00
     Storage Coeff.  (min)=        .43 (ii)    4.13 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.53          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .034 (iii)
     TIME TO PEAK    (hrs)=       1.93         2.03         2.000
     RUNOFF VOLUME    (mm)=      85.27        30.90        66.785
     TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
     RUNOFF COEFFICIENT  =        .99          .36          .774

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

--------------------------------------------------------------------------------
100:0005--------------------------------------------------------------------------
*# ALLOWABLE - EXISTING CONDITIONS (Allowable Discharge)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 03:101    DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .08          .15
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      20.00        20.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     163.18        56.39
                   over (min)        1.00         7.00
     Storage Coeff.  (min)=        .71 (ii)    7.09 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.29          .16
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .02          .049 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.08         2.000
     RUNOFF VOLUME    (mm)=      85.27        30.90        50.474
     TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
     RUNOFF COEFFICIENT  =        .99          .36          .585

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

--------------------------------------------------------------------------------
100:0006--------------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
**#*************************************************************************|
*# CATCHMENT 201 - PROPOSED CONDITIONS (Controlled To Prospect Street)
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .20
| 04:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .00
     Dep. Storage     (mm)=       1.00        10.80
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      10.00        10.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     163.18        62.91
                   over (min)        1.00         4.00
     Storage Coeff.  (min)=        .43 (ii)    4.13 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
     Unit Hyd. peak  (cms)=       1.53          .28
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .09          .00          .092 (iii)
     TIME TO PEAK    (hrs)=       1.95         2.03         2.000
     RUNOFF VOLUME    (mm)=      85.27        30.90        84.727
     TOTAL RAINFALL   (mm)=      86.27        86.27        86.271
     RUNOFF COEFFICIENT  =        .99          .36          .982

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  70.0    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.

--------------------------------------------------------------------------------
100:0007--------------------------------------------------------------------------
```

```
01621> *# CATCHMENT 202 - PROPOSED CONDITIONS (Uncontrolled To Brant Street)
01622> ---------------------
01623> | CALIB STANDHYD     |   Area    (ha)=     .03
01624> | 05:202    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
01625> ---------------------
01626>                             IMPERVIOUS    PERVIOUS (i)
01627>      Surface Area     (ha)=        .02          .00
01628>      Dep. Storage     (mm)=       1.00        10.80
01629>      Average Slope     (%)=       2.00         2.00
01630>      Length            (m)=      10.00        10.00
01631>      Mannings n             =       .013         .250
01632>
01633>      Max.eff.Inten.(mm/hr)=     163.18        62.91
01634>                   over (min)        1.00         4.00
01635>      Storage Coeff.  (min)=        .43 (ii)    4.13 (ii)
01636>      Unit Hyd. Tpeak (min)=       1.00         4.00
01637>      Unit Hyd. peak  (cms)=       1.53          .28
01638>                                                          *TOTALS*
01639>      PEAK FLOW       (cms)=        .01          .00           .011 (iii)
01640>      TIME TO PEAK    (hrs)=       1.93         2.03          2.000
01641>      RUNOFF VOLUME    (mm)=      85.27        30.90         84.727
01642>      TOTAL RAINFALL   (mm)=      86.27        86.27         86.271
01643>      RUNOFF COEFFICIENT   =        .99          .36           .982
01644>
01645>        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
01646>            CN* =  70.0    Ia = Dep. Storage  (Above)
01647>       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
01648>            THAN THE STORAGE COEFFICIENT.
01649>      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
01650>
01651> ------------------------------------------------------------------------------
01652> 100:0008---------------------------------------------------------------------
01653> *# ROUTE CATCHMENT 201 THROUGH ORIFICE CONTROL
01654> *
01655> ---------------------
01656> | ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
01657> |  IN>04:(201   )    |
01658> | OUT<06:(201   )    |    =========  OUTLFOW STORAGE TABLE  =========
01659> ---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
01660>                            (cms)    (ha.m.)   |    (cms)    (ha.m.)
01661>                             .000  .0000E+00   |     .012  .7000E-02
01662>                             .012  .1000E-02   |     .012  .9400E-02
01663>                             .012  .1000E-02   |     .018  .1020E-01
01664>                             .012  .3000E-02   |     .021  .1080E-01
01665>                             .012  .5000E-02   |     .000  .0000E+00
01666>
01667>      ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
01668>      --------------------       (ha)     (cms)     (hrs)       (mm)
01669>      INFLOW >04: (201   )        .20      .092     2.000     84.727
01670>      OUTFLOW<06: (201   )        .20      .012     1.767     84.727
01671>     OVERFLOW<07: (OVF   )        .00      .000      .000       .000
01672>
01673>                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
01674>                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
01675>                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
01676>
01677>
01678>                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   13.442
01679>                    TIME SHIFT OF PEAK FLOW       (min)=   -14.00
01680>                    MAXIMUM  STORAGE   USED       (ha.m.)=.7315E-02
01681>
01682> ------------------------------------------------------------------------------
01683> 100:0009---------------------------------------------------------------------
01684> ----------------------
01685> | ADD HYD (Total     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
01686> ----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
01687>                       ID1 05:202             .03     .011    2.00  84.73    .000
01688>                      +ID2 06:201             .20     .012    1.77  84.73    .000
01689>                      +ID3 07:OVF             .00     .000     .00    .00    .000
01690>                       ==========================================================
01691>                       SUM 08:Total           .23     .024    2.00  84.73    .000
01692>
01693>    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
01694>
01695> ------------------------------------------------------------------------------
01696> 100:0010---------------------------------------------------------------------
01697> * RUN REMAINING DESIGN STORMS (City of Burlington 5 TO 100-YR)
01698> *
01699> ------------------------------------------------------------------------------
01700> 100:0002---------------------------------------------------------------------
01701> *
01702> ------------------------------------------------------------------------------
01703> 100:0002---------------------------------------------------------------------
01704> *
01705> ------------------------------------------------------------------------------
01706> 100:0002---------------------------------------------------------------------
01707> *
01708> ------------------------------------------------------------------------------
01709> 100:0002---------------------------------------------------------------------
01710> *
01711> ------------------------------------------------------------------------------
01712> 100:0002---------------------------------------------------------------------
01713> *
01714>       FINISH
01715> ------------------------------------------------------------------------------
01716> ******************************************************************************
01717>      WARNINGS / ERRORS / NOTES
01718>      -------------------------
01719>    Simulation ended on 2022-09-09     at 11:38:42
01720> ==============================================================================
01721>
01722>
```

APPENDIX C

FIRE FLOW ANALYSIS

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

Project Number: 22065
Project Name: 789-795 Brant Street
Date: 15-Aug-22

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 wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

	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)**
31-Storey Building	**987.3**	**31**	**30605**	**0.8**	31000	516.7	**-15**	-4650.0	**26350.0**	**-50**	-13175.0	35	9222.5	**22000**	**367**

(2) Occupancy

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

(3) Sprinkler

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

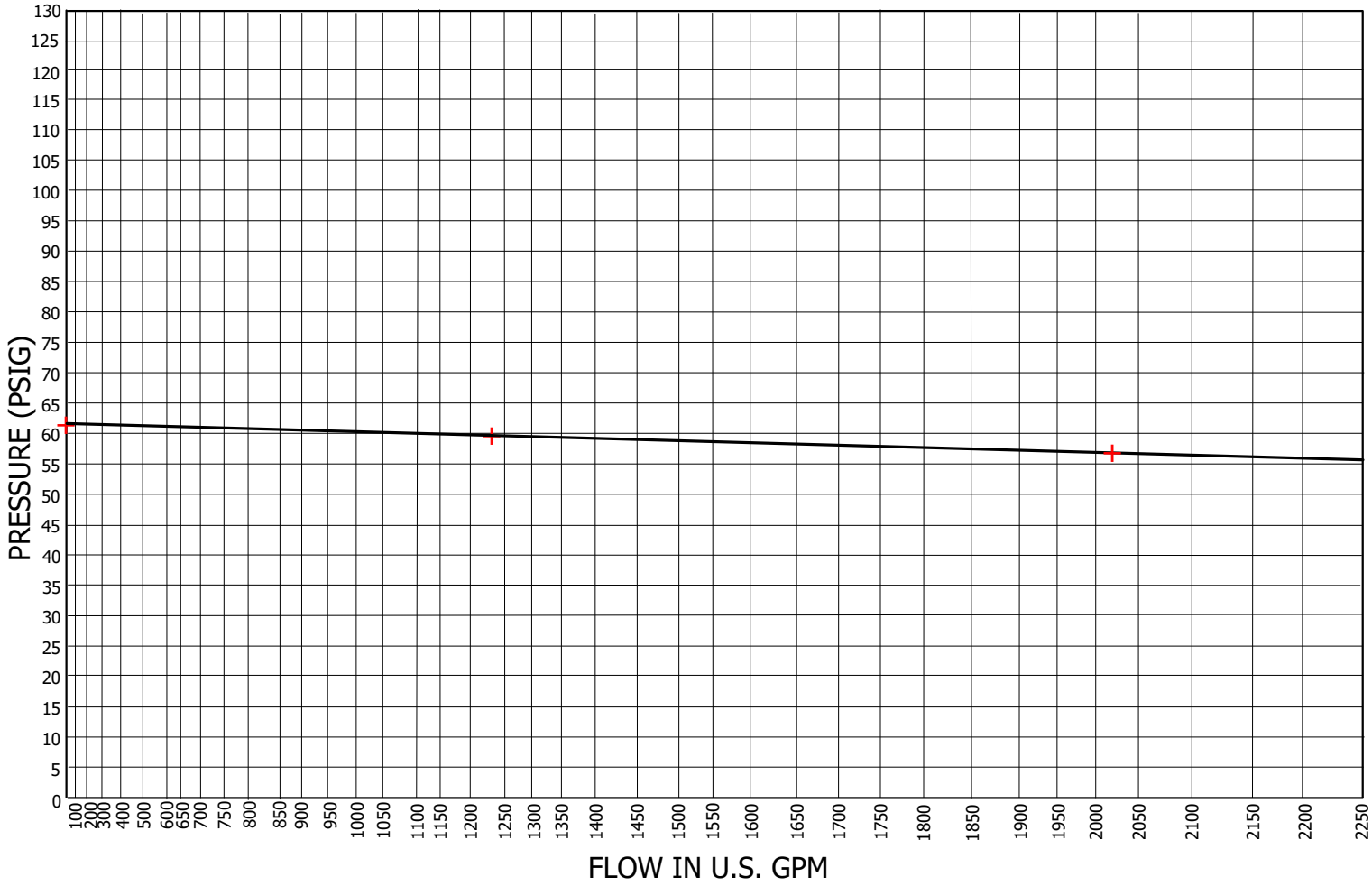
If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

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

(4) Exposure

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

Side	Exposure (m)	Charge (%)
North =	**30.1 to 45m**	**5**
South =	**0 to 3m**	**25**
East =	**30.1 to 45m**	**5**
West =	**>45**	**0**
Total Expoure =		***35***



# of Ports	PORT DIA. (in/mm)	PITOT (psig)	FLOW (usgpm)	RESIDUAL (psig)
1	2.50/63	54	1233	60
2	2.50/63	36/36	2014	57
THEORETICAL FLOW @ 20psi			7355	

General Data	
Test Date	23 October 2020
Test Time	08:30am
Pipe Dia.	16"
Static	62

Site Information	
Site or Developer Name	S. Llewellyn & Associates
Site Address/Municipality	Brant Street, Burlington
Location of Test Hydrant	Front of 786 Brant Street
Location of Base Hydrant	Front of 760 Brant Street
Technician's Comments	No conversion factor used for flow calculation based on round and flush internal nozzle
	configuration. Flow testing has been conducted in accrodance with NFPA 291 guidelines
	wherever possible. Refer to attached report for further information.
	Verified By: Mark Schmidt

APPENDIX D

GEOTECHNICAL INVESTIGATION

PRELIMINARY GEOTECHNICAL INVESTIGATION

789-795 Brant Street
Burlington, Ontario

Client

Camarro Developments Inc.
25 Main Street West, Unit 1702
Hamilton, ON L8P 1H1

Project Number

BIGC-ENV-461A

Prepared By:

B.I.G. Consulting Inc.
12-5500 Tomken Road
T: 416.214.4880
www.bigconsultinginc.com

Date Submitted

July 29, 2021

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- Records of Boreholes

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1 Introduction

B.I.G. Consulting Inc. (BIG) has been retained by Camarro Developments Inc. (the Client) to conduct a preliminary geotechnical investigation for the proposed development on the property located at 789-795 Brant Street, Burlington, Ontario (the Site). The Site location plan is shown on Figure 1 in Appendix A.

The investigation was authorized by Mr. Kyle Camarro on behalf of the Client.

It is our understanding that the proposed development will comprise of a High-rise Building with 5-Levels of underground parking structure.

The field work for this investigation was carried out in conjunction with Phase I Environmental Site Assessment (ESA I), Hydrogeological Investigation (HG) and Filing of Record of Site Condition (RSC). This report addresses the geotechnical aspects of the proposed development only and the reports for the ESA I, HG and RSC will be issued under separate covers.

The purpose of this investigation was to obtain the information on the subsurface soil and groundwater conditions at the Site by means of advancing a limited number of boreholes, in-situ tests as well as laboratory tests of selected soil samples and based on this information to prepare an engineering report on geotechnical perspective pertaining to the preliminary design and construction of the proposed development. Final design drawings of the proposed development were not available to BIG at the time of preparation of this report. Therefore, once the existing buildings are demolished and final design drawings are available, additional investigation and analysis will be necessary and further recommendations will be provided as appropriate.

The recommendations and comments made in this report are based on factual information and are intended only to use for the design engineers. The number of boreholes, depths, tests data and their interpretation presented in this report may not be sufficient to determine all the factors that may have effects on the design and construction of the proposed development.

The report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. On-going liaison with BIG during the final design and construction phase of the project is recommended to ensure that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed development should be directed to BIG for further elaboration and/or clarification.

The attached 'Report Limitations' is an integral part of this report.

2 Site Description

The municipal address of the Site is 789-795 Brant Street which is located at the southeast corner of Brant Street and Prospect Street in Burlington, Ontario. The Site is bound to the west by Brant Street followed by commercial properties, to the north by Prospect Street followed by commercial and residential properties, to the east by residential properties, and to the south by a commercial property. For the simplicity of the description in this report, Brant Street and Prospect Street have been considered running north-south and east-west respectively.

The Site is irregular in shape and measures approximately 2,250 m^2 in area. The Site is currently occupied by one 1-Storey slab-on-grade commercial building at 795 Brant Street, and another 2-storey

commercial building with 1-Level of basement and a parking garage at 789 Brant Street (Site buildings). The Site buildings have a combined footprint area of approximately 420 m² and occupy approximately 19 % of the Site area. The areas surrounding the Site buildings are covered with asphalt and landscaping.

The topography of the site was generally flat. Based on the ground surface elevation at borehole locations, a grade difference, in order of 0.4 m, was noted across the site.

3 Field Investigation Procedures

Prior to initiating the subsurface investigation activities, the borehole locations were marked at the Site by BIG personnel and all applicable public utility services (Gas, Bell, Rogers, Hydro, Network cables, etc.) were cleared with the assistance of Ontario-One-Call. A Private Utility Locator was also retained to locate underground private utility lines adjacent to the borehole locations to ensure the lines will not be damaged and safety of the worker during the investigation work.

The fieldwork for this investigation was carried out between June 10 and 19, 2021 and consisted of advancing a total of 5-Boreholes BH/MW1 to BH/MW5 to depths varying between 19.8 and 24.8 m below the existing ground surface (BGS) including bedrock coring in all 5-Boreholes. Bedrock was cored using wire line diamond coring method to confirm the presence and quality of bedrock. The approximate borehole/core-hole locations established and drilled/cored at the Site are shown on Figure 2 in Appendix A.

The boreholes were advanced by using power operated solid and hollow stem continuous flight augers (truck-mounted drill rig), supplied and operated by a specialist drilling contractor, working under the full-time supervision of an experienced BIG geotechnical personnel. Soil samples of the overburden were generally taken at 0.76 m or 1.5 m intervals while performing the Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg hammer for a vertical distance of 0.76m to drive a 51 mm outer diameter split-barrel (split-spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the ground by a vertical distance of 0.30 m was recorded as SPT 'N' value of the soil which indicates the consistency of cohesive soils or the relative density of non-cohesive soils.

The BIG's drilling supervisor examined and logged the overburden soil/rock-core samples as they were obtained from the boreholes. The recovered soil samples were sealed in clean, airtight plastic bags and rock-core samples were put in wooden box, and transferred to the BIG's Mississauga laboratory for further examination and laboratory testing.

Groundwater observations were made in all boreholes during and immediately upon completion of drilling. In order to obtain the information on stabilized groundwater levels, all boreholes were equipped with monitoring wells, one in each borehole, upon completion of drilling. Monitoring Wells installation details are shown on the Record of Borehole logs, and the details of the groundwater observation are presented on Section 4.7.

The ground surface elevations at the borehole locations were surveyed by BIG personnel with reference to Monument No. BM1045 shown on City of Burlington Monument Position Sketch, dated March 31, 2015 with a Geodetic Elevation of 93.477 mASL, which is located at Culvert over Rambo Creek on Prospect Street, 45 m Southwest of Pearson Street and 560 m Northeast of Brant Street.

It should be noted that the ground surface elevations at the borehole locations are approximate and should not be used for design and construction purpose. Contractors performing the work should confirm the elevations prior to construction. The borehole locations plotted on Borehole/Monitoring

Well Location Plan are based on the measurements of the Site features and should be considered to be approximate.

4 Subsurface Conditions

The following summary is to assist the designers of the project with an understanding of the anticipated subsurface conditions across the Site. However, it should be noted that the subsurface soil/rock and groundwater conditions between and beyond the drilled borehole locations may differ from those encountered at the borehole locations, and conditions may become apparent during the construction, which could not be detected or anticipated at the time of the Site investigation. The boundaries between the various strata as shown on the Record of Boreholes are based on the non-continuous sampling and represent an inferred transition between the various strata and their lateral continuation, rather than a precise plane of geological change.

Based on the subsurface conditions encountered at the borehole locations, the soil profile generally consisted of ground surface cover (topsoil and asphalt pavement) overlying existing fills, which in turn was underlain by native clayey silt till, silty sand till, clayey silt till and Shale bedrock, respectively.

A brief description of the subsurface stratigraphy and groundwater conditions encountered at the borehole locations are summarized, in order of depth, in the following sections and more information are provided in the Record of Boreholes presented in the Appendix B.

4.1 Ground Surface Cover

Borehole, BH/MW1 was advanced through an existing ground surface cover consisting of approximately 120 mm thick topsoil. Topsoil in general, consists of high contents of organics and rootlets. It should be noted that topsoil thickness may vary between and beyond the borehole locations, and thickness could also be changed significantly due to some on-site activities. Therefore, it is recommended that allowance be made for possible variations when making construction estimates.

Remaining boreholes BH/MW2 to BH/MW5 were advanced through existing asphalt pavement consisting of approximately 50-80 mm thick asphalt concrete over 120 to 150 mm thick granular bases.

4.2 Existing Fill

Below the ground surface cover in all boreholes, existing fill generally consisted of clayey silt with trace to some sand, and trace to some gravels were encountered in all boreholes that extended to depths varying between 1.5 and 2.3 mBGS. Fill also contained occasional Shale fragments, glass pieces, and trace organics.

The SPT 'N' values recorded were generally varied from 4 to 12 blows per 300 mm of penetration indicating soft to stiff consistencies. The moisture content measurement of the recovered samples generally varied between 8 and 22 % by weight indicating a moist condition.

4.3 Upper Clayey Silt Till

Below existing fill in all borehole, native deposit of upper clayey silt till was encountered that extended to depths varying between 3.1 and 6.1 mBGS. Clayey silt till deposit also contained trace to sand and trace gravel.

The SPT 'N' values recorded in this till deposit varied from 9 to over 50 blows per 300 mm of penetration indicating stiff to hard consistencies. The moisture content measurement of the recovered samples was between 12 and 23 % by weight, indicating moist to very moist conditions.

Due to the nature of till formation, cobbles and boulders should be anticipated within the glacial till deposits.

Geotechnical laboratory test consisting of Particle Size Analysis (Hydrometer) was conducted on selected soil sample from this deposit as summarized below:

Particle Size Analysis Test Results:

Borehole No.	Sample No.	Approx. Sample Depth (m)	% Gravel	% Sand	% Silt	% Clay
BH/MW1	SS5	3.4	6	26	48	20

Based on the above noted information, the on-Site native soil may be classified as clayey silt till, sandy with trace gravel.

Summary of test results are also included in the respective Record of Boreholes in Appendix B and Lab Test Reports are included in Appendix C.

4.4 Silty Sand Till

Below upper clayey silt till in boreholes BH/MW2 to BH/MW5, a layer on glacial silty sand till was encountered that extended to depths varying between 3.2 to 4.6 mBGS. Silty sand till also contained trace clay, and trace to some gravel.

The SPT 'N' values recorded in this layer varied from 21 to over 50 blows per 300 mm of penetration indicating compact to very dense relative density. The moisture content measurement of the recovered samples was between 10 and 16 % by weight, indicating moist to wet conditions.

Geotechnical laboratory test consisting of Particle Size Analysis (Hydrometer) test was conducted on selected soil sample from this deposit as summarized below:

Particle Size Analysis Test Results:

Borehole No.	Sample No.	Approx. Sample Depth (m)	% Gravel	% Sand	% Silt	% Clay
BH/MW3	SS5	3.4	20	41	32	7

Based on the above noted information, the on-Site native soil may be classified as silty sand till with some gravel and trace clay.

Summary of test results are also included in the respective Record of Boreholes in Appendix B and Lab Test Reports are included in Appendix C.

4.5 Lower Clayey Silt Till

Below silty sand till in boreholes BH/MW3 and BH/MW5, another glacial deposit of lower clayey silt till was encountered that extended to the depth of 6.1 mBGS. Clayey silt till deposit also contained trace to some sand and trace gravel.

The SPT 'N' values recorded in this till deposit were over 50 blows per 300 mm of penetration indicating a hard consistency. The moisture content measurement of the recovered samples varied between 5 and 12 % by weight, indicating a moist condition.

4.6 Shale Bedrock

Below upper clayey silt till at borehole BH/MW1; below sandy silt till at boreholes BH/MW2 and BH/MW4; and below lower clayey silt till at boreholes BH/MW3 and BH/MW5; highly weathered to excellent quality of reddish brown/grey Shale bedrock was encountered in all boreholes.

Further, from borehole auger termination depths into the Shale bedrock varying between 11.9 and 12.2 mBGS, HQ size samples of Shale bedrock were cored to the depths varying between 19.8 and 24.8 mBGS. The percentage of recoveries of rock core samples were between 86% and 100%, however, the Rock Quality Designation (R.Q.D.) values were found widely varying between 0% and 100%, indicating very poor to excellent quality of rock mass. Within the Shale bedrock core samples, occasional interbedded Limestone layers were also present.

More information pertaining to bedrock and rock cores are provided in the respective Record of Boreholes in Appendix B and the Pictures of Rock Core Samples are included in Appendix D.

4.7 Groundwater Observation

Groundwater observations were made in all boreholes during and immediately upon completion of drilling. It should be noted that the sufficient time was not available for the groundwater to stabilize within open boreholes/monitoring wells immediately upon completion of drilling and sampling operations. In order to obtain information on the stabilized groundwater level in conjunction with hydrogeological investigation, all boreholes were equipped with Monitoring Wells, one in each borehole, upon completion of drilling.

Groundwater observation made in open boreholes during Site exploration as well as the groundwater levels recorded in the installed monitoring wells on June 28, 2021 are tabulated below:

Groundwater Observation:

Borehole No.	Ground Elevation (m)	Borehole Depth (mBGS)	MW Depth (mBGS)	Screen Length (m)	Groundwater Depth (mBGS)/Elevation (mASL)	
					Upon Completion of Drilling	June 28, 2021
BH/MW1	92.24	19.8	15.2	3	*	2.09 / 90.15
BH/MW2	92.34	20.4	15.2	3	*	2.14 / 90.20
BH/MW3	92.55	24.7	21.3	3	*	2.60 / 89.95
BH/MW4	92.12	20.3	16.8	3	*	1.94 / 90.18
BH/MW5	92.17	24.8	19.8	3	*	2.03 / 90.10

mBGS: Meter Below Ground Surface
mASL: Meter Above Sea Level
**: Not measured due to Drilling Water Introduced for Rock Coring.*

Records of groundwater observation are also shown on the respective Record of Boreholes. It should be noted that the groundwater levels at the Site may fluctuate seasonally and may be expected to be somewhat higher during the spring months and in response to major weather events.

5 Engineering Discussion and Recommendation

It is our understanding that the proposed development will comprise of a High-rise Building with 5-Levels of underground parking structure. Final design drawings of the proposed development were not available to BIG at the time of preparation of this report. Therefore, once the existing buildings are

demolished and final design drawings are available, additional investigation and analysis will be necessary and further recommendations will be provided as appropriate.

It is anticipated that the Finished Floor of 5-Levels of underground parking structure of the proposed high-rise building will be at an approximate depth of 15 mBGS, and the footings will be founded approximately between 16 and 17 mBGS (approximately elevations between 76 and 75 mASL) on Shale bedrock. However, based on very poor conditions of bedrock at few borehole locations, foundations may need to be founded on deeper depths as recommended in Foundation Options and Design Parameters section.

Considering the shallow measurements of stabilized groundwater levels in the monitoring wells varying between elevations of 90.20 and 89.95 mASLs, an appropriate temporary groundwater control system should be designed, installed and operated by an experienced dewatering contractor, prior to excavation and duration of below grade construction works, in order to preserve the structural integrity of the sidewalls and base of excavation. The hydrogeological investigation report provides details of the anticipated construction dewatering quantities and permit requirements.

The recommendations and comments provided in this report are based on factual information obtained from this preliminary investigation and are intended only to use for the design engineers. The number of boreholes, tests data and their interpretation presented in this report may not be sufficient to determine all the factors that may have effects on the design and construction of the proposed development.

The following preliminary discussion and recommendations should be revised or supplemented where necessary, when the conditions of the proposed development are different from the noted conditions/assumptions.

5.1 Grading and Site Preparation

As parts of effective and efficient design and construction of the proposed development, following items highlight the fundamental geotechnical requirements to be considered during Grading and Site Preparation. Detailed recommendations are provided in the following sections:

a) All ground surface cover (asphalt pavement, topsoil, existing fill, construction debris, soft/loose/wet materials containing organics, etc.) should be stripped and removed from the area of the proposed development.
b) It is our understanding that all existing buildings at the Site will be demolished, and the floor slabs, foundations, and underground infrastructure of the demolished buildings will be removed completely.
c) Any existing infrastructures (e.g., manholes, catch basins, buried structures, construction debris, etc.) should be sub-excavated and removed from the area of the proposed development, if they are located in the zone of influence of foundations of the proposed building. The zone of influence of the foundation is defined as an area laterally extending 1 m beyond the bottom edge of the foundation with downward slope of 1H:1V. Furthermore, any existing underground services, outside of the foundation influence, should be either removed or abandoned by injecting with non-shrinkable grout.
d) Care must be taken during excavation near any existing structures and underground services/utilities located within or adjacent to the excavation. Foundations of heavily loaded settlement sensitive structures and utilities located within the close proximity to the proposed excavation should be accurately located and supported adequately with the suitable temporary or permanent support system where required, prior to excavation, to preserve the integrity of these

structures. Similarly, the excavation near the vicinity of any existing structure should be carried out without disturbing and/or undermining their foundations.

e) Where open excavation is not feasible, a properly designed perimeter shoring system should be installed prior to the mass excavation for the proposed development. For the drilling and installation of shoring system (e.g., caissons, etc.), travel path and working platform areas of the Site for drill rig must be properly prepared, inspected and approved by a geotechnical engineer from BIG prior to starting the installation of shoring system.

f) An appropriate temporary groundwater control system should be designed, installed and operated by an experienced dewatering contractor prior to excavation and keep the base of excavation dry all the times for the duration of below grade construction works, in order to preserve the structural integrity of the founding soils. The groundwater level should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation). In no case should the footing be placed on dilated or disturbed subgrade level.

g) The base of excavation at design subgrade level should be inspected and approved by a geotechnical engineer from BIG. During inspection, any soft/loose and wet spots identified, should be sub-excavated and replaced with compacted approved material as directed by the geotechnical engineer.

h) Any fill, required to be used, should be used as an engineered fill. Materials used for engineered fill may consist of portion of the approved on-site soils and/or imported soils (OPSS Granular B, OPSS Select Sub-grade) which do not contain organics and deleterious materials. Some reconditioning (i.e., drying) prior to reuse may require, if the materials are found to be too wet. However, any imported soils to the Site for engineered fill must meet the requirements of O. Reg. 153/04 as determined by BIG.

i) To reduce the post-construction settlements, all new fills should be placed in thin lifts, not exceeding 200 mm thick loose lifts, within ±2 % of its optimum moisture content, and thoroughly compacted with suitable heavy compactors to at least 98% of Standard Proctor Maximum Dry Density (SPMDD) of the fill material, before placing the next lift.

j) Surface water runoff from the neighboring properties should not be permitted to enter and/or pond within the construction area. Consideration should be given to redirecting the surface water runoff from the neighboring properties (temporary and/or permanent) if there would be a down gradient and grade difference between site grades and existing neighboring property grades. This is especially important to the success of the planned construction.

k) The existing on-site soils are susceptible to disturbance when exposed to weather and construction traffics. Construction traffic over exposed subgrade materials should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, adequately reinforced haul roads (e.g., increased thickness of granular sub-base, geo-fabrics, etc.) should be constructed to reduce disturbance to the subgrade soils. Similarly, if the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional subbase material is best determined during construction.

5.2 Foundation Options and Design Parameters

Based on the preliminary information obtained from the investigation, the Site is considered suitable for the construction of the proposed development from geotechnical viewpoint. Following foundation options are recommended for the design and construction of the proposed developments. The selection of the option would predominantly depend on the estimated cost, project schedule, ease of construction, etc.

OPTION-1: Conventional Strip/Spread Footings

Considering existing bedrock and groundwater conditions, the proposed building can be supported by conventional spread/strip footings with the following preliminary geotechnical bearing resistances at Serviceability Limits State (SLS) and factored geotechnical bearing resistance at Ultimate Limit State (ULS) subject to inspection and adequate groundwater control during construction:

Preliminary Geotechnical Bearing Resistances at Borehole Locations:

BH No.	Ground Elevation (m)	Approximate Footing Elevation (mASL)	Geotechnical Bearing Resistance at SLS (kPa)	Fac. Geotechnical Bearing Resistance at ULS (kPa)
BH/MW1	92.24	76 - 75	-	2000
BH/MW2	92.34	76 - 75	-	2000
BH/MW3	92.55	76 - 75	-	2000
BH/MW4	92.12	76 - 75	1000	1500
		75 or below	-	2000
BH/MW5	92.17	76 - 75	1000	1500
		75 or below	-	2000

mBGS: Meter Below Ground Surface
mASL: Meter Above Sea Level

It should be noted that higher bearing capacity may be available subject to review of final design drawings and additional deeper investigation and analysis after the demolition of the existing structures.

It should be noted that, in the areas, if the footing excavation has to be extended deeper than the design depth/elevation (e.g., BH/MW4 and BH/MW5) to the competent bedrock levels, then consideration may be given placing the footing on competent bedrock levels or raise the grade to the design footing level using the un-shrinkable concrete of minimum 20 MPa strength. In this case, higher factored geotechnical bearing resistance at Ultimate Limit State (ULS) can be used.

The minimum footing sizes, footing thickness, excavations and other footing requirements should be designed in accordance with the latest edition of the Ontario Building Code. However, a minimum width of 600 mm is recommended for the strip footings.

A temporary groundwater control system should be in place prior to excavation and groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation). The base of excavation should be kept dry all the time for the duration of below grade construction works, in order to preserve the structural integrity of the founding bedrock. In no case should the footing be placed on disturbed bedrock subgrade.

The Shale bedrock, if left exposed, will slake. Therefore, we recommend that the foundations should be poured as soon as possible on completion of excavation, or the base of excavation should be skim coated with a lean mix concrete, minimum 75 mm thick, to level and protect the integrity of exposed subgrade.

Where, it is necessary to place foundations at different levels, the upper foundation must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower foundation. The lower footing must be installed first to help minimize the risk of undermining the upper footings/foundations.

Total and differential settlements for footings founded on Shale bedrock and designed as outlined above should not exceed 25 and 19 mm respectively, provided that the founding subgrade is not loosened or softened by construction activities or prolonged exposure to the weather. However, for sound Shale bedrock, the foundation design is not governed by resistance at Serviceability Limit State (SLS) since the stress required to produce 25 mm of deformation will generally be much larger than the factored resistance at ULS.

Prior to the placement of concrete, all footing subgrades must be inspected and approved by a geotechnical engineer from BIG to ensure that the founding soils are similar to those identified in the boreholes and are capable of supporting the design bearing resistance.

OPTION-2: Raft Foundation

Alternatively, if the bearing resistance provided above is not sufficient, the proposed building may also be supported by continuous raft foundation using the following preliminary geotechnical bearing resistance at an approximate elevation of 75.0 mASL subject to inspection and adequate groundwater control during construction:

- Factored Ultimate Limit State (ULS) = 3000 kPa

The advantage of raft foundation is that the wall and column loads are distributed over the entire area of the raft slab, thereby greatly reducing the bearing pressures and the differential settlements. The thickness and reinforcement of the raft foundation should be designed by a structural engineer to account for differential settlements.

Groundwater (if any) should be kept at least 1 m below the base of excavation during the below grade construction works in order to preserve the structural integrity of the founding soils. In no case should the footing be placed on disturbed bedrock subgrades.

The Shale bedrock, if left exposed, will slake. Therefore, it is recommended that the foundation should be constructed as soon as possible on the completion of excavation, or the base of excavation should be skim coated with a lean mix concrete, minimum 75 mm thick, to level and protect the integrity of exposed subgrade.

A granular bed minimum 200 mm thick Granular 'A' or its equivalent, compacted to at least 98 % of SPMDD, is recommended below the raft foundation. A modulus of subgrade reaction of 40,000 kN/m^3 may be used for the design of the raft slab.

Total and differential settlements for raft footing founded on Shale bedrock and designed as outlined above should not exceed 50 and 20 mm respectively, provided that the founding subgrade is not softened by construction activities or prolonged exposure to the weather. However, for Shale bedrock, the foundation design is not governed by resistance at Serviceability Limit State (SLS) since the stress required to produce 50 mm of deformation will be much larger than the factored resistance at ULS.

Prior to the placement of concrete, foundation subgrade must be inspected and approved by a geotechnical engineer from BIG to ensure that the founding soils are similar to those identified in the boreholes and are capable of supporting the design bearing resistance.

5.3 Floor Slab Construction

For Option-1 above, the subsoil immediately under 5th level of underground parking garage slab will consist of poor to good quality of Shale bedrock. The floor-slab on this bedrock can be designed and constructed as a conventional slab-on-grade method provided that the proper dewatering measures are in place.

A floor bedding consisting of at least 200 mm of Granular A (OPSS 1010) or its approved equivalent, is recommended to improve the support and work as a moisture barrier. The bedding should be compacted to at least 98% of SPMDD. A polyethylene vapour barrier or equivalent may be placed on the granular bedding if a moisture sensitive finish is to be placed on the floor.

The thickness of the concrete slab and the reinforcement (if any) should be designed by a structural engineer. A modulus of subgrade reaction of 40,000 kN/m^3 may be used for the design of the floor slab, provided that the construction is in accordance with the recommendations provided herein.

The floor slab should not be tied to any load-bearing walls or columns unless they have been designed accordingly. Contraction and expansion joints should be provided for the slabs as required by the structural engineer.

5.4 Permanent Perimeter and Under-floor Drainage

Permanent perimeter drainage system should be provided around the perimeter walls of the underground parking structure. Where adequate space is not available for open-cut excavation with slopes, then properly designed vertical shoring system should be installed to support the sides of excavation. In this case, a permanent perimeter drainage system consisting of pre-fabricated continuous vertical blanket, Miradrain 6000 or its equivalent, should be used at and along the shoring location, just outside of the perimeter walls of the underground parking structure. Several collection pipes, installed through the perimeter walls, connect the pre-fabricated perimeter vertical drains with the solid collector pipe installed in a positive grade leading to a frost-free sump. The installation and connections of pre-fabricated perimeter vertical drains should be carried out as per the manufacturer's specifications.

The walls of the underground parking structure should be waterproofed/damp proofed suitably and wrapped with a continuous drainage blanket connecting to the permanent perimeter drainage system.

Underfloor drainage system may not be required, if any ingress of water under the slab is prevented. However, the need for vertical and underfloor drainage systems and the anticipated volumes of water to be pumped during and post construction should be based on the findings of the hydrogeological investigation report. The underfloor drainage system, if needed, should be kept separate from the perimeter drainage system.

A provision of additional groundwater control measures, consisting of underfloor sump pumps connected to an emergency power grid, should be installed below the lowest floor level of the parking for the consequence arising from a failure of the regular system.

A conceptual design of Permanent Perimeter & Under-floor Drainage System with Shoring is shown in Appendix E.

5.5 Lateral Pressure

The lateral earth pressures acting on retaining structures (perimeter basement walls, cantilever walls, etc.) may be calculated from the following expression:

$$P = K (\gamma H + q)$$

Where,

P	= Lateral earth pressure at depth H (m)	kPa
K_a	= Lateral earth pressure coefficient	0.4
γ	= Bulk unit weight of the soil	21 kN/m^3
H	= Depth of the wall below outer finish grade	m
q	= Equivalent value of all surcharge loads on the ground surface	kPa

The above equation assumes an effective drainage system to prevent the build-up of hydrostatic pressure behind the buried retaining structures. If a drainage system is not provided, the buried portion of retaining structures must be designed to withstand the full hydrostatic pressure.

5.6 Frost Protection

The design frost penetration depth for the general Site area is 1.2 m as per OPSD 3090.101. Therefore, any structural foundation (perimeter and other footings) and buried underground utilities exposed to seasonal freezing conditions should be provided with frost protection comprising at least 1.2 m of earth cover or its equivalent thermal insulation. As a general guidance, a 25 mm of insulation provides the same thermal equivalency as 600 mm of soil cover.

5.7 Earthquake Consideration

In conformance to the criteria in Table 4.1.8.4.A, Division B - Part 4 of the Ontario Building Code OBC 2012, the project site may be classified as Site Class “C-Very dense Soil and Soft Rock”. The four values of the Spectral response acceleration Sa (T) for different periods and the Peak Ground Acceleration (PGA) can be obtained from Table C-2 in Appendix C, Division B. The design values of F_a and F_v for the project site should be calculated in accordance to Table 4.1.8.4.B and C.

5.8 Excavation and Temporary Groundwater Control

The excavation for 5-Levels of underground parking structure depths is expected through the existing fills, glacial till and highly to moderately weathered shale bedrock can be handled by conventional mechanical excavation equipment. Allowance should be made for cobbles and boulders that may occur randomly in the earth fills, glacial till deposits and remnants of demolished buildings during excavation. Similarly, it is expected that excavation through the good to excellent quality of shale bedrock may also be possible by using a large hydraulic hoe or excavator equipped with rock or tiger-toothed bucket. A jackhammer or hoe ram may also be required to penetrate relatively harder zones within the bedrock. Progressively more difficult conditions should be anticipated with increasing depth of excavation as well as in areas where limestone layers are encountered. The actual equipment required and method of excavation within the bedrock will also dependent upon the geometry of the cut and relative depth of excavation.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and Regulation 213/1991 for Construction Projects to ensure the protection of workers from on-Site contaminants of concerned impacted soil and groundwater. Under the Act, the soils to be excavated can be classified as follows:

Fill soils	Type 3	When submerged/saturated	Type 4
Silty sand till (compact)	Type 3	When submerged	Type 4
Silty sand till (dense to very dense)	Type 2	When submerged	Type 3
Clayey silt till (stiff to firm)	Type 3	When saturated and/or fissured	Type 4
Clayey silt till (very stiff)	Type 2	when saturated and/or fissured	Type 3
Clayey Silt Till (hard)	Type 1	when saturated and/or fissured	Type 2
Weathered Shale	Type 1	when saturated and/or fissured	Type 2

For Type 3 soils, a bank slope of 1H:1V is required. For Type 2 soils, a 1.2 m high vertical cut at the bottom of excavation may generally be used. Near the ground surface, occasional 3H:1V slopes may be required due to disturbed surficial soils. If an excavation contains more than one soil types, the excavation slope geometry shall be governed by the highest soil type number. In general, above the water table, side slopes of trenches deeper than 1.2 m should be cut to a gradient no steeper than 1V:1H upon the inspection of a qualified geotechnical engineer. Similarly, vertical to near vertical slopes are feasible in weathered shale bedrock, subject to inspection by a professional engineer during construction.

Stockpiles of excavated materials should be kept at a horizontal distance of at least the excavation depth away from the edge of any excavation to avoid the slope instability, subject to confirmation by the geotechnical engineer. Care should also be taken to avoid overloading of any underground services/structures by stockpiles

In areas where an open excavation slope cannot be maintained due to the close proximity of the existing structures on the adjacent properties (e.g., buildings, roads, etc.), the excavation within the overburden should be supported by using a shoring system (e.g., tight wooden bracing, sheet pile, trench box, strutted soldier pile & lagging wall etc.), designed by a shoring consultant. Further, the depths of shoring walls should be extended sufficiently below the base of the excavation to ensure that toe resistance is maintained when the soil is excavated.

Perched water may be encountered during excavation in the earth fill and/or water bearing seams/pockets present in the glacial till deposits above the groundwater level. The amount of free water from this source is anticipated to be minor and the water accumulated in the excavation can readily be handled by using temporary filtered sumps and pumps. However, based on the water levels measured in the observation wells, it is anticipated that the excavation extending deeper than the elevation of 90.2 mASL may encounter groundwater during excavation. A temporary groundwater control system should, therefore, be in place prior to excavation and groundwater should be kept at least 1 m below the base of excavation (i.e., lowest depth of excavation), before the excavation deepens. The base of excavation should be kept dry all the time for the duration of below grade construction works, in order to preserve the structural integrity of the founding soils. The hydrogeological investigation report provides details of the anticipated construction dewatering quantities and permit requirements.

Consideration should be given to carrying out the construction during the drier seasons of the year to reduce the need for dewatering and disturbances to the founding soils caused by the excavation below prevailing groundwater table.

5.9 Reuse of On-Site Soils

Based on the conditions encountered in the boreholes, portions of on-site excavated soils which do not contain organics and deleterious materials can be re-used for backfill as an engineered fill. However, depending upon the weather condition, the excavated soils may require some reconditioning prior to reuse, i.e., maintain the moisture contents of these materials within ±2% of SPMDD values (i.e., Proctor values) to obtain the required compaction. For reuse as an engineered fill for foundation support, a uniform material must be used. Significant variations in fill type will require thinner lifts, more compaction effort and more field and laboratory testing. Less stringent requirements may be considered for fills placement below slab-on-grade, above footing levels and pavement areas. Special care should be exercised to ensure compaction around columns and adjacent to foundation walls.

Unsuitable material such as organic rich pockets, frozen soils, cobbles, boulders, remnants of demolished structures, etc., should be wasted. Ideally, dissimilar materials should be stockpiled separately during excavation.

Portion of the existing soils are considered as frost susceptible (e.g., fine sand, silt) and should not be reused where a volume change in the presence of freezing conditions would have an adverse effect on the serviceability of the proposed infrastructure.

5.10 Underground Services

It is considered that the sewer depths will not exceed 4.0 m below grades. Trench excavation should be carried out in accordance with the most recent version of the Ontario Occupational Health and Safety Act & Regulations for Construction Projects. The boreholes show that the trenches, generally, will be dug through existing fill and glacial till deposits. Normal conventional excavation equipment will be suitable for excavating trenches in the fill and native soil deposits.

Within these soils, above the groundwater table, the side-slopes of excavations are expected to be temporarily stable at 1V:1H. Flatter slopes will be required for the soils located below groundwater table, if encountered as noted on Section 5.8.

In areas where an open excavation slopes cannot be maintained, the excavation within the overburden should be supported using a temporary shoring system (e.g., tight wooden bracing, etc.), designed by a shoring consultant. Excavations can also be carried out at steeper side slopes by using trench box, designed in accordance with the Safety Regulations, for the protection of the workers.

Groundwater seepage into the excavations may occur from perched groundwater, surface water flow or wet seams within glacial till deposits. Dewatering should be achievable by properly filtered sumps and pumps. The groundwater level in the trench should be kept below the bottom of the excavation by dewatering. Ideally, to prevent disturbance of the soil at the bedding level, the groundwater table must be lowered to at least 0.6 m below the base of the trench. In no case should the pipes be placed on disturbed subsoil.

The boreholes show, the anticipated subgrade soils at the base of trench for pipe bedding at their current state comprise of compact to very dense silty sand till and/or very stiff to hard silty clay till. The native soils, in their undisturbed state, are considered to be suitable for supporting the pipes, provided the integrity of the base of the trench is maintained during construction. However, the suitability of the materials should be further assessed by qualified geotechnical personnel from BIG during construction. This assessment consists of inspection and recommendation as required.

Pipe bedding should be in accordance with the pipe manufacturer's recommendations, appropriate local municipality requirements and standards (e.g., OPS). As a guideline, normal Class 'B' Type bedding (OPSD-802) may be considered. In general, a minimum of 150 mm thick base bedding and 300 mm above & adjacent to the pipes of OPSS Granular A is recommended for pipes 450 mm diameter or less; for large diameter pipes, the thickness of the base bedding should be increased to 200 mm. The bedding and cover materials should be compacted to a minimum of 95% of their SPMDD to provide support and protection to the pipes.

The thickness of the bedding material, however, may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. Similarly, where moist to wet conditions are encountered, the use of 'clear stone' bedding (such as 19mm clear stone, OPSS 1004) may be considered, only in conjunction with a suitable geotextile filter (e.g., Terrafix 270R or equivalent). Without proper filtering, there may be loss of fines from native soils and/or trench backfill materials into or through the bedding materials. This loss of fines could result in loss of support to the pipes and possible surface settlements.

Based on visual and tactile examination of the soil samples, portion of the on-site excavated soils can be re-used to backfill the service trenches subject to the conditions noted in Sections 5.1 and 5.9.

The fills should be placed in thin lifts not exceeding 200 mm thick loose lifts, within ±2 % of its optimum moisture content, and thoroughly compacted with suitable heavy rollers to at least 95% of SPMDD, before placing the next lift. This value should be increased to at least 98 % within 0.8 m of the final subgrade of trench for the road pavement.

5.11 Shoring Considerations

In areas where an open excavation slope cannot be maintained, the excavation within the overburden should be supported by using a shoring system. Where settlement sensitive structures are located at the close proximity of the proposed excavation, a series of caisson walls embedded sufficiently below the bottom of the excavation, will have to be used to prevent any movement in the adjacent properties. Shoring system consisting of soldier piles and timber laggings can be used, on the other sides, where slight movement in the ground surface can be tolerated, i.e., where non-sensitive structures exist.

The shoring system should be designed by an experienced shoring consultant in accordance with the guidelines provided in the latest edition of the Canadian Foundation Engineering Manual (Manual). Similarly, the construction of the shoring system should also be carried out by a contractor, experienced in this type of construction.

The soldier piles should be installed in pre-augured holes which should be filled up to excavation level with 20 MPa (3000 psi) concrete and above that with 1-1/2 bag mix.

The following thicknesses of lagging boards have been recommended in the Manual:

Thickness of lagging	Maximum Spacing of Soldier Piles
50 mm (2 in)	2.0 m (6.5 ft)
75 mm (3 in)	2.5 m (8.0 ft)
100 mm (4 in)	3.0 m (10 ft)

Local experience has indicated that the lagging thickness of 75 mm has been adequate for soldier pile spacing of 3 m for soil conditions similar to those encountered at the subject site. However, it is important to consider all local conditions, such as the duration of excavation, the weather likely to be encountered, seasonal variations in the ground water and ice lensing causing frost heave in determining the lagging thickness.

All spaces behind the lagging must be filled with free draining granular fill. If wet conditions are encountered the space between boards should be packed with geotextile filter fabric or straw to prevent loss of ground.

The shoring system should be designed for a factor of safety of F = 2 for soils and 3 for rocks. The overall factor of safety of the anchored block of soil must be considered. Minimum spacing and the depths of the soil anchors should be as recommended in the Manual.

5.12 Pavement Construction

Pavement design and pavement thicknesses are highly dependent on the subgrade conditions. The pavement subgrade should, therefore, be adequately prepared to receive the granular bases for the pavement construction noted in Section 5.1.

Prior to the placement of granular bases, the exposed subgrade for pavement construction should be thoroughly and consistently compacted followed by a proof-rolled operation in the presence of the qualified geotechnical personnel from BIG. Any wet/soft areas of subgrade, revealed by this process, should be sub-excavated and replaced with an approved on-site or imported fill material compatible to the existing subgrade condition. Similarly, if the grade beneath the proposed pavement areas is required to be raised, approved on-site or imported fill can be used.

All new fills should be placed in a maximum of 200 mm loose lifts, within ±2 % of its optimum moisture content, and each lift should be compacted by a suitable heavy equipment to minimum 95% of SPMDD before placing the next lift. The uppermost 600 mm of the pavement subgrade should be compacted to a minimum 98% of SPMDD.

Construction traffic over exposed subgrade should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, hauling roads should be adequately reinforced with increased thickness of granular bases and/or geo-grids, etc. to reduce the disturbance to the subgrade soils.

Considering the proposed pavement usage, frost susceptibility and assuming adequate drainage provided, the following minimum pavement structure thicknesses are recommended for the long-term satisfactory performance of the pavement:

Recommended Minimum Pavement Structure Thickness:

Particulars	Heavy Duty Driveway (mm)	Standard Duty Driveway (mm)
Asphaltic Concrete: OPSS HL3	40	50
Asphaltic Concrete: OPSS HL8	70	50
Base Course - OPSS Granular A or equivalent	150	150
Sub-base Course - OPSS Granular B or equivalent	350	250

The recommended pavement structure may have to be adjusted according to the local regulations and/or respective city/town/region standards.

The granular base and subbase materials should conform to the OPSS 1010 and should be compacted to 98% of the ASTM D698 SPMDD within ±2% of the optimum moisture content.

Hot mix asphalt concrete should conform to OPSS 1150 and OPSS 310 and be placed and compacted to at least 92 to 96.5 % of the Marshall Maximum Relative Density (MMRD). It is recommended that the asphalt mix design be reviewed by BIG prior to the start of the paving.

The pavement thickness considers that construction will be carried out during the drier time of the year and that the subgrade is competent. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional subbase material is best determined during construction.

6 Construction Monitoring

Qualified Geotechnical personnel should monitor the foundation excavation, subgrade inspection, in-situ density tests and material testing services in all stages of the proposed development, to ensure that the materials and conditions comply with this geotechnical report and project requirements. Should the condition that encountered vary from those described in this report, our office should be informed immediately so that the proper measures are undertaken. The on-Site review of the condition of the foundation soil is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code.

All backfilling should be supervised to ensure that proper materials are used, and that adequate compaction is achieved. Strict quality control guidelines should be followed during the placement of fill materials.

7 Closure

The subsoil information and recommendations contained in this report was prepared solely for the purpose to use at the specific project as described in this report and should not be used to any other project or site location. The information contained in this report is for the sole benefit of the Client and his/her Consultants. *In order to properly understand the contents of the report, reference must be made to the whole of the report. BIG cannot be held responsible for the use of portions of the report without reference to the entire report.*

We recommend that BIG be retained to review the recommendations for this specific applicability, once the details of the proposed development are finalized and prior to the final design stage of the project.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

B.I.G. Consulting Inc.



Subir Shrestha, M.Eng., P.Eng.
Principal Geotechnical Engineer





Darko Strajin, P.Eng.
Managing Partner

8 Report Limitations

The conclusions and recommendations given in this report are based on information determined at the test hole (borehole, test pit, probe hole, etc.) locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations and opinions given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

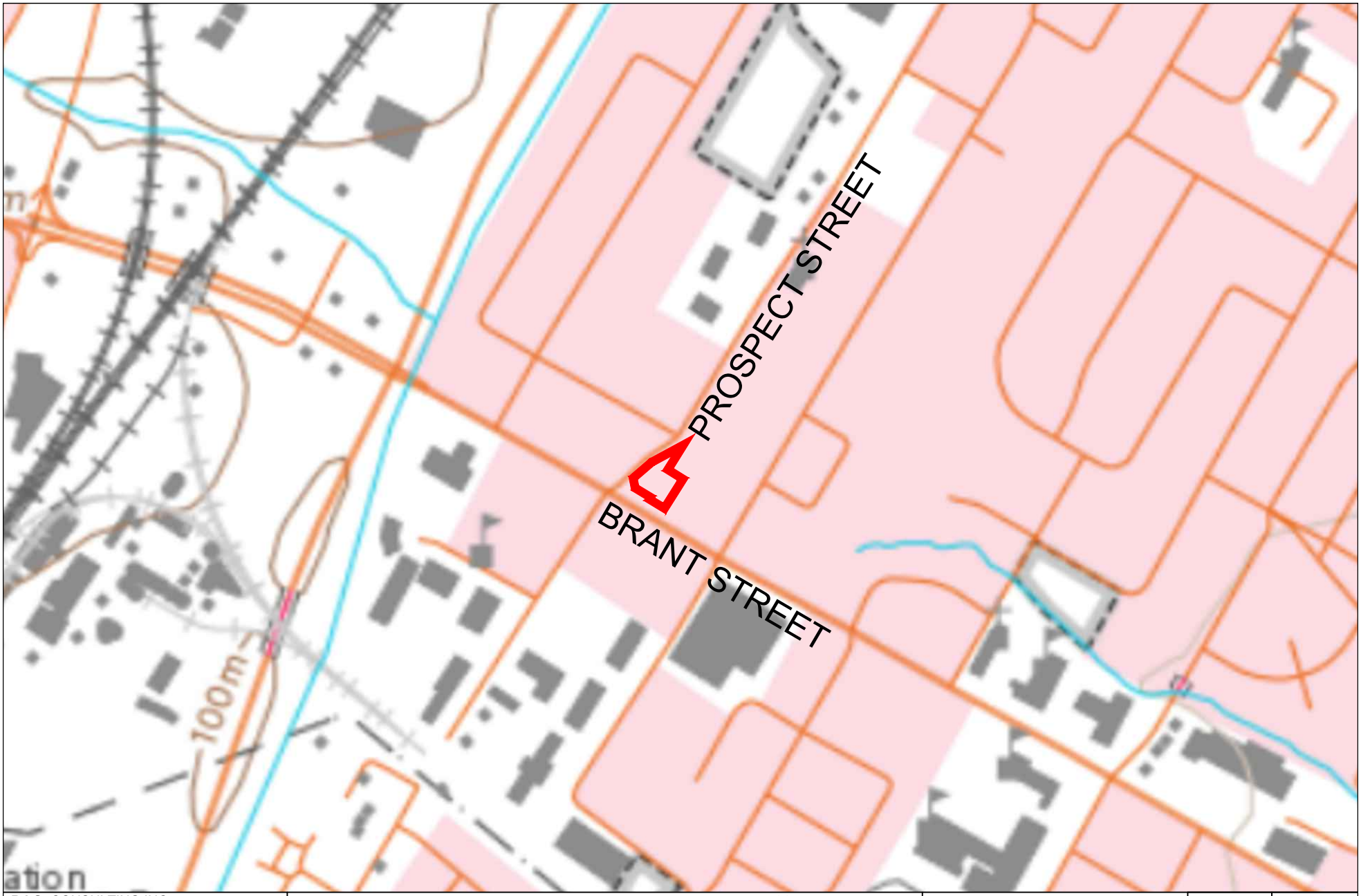
The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance to the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. Construction methods discussed, however, express BIG's opinion only and are not intended to direct the contractors on how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all the factors that may have an effect upon the construction. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably at the site. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

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

Appendix A - Figures



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LEGEND

SITE BOUNDARY

SCALE

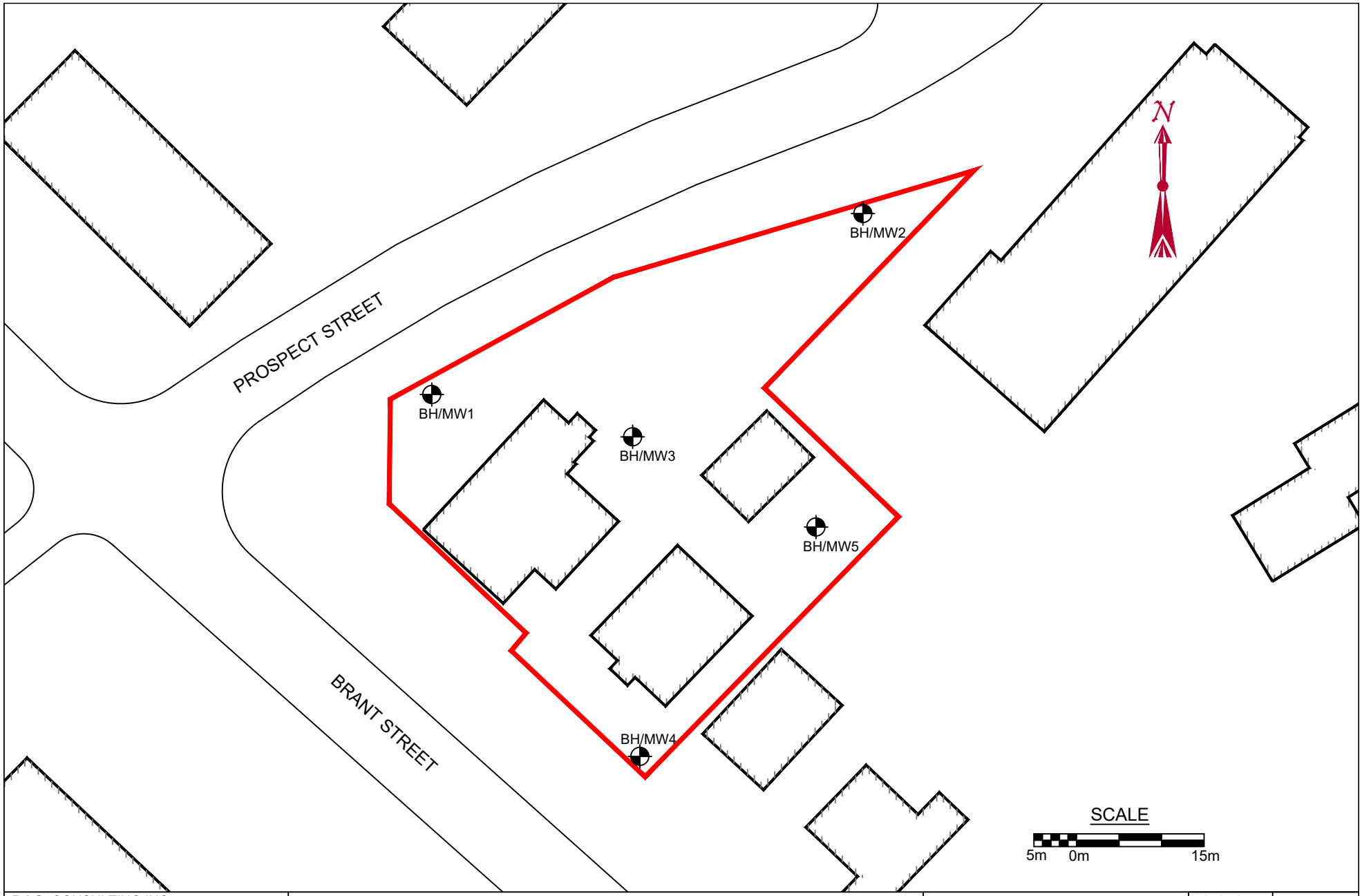
40 20 0 40 80 120 160 200

IMAGERY OBTAINED FROM TOPORAMA, NATURAL RESOURCES CANADA,2017

TITLE AND LOCATION

SITE LOCATION PLAN
PRELIMINARY GEOTECHNICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JULY 2021	1



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LEGEND

- SITE BOUNDARY
- BUILDING FOOTPRINT
- BOREHOLE/MONITORING WELL

TITLE AND LOCATION

BOREHOLE/MONITORING WELL LOCATION PLAN PRELIMINARY GEOTECHNICAL INVESTIGATION

789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JULY 2021	2

Appendix B – Records of Boreholes

NOTES TO RECORD OF BOREHOLES

DRILLING METHOD		SAMPLE TYPE		LABORATORT DATA	
SSA	Solid Stem Auger	SS	Split Spoon	W	Water Content
HSA	Hollow Stem Auger	AS	Auger Flight Sample	W_p	Plastic Limit
WB	Wash Boring	TW	Thin Wall Open	W_l	Liquid Limit
RM	Rotary Mud Drilling	TP	Thin Wall Piston	γ	Natural Unit Weight (kN/m^3)
		WS	Washed Sample	C_u	Undrained Shear Strength (kPa)
		VT	Vane Test	PP	Pocket Penetrometer
		GS	Grab Sample	UC	Unconfined Compression
		RC	Rock Core	UU	Unconsolidated Undrained
		PH	Sample Advanced Hydraulically	CU	Consolidated Undrained
		PM	Sample Advanced Manually	CD	Consolidated Drained
		CC	Continuous Core	TOV	Total Organic Vapors

STANDARD PENETRATION TEST (SPT 'N'): The number of blows required to advance a standard 51 mm outer diameter split spoon sampler to penetrate 0.3 m distance into the undisturbed ground in a borehole driven by means of a 63.5 kg hammer falling freely from a distance of 0.76m.

DYNAMIC CONE PENETRATION TEST (DCPT): The number of blows required to advance a 51 mm diameter – 60 degree cone fitted to the end of the drill rods to penetrate 0.3 m distance into the undisturbed ground driven by 475 Joules driving energy per blow.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR RELATIVE DENSITY

CONSISTENCY: Cohesive soils are described on the basis of their undrained shear strength (Cu) or 'N' values as follows:

N (blows/0.3m)	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	>30
Consistency	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
Cu (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200

RELATIVE DENSITY: Cohesionless soils are described on the basis of their relative density as indicated by 'N' values as follows:

N (blows/0.3m)	0 - 4	4 - 10	10 - 30	30 - 50	>50
Relative Density	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

RECOVERY: Sum of the lengths of all recovered rock core pieces divided by the total length of the core run (expressed as a percent).

ROCK QUALITY DESIGNATION (RQD): Sum of the lengths of intact rock core pieces, 100 mm or more in lengths, divided by the total length of the core run (expressed as a percent). Classifications of a rock based on the RQD value are as follows:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
Quality	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

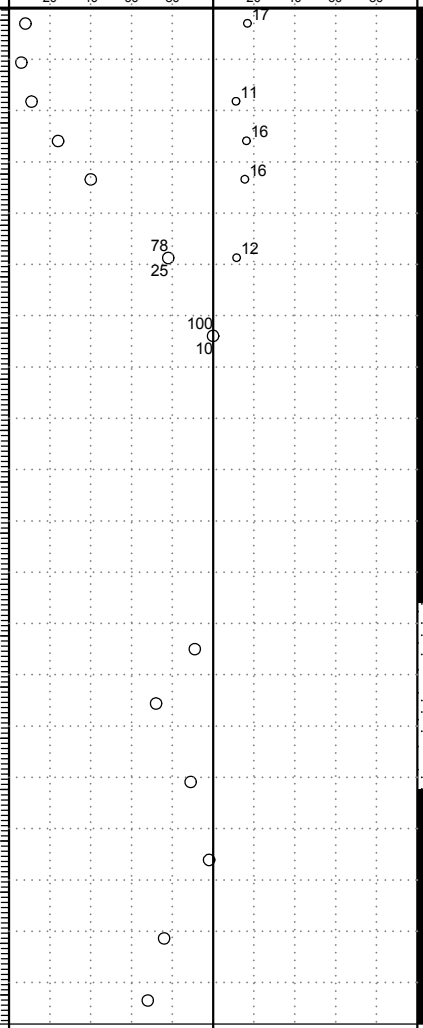
SPACING	50 Millimeters	50 - 300 Millimeters	0.3 – 1.0 Metres	1.0 – 3.0 Metres	> 3.0 Metres
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

RECORD OF BOREHOLE No. BH/MW1

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	14 Jun 21	Date Completed: 15 Jun 21	Revision No.: 0, 27/7/21

Geodetic Ground Surface Elevation: 92.24 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS
	TOPSOIL: 120mm 92.12	SS	1	67	8	0	92				
	FILL: Clayey silt, trace to some sand, trace gravel, trace organics, brown, moist, firm	SS	2	0	6	1	91				
	- silty sand, brown, moist to wet, compact 89.95	SS	3	100	11	2	90				
	CLAYEY SILT TILL: trace to some sand, trace gravel, greyish brown, moist, very stiff to hard 2.3	SS	4	75	24	3	89				
	-sandy	SS	5	100	40	4	88				Gr-6%; Sa-26%; Si-48%; Cl-20%
	86.14	SS	6	70	78/25	5	87				
	BEDROCK: Shale, highly weathered to excellen 6.1 quality, occasional limestone layers, reddish brown to grey, damp to moist	SS	7	13	100/10	6	86				
		AU	8	100		7	85				
		AU	9	100		8	84				
		AU	10	100		9	83				
		AU	11	100		10	82				
	ROCK CORE BEGINS	RC	1	93	91	11	81				
	- Excellent Quality - Fair Quality	RC	2	96	72	12	80				
	- Good Quality	RC	3	100	89	13	79				
	- Excellent Quality	RC	4	98	98	14	78				
	- Good Quality	RC	5	100	76	15	77				
	- Fair Quality 72.43	RC	6	100	68	16	76				
	End of Borehole 19.8					17	75				
						18	74				
						19	73				



Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.09 m bgs on June 28, 2021.

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

Groundwater depth observed on 28/06/2021 at a depth of: 2.09 m.

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

Scale: 1 : 147

RECORD OF BOREHOLE No. BH/MW2

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	11 Jun 21	Date Completed: 14 Jun 21	Revision No.: 0, 27/7/21

Geodetic Ground Surface Elevation: 92.34 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases (92.14, 0.2)	SS	1	46	4	0	92				
	FILL: Clayey silt, some to with sand, trace to some gravel, occasional Shale fragments, brown, moist, soft to firm (90.84, 1.5) -sandy	SS	2	100	6	1	91		13		Sieve Analysis: 17, 25, (58)
		SS	3	100	24	2	90		12		
	CLAYEY SILT TILL: trace to some sand, trace gravel, greyish brown, moist to very moist, very stiff (89.29, 3.1)	SS	4	92	28	3	89		22		
	SILTY SAND TILL: trace clay, trace to some gravel, occasional shale fragments, reddish brown, moist, dense (87.77)	SS	5	59	24	4	88		16		
	BEDROCK: Shale, highly weathered to good quality, occasional limestone layers, reddish brown to grey, damp to moist (4.6)	SS	6	13	50/8	5	87	50/8			
		SS	7	13	50/8	6	86	50/8			
		AU	8	100		7	85				
		AU	9	100		8	84				
		AU	10	100		9	83				
		AU	11	100		10	82				
	ROCK CORE BEGINS	RC	1	88	63	11	81				
	- Fair Quality					12	80				
	- Poor Quality	RC	2	96	45	13	79				
	- Good Quality	RC	3	100	79	14	78				
	- Good Quality	RC	4	100	78	15	77				
	- Fair Quality	RC	5	98	58	16	76				
	- Fair Quality (71.92)	RC	6	100	67	17	75				
	End of Borehole (20.4)					18	74				
						19	73				
						20	72				

Penetration Testing: SPT, DCPT
MTO Vane*: Intact, Remould
Nilcon Vane*: Intact, Remould
* Undrained Shear Strength (kPa): 20 40 60 80

Rinse pH Values: 2 4 6 8 10 12
Soil Vapour Reading: parts per million (ppm) 100 200 300 400
Lower Explosive Limit (LEL)
W_P W W_L
Plastic Liquid
20 40 60 80

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.14 m bgs on June 28, 2021.

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

Groundwater depth observed on 28/06/2021 at a depth of: 2.14 m.

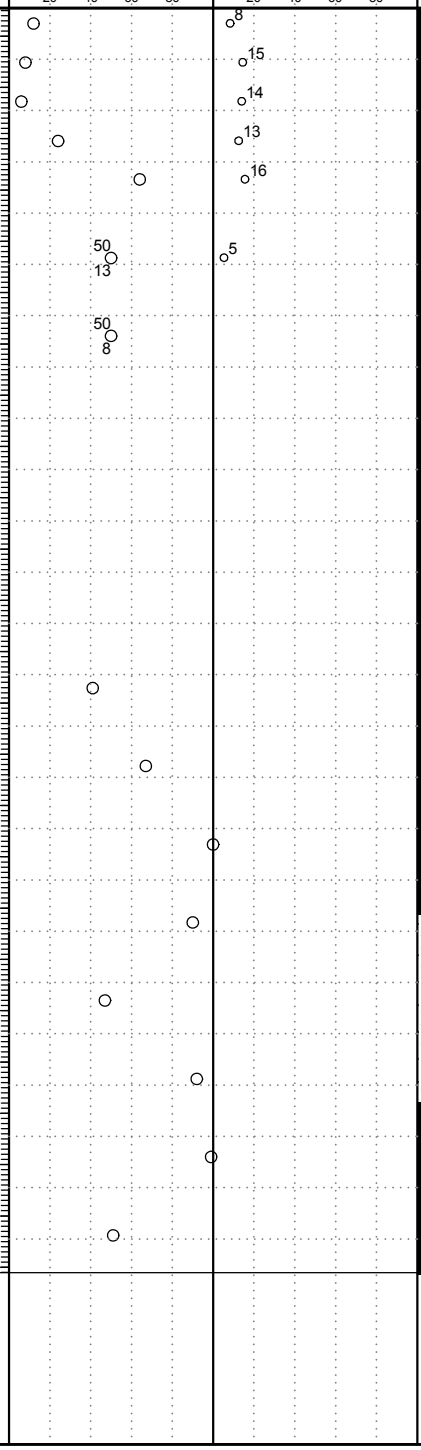
Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and requires interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commisioned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

RECORD OF BOREHOLE No. BH/MW3

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developements Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	10 Jun 21	Date Completed: 11 Jun 21	Revision No.: 0, 27/7/21

Geodetic Ground Surface Elevation: 92.55 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)
	ASPHALT PAVEMENT: 80 mm asphalt over 120 mm granular bases 0.2	SS	1	59	12	0	92
	FILL: Clayey silt, some sand, trace gravel, occasional glass pieces, dark brown/ black, moist, firm	SS	2	95	8	1	91
	- dark reddish brown 90.26	SS	3	59	6	2	90
	CLAYEY SILT TILL: trace to some sand, trace gravel, occaisonal cobble, brown, moist, very stiff 2.3 89.35	SS	4	92	24	3	89
	SILTY SAND TILL: gravelly, trace clay, occasional Shale fragments, reddish brown, moist, very dense 3.2 87.98	SS	5	100	64	4	88
	CLAYEY SILT TILL: trace to some sand, trace gravel, occasional cobble, brown, moist, hard 4.6 86.45	SS	6	41	50/13	5	87
	BEDROCK: Shale, highly weathered to poor quality, occasional limestone layers, reddish brown to grey, damp to moist 6.1	SS	7	13	50/8	6	86
		AU	8			7	85
		AU	9			8	84
		AU	10			9	83
		AU	11			10	82
	ROCK CORE BEGINS					11	81
	- Poor Quality	RC	1	100	41	12	80
	- Fair Quality	RC	2	99	67	13	79
	- Excellent Quality	RC	3	100	100	14	78
	- Excellent Quality	RC	4	99	90	15	77
	- Poor Quality	RC	5	100	47	16	76
	- Excellent Quality	RC	6	100	92	17	75
	- Excellent Quality *observed calcite precipitation at 22.42 m	RC	7	99	99	18	74
	- Fair Quality *observed calcite precipitation at 23.18 m 67.89	RC	8	100	51	19	73
	End of Borehole 24.7					20	72
						21	71
						22	70
						23	69
						24	68



INSTRUMENTATION INSTALLATION

COMMENTS

Sieve Analysis: 1, 16, (83)

Gr-20%; Sa-41%; Si-32%; Cl-7%

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.60 m bgs on June 28, 2021.

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

Groundwater depth observed on 28/06/2021 at a depth of: 2.60 m.

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

Scale: 1 : 147

RECORD OF BOREHOLE No. BH/MW4

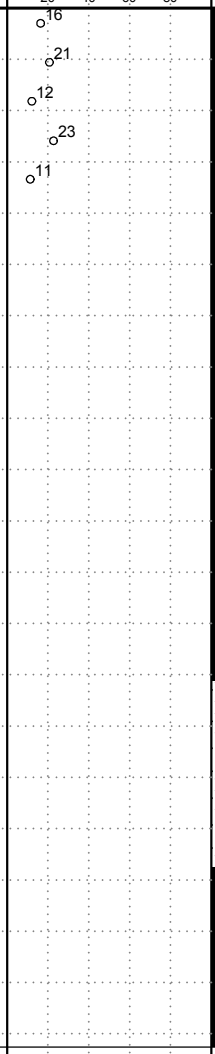
Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	19 Jun 21	Date Completed: 19 Jun 21	Revision No.: 0, 27/7/21

Geodetic Ground Surface Elevation: 92.12 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)
	ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases 0.2	SS	1	92	4	0	92
	FILL: Clayey silt, trace sand, trace gravel, trace Shale fragments, greyish brown, moist, soft to stiff 91.92 / 91.60	SS	2	84	9	1	91
	CLAYEY SILT TILL: trace to some sand, trace gravel, brownish grey, moist to very moist, stiff to very stiff 1.5	SS	3	75	9	2	90
	89.07	SS	4	75	16	3	89
	SILTY SAND TILL: trace clay, trace to some gravel, occasional Shale fragments, reddish brown, moist to wet, compact 3.1	SS	5	75	21	4	88
	87.65						
	BEDROCK: Shale, highly weathered to good quality, occasional limestone layers, reddish brown to grey, damp to moist 4.5	SS	6	13	50/8	5	87
		SS	7	13	50/8	6	86
		AU	8	100		7	85
		AU	9	100		8	84
		AU	10	100		9	83
		AU	11	100		10	82
	ROCK CORE BEGINS	RC	1	100	0	11	81
	- Very Poor Quality *clay infill in weathered limestone between 12.2 & 12.7 m - Poor Quality	RC	2	100	47	12	80
	- Poor Quality *clay infill between 14.4 & 14.3 m and 14.9 & 15.4 m	RC	3	86	44	13	79
	- Very Poor Quality	RC	4	92	0	14	78
	- Good Quality	RC	5	99	78	15	77
	- Fair Quality 71.86	RC	6	99	55	16	76
						17	75
						18	74
						19	73
						20	72
	End of Borehole 20.3						

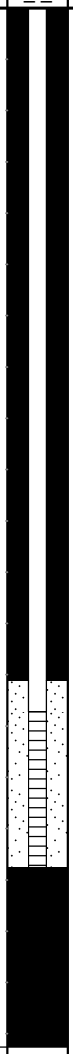
Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 1.94 m bgs on June 28, 2021.

FIELD TESTING: Penetration Testing (SPT, DCPT); MTO Vane* (Intact, Remould); Nilcon Vane* (Intact, Remould); * Undrained Shear Strength (kPa) 20 40 60 80



LAB TESTING: Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading parts per million (ppm) 100 200 300 400; Lower Explosive Limit (LEL) W_P W W_L; Plastic Liquid 20 40 60 80

INSTRUMENTATION INSTALLATION



COMMENTS

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

▼ Groundwater depth observed on 28/06/2021 at a depth of: 1.94 m.

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

Scale: 1 : 147

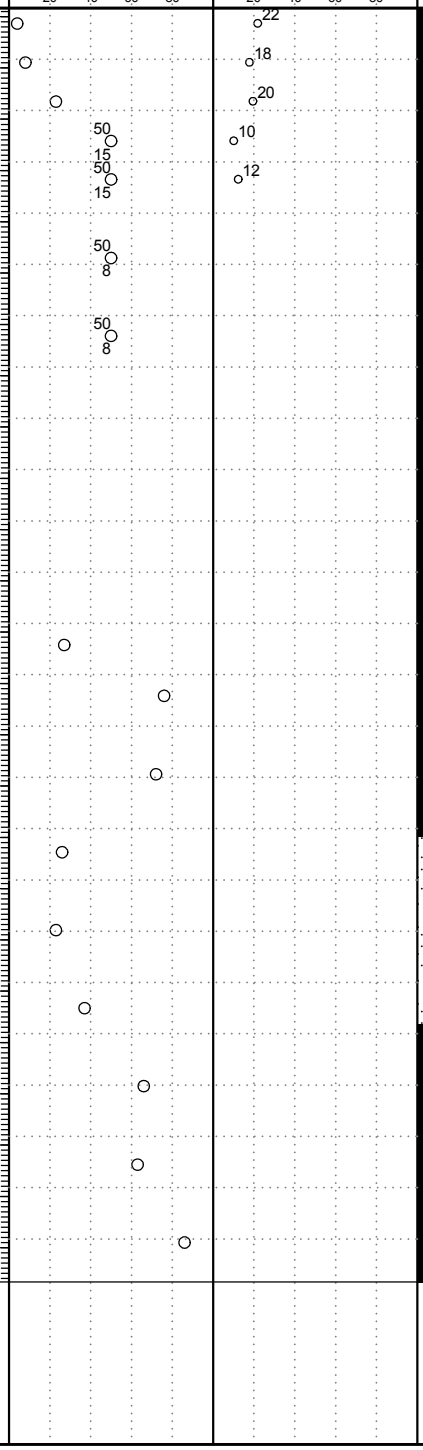
RECORD OF BOREHOLE No. BH/MW5

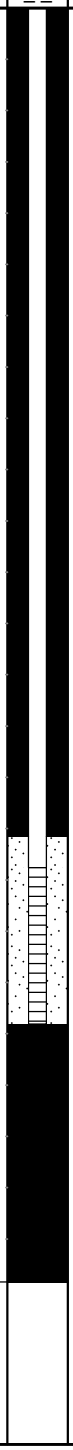
Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	15 Jun 21	Date Completed: 17 Jun 21	Revision No.: 0, 27/7/21

Geodetic Ground Surface Elevation: 92.17 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value/RQD%	DEPTH (m)	ELEVATION (m)
	ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases 91.97 / 0.2	SS	1	84	4	0	92
	FILL: Clayey silt, trace sand, brown, moist, firm 90.67	SS	2	100	8	1	91
	CLAYEY SILT TILL: trace to some sand, trace gravel, occasional cobble, brown, moist to very moist, very stiff 89.88 / 1.5	SS	3	95	23	2	90
	SILTY SAND TILL: trace clay, trace to some gravel, brown, moist, very dense 88.97 / 2.3	SS	4	25	50/15	3	89
	CLAYEY SILT TILL: trace to some sand, trace gravel, reddish brown, moist, hard 86.07 / 3.2	SS	5	51	50/15	4	88
	---------- limestone fragments	SS	6	25	50/8	5	87
	BEDROCK: Shale, highly weathered to good quality, occasional limestone layers, reddish brown to grey, damp to moist 6.1	SS	7	25	50/8	6	86
		AU	8	100		7	85
		AU	9	100		8	84
		AU	10	100		9	83
		AU	11	100		10	82
	ROCK CORE BEGINS	RC	1	85	27	11	81
	- Poor Quality Good Quality	RC	2	100	76	12	80
	- Fair Quality *clay infill between14.37 and 14.42 m	RC	3	100	72	13	79
	- Poor Quality *clay infill between 15.76 and 15.78 m	RC	4	100	26	14	78
	- Very Poor Quality *clay infill between 18.08 and 18.38 m	RC	5	100	23	15	77
	- Poor Quality *clay infill between 18.79 & 18.88 m and 19.09 & 19.19 m	RC	6	95	37	16	76
	- Fair Quality *clay infill between 20.32 and 20.36 m	RC	7	95	66	17	75
	- Fair Quality *clay infill between 23.05 and 23.17 m	RC	8	100	63	18	74
	- Good Quality 67.33	RC	9	99	86	19	73
	End of Borehole 24.8					20	72
						21	71
						22	70
						23	69
						24	68

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.03 m bgs on June 28, 2021.





COMMENTS

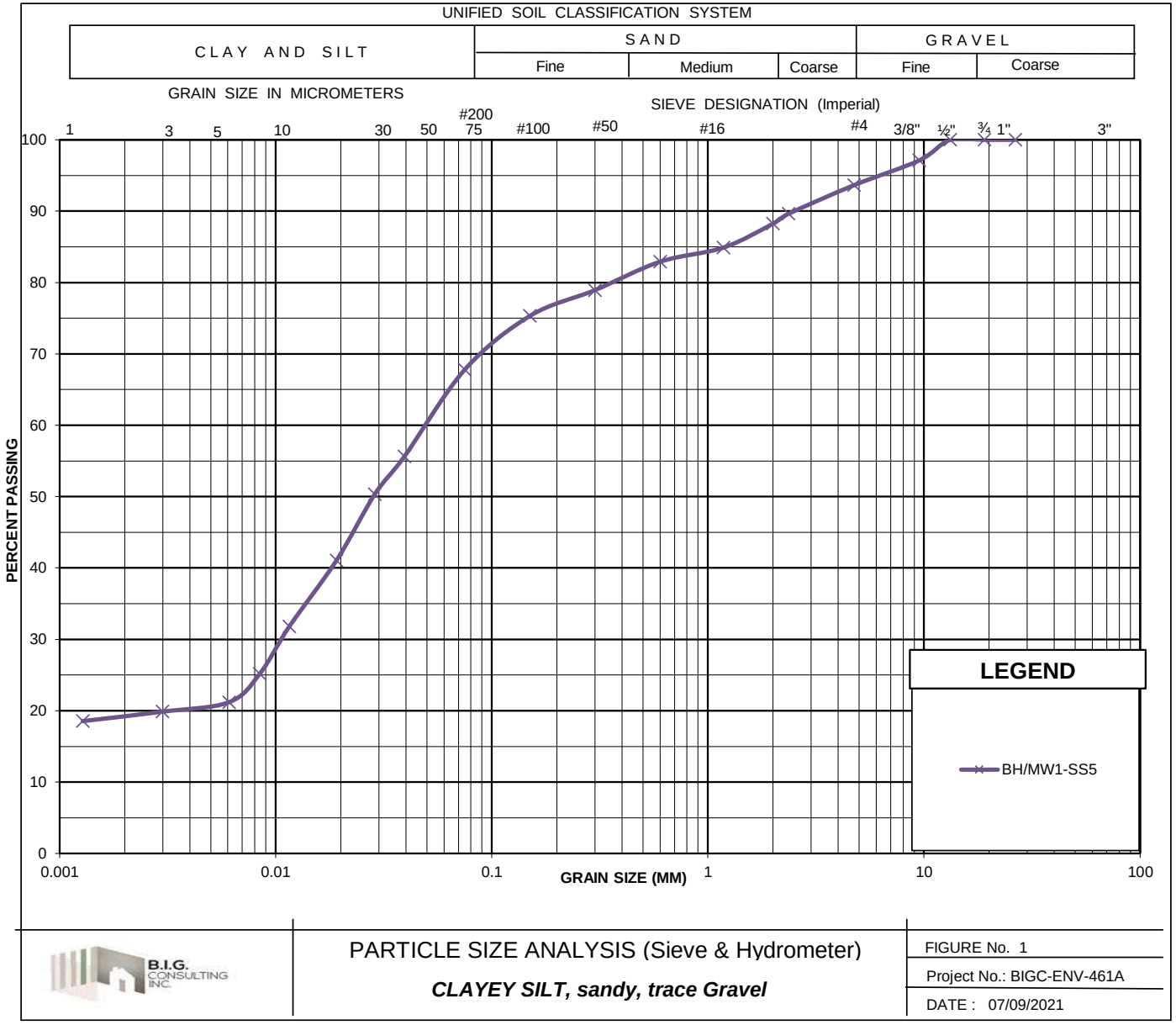
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Mississauga, ON L4W 2Z4
Canada
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▽ No freestanding groundwater measured in open borehole on completion of drilling.

▼ Groundwater depth observed on 28/06/2021 at a depth of: 2.03 m.

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

Appendix C – Geotechnical Laboratory Test Results



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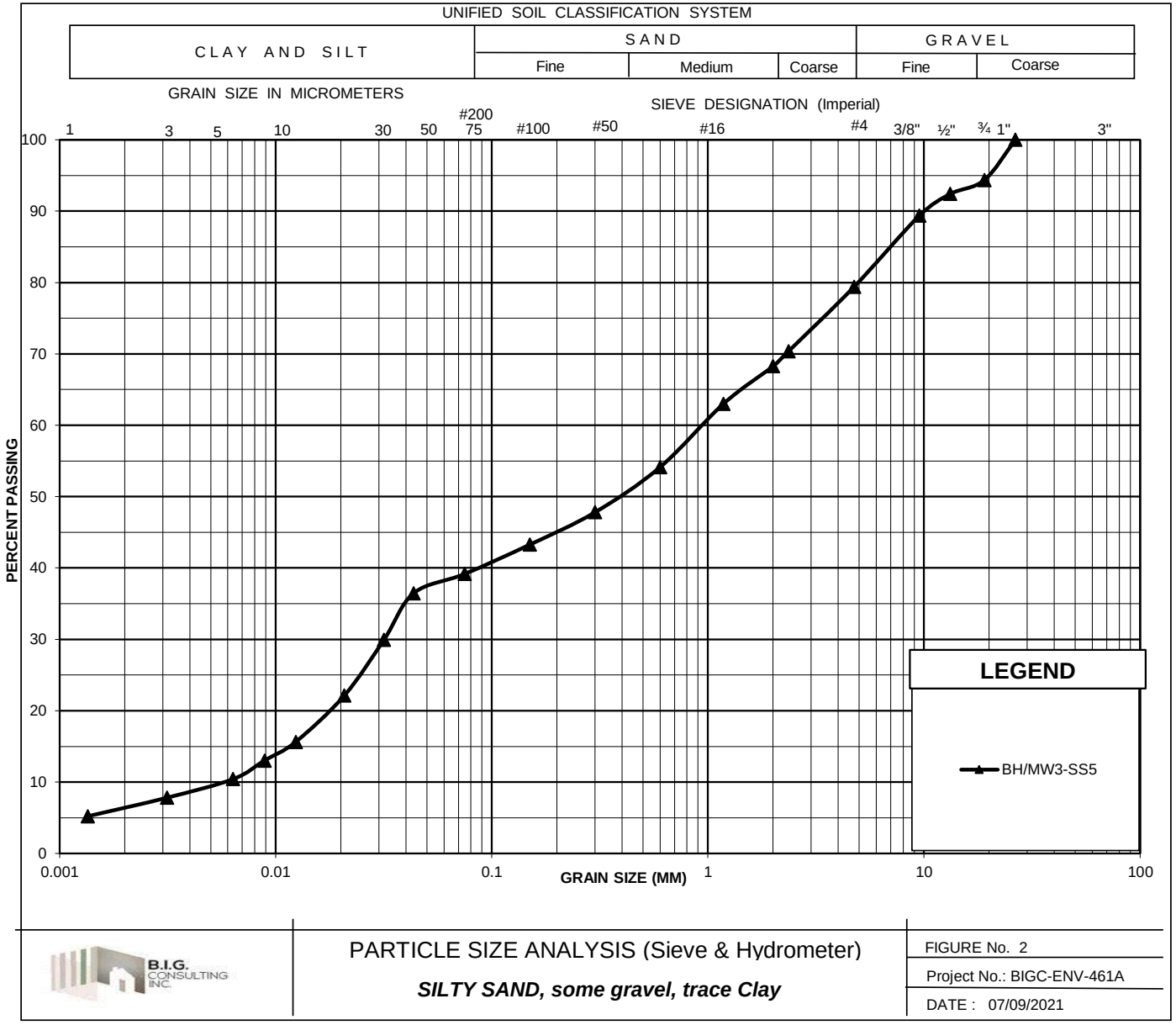
PARTICLE SIZE ANALYSIS (Sieve & Hydrometer)

CLAYEY SILT, sandy, trace Gravel

FIGURE No. 1

Project No.: BIGC-ENV-461A

DATE : 07/09/2021



B.I.G. CONSULTING INC.

PARTICLE SIZE ANALYSIS (Sieve & Hydrometer)

SILTY SAND, some gravel, trace Clay

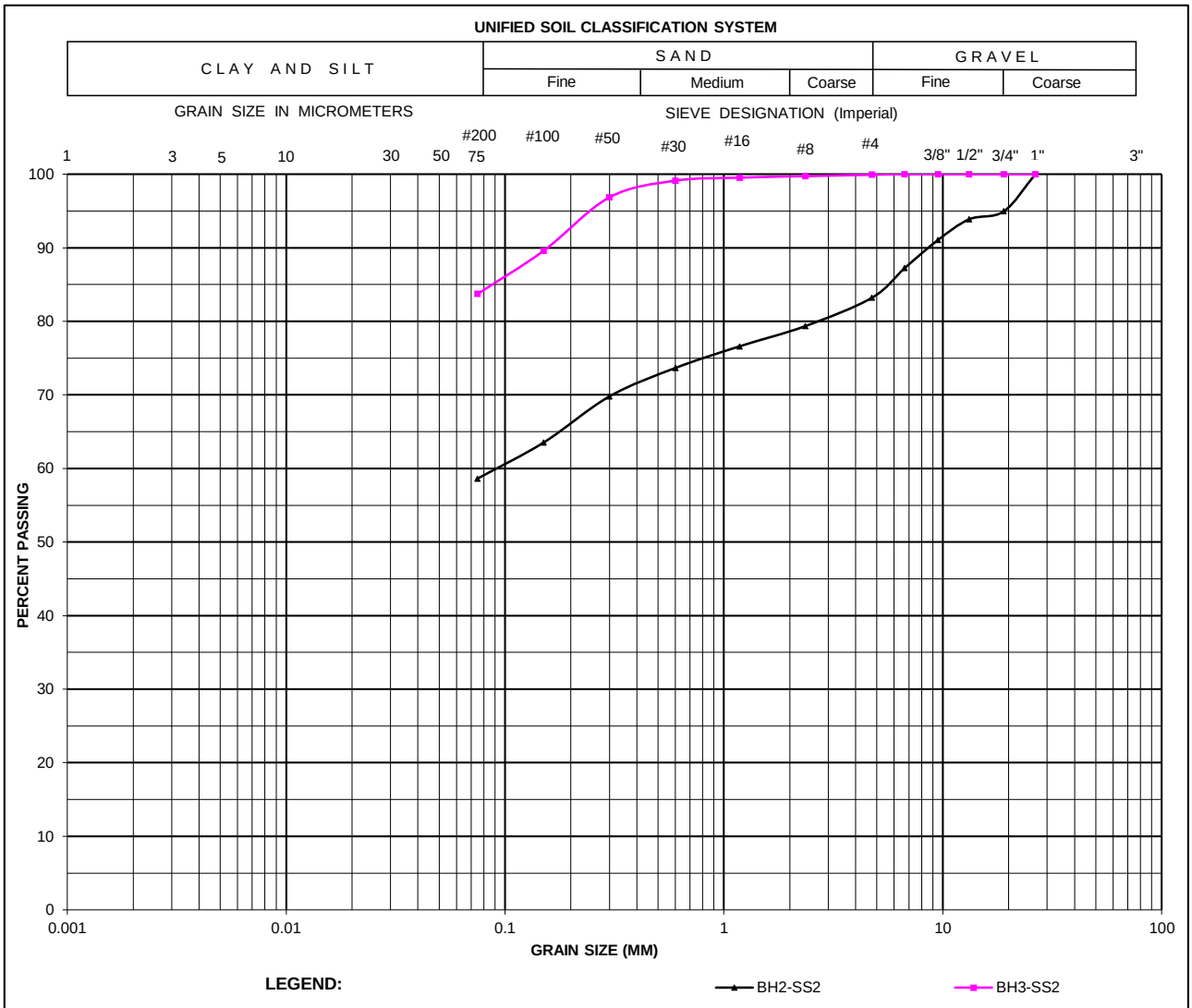
FIGURE No. 2

Project No.: BIGC-ENV-461A

DATE : 07/09/2021

PARTICLE SIZE ANALYSIS
(Sieve)

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CLAYEY SILT, some to with sand, trace to some gravel

FIGURE No.	3
Project No.:	BIGC-ENV-461A
DATE:	July 9, 2021

Appendix D - Pictures of Rock Core Samples

ROCK CORE PICTURES

BH/MW1

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www.bigconsultinginc.com

Project No.:	BIGC-ENV-461A	**Prepared By:**	KK
Project:	Preliminary Geotechnical Investigation	**Checked By:**	SS
Location:	789-795 Brant Street, Burlington, Ontario	**Date:**	Jul. 07'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	12.20	0.61	93	92
RC-2	12.81	1.52	96	72
RC-3	14.33	1.52	100	89
RC-4	15.86	1.52	98	98
RC-5	17.38	1.52	100	76
RC-6	18.90	0.91	100	68



FIGURE- D1

ROCK CORE PICTURES
BH/MW2

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Project No.:	BIGC-ENV-461A	**Prepared By:**	KK
Project:	Preliminary Geotechnical Investigation	**Checked By:**	SS
Location:	789-795 Brant Street, Burlington, Ontario	**Date:**	Jul. 07'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	12.20	0.92	87	63
RC-2	13.12	1.52	96	45
RC-3	14.64	1.52	100	79
RC-4	16.17	1.52	100	78
RC-5	17.69	1.52	97	58
RC-6	18.90	1.52	100	67



FIGURE- D2

ROCK CORE PICTURES
BH/MW3

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Mississauga, Ontario, L4W 2Z4
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Project No.:	BIGC-ENV-461A	**Prepared By:**	KK
Project:	Preliminary Geotechnical Investigation	**Checked By:**	SS
Location:	789-795 Brant Street, Burlington, Ontario	**Date:**	Jul. 07'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	12.50	1.52	100	40
RC-2	14.02	1.52	99	78
RC-3	15.55	1.52	100	100
RC-4	17.07	1.52	99	90
RC-5	18.60	1.52	100	47
RC-6	20.12	1.52	100	92
RC-7	21.64	1.52	99	99
RC-8	23.14	1.52	100	51



FIGURE- D3

ROCK CORE PICTURES

BH/MW4

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Project No.:	BIGC-ENV-461A	**Prepared By:**	KK
Project:	Preliminary Geotechnical & Hydrogeological Investigation	**Checked By:**	SS
Location:	789-795 Brant Street, Burlington, Ontario	**Date:**	Jul. 07'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	12.19	0.46	113	0
RC-2	12.65	1.52	100	47
RC-3	14.17	1.52	85	44
RC-4	15.70	1.52	92	0
RC-5	17.22	1.52	99	78
RC-6	18.74	1.52	99	55



FIGURE- D4

ROCK CORE PICTURES
BH/MW5

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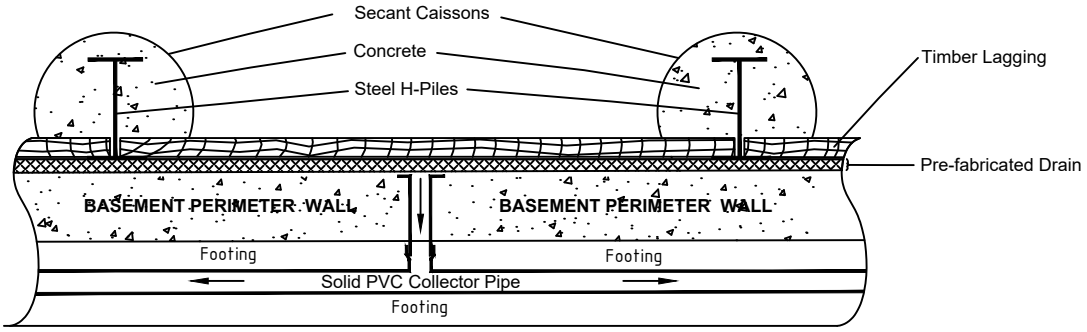
Project No.:	BIGC-ENV-461A	**Prepared By:**	KK
Project:	Preliminary Geotechnical & Hydrogeological Investigation	**Checked By:**	SS
Location:	789-795 Brant Street, Burlington, Ontario	**Date:**	Jul. 07'21

Rock Core No.	Core Depth From (m)	Core Length (m)	Core Recovery (%)	RQD (%)
RC-1	12.19	0.41	95	27
RC-2	12.60	1.52	69	76
RC-3	14.12	1.52	98	72
RC-4	15.65	1.52	100	36
RC-5	17.17	1.52	100	47
RC-6	18.70	1.52	95	37
RC-7	20.22	1.52	95	66
RC-8	21.74	1.52	100	63
RC-9	23.32	1.52	99	87

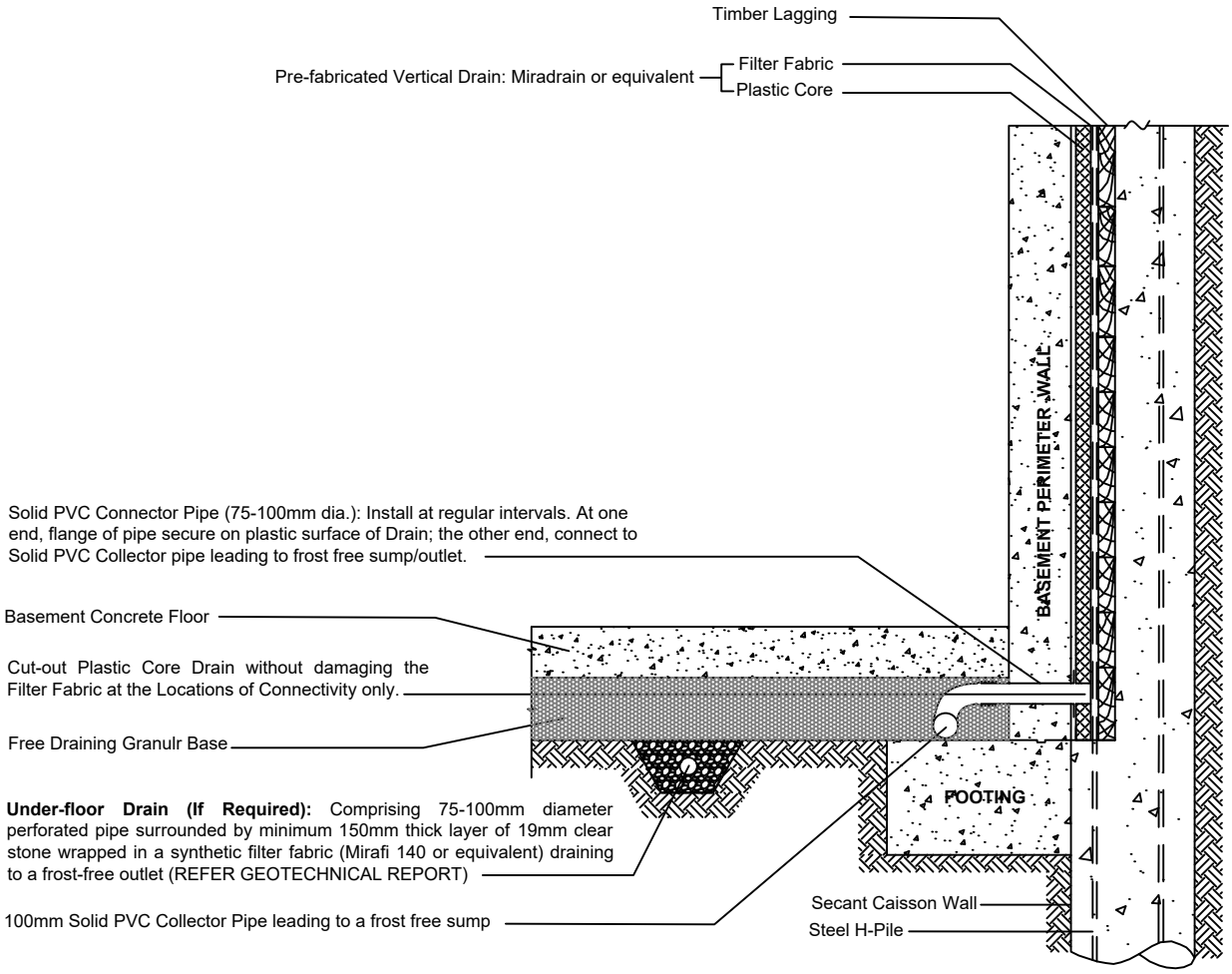


FIGURE- D5

Appendix E - Conceptual Permanent Perimeter and Underfloor Drainage Systems with Shoring



PLAN



TYPICAL SECTION

Note:

1. A continuous blanket of prefabricated drainage system, Miradrain 6000 or equivalent, should extend continuously from the top of footings to approximately 1.2m below the ground surface.
2. All terminal end openings (top, bottom & sides) of drain must be covered with terminal fabic flaps and fasten to prevent intrusion of concrete and soils into the drainage core.
3. All surface joints of the Miradrain should be sealed with tape.
3. The backfill materials behind the lagging should be free draining. If wet conditions are encountered, geotextile flter fabric or straw should be used to prevent loss of ground.
4. Subfloor drainage system (if required) should keep/treat separate from the perimeter drainage system.

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LEGEND

TITLE AND LOCATION

PERMANENT PERIMETER & UNDER-FLOOR DRAINAGE SYSTEM
(CONCEPTUAL-FOR SHORING)
PRELIMINARY GEOTECHNICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	O.A.
SCALE	CK.
AS NOTED	S.S.
DATE	FIG NO.
JUly 2021	E

APPENDIX E

HYDROGEOLOGICAL INVESTIGATION

DRAFT - HYDROGEOLOGICAL INVESTIGATION

789 and 795 Brant Street, Burlington, Ontario

Client

Mr. Kyle Camarro
Camarro Developments Inc.
25 Main Street West, Unit 1702
Hamilton, Ontario, L8P 1H1

Project Number

BIGC-ENV-461A

Prepared By:

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Date Submitted

April 27, 2022

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1 Introduction

1.1 Project Description

B.I.G. Consulting Inc. (BIG) was retained by Mr. Kyle Camarro on behalf of Camarro Developments Inc. (the Client) to conduct a Preliminary Hydrogeological Investigation to support the proposed development of the site located at 789 and 795 Brant Street, Burlington, Ontario (Site).

The Site is located to the south of Prospect Street and east of Brant Street, in Burlington, Ontario, as shown on Figure 1. The Site is irregular in shape and measures approximately 2,250 m^2 in size. The Site is currently occupied by one (1) irregularly shaped two-storey slab-on-grade commercial building at 795 Brant Street, and one (1) irregularly shaped two-storey commercial building with one (1) level of basement and a parking garage at 789 Brant Street (Site buildings). The Site buildings have a total footprint of approximately 420 m^2 and occupy approximately 19 % of the Site. The areas surrounding the Site buildings are covered with asphalt and landscaping.

It is BIG's understanding that the proposed re-development at the Site will consist of a structure with five (5) levels of underground parking.

This report addresses the hydrogeological aspects of the proposed project. Reports for the Preliminary Geotechnical Investigation, Phase One and Phase Two Environmental Site Assessments will be issued under separate covers. The field investigation for the geotechnical, environmental and hydrogeological investigations was carried out concurrently.

1.2 Project Objectives

The main objectives of the Hydrogeological Investigation were to:

a) Establish the local hydrogeological settings of the Site;
b) Provide preliminary assessment of anticipated construction dewatering flow rates for a generic construction scenario;
c) Estimate foundation sub-drain discharge volumes, if applicable;
d) Assess groundwater quality and compare the results to Region of Halton and City of Burlington Combined/Sanitary and Storm Sewer Use By-Law parameters;
e) Qualitatively assess the potential impact to the nearby water body and comment on future regulatory agency involvement; and,
f) Prepare a Preliminary Hydrogeological Investigation Report.

1.3 Scope of Work

To achieve the investigation objectives, BIG proposed and initiated the following scope of work:

a) Background desktop review of pertinent geological and hydrogeological resources;
b) Review of the Ministry of Environment, Conservation and Parks (MECP) Water Well Records;
c) Advancement of five (5) boreholes (BH1 to BH5) to a maximum depth of 24.8 m bgs and installation of monitoring wells (MW1 to MW5);
d) Perform single well response tests (SWRT) at selected monitoring wells to assess the hydraulic characteristics of the bedrock at the Site;
e) Complete groundwater level measurements at monitoring wells;
f) Evaluate the information of groundwater level measurements and groundwater quality;

g) Collection of one (1) groundwater sample for laboratory testing and compare it against the Region of Halton and City of Burlington Combined/Sanitary and Storm Sewer Use By-Law parameters;
h) Assess groundwater discharges during construction phases;
i) Assess foundation sub-drain discharge volumes, if applicable; and,
j) Prepare a Preliminary Hydrogeological Investigation Report.

2 Regional Setting

2.1 Regional Physiography

The Ontario Geological Survey indicates the Site lies in the Iroquois Plain physiographic region of Southern Ontario known as the shale plains. Figure 2 shows the physiographic regions of Southern Ontario around the Site.

During the last retreat of the Laurentide Ice Sheet (12,000 years B.P.) lake levels in what was to become Lake Ontario where much higher due to ice blockage in the St. Lawrence waterway. This created the glacial Lake Iroquois which was up to 60 m higher in elevation in the Toronto area than the current Lake Ontario water levels. The Iroquois Shoreline that coincided with this elevated lake, terminated just above St. Clair Avenue West.

2.2 Regional Geology

The surficial geology of the immediate area around the Site is described as coarse-textured glaciolacustrine deposits. The surficial geology for the Site and surrounding areas is shown on Figure 3.

Bedrock of the region corresponds to the Queenston Formation consisting of shale, limestone, dolostone and siltstone. The contact between the bedrock and the overlying overburden is expected to be at approximately 4.5 m bgs.

2.3 Regional Hydrogeology

Groundwater movement through the subsurface is controlled by hydraulic gradients, the physical characteristics of the sediments, and the interconnectedness of lithological formations. Fine grained sediments restrict lateral movement of groundwater and induce vertical infiltration, while coarse grained sediments allow vertical flow with increased transmissivity.

The regional shallow groundwater flow is expected to follow the local topography and discharge to local area creeks and streams. Local deviation from the regional groundwater flow directions may occur in response to changes in topography and/or soil stratigraphy, as well as the presence of surface water features and/or existing subsurface infrastructure.

Based on the Conservation of Halton Planning & Permits Map, the Site is located within a highly vulnerable aquifer as identified in the Region's Source Water Protection Planning under the Clean Water Act, 2006.

3 Site Setting

3.1 Site Topography and Drainage

The Site is irregular in shape and measures approximately 2,250 m^2 in size. The Site is currently occupied by one (1) irregularly shaped two-storey slab-on-grade commercial building at 795 Brant Street, and one (1) irregularly shaped two-storey commercial building with one (1) level of basement and a parking garage at 789 Brant Street (Site buildings). The areas surrounding the Site buildings are covered with asphalt and landscaped areas. The topography of the Site generally slopes to the south/southeast and based on the borehole logs, the ground elevation ranges between 92.55 and 92.12m above sea level (asl). Precipitation that falls on the Site is inferred to predominantly be directed to the catch basins located in the parking lot of the Site and nearby City of Burlington catch basins.

3.2 Local Surface Water Features

The Site does not feature any surface water bodies on the Site. The closest surface water body to the Site is a tributary to Indian Creek, located approximately 260 m northwest of the Site. The Site is situated within the Lower Rambo Creek watershed and is part of Conservation Halton regulated area.

3.3 Ministry of Environment, Conservation and Parks Water Well Review

Well Records from the Ministry of Environment, Conservation and Parks (MECP) Water Well Record Database (WWR) were reviewed to determine the number of water wells and locations present within a 500 m radius of the Site boundaries.

The MECP WWR database indicated 53 well records within 500 m radius of the Site. All identified wells are shown on Figure 4. A summary of the Water Well Records is included in Appendix B, Table B-1. A review of the records indicated that the majority of the wells were classified for observation well, monitoring well and test hole purposes within 500 m radius of the Site.

3.4 Permit to Take Water and Environmental Activity and Sector Registry Search

The MECP also maintains a database of all active and expired Permit to Take Water (PTTW) and Environmental Activity and Sector Registry (EASR) items related to construction dewatering and pumping test. There are no PTTW or EASR registrations within 1 km of the Site.

4 Field Program

4.1 Borehole and Monitoring Well Details

BIG advanced five (5) borehole (BH1 to BH5) to a maximum depth of 24.8 m bgs between June 10 and 19, 2021 and instrumented all boreholes with monitoring wells (MW1 to MW5). The boreholes were advanced by using a truck mounted hollow and solid stem continuous flight auger equipment under the direction and supervision of BIG field personnel. Soil samples were retrieved at regular intervals with a 50 mm outside diameter split barrel sampler drive and accordance with the Standard Penetration Test Procedure (ASTM D1586). The samples were logged in the field and returned to the BIG laboratory for detailed visual examination. The borehole records and monitoring well construction detail are included in Appendix A.

4.2 Site Specific Overburden Geology

Table 4-1: Soil description

Layer	Description
Ground Surface Cover	Borehole, BH/MW1 was advanced through an existing ground surface cover consisting of approximately 120 mm thick topsoil. Topsoil in general, consists of high contents of organics and rootlets. Remaining boreholes BH/MW2 to BH/MW5 were advanced through existing asphalt pavement consisting of approximately 50-80 mm thick asphalt concrete over 120 to 150 mm thick granular bases.
Fill	Below the ground surface cover in all boreholes, existing fill generally consisted of clayey silt with trace to some sand, and trace to some gravels were encountered in all boreholes that extended to depths varying between 1.5 and 2.3 m bgs. Fill also contained occasional Shale fragments, glass pieces, and trace organics.
Upper Clayey Silt Till	Below existing fill in all boreholes, native deposit of upper clayey silt till was encountered that extended to depths varying between 3.1 and 6.1 m bgs. Clayey silt till deposit also contained trace to sand and trace gravel.
Silty Sand Till	Below upper clayey silt till in boreholes BH/MW2 to BH/MW5, a layer on glacial silty sand till was encountered that extended to depths varying between 3.2 to 4.6 m bgs. Silty sand till also contained trace clay, and trace to some gravel.
Lower Clayey Silt Till	Below silty sand till in boreholes BH/MW3 and BH/MW5, another glacial deposit of lower clayey silt till was encountered that extended to the depth of 6.1 m bgs. Clayey silt till deposit also contained trace to some sand and trace gravel.
Bedrock	Below upper clayey silt till at borehole BH/MW1; below sandy silt till at boreholes BH/MW2 and BH/MW4; and below lower clayey silt till at boreholes BH/MW3 and BH/MW5; highly weathered to excellent quality of reddish brown/grey Shale bedrock was encountered in all boreholes.

4.3 Water Level Monitoring

Water levels at all monitoring well locations were recorded after installation. A summary of all available water level observations is included in Table 4-2. Groundwater was observed in all monitoring wells on June 28, 2021 and depths to the groundwater ranged from 1.94 m to 2.60 m bgs. The shallow wells, BH/MW1, BH/MW2 and BH/MW4 were observed with groundwater elevations of 90.15 m to 90.20 m asl. The deep wells, BH/MW3 and BH/MW5 were observed with groundwater elevations of 89.95 m and 90.14 m asl.

An interpreted shallow groundwater contour map for the water level measurements recorded on June 28, 2021 is included as Figure 8. Based on the water level measurements obtained, the inferred direction of shallow groundwater flow across the Site is interpreted to be to the west direction.

Seasonal variability can produce significant changes to the static water level. It has been observed that groundwater can rise and lower in response to changing weather and climate.

Table 4-2: **Monitoring Well Details and Water Levels Elevations**

Well ID	Ground Elevation (m asl)	Well Depth (m bgs)	June 28, 2021	
			Water Level (m bgs)	Elevation (m asl)
MW1	92.24	15.2	2.09	90.15
MW2	92.34	15.2	2.14	90.20
MW3	92.55	21.3	2.60	89.95
MW4	92.12	16.8	1.94	90.18
MW5	92.17	19.8	2.03	90.14

4.4 Hydraulic Conductivity Testing

The hydraulic conductivity test was completed to estimate the saturated hydraulic conductivity (K) of the soil at the well screen depth at selected monitoring well locations.

In advance of performing SWRT, the monitoring well was developed to remove the potential presence of fine sediments. The development process involved purging of the monitoring wells to induce the flow of fresh formation water through the screen. The monitoring well water level was permitted to fully recover prior to performing SWRTs.

During the SWRT, a slug of water was instantaneously removed from the well and the response to the water level is recorded. The Hydraulic Conductivity values for each of the tested wells were calculated from the SWRT data using Aqtesolv Software and the Hvorslev solution for unconfined conditions. The semi-log plots for normalized drawdown versus time are included in Appendix C.

The summary of the hydraulic conductivity (K) values estimated from the SWRTs are provided below in Table 4-3:

Table 4-3: Summary of Hydraulic Conductivity (K) Testing Results

Monitoring Well	Well Depth (m bgs)	Hydraulic Conductivity (m/s)
MW1	15.2	6.15×10^{-8}
MW2	15.2	1.80×10^{-5}
MW3	21.3	5.15×10^{-8}
MW4	16.8	1.58×10^{-5}
MW5	19.8	3.87×10^{-5}
Geometric mean K value (m/s)		**2.03×10^{-6}**

The SWRT provides an estimate of K for the geological formation in the immediate media zone surrounding the well screen and may not be representative of bulk formation hydraulic conductivities.

Given the fast recovery, the hydraulic conductivity test results should be considered as approximate and will require further confirmation. The appropriate method to estimate hydraulic conductivity is by conducting a pump test. Prior to finalizing the dewatering quantity, a properly designed pump test should be conducted. For discussion purposes of this report, a geometric mean hydraulic conductivity value is considered for dewatering calculations.

4.5 Groundwater Sampling

To assess the suitability for discharge of pumped groundwater to the Region of Halton Sanitary or City of Burlington Storm Sewer during dewatering activities, a groundwater sample was collected from BH/MW4 on June 28, 2021.

Prior to collection of the samples, approximately three (3) standing well volumes of groundwater were purged from the well. The sample was collected and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required.

The sample was not field filtered. Dedicated nitrile gloves were used during sample handling. The groundwater sample was submitted to an independent laboratory, Bureau Veritas Laboratories, of Mississauga, Ontario, for analysis.

For the assessment purposes, the analytical results were compared to Table 1 – Limits for Storm Sewer Discharge (By-Law No. 86-2002) of the Corporation of City of Burlington; and Table 2 – Limits for Sanitary and Combined Sewer Discharge (By-Law No. 2-03) of the Regional Municipality of Halton.

The laboratory Certificate of Analysis (CofAs) and chain of custody are enclosed in Appendix D.

The laboratory CofAs show that there were no exceedances against the Limits for Sanitary and Combined Sewer Discharge, or the Storm Sewer Discharge By-Law of the Corporation of the City of Burlington.

If the groundwater encountered during excavation activities is discharged to the Region of Halton sanitary and combined sewer, no treatment will be required. Given there is no chemical criteria for City of Burlington storm sewer, consultation with the City of Burlington is required prior to discharge any water to the sewer system.

5 Temporary Construction Dewatering

5.1 Construction Dewatering Requirements

It is BIG's understanding that the proposed re-development at the Site will consist of a structure with five (5) levels of undergrounding parking structure. It is anticipated that slab of five (5) levels of underground parking structure will be at an approximate depth of 15 m bgs. The footing elevation is assumed approximately 17 m bgs.

Groundwater was observed in all monitoring wells on June 28, 2021 and depths to the groundwater ranged from 1.94 m to 2.60 m bgs. The shallow wells, BH/MW1, BH/MW2 and BH/MW4 were observed with groundwater elevations of 90.15 m to 90.20 m asl. The deep wells, BH/MW3 and BH/MW5 were observed with groundwater elevations of 89.95 m and 90.14 m asl. For conservative purposes, the construction dewatering calculation is based on an open cut excavation at the present time. To excavate under dry conditions, the water level is anticipated to be lowered at least to a minimum of approximately 1.0 m below the footing elevation.

Additional dewatering capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. It should be noted that the dewatering estimates provided in this report are based on the conceptual building information available at this time. If design details are changed (including any changes to excavation depth), the dewatering estimates must be revised to include the final layout of the development.

5.2 Construction Dewatering Flow Rate Assumptions

The assumptions used for the calculation of the dewatering rate for the proposed development are presented in Table 5-1.

Table 5-1 Dewatering Estimate Assumptions

Input Parameter	Values	Notes
Lowest Surface Elevation (m asl)	92.12	Based on the borehole logs
Footing Elevation (m asl)	75.12	Assumed 17 m below ground
Dewatered Elevation Target (m asl)	74.12	Approximate 1 m below footing elevation
Groundwater Elevation (m asl)	90.2	Highest groundwater elevation from shallow wells on June 28, 2021
Estimated Excavation Area	50 m x 45 m	Based on area extent equivalent
Hydraulic Conductivity (m/s)	**2.03×10^{-6}**	Geometric mean K

5.3 Dewatering Flow Rate Equation

The Dupuit equation for steady flow from a circular source of an excavation at distance of radius of influence (R_0) through an unconfined aquifer resting on a horizontal impervious surface was used to obtain a flow rate estimate, and is expressed as follows:

$$Q_w = \frac{\pi K(H^2 - h^2)}{\ln\left[\frac{R_0}{R_e}\right]}$$

Where:

Q_w = Rate of pumping (m^3/s)

R_0 = Radius of influence (m)

R_e = Equivalent radius of well (m)

K = Hydraulic conductivity (m/s)

H = Head beyond the influence of pumping (static groundwater elevation) (m)

h = Head above base of aquifer at the excavation (m)

It is expected that the initial dewatering rate will be higher in order to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint as groundwater will have been removed locally from storage resulting in lower seepage rates into the excavation. Additionally, the use of a continuous caisson shoring system will further reduce groundwater migration into the excavation reducing the ongoing seepage rate.

5.4 Radius of Influence

The Radius of Influence (ROI) for the construction dewatering is based on the empirical Sichardt Equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible. This equation is empirical and was developed to provide representative flow rates using the steady state flow dewatering equations, as discussed below.

It is noted that in steady state conditions, the radius of influence of pumping will extend until boundary flow conditions are reached and provide sufficient water inputs to the aquifer, such as recharge and surface water bodies. As a result, the distance of influence calculated using Sichardt equation is used to provide a representative flow rate calculation, but it is not precise in determining the actual radius influenced by pumping.

The ROI of pumping (dewatering) for radial flow is calculated based on the Sichardt equation, which is described as follows:

$$R_0 = R_e + 3000\ (\mathrm{H} - \mathrm{h})\sqrt{\mathrm{K}}$$

Where:

K = Hydraulic conductivity (m/s)

H = Static Saturated Head (m)

h = Dynamic Saturated Head (m)

R_0 = Radius of influence (m)

R_e = Equivalent radius of well (m)

Based on the Sichardt equation and the geometric mean K value, the ROI is approximately 69 m from the centre of the excavation for radial flow. The ROI calculation is provided in Appendix E.

The ROI calculation is a conservative methodology and is calculated based on the assumption of active pumping during the construction dewatering. It should be noted that most of the water will be pumped during the first stage of the construction period or when a rain event occurs. Although the ROI was conservatively predicted as 69 m from the centre of the excavation, over a period of time, the drawdown curve will be very close to the bottom of the excavation and thus resulting in negligible ROI. The likelihood for impacts to the nearby structures are negligible. Additionally, the use of a shoring system will further reduce radius of influence.

5.5 Results of Construction Dewatering Flow Rate Estimates

Based on the assumptions provided in this report, the results of the dewatering rate estimate are as follows:

Table 5-2 Summary of Construction Dewatering Flow Rate Estimate

Location	Construction Dewatering Flow Rate Without Safety Factor (L/day)	Peak Construction Dewatering Flow Rate Including Safety Factor of 2.5 (L/day)
Excavation area	151,000	378,000

Construction dewatering flow rate estimates are provided in Table E-1, in Appendix E.

The peak construction dewatering flow rate includes a factor of safety of 2.5 to account for accumulation of rainfall, seasonal fluctuations in the groundwater table, flow from beddings of existing sewers, and variation in hydrogeological properties beyond those encountered during the course of this study. This total dewatering flow rate also provides additional capacity for the dewatering contractors. Given that the predicted dewatering volume exceeds the 50,000 L/day limit, an EASR for construction dewatering will be required.

It should be noted that if caisson wall shoring system is considered for the subject Site, reduction in groundwater quantities can be anticipated.

Please note that it is the responsibility of the contractor to ensure dry conditions are maintained within the excavation at all times.

Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Additionally, the presence of near-surface fill material could hold significant groundwater.

The maximum flow calculation is intended to provide a conservative estimate to account for unforeseeable conditions that may arise during construction. It should be noted that the dewatering estimate provided in this report are based on the proposed development information available at this time. If changes to the design are implemented (e.g., increase to planned excavation depths, widening of excavations, etc.), the dewatering estimates must be revised to include and reflect future changes.

6 Long Term Discharge Estimate

6.1 Long-Term Dewatering Assumptions

Given that the groundwater level is above foundation depths for the development, a permanent foundation sub-drain is recommended. It is assumed that the below grade structure will feature a perimeter drain and sub-drain system installed at approximately 0.5 m below the basement elevation. Table 6-1 presents the assumptions used to calculate the long-term drainage rate estimates.

Table 6-1 Dewatering Estimate Assumptions

Input Parameter	Values	Notes
Lowest Surface Elevation (m asl)	92.12	Based on the borehole logs
P5 Slab Elevation (m asl)	77.12	Assumed 15 m below ground
Groundwater Elevation (m asl)	90.20	Highest deep groundwater elevation on June 28, 2021
Foundation Elevation (m asl)	76.62	Assumed 0.5 m below the P5 slab elevation
Sub-drain Elevation Target (m asl)	76.62	Assumed 0.5 m below the P5 slab elevation
Drainage Dimensions	50 m x 45 m	Based on area extent equivalent
Hydraulic Conductivity (m/s)	**2.03×10^{-6}**	Geometric mean K

6.2 Radius of Influence

The Radius of Influence (ROI) for the long-term dewatering is based on the empirical Cooper and Jacob Equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible. This equation is empirical and was developed to provide representative flow rates using the steady state flow dewatering equations, as discussed below.

Based on the Cooper and Jacob equation and the geometric mean K value, the ROI is approximately 115.6 m from the centre of the drainage area for radial flow. The ROI calculation is provided in Table F-1, Appendix F.

Given there are fast and slow hydraulic conductivities generated at the Site, the estimated ROI is affected by the fast recovery bedrock. The ROI is unlikely will extend to approximately 115.6 m from the centre of the drainage area. The ROI will be re-evaluated when a pump test is conducted in the future.

6.3 Long-Term Perimeter Drain Flow Rate Estimate

Based on the assumptions provided in this report (outlined in Section 6.1), the results of the long-term discharge volume estimate are summarized below:

Table 6-2 Summary of Long-Term Discharge Flow Rate

Location	Long-Term Peak Flow Rate (L/day)	Notes
Flow into sub-drain after initial dewatering stages	113,000	Long term sub-drain flow value rounded based on Dupuit's equation including flow from all sides. Safety factor of 1.5 was used.

The results for the estimate are available in Appendix F, Table F-1. The maximum flow rate estimates represent short term events and are not indicative of long-term continuous contributions to the drainage system. Intermittent cycling of sump pumps and seasonal fluctuation in groundwater regimes should be

considered for pump specifications. Given that the predicted dewatering volume exceeds the 50,000 L/day limit, a PTTW is required.

It should be noted that the dewatering estimates provided in this report are based on the proposed building information available at this time.

If the groundwater encountered during long-term dewatering is discharged to the Region of Halton sanitary and combined sewer, no treatment will be required. Given there is no chemical criteria for City of Burlington storm sewer, consultation with the City of Burlington is required prior to discharge any water to the sewer system.

In the event that the long-term foundation drainage is not allowed to discharge into the City's sewer system, the proposed building may be designed and supported by "tanked" water-proofed continuous raft foundation without permanent dewatering (i.e., avoiding permanent perimeter and under-floor drainage system).

7 Potential Groundwater Impacts

7.1 Impacts to Nearby Groundwater Users

The Site lies within an urban area of Burlington. Given the area is serviced by municipal system, no private well water user is expected. There are no potential impacts to nearby groundwater users due to construction dewatering or long-term dewatering is expected.

7.2 Impacts to Nearby Structures

As discussed in Section 5, the ROI calculation is a conservative methodology and is calculated based on the assumption of active pumping during the construction dewatering. It should be noted that most of the water will be pumped during the first stage of the construction period or when a rain event occurs. Although the ROI was conservatively predicted as 69 m from the centre of the excavation, over a period of time, the drawdown curve will be very close to the bottom of the excavation and thus resulting in negligible ROI. The likelihood for impacts to the nearby structures are negligible. Additionally, the use of a shoring system will further reduce radius of influence.

As discussed in Section 6, the ROI for long-term dewatering is approximately 115.6 m from the centre of the drainage area for radial flow. Given there are fast and slow hydraulic conductivities generated at the Site, the estimated ROI is affected by the fast recovery bedrock. The ROI is unlikely will extend to approximately 115.6 m from the centre of the drainage area. The ROI will be re-evaluated when a pump test is conducted in the future.

8 Water Taking and Discharge Permits

8.1 EASR

During the active construction dewatering phase, the volume of water expected to be pumped exceeds the daily limit on groundwater taking under the Ontario Water Resources Act (50,000 L/day) if the excavation is to be undertaken all at once. Therefore, it is necessary to register the construction dewatering under the EASR guidelines, as cumulative discharge rate for construction is 378,000 L/day. The limit for water taking under an EASR is 400,000 L/day. If combined storm and groundwater were to exceed this limit, the dewatering rate would need to be capped to 400,000 L/day of pumped water. If it is necessary to exceed 400,000 L/day of water taking, a Permit to Take Water as per O.Reg.387/04 would be required. Given that the predicted long-term dewatering volume exceeds the 50,000 L/day limit, a PTTW is required.

9 Conclusions

Based on the findings of the Hydrogeological Investigation, the following summary of conclusions are provided:

a) It is BIG's understanding that the proposed re-development at the Site will consist of a structure with five (5) levels of undergrounding parking.
b) The Site is located within a physiographic region within the Iroquois Plain known as the shale plains;
c) The surficial geology of the immediate area around the Site is described as coarse-textured glaciolacustrine deposits ;
d) The MECP WWR database indicate that there are 53 well records registered with the database within 500 m of the Site;
e) Groundwater was observed in all monitoring wells on June 28, 2021 and depths to the groundwater ranged from 1.94 m to 2.60 m bgs. The shallow wells, BH/MW1. BH/MW2 and BH/MW4 were observed with groundwater elevations of 90.15 m to 90.20 m asl. The deep wells, BH/MW3 and BH/MW5 were observed with groundwater elevations of 89.95 m and 90.14m asl;
f) Based on the water level measurements obtained, the inferred direction of shallow groundwater flow across the Site is interpreted to be to the west direction;
g) The estimated hydraulic conductivity of the soil ranges from 3.87×10^{-5} m/s to 5.15×10^{-8} m/s with a geometric mean of 2.03×10^{-6} m/s;
h) Based on the assumptions outlined in this report, the estimated peak construction dewatering flow rate including rainfall for the proposed construction activity is 378,000 L/day;
i) Given that the predicted dewatering volume exceeds the 50,000 L/day limit, an EASR for construction dewatering will be required;
j) Based on the assumptions outlined in this report, the cumulative contribution to the foundation drains is 113,000 L/day;
k) The ROI for long-term dewatering is approximately 115.6 m from the centre of the drainage area for radial flow. Given there are fast and slow hydraulic conductivities generated at the Site, the estimated ROI is affected by the fast recovery bedrock. The ROI is unlikely will extend to approximately 115.6 m from the centre of the drainage area. The ROI will be re-evaluated when a pump test is conducted in the future;
l) Given that the predicted dewatering volume exceeds the 50,000 L/day limit, a PTTW is required;
m) The laboratory CofA shows that no exceedance under Limits for Sanitary and Combined Sewer Discharge, or the City of Burlington Storm Sewer Discharge By-Law;
n) If the groundwater encountered during excavation activities is discharged to the Region of Halton sanitary and combined sewer, no treatment will be required. Given there is no chemical criteria for City of Burlington storm sewer, consultation with the City of Burlington is required prior to discharge any water to the sewer system.

It should be noted that the comments and recommendations in this report are based on the assumption that the present design concept described throughout the report will proceed to construction. Any changes to the design concept may result in a modification to the recommendations provided in this report. It is noted that these conclusions and recommendations should be read in conjunction with the entirety of the report.

10 Limitations

This report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the study area. The conclusion and recommendations presented within this report reflect Site conditions existing at the time of the assessment. BIG must be contacted immediately if any unforeseen Site conditions are experienced during the dewatering activities. This will allow BIG to review the new findings and provide appropriate recommendations to allow the construction to proceed in a timely and cost-effective manner.

Our undertaking at BIG, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the geoscience profession. No other warranty or presentation, either expressed or implied, is included or intended in this report.

This report was prepared for the exclusive use of Camarro Developments Inc. This report may not be reproduced in whole or in part, without the prior written consent of BIG, or used or relied upon in whole or in part by other parties for any purpose. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. BIG 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 information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact our office.

Yours truly,

B.I.G. Consulting Inc.

DRAFT

Peilin (Eileen) Liu, M.Env.Sc., P.Geo.
Project Manager

DRAFT

Prem Manicks, P.Geo.
Partner

11 References

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The Regional Municipality of Halton (2001). By-Law No.2-03

FIGURES



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LEGEND

SITE BOUNDARY

SCALE

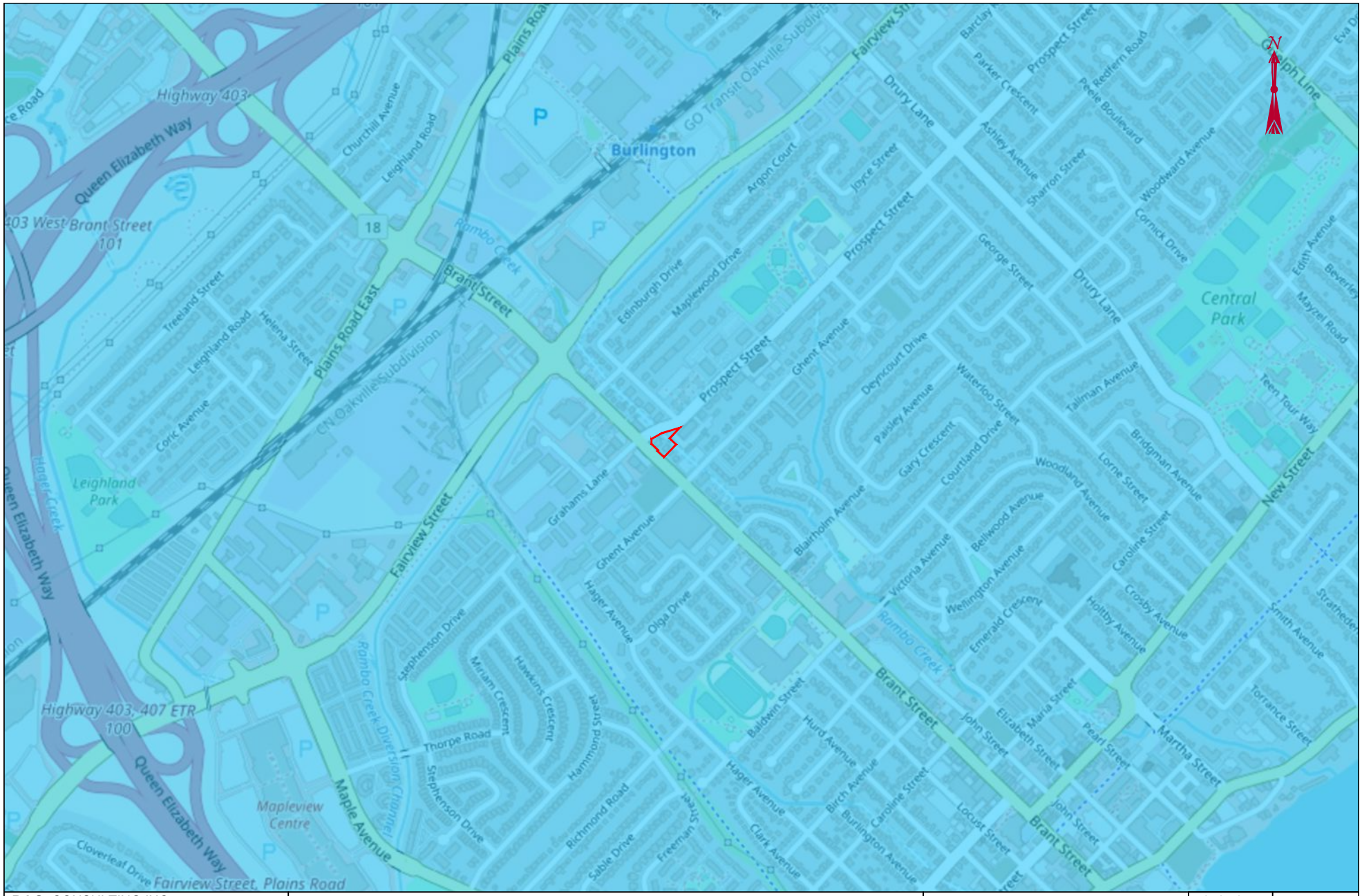
100m 0m 100m 200m 300m 400m 500m

IMAGERY OBTAINED FROM TOPORAMA, NATURAL RESOURCES CANADA,2017

TITLE AND LOCATION

SITE LOCATION PLAN
HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET, BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	1



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LEGEND

SITE BOUNDARY

IROQUOIS PLAIN

SCALE

100m 0m 100m 200m 300m 400m 500m

NOTES:

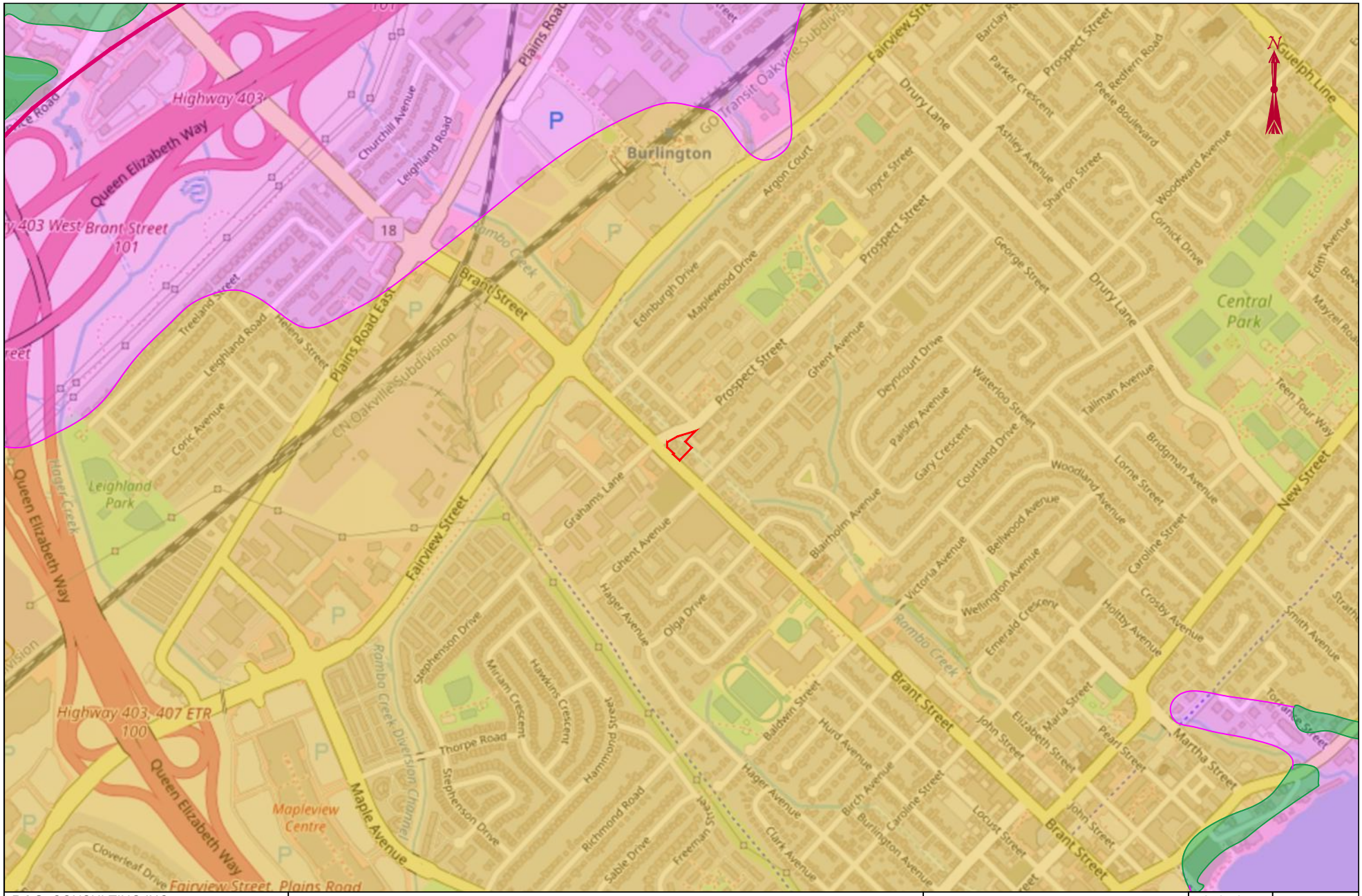
1. PHYISIOGRAPHIC REGIONS PRODUCED BY MINISTRY OF ENERGY, NORTHERN DEVELOPMENT AND MINES, 2021
2. IMAGERY OBTAINED FROM OPENSTREETMAP, 2016

TITLE AND LOCATION

PHYSIOGRAPHIC REGIONS OF SOUTHERN ONTARIO HYDROGEOLOGICAL INVESTIGATION

789-795 BRANT STREET, BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	2



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LEGEND

- SITE BOUNDARY
- TILL
- PALEOZOIC BEDROCK
- 9 COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- SHORE BLUFF OR SCARP

SCALE

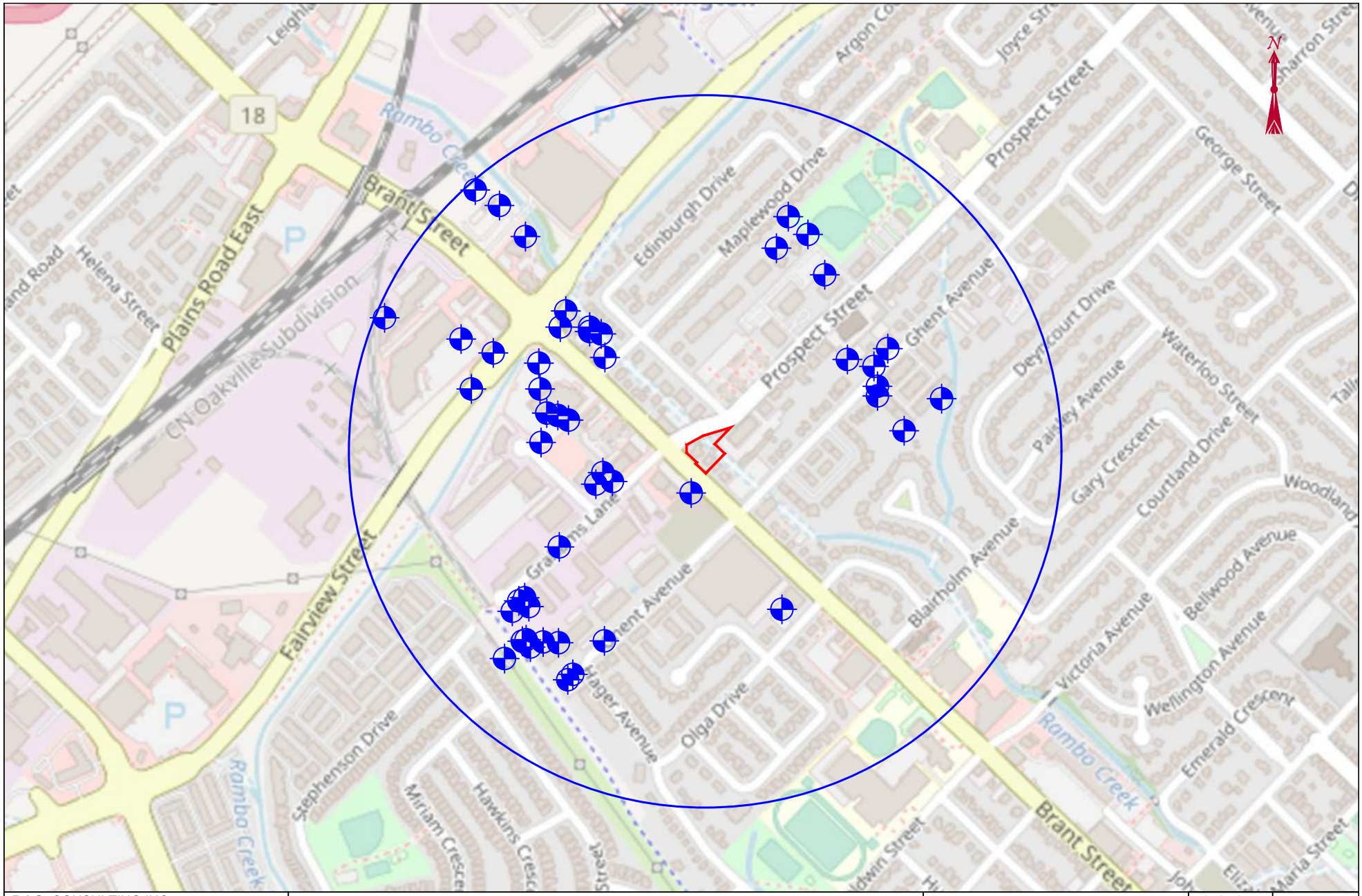
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NOTES:
1. SURFICIAL GEOLOGY PRODUCED BY MINISTRY OF ENERGY, NORTHERN DEVELOPMENT AND MINES, 2021
2. IMAGERY OBTAINED FROM OPENSTREETMAP, 2016

TITLE AND LOCATION

SURFICIAL GEOLOGY OF SOUTHERN ONTARIO
HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET, BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	3



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LEGEND

- SITE BOUNDARY
- WELL RECORD STUDY BOUNDARY
- WELL RECORD LOCATION (2021)

SCALE

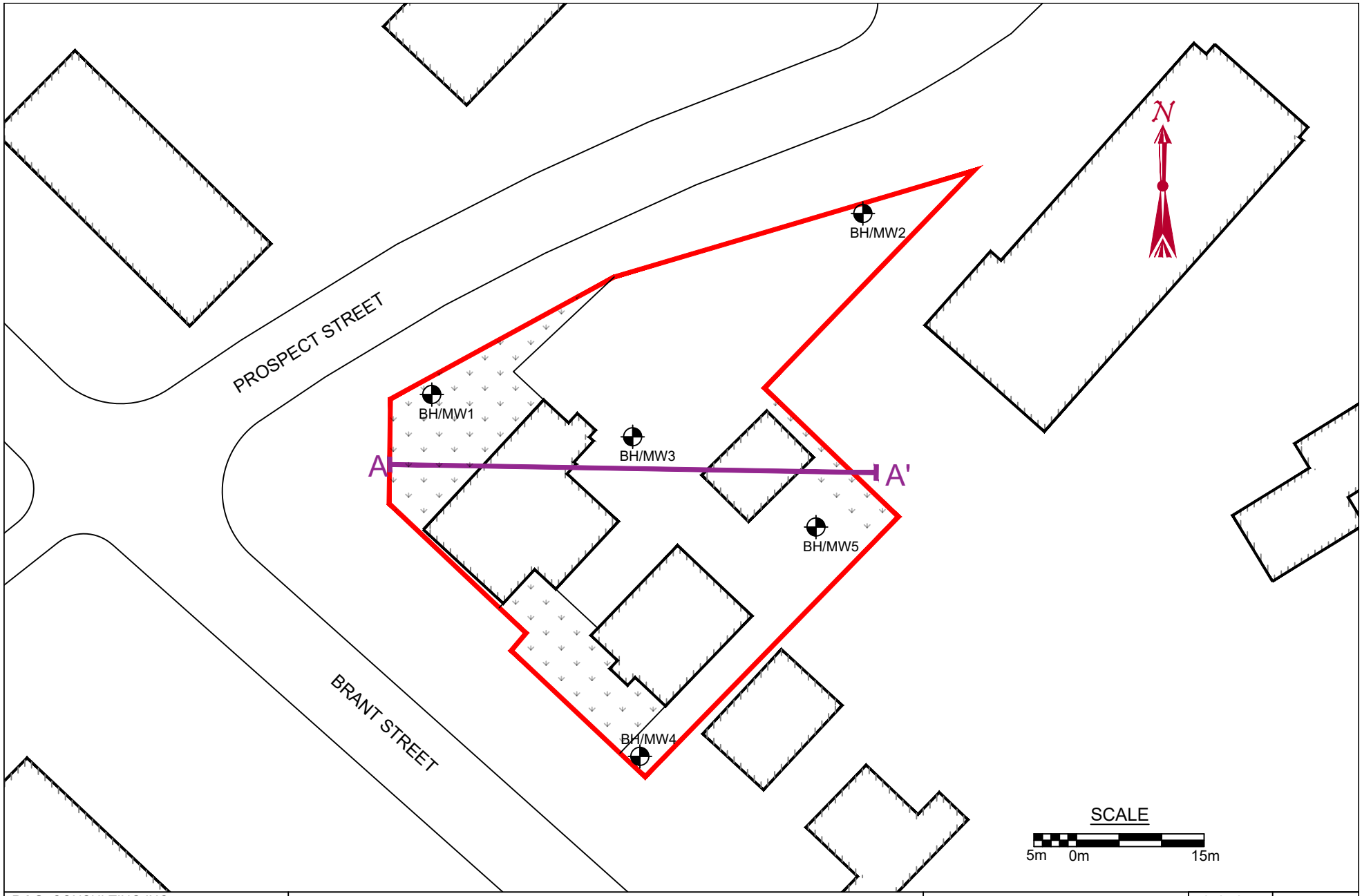
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IMAGERY OBTAINED FROM OPEN STREET MAP, 2016

TITLE AND LOCATION

MECP WATER WELL RECORD LOCATIONS
HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	4



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LEGEND

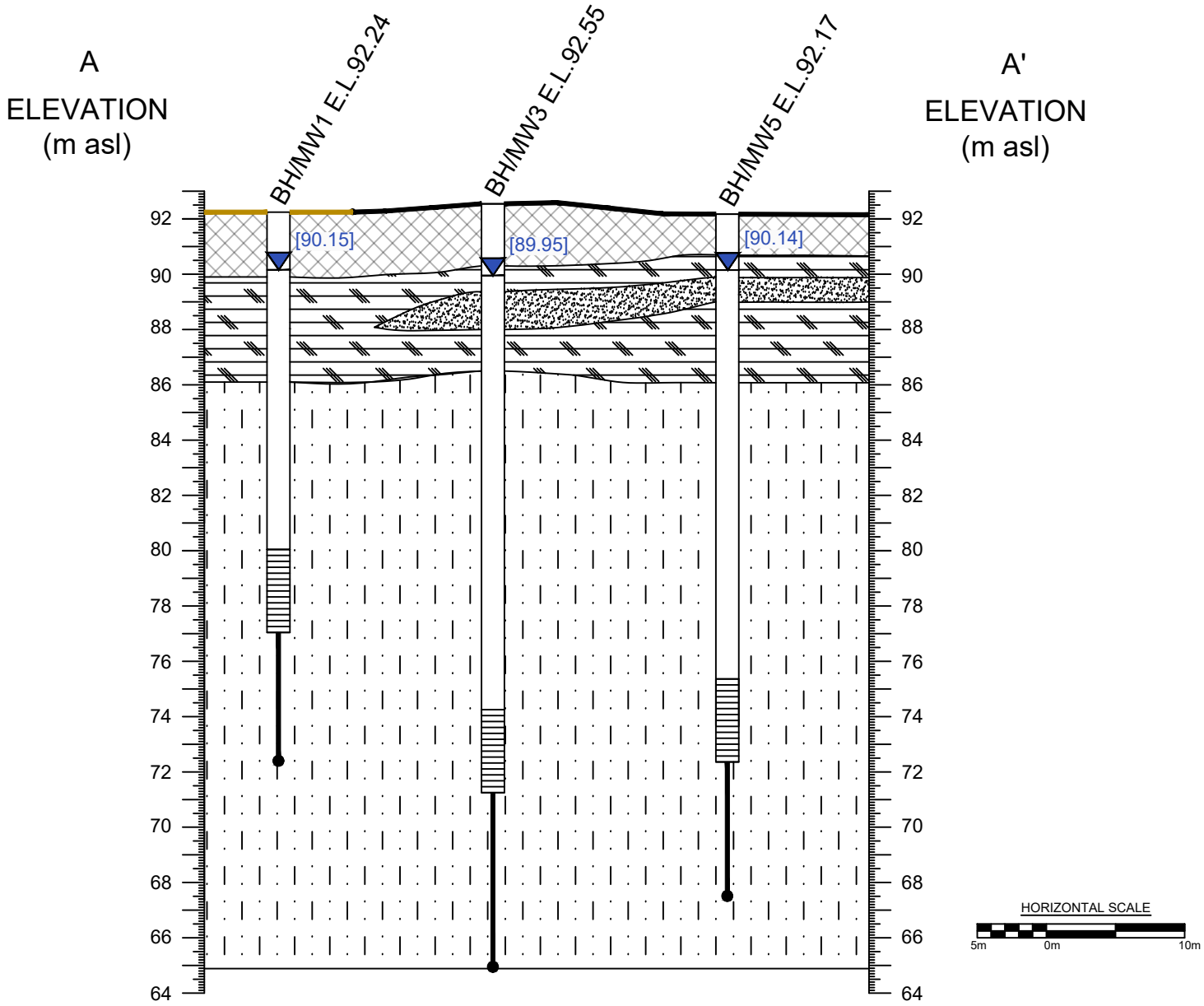
- SITE BOUNDARY
- BUILDING FOOTPRINT
- BOREHOLE/MONITORING WELL
- A A' GEOLOGICAL CROSS SECTION
- LANDSCAPED AREAS

TITLE AND LOCATION

BOREHOLE/MONITORING WELL LOCATION PLAN

HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	5



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LEGEND

- TOPSOIL
- ASPHALT / GRANULAR
- FILL
- CLAYEY SILT / SILTY CLAY
- SILTY SAND / SANDY SILT
- BEDROCK

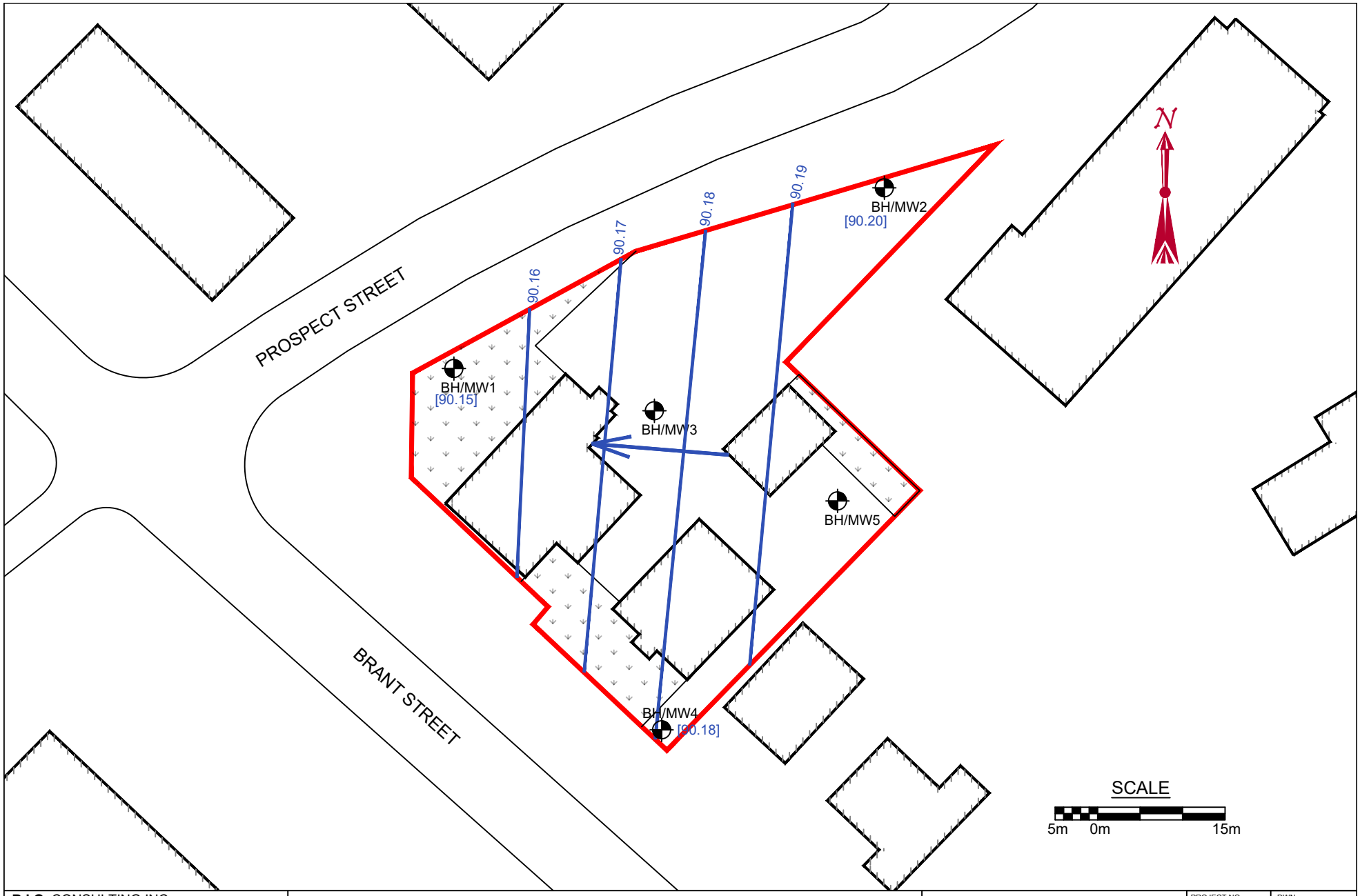
▼ WATER LEVEL

[xx.xx] WATER LEVEL MEASUREMENT (JUNE 28, 2021) (m asl)

TITLE AND LOCATION

GEOLOGICAL CROSS SECTION A-A'
HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	6



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LEGEND

- SITE BOUNDARY
- BUILDING FOOTPRINT
- LANDSCAPED AREAS
- LOCATION OF BOREHOLE/MONITORING WELL
- GROUNDWATER CONTOUR
- INTERPRETED DIRECTION OF GROUNDWATER FLOW
- [XX.XX] WATERLEVEL MEASUREMENT (JUNE 28, 2021) (m asl)

TITLE AND LOCATION

SHALLOW GROUNDWATER CONTOUR MAP
HYDROGEOLOGICAL INVESTIGATION
789-795 BRANT STREET,
BURLINGTON, ONTARIO

PROJECT NO.	DWN.
BIGC-ENV-461A	L.C.K.
SCALE	CK.
AS NOTED	E.L.
DATE	FIG NO.
JULY 2021	7

APPENDIX A: BOREHOLE LOGS

RECORD OF BOREHOLE No. BH/MW1

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical and Hydrogeological Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	14 Jun 21	Date Completed: 15 Jun 21	Revision No.: 0, 20/7/21

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: SPT ○ DCPT ●; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Geodetic Ground Surface Elevation: 92.2 m										
	TOPSOIL: 120mm 92.1	SS	1	67	8	0	92	○	17		
	FILL: silty clay/ clayey silt, trace sand, trace organics, brown, moist, firm	SS	2	0	6	1	91	○			
	- silty sand, brown, moist to wet, compact 90.0	SS	3	100	11	2 ▼	90	○	11		
	SILTY CLAY/ CLAYEY SILT TILL: trace gravel, greyish brown, moist, very stiff to hard 2.3	SS	4	75	24			○	16		
	-sandy	SS	5	100	40	3	89	○	16		Gr-6%; Sa-26%; Si-48%; Cl-20%
						4	88				
		SS	6	70	78/25	5	87	78 ○ 25	12		
	86.1					6					
	BEDROCK: Shale, highly weathered to excellent quality, occasional limestone layers, reddish brown to grey, damp to moist 6.1	SS	7	13	100/10		86	100 ○ 10			
		AU	8	100		7	85				
		AU	9	100		8	84				
		AU	10	100		9	83				
		AU	11	100		10	82				
	ROCK CORE BEGINS	RC	1	93	91	11	81				
	- Excellent Quality					12	80	○			
	- Fair Quality	RC	2	96	72	13	79	○			
	- Good Quality	RC	3	100	89	14	78				
	- Excellent Quality	RC	4	98	98	15	77	○			
	- Good Quality	RC	5	100	76	16	76				
	- Fair Quality 72.4	RC	6	100	68	17	75	○			
	End of Borehole 19.8					18	74	○			
						19	73				

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.09 m bgs on June 28, 2021.

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

▼ Groundwater depth observed on 28/06/2021 at a depth of: 2.09 m.

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

RECORD OF BOREHOLE No. BH/MW2

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical and Hydrogeological Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	11 Jun 21	Date Completed: 14 Jun 21	Revision No.: 0, 20/7/21

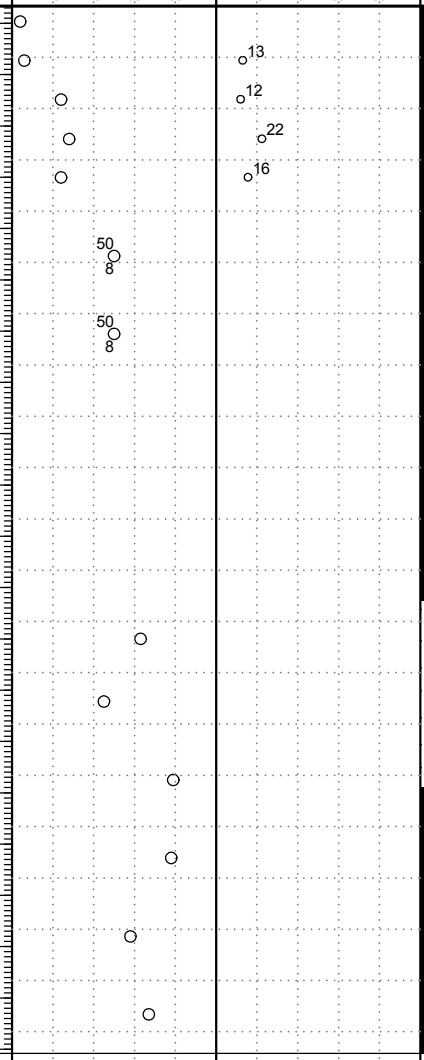
Geodetic Ground Surface Elevation: 92.3 m

DESCRIPTION	Elev.	Depth	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases	92.1	0.2	SS	1	46	4
FILL: silty clay/ clayey silt, trace sand, trace gravel, occasional shale fragments, brown, moist, soft to firm	90.8	1.5	SS	2	100	6
-sandy			SS	3	100	24
SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, greyish brown, moist, very stiff	89.3	3.1	SS	4	92	28
SANDY SILT/ SILTY SAND TILL: trace clay, trace gravel, occasional shale fragments, reddish brown, moist, dense	87.8	4.6	SS	5	59	24
BEDROCK: Shale, highly weathered to good quality, occasional limestone layers, reddish brown to grey, damp to moist			SS	6	13	50/8
			SS	7	13	50/8
			AU	8	100	
			AU	9	100	
			AU	10	100	
			AU	11	100	
ROCK CORE BEGINS			RC	1	88	63
- Fair Quality						
- Poor Quality			RC	2	96	45
- Good Quality			RC	3	100	79
- Good Quality			RC	4	100	78
- Fair Quality			RC	5	98	58
- Fair Quality	71.9	20.4	RC	6	100	67
End of Borehole						

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.14 m bgs on June 28, 2021.

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

LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL); W_P W W_L; Plastic Liquid; 20 40 60 80



INSTRUMENTATION INSTALLATION

COMMENTS: Sieve Analysis: 17, 25, (58)

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Fax: 416-551-2633

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

▼ Groundwater depth observed on 28/06/2021 at a depth of: 2.14 m.

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

RECORD OF BOREHOLE No. BH/MW3

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical and Hydrogeological Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	10 Jun 21	Date Completed: 11 Jun 21	Revision No.: 0, 20/7/21

Geodetic Ground Surface Elevation: 92.6 m

Lithology Plot	DESCRIPTION	Elev.	Depth	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
	ASPHALT PAVEMENT: 80 mm asphalt over 120 mm granular bases	92.4	0.2	SS	1	59	12
	FILL: silty sand, trace clay, trace gravel, occasional glass pieces, dark brown/ black, moist, loose to compact			SS	2	95	8
	- clayey silt, some sand, trace gravel, dark reddish brown, moist, firm	90.3	2.3	SS	3	59	6
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, occaisonal cobble, brown, moist, very stiff	89.4	3.2	SS	4	92	24
	SILTY SAND/ SANDY SILT TILL: some gravel, trace clay, occasional shale fragments, reddish brown, moist, very dense	88.0	4.6	SS	5	100	64
	CLAYEY SILT/ SILTY CLAY TILL: trace to some sand, trace gravel, occasional pebble, brown, moist, hard	86.5	6.1	SS	6	41	50/13
	BEDROCK: Shale, highly weathered to poor quality, occasional limestone layers, reddish brown to grey, damp to moist			SS	7	13	50/8
				AU	8		
				AU	9		
				AU	10		
				AU	11		
	ROCK CORE BEGINS						
	- Poor Quality			RC	1	100	41
	- Fair Quality			RC	2	99	67
	- Excellent Quality			RC	3	100	100
	- Excellent Quality			RC	4	99	90
	- Poor Quality			RC	5	100	47
	- Excellent Quality			RC	6	100	92
	- Excellent Quality *observed calcite precipitation at 22.42 m			RC	7	99	99
	- Fair Quality *observed calcite precipitation at 23.18 m	67.9		RC	8	100	51
	End of Borehole		24.7				

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.60 m bgs on June 28, 2021.

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

LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL); W_P W W_L; Plastic Liquid; 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

Sieve Analysis: 1, 16, (83)

Gr-20%; Sa-41%; Si-32%; Cl-7%

B.I.G. Consulting Inc.
12-5500 Tomken Road
Mississauga, Ontario L4W 2Z4, Canada
Tel: 416-214-4880
Fax: 416-551-2633

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

▼ Groundwater depth observed on 28/06/2021 at a depth of: 2.60 m.

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

RECORD OF BOREHOLE No. BH/MW4

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical and Hydrogeological Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	19 Jun 21	Date Completed: 19 Jun 21	Revision No.: 0, 20/7/21

Geodetic Ground Surface Elevation: 92.1 m

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT ○ / DCPT ●); MTO Vane* (Intact △ / Remould ▲); Nilcon Vane* (Intact ◇ / Remould ◆); * Undrained Shear Strength (kPa) 20 40 60 80	LAB TESTING: ★ Rinse pH Values 2 4 6 8 10 12; Soil Vapour Reading △ parts per million (ppm) 100 200 300 400; ▲ Lower Explosive Limit (LEL) W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases 91.9 / 0.2	SS	1	92	4	0	92				
	FILL: silty clay/ clayey silt, trace sand, trace gravel, trace shale fragments, greyish brown, moist, soft to stiff 90.6 / 1.5	SS	2	84	9	1	91				
	SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, brownish grey, moist, stiff to very stiff 89.1	SS	3	75	9	2 ▼	90				
		SS	4	75	16	3	89				
	SILTY SAND/ SANDY SILT TILL: trace clay, trace gravel, occasional shale fragments, reddish brown, moist to wet, compact 3.1 / 87.7	SS	5	75	21	4	88				
	BEDROCK: Shale, highly weathered to poor quality, occasional limestone layers, reddish brown to grey, damp to moist 4.5	SS	6	13	50/8	5	87	50/8			
		SS	7	13	50/8	6	86	50/8			
		AU	8	100		7	85				
		AU	9	100		8	84				
		AU	10	100		9	83				
		AU	11	100		10	82				
	ROCK CORE BEGINS	RC	1	100	0	11	81				
	- Very Poor Quality - *clay infill in weathered limestone between 12.2 & 12.7 m - Poor Quality	RC	2	100	47	12	80				
	- Poor Quality *clay infill between 14.4 & 14.3 m and 14.9 & 15.4 m	RC	3	86	44	13	79				
	- Very Poor Quality	RC	4	92	0	14	78				
	- Good Quality	RC	5	99	78	15	77				
	- Fair Quality 71.9	RC	6	99	55	16	76				
	End of Borehole 20.3					17	75				
						18	74				
						19	73				
						20	72				

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 1.94 m bgs on June 28, 2021.

B.I.G. Consulting Inc.
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Mississauga, Ontario L4W 2Z4, Canada
Tel: 416-214-4880
Fax: 416-551-2633

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

▼ Groundwater depth observed on 28/06/2021 at a depth of: 1.94 m.

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

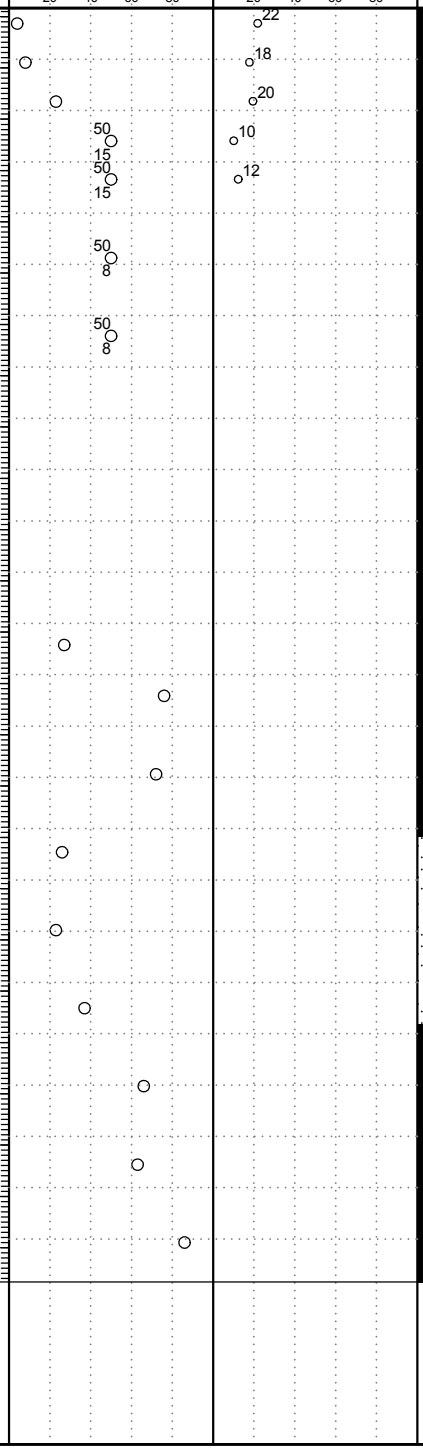
RECORD OF BOREHOLE No. BH/MW5

Project Number:	BIGC-ENV-461A	Drilling Location:	See Borehole Location Plan	Logged by:	MV
Project Client:	Camarro Developments Inc.	Drilling Method:	HSA+HQ Rock Coring	Compiled by:	MV
Project Name:	Preliminary Geotechnical and Hydrogeological Investigation	Drilling Machine:	CME75	Reviewed by:	SS
Project Location:	789-785 Brant Street, Burlington, Ontario	Date Started:	15 Jun 21	Date Completed: 17 Jun 21	Revision No.: 0, 20/7/21

Geodetic Ground Surface Elevation: 92.2 m

DESCRIPTION	Depth (m)	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
ASPHALT PAVEMENT: 50 mm asphalt over 150 mm granular bases	0.2	92.0	SS	1	84	4
FILL: silty clay/ clayey silt, trace sand, brown, moist, firm	1.5	90.7	SS	2	100	8
SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, occasional cobble, brown, moist, very stiff	2.3	89.9	SS	3	95	23
SILTY SAND/ SANDY SILT TILL: trace clay, trace gravel, brown, moist, very dense	3.2	89.0	SS	4	25	50/15
SILTY CLAY/ CLAYEY SILT TILL: trace sand, trace gravel, reddish brown, moist, hard			SS	5	51	50/15
---------- limestone fragments		86.1	SS	6	25	50/8
BEDROCK: Shale, highly weathered to good quality, occasional limestone layers, reddish brown to grey, damp to moist	6.1		SS	7	25	50/8
			AU	8	100	
			AU	9	100	
			AU	10	100	
---------- ROCK CORE BEGINS			AU	11	100	
- Poor Quality			RC	1	85	27
Good Quality			RC	2	100	76
- Fair Quality *clay infill between14.37 and 14.42 m			RC	3	100	72
- Poor Quality *clay infill between 15.76 and 15.78 m			RC	4	100	26
- Very Poor Quality *clay infill between 18.08 and 18.38 m			RC	5	100	23
- Poor Quality *clay infill between 18.79 & 18.88 m and 19.09 & 19.19 m			RC	6	95	37
- Fair Quality *clay infill between 20.32 and 20.36 m			RC	7	95	66
- Fair Quality *clay infill between 23.05 and 23.17 m			RC	8	100	63
- Good Quality		67.3	RC	9	99	86
End of Borehole	24.8					

Notes:
1. Borehole open upon completion of drilling.
2. Ground water level not measured upon completion of drilling due introduced drilling water.
3. Groundwater level reading at 2.03 m bgs on June 28, 2021.



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Mississauga, Ontario L4W 2Z4, Canada
Tel: 416-214-4880
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No freestanding groundwater measured in open borehole on completion of drilling.

Groundwater depth observed on 28/06/2021 at a depth of: 2.03 m.

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

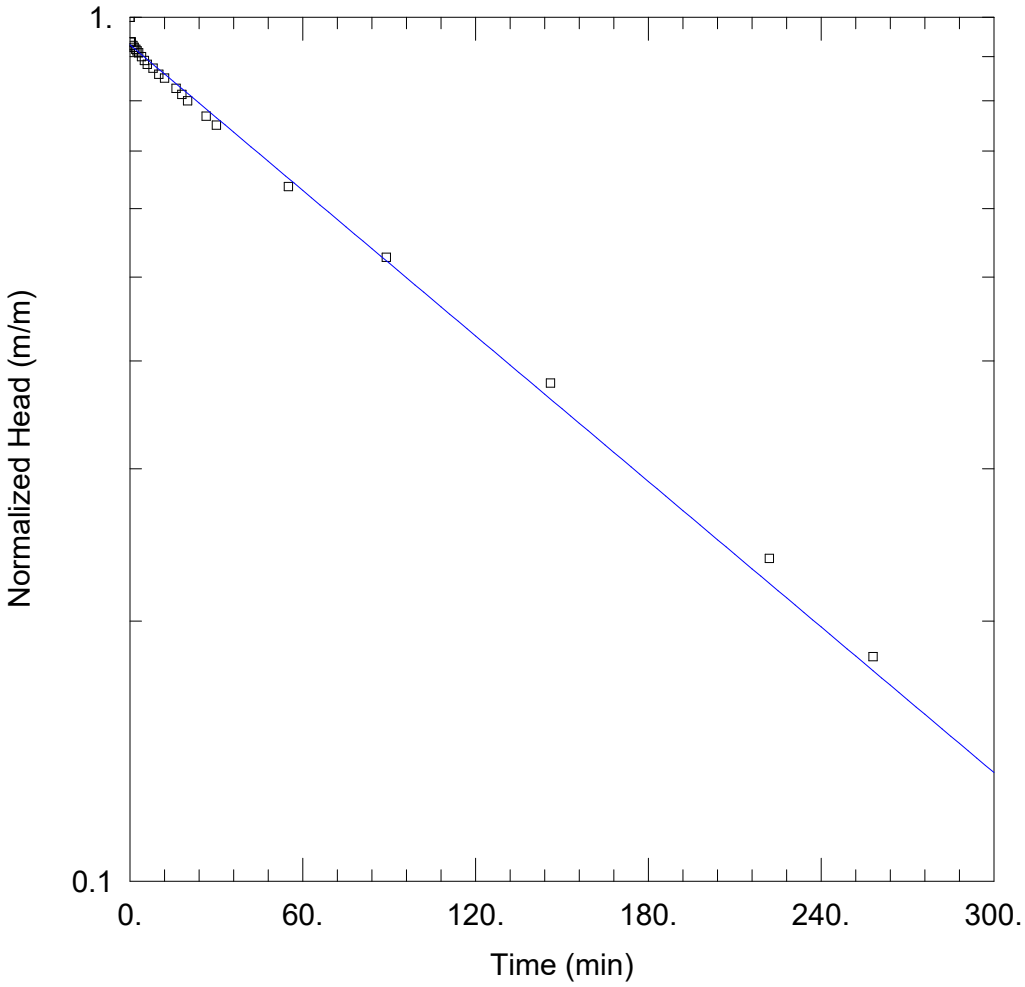
APPENDIX B: MECP WWR AND PTTW AND SUMMARY TABLES

Table B-1: MECP WWR Summary Table

Count	Well ID	Date Completed	Depth (m)	Reported Water Level (m)	Status of Well
1.	2810058	07/05/2004	7.6	N/A	Observation Well
2.	2810171	02/09/2005	4.5	3.5	Observation Well
3.	2810214	03/21/2005	4.5	2	Observation Well
4.	2810308	05/16/2005	4.6	2.5	Observation Well
5.	6715010	07/06/2004	4.5	3.2	Observation Well
6.	7042731	04/03/2007	4.0	N/A	Observation Well
7.	7128794	01/09/2008	N/A	N/A	Abandoned
8.	7128794	01/09/2009	N/A	N/A	Abandoned
9.	7129794	01/09/2009	N/A	N/A	Abandoned
10.	7161863	03/10/2011	N/A	N/A	N/A
11.	7179514	01/19/2012	5.1	N/A	Test Hole
12.	7179515	01/19/2012	5.1	N/A	Monitoring and Test Hole
13.	7179516	01/19/2010	5.1	N/A	Monitoring and Test Hole
14.	7179605	01/19/2012	5.5	N/A	Monitoring and Test Hole
15.	7187211	N/A	6.1	N/A	Observation Well
16.	7187212	N/A	6.1	N/A	Observation Well
17.	7220604	04/21/2014	5.2	N/A	Monitoring Well
18.	7220605	04/21/2014	N/A	N/A	Monitoring Well
19.	7243101	04/29/2015	7.6	N/A	Monitoring Well
20.	7244979	06/03/2015	N/A	2.1	Abandoned
21.	7244980	06/03/2015	5.5	N/A	Observation Well
22.	7244981	06/03/2015	5.5	N/A	Observation Well
23.	7244982	06/03/2015	N/A	N/A	Abandoned
24.	7251865	09/11/2015	6.1	N/A	N/A
25.	7252011	09/04/2015	6.1	N/A	Observation Well
26.	7265586	03/10/2016	N/A	N/A	N/A
27.	7283351	11/04/2016	6.0	N/A	Monitoring and Test Hole
28.	7284939	03/07/2017	4.6	N/A	Monitoring and Test Hole
29.	7284940	03/07/2017	4.6	N/A	Monitoring and Test Hole
30.	7290057	05/26/2017	6.1	N/A	Observation Well
31.	7290058	05/26/2017	6.1	N/A	Observation Well
32.	7291911	06/12/2017	N/A	N/A	N/A
33.	7292314	06/21/2017	6.1	N/A	Observation Well
34.	7292315	06/21/2017	9.1	N/A	Observation Well
35.	7292316	06/21/2017	5.5	N/A	Observation Well
36.	7292317	06/21/2017	5.5	N/A	Observation Well
37.	7314898	07/04/2018	4.6	N/A	Observation Well
38.	7320914	08/22/2018	20.0	N/A	Test Hole
39.	7320915	08/22/2018	20.0	N/A	Test Hole
40.	7320916	08/22/2018	20.0	N/A	Test Hole
41.	7323581	10/05/2018	N/A	N/A	Test Hole
42.	7330854	02/14/2019	4.0	N/A	Observation Well

Count	Well ID	Date Completed	Depth (m)	Reported Water Level (m)	Status of Well
43.	7330855	02/14/2019	4.8	N/A	Observation Well
44.	7330856	02/15/2019	4.8	N/A	Monitoring and Test Hole
45.	7330857	02/15/2019	4.8	N/A	Observation Well
46.	7330858	02/15/2019	4.8	N/A	Monitoring and Test Hole
47.	7330859	02/14/2019	6.1	N/A	Observation Well
48.	7331850	08/23/2018	6.1	N/A	Observation Well
49.	7343297	08/13/2019	7.3	N/A	Monitoring and Test Hole
50.	7343298	08/13/2019	5.2	N/A	Monitoring and Test Hole
51.	7343299	08/13/2019	4.9	N/A	Monitoring and Test Hole
52.	7354371	01/31/2020	N/A	N/A	Abandoned
53.	7354375	01/31/2020	N/A	N/A	Abandoned

APPENDIX C: SWRT RESULTS



WELL TEST ANALYSIS

Data Set: C:\...\MW1.aqt
Date: 07/16/21 Time: 17:20:48

PROJECT INFORMATION

Company: B.I.G. Consulting Inc.
Client: Camarro Developments Inc.
Project: BIGC-ENV-461A
Location: 789-795 Brant Street
Test Well: MW1
Test Date: June 28, 2021

AQUIFER DATA

Saturated Thickness: 12.91 m Anisotropy Ratio (Kz/Kr): 1.

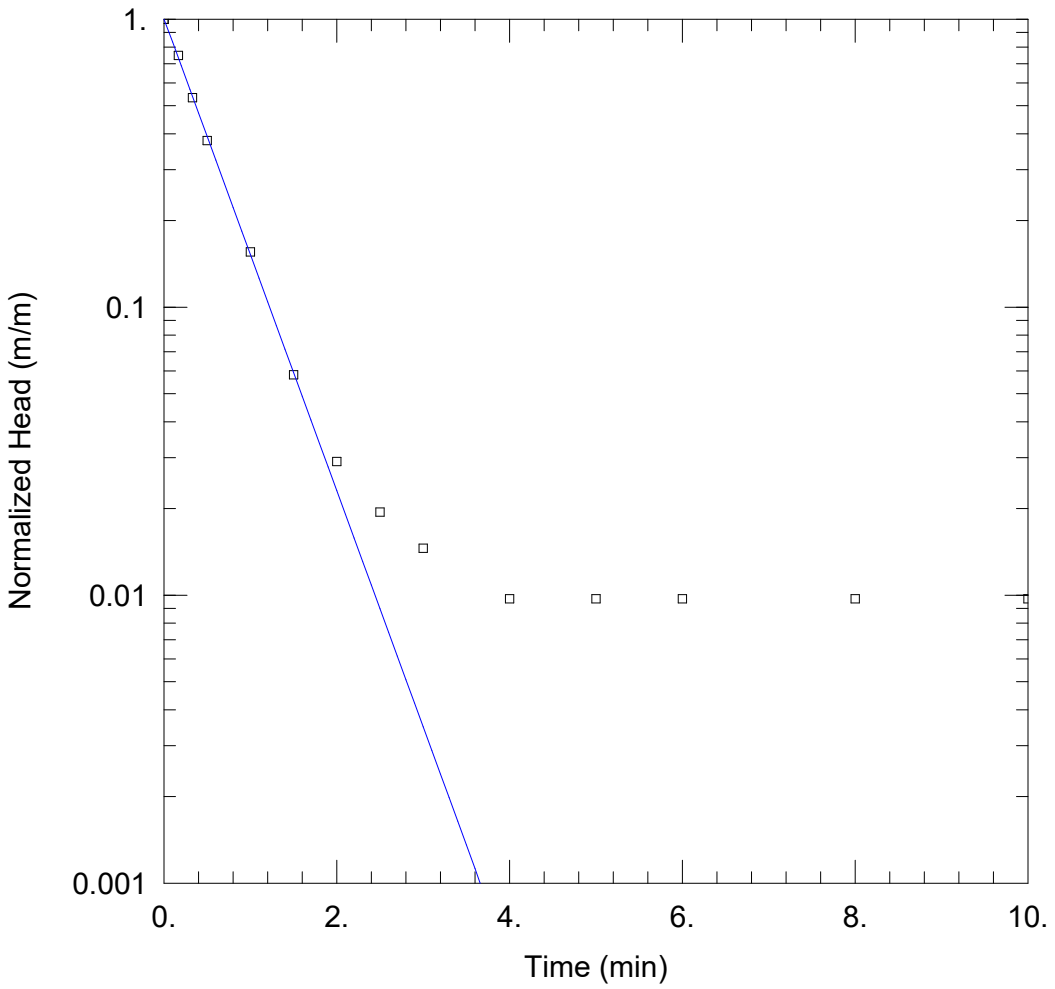
WELL DATA (MW1)

Initial Displacement: 1.1 m
Total Well Penetration Depth: 12.91 m
Casing Radius: 0.025 m
Static Water Column Height: 12.91 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.151E-8 m/sec y0 = 1.022 m



WELL TEST ANALYSIS

Data Set: C:\...\MW2.aqt
Date: 07/16/21 Time: 17:24:45

PROJECT INFORMATION

Company: B.I.G. Consulting Inc.
Client: Camarro Developments Inc.
Project: BIGC-ENV-461A
Location: 789-795 Brant Street
Test Well: MW2
Test Date: June 28, 2021

AQUIFER DATA

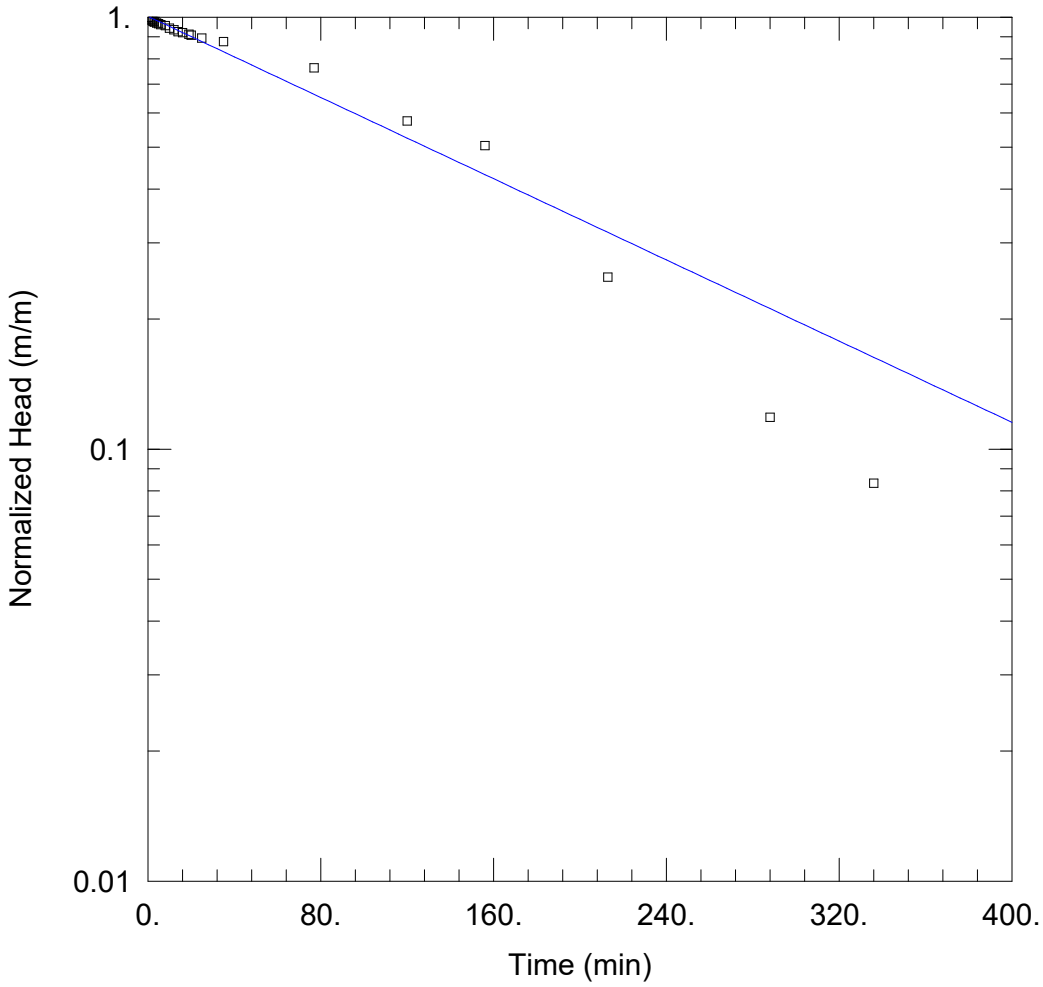
Saturated Thickness: 13.39 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW2)

Initial Displacement: 1.03 m
Total Well Penetration Depth: 13.39 m
Casing Radius: 0.025 m
Static Water Column Height: 13.39 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.796E-5 m/sec
y0 = 1.035 m



WELL TEST ANALYSIS

Data Set: C:\...\MW3.aqt
Date: 07/16/21 Time: 17:20:11

PROJECT INFORMATION

Company: B.I.G. Consulting Inc.
Client: Camarro Developments Inc.
Project: BIGC-ENV-461A
Location: 789-795 Brant Street
Test Well: MW3
Test Date: June 28, 2021

AQUIFER DATA

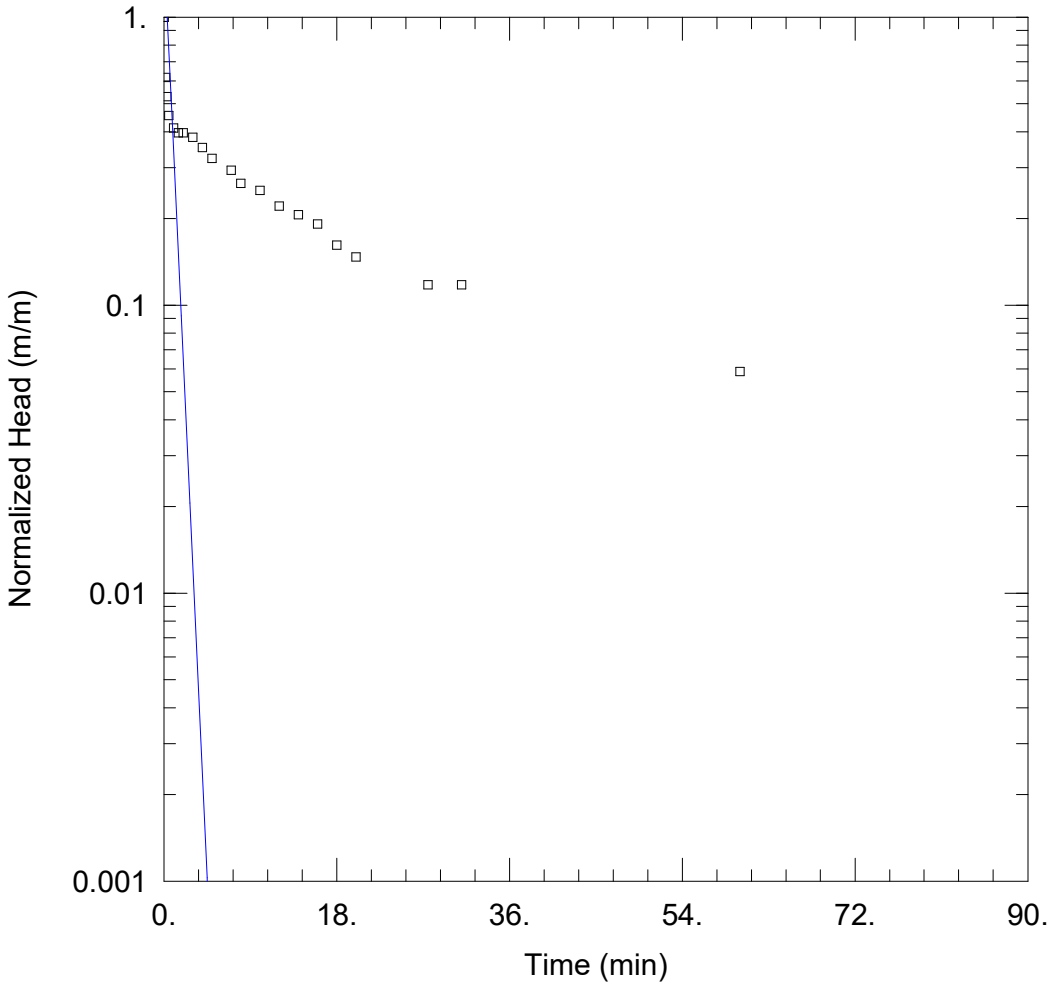
Saturated Thickness: 19.94 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW3)

Initial Displacement: 1.14 m
Total Well Penetration Depth: 19.94 m
Casing Radius: 0.025 m
Static Water Column Height: 19.94 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.148E-8 m/sec
y0 = 1.145 m



WELL TEST ANALYSIS

Data Set: C:\...\MW4.aqt
Date: 07/16/21 Time: 17:19:50

PROJECT INFORMATION

Company: B.I.G. Consulting Inc.
Client: Camarro Developments Inc.
Project: BIGC-ENV-461A
Location: 789-795 Brant Street
Test Well: MW4
Test Date: June 28, 2021

AQUIFER DATA

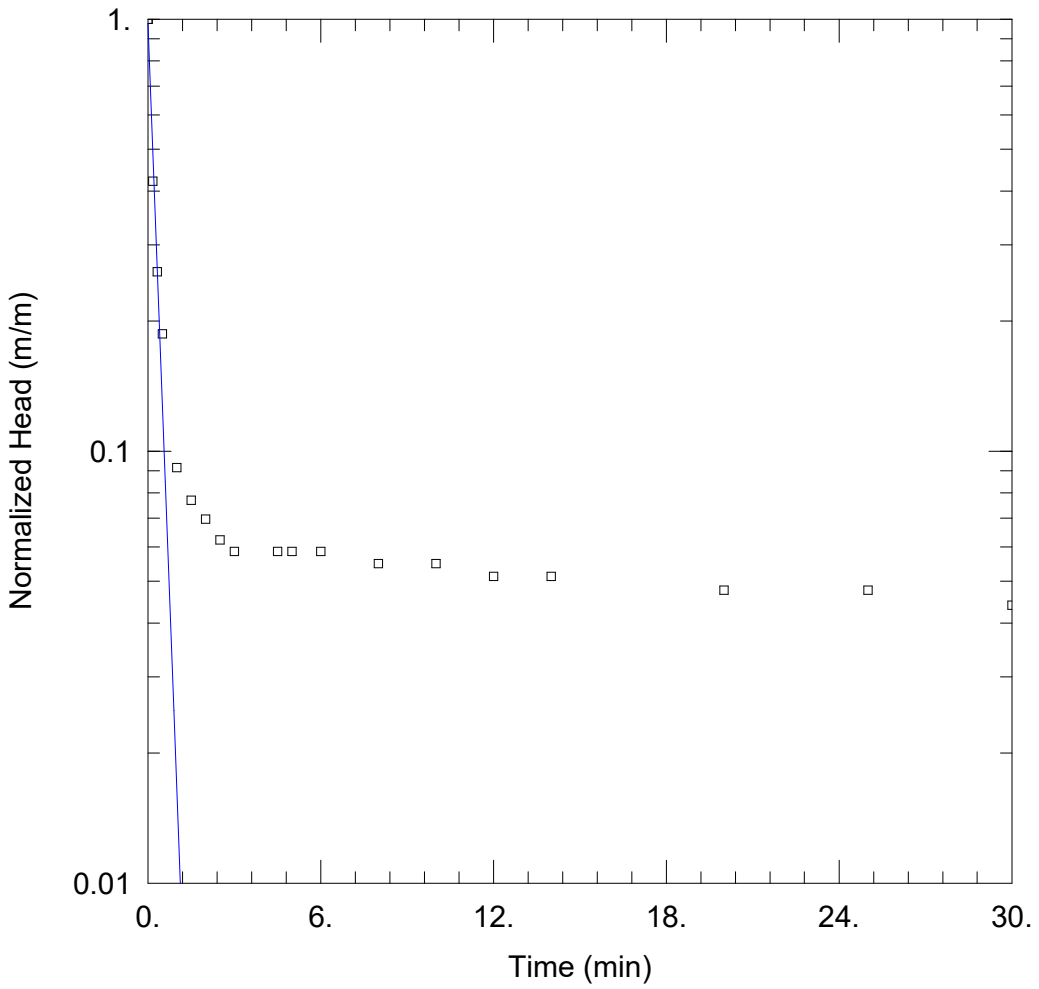
Saturated Thickness: 15.34 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4)

Initial Displacement: 0.34 m
Total Well Penetration Depth: 15.34 m
Casing Radius: 0.025 m
Static Water Column Height: 15.02 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.583E-5 m/sec
y0 = 0.6239 m



WELL TEST ANALYSIS

Data Set: C:\...\MW5.aqt
Date: 07/16/21 Time: 17:19:18

PROJECT INFORMATION

Company: B.I.G. Consulting Inc.
Client: Camarro Developments Inc.
Project: BIGC-ENV-461A
Location: 789-795 Brant Street
Test Well: MW5
Test Date: June 28, 2021

AQUIFER DATA

Saturated Thickness: 17.07 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5)

Initial Displacement: 1.365 m
Total Well Penetration Depth: 17.07 m
Casing Radius: 0.025 m
Static Water Column Height: 17.07 m
Screen Length: 3. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.869E-5 m/sec y0 = 1.33 m

APPENDIX D: WATER QUALITY LABORATORY CERTIFICATE OF ANALYSIS AND CHAIN OF CUSTODY

Your Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Your C.O.C. #: 833962-01-01

Attention: Eileen Liu

B.I.G Consulting Inc.
12-5500 Tomken Road
Mississauga, ON
CANADA L4W 2Z4

Report Date: 2021/07/06
Report #: R6706680
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H8682
Received: 2021/06/28, 19:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonaceous BOD	1	2021/06/30	2021/07/05	CAM SOP-00427	SM 23 5210B m
Total Cyanide	1	2021/06/30	2021/06/30	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2021/06/29	2021/06/30	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2021/06/30	2021/06/30	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2021/07/02	2021/07/05	CAM SOP-00408	EPA 6010D m
E.coli, (CFU/100mL)	1	N/A	2021/06/28	CAM SOP-00552	MOE LSB E3371
Animal and Vegetable Oil and Grease	1	N/A	2021/07/06	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2021/07/05	2021/07/06	CAM SOP-00326	EPA1664B m,SM5520B m
PAH Compounds in Water by GC/MS (SIM)	1	2021/07/02	2021/07/03	CAM SOP-00318	EPA 8270D m
pH	1	2021/06/29	2021/06/30	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2021/06/30	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2021/07/02	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2021/06/29	2021/06/29	CAM SOP-00938	OMOE E3516 m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2021/07/05	2021/07/06	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2021/07/02	2021/07/05	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2021/07/01	CAM SOP-00228	EPA 8260C m

Remarks:

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

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

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

Your Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Your C.O.C. #: 833962-01-01

Attention: Eileen Liu

B.I.G Consulting Inc.
12-5500 Tomken Road
Mississauga, ON
CANADA L4W 2Z4

Report Date: 2021/07/06
Report #: R6706680
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H8682
Received: 2021/06/28, 19:50

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Deepthi Shaji, Project Manager
Email: Deepthi.Shaji@bureauveritas.com
Phone# (905)817-5700 Ext:7065843
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H8682
Report Date: 2021/07/06

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				PYO804			PYO804		
Sampling Date				2021/06/28 16:00			2021/06/28 16:00		
COC Number				833962-01-01			833962-01-01		
	UNITS	Criteria	Criteria-2	MW4	RDL	QC Batch	MW4 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	-	150	0.80	0.50	7432655			
Inorganics									
Total Carbonaceous BOD	mg/L	-	300	ND	2	7437858			
Fluoride (F-)	mg/L	-	10	0.63	0.10	7435748			
Total Kjeldahl Nitrogen (TKN)	mg/L	-	100	9.0	0.50	7435698			
pH	pH	6.5:8.5	6.0:10.0	7.70		7435760			
Phenols-4AAP	mg/L	-	1	ND	0.0010	7437624			
Total Suspended Solids	mg/L	-	350	30	10	7442028			
Dissolved Sulphate (SO4)	mg/L	-	1500	1100	5.0	7436117	1000	5.0	7436117
Total Cyanide (CN)	mg/L	-	2	ND	0.0050	7438854			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	1.4	0.50	7445257			
Total Oil & Grease Mineral/Synthetic	mg/L	-	-	0.60	0.50	7445259			
Metals									
Total Aluminum (Al)	mg/L	-	50	0.2	0.1	7441395			
Total Antimony (Sb)	mg/L	-	5	ND	0.02	7441395			
Total Arsenic (As)	mg/L	-	1	ND	0.01	7441395			
Total Beryllium (Be)	mg/L	-	5	ND	0.0005	7441395			
Total Cadmium (Cd)	mg/L	-	1	ND	0.002	7441395			
Total Chromium (Cr)	mg/L	-	3	ND	0.01	7441395			
Total Cobalt (Co)	mg/L	-	5	ND	0.002	7441395			
Total Copper (Cu)	mg/L	-	3	0.03	0.01	7441395			
Total Iron (Fe)	mg/L	-	50	1.2	0.02	7441395			
Total Lead (Pb)	mg/L	-	3	ND	0.01	7441395			
Total Manganese (Mn)	mg/L	-	5	0.38	0.001	7441395			
Mercury (Hg)	mg/L	-	0.05	ND	0.00010	7437958			
Total Molybdenum (Mo)	mg/L	-	5	0.010	0.005	7441395			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: The City of Burlington Storm Sewer Discharge By-Law 86-2002
Criteria-2: Halton Sanitary & Combined Sewer Bylaw (2-03)
ND = Not detected

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

BV Labs Job #: C1H8682
Report Date: 2021/07/06

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

HALTON SANITARY & COMBINED SEWER (2-03)

BV Labs ID				PYO804			PYO804		
Sampling Date				2021/06/28 16:00			2021/06/28 16:00		
COC Number				833962-01-01			833962-01-01		
	UNITS	Criteria	Criteria-2	MW4	RDL	QC Batch	MW4 Lab-Dup	RDL	QC Batch
Total Nickel (Ni)	mg/L	-	3	ND	0.005	7441395			
Total Phosphorus (P)	mg/L	-	10	ND	0.05	7441395			
Total Selenium (Se)	mg/L	-	5	ND	0.02	7441395			
Total Silver (Ag)	mg/L	-	5	ND	0.01	7441395			
Total Tin (Sn)	mg/L	-	5	ND	0.02	7441395			
Total Titanium (Ti)	mg/L	-	5	ND	0.005	7441395			
Total Zinc (Zn)	mg/L	-	3	0.005	0.005	7441395			
Polyaromatic Hydrocarbons									
Naphthalene	ug/L	-	140	0.059	0.050	7442712			
Volatile Organics									
Benzene	ug/L	-	10	ND	0.40	7435856			
Chloroform	ug/L	-	40	1.4	0.40	7435856			
1,4-Dichlorobenzene	ug/L	-	80	ND	0.80	7435856			
Ethylbenzene	ug/L	-	160	ND	0.40	7435856			
Methylene Chloride(Dichloromethane)	ug/L	-	2000	ND	4.0	7435856			
Tetrachloroethylene	ug/L	-	1000	ND	0.40	7435856			
Toluene	ug/L	-	16	ND	0.40	7435856			
Trichloroethylene	ug/L	-	400	ND	0.40	7435856			
Surrogate Recovery (%)									
D10-Anthracene	%	-	-	105		7442712			
D14-Terphenyl (FS)	%	-	-	109		7442712			
D8-Acenaphthylene	%	-	-	99		7442712			
4-Bromofluorobenzene	%	-	-	87		7435856			
D4-1,2-Dichloroethane	%	-	-	111		7435856			
D8-Toluene	%	-	-	88		7435856			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: The City of Burlington Storm Sewer Discharge By-Law 86-2002
Criteria-2: Halton Sanitary & Combined Sewer Bylaw (2-03)
ND = Not detected

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BV Labs Job #: C1H8682
Report Date: 2021/07/06

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

MICROBIOLOGY (WATER)

BV Labs ID			PYO804		
Sampling Date			2021/06/28 16:00		
COC Number			833962-01-01		
	UNITS	Criteria	MW4	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	200	<10	10	7434598

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: The City of Burlington Storm Sewer Discharge By-Law 86-2002

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

BV Labs Job #: C1H8682
Report Date: 2021/07/06

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

GENERAL COMMENTS

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

Package 1	22.7°C

Sample PYO804 [MW4] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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

BV Labs Job #: C1H8682
Report Date: 2021/07/06

QUALITY ASSURANCE REPORT

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7435856	4-Bromofluorobenzene	2021/06/30	104	70 - 130	104	70 - 130	95	%				
7435856	D4-1,2-Dichloroethane	2021/06/30	103	70 - 130	95	70 - 130	108	%				
7435856	D8-Toluene	2021/06/30	108	70 - 130	108	70 - 130	89	%				
7442712	D10-Anthracene	2021/07/05	53	50 - 130	95	50 - 130	97	%				
7442712	D14-Terphenyl (FS)	2021/07/05	67	50 - 130	103	50 - 130	83	%				
7442712	D8-Acenaphthylene	2021/07/05	94	50 - 130	89	50 - 130	94	%				
7435698	Total Kjeldahl Nitrogen (TKN)	2021/06/29	102	80 - 120	96	80 - 120	ND, RDL=0.10	mg/L	1.8	20	94	80 - 120
7435748	Fluoride (F-)	2021/06/30	118	80 - 120	106	80 - 120	ND, RDL=0.10	mg/L	5.1	20		
7435760	pH	2021/06/30			102	98 - 103			0.21	N/A		
7435856	1,4-Dichlorobenzene	2021/06/30	114	70 - 130	110	70 - 130	ND, RDL=0.40	ug/L	NC	30		
7435856	Benzene	2021/06/30	93	70 - 130	91	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7435856	Chloroform	2021/06/30	98	70 - 130	93	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7435856	Ethylbenzene	2021/06/30	89	70 - 130	92	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7435856	Methylene Chloride(Dichloromethane)	2021/06/30	98	70 - 130	92	70 - 130	ND, RDL=2.0	ug/L	NC	30		
7435856	Tetrachloroethylene	2021/06/30	93	70 - 130	91	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7435856	Toluene	2021/06/30	99	70 - 130	98	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7435856	Trichloroethylene	2021/06/30	101	70 - 130	100	70 - 130	ND, RDL=0.20	ug/L	0.037	30		
7436117	Dissolved Sulphate (SO4)	2021/07/02	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	4.1	20		
7437624	Phenols-4AAP	2021/06/30	96	80 - 120	96	80 - 120	ND, RDL=0.0010	mg/L	0	20		
7437858	Total Carbonaceous BOD	2021/07/05					ND,RDL=2	mg/L	13	30	95	85 - 115
7437958	Mercury (Hg)	2021/06/30	92	75 - 125	96	80 - 120	ND, RDL=0.00010	mg/L	NC	20		
7438854	Total Cyanide (CN)	2021/07/02	101	80 - 120	97	80 - 120	ND, RDL=0.0050	mg/L	1.3	20		
7441395	Total Aluminum (Al)	2021/07/05	95	80 - 120	102	80 - 120	ND, RDL=0.1	mg/L	NC	20		
7441395	Total Antimony (Sb)	2021/07/05	105	80 - 120	105	80 - 120	ND, RDL=0.02	mg/L	NC	20		
7441395	Total Arsenic (As)	2021/07/05	100	80 - 120	100	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7441395	Total Beryllium (Be)	2021/07/05	98	80 - 120	99	80 - 120	ND, RDL=0.0005	mg/L	NC	20		
7441395	Total Cadmium (Cd)	2021/07/05	101	80 - 120	102	80 - 120	ND, RDL=0.002	mg/L	NC	20		

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

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7441395	Total Chromium (Cr)	2021/07/05	99	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7441395	Total Cobalt (Co)	2021/07/05	100	80 - 120	100	80 - 120	ND, RDL=0.002	mg/L	NC	20		
7441395	Total Copper (Cu)	2021/07/05	NC	80 - 120	100	80 - 120	ND, RDL=0.01	mg/L	3.3	20		
7441395	Total Iron (Fe)	2021/07/05	97	80 - 120	101	80 - 120	ND, RDL=0.02	mg/L	NC	20		
7441395	Total Lead (Pb)	2021/07/05	100	80 - 120	100	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7441395	Total Manganese (Mn)	2021/07/05	97	80 - 120	99	80 - 120	ND, RDL=0.001	mg/L	NC	20		
7441395	Total Molybdenum (Mo)	2021/07/05	104	80 - 120	104	80 - 120	ND, RDL=0.005	mg/L	NC	20		
7441395	Total Nickel (Ni)	2021/07/05	100	80 - 120	100	80 - 120	ND, RDL=0.005	mg/L	NC	20		
7441395	Total Phosphorus (P)	2021/07/05	108	80 - 120	110	80 - 120	ND, RDL=0.05	mg/L	NC	20		
7441395	Total Selenium (Se)	2021/07/05	103	80 - 120	102	80 - 120	ND, RDL=0.02	mg/L	NC	20		
7441395	Total Silver (Ag)	2021/07/05	98	80 - 120	98	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7441395	Total Tin (Sn)	2021/07/05	102	80 - 120	103	80 - 120	ND, RDL=0.02	mg/L	NC	20		
7441395	Total Titanium (Ti)	2021/07/05	100	80 - 120	101	80 - 120	ND, RDL=0.005	mg/L	NC	20		
7441395	Total Zinc (Zn)	2021/07/05	103	80 - 120	103	80 - 120	ND, RDL=0.005	mg/L	NC	20		
7442028	Total Suspended Solids	2021/07/05					ND, RDL=10	mg/L	8.5	25	99	85 - 115
7442712	Naphthalene	2021/07/03	56	50 - 130	67	50 - 130	ND, RDL=0.050	ug/L	NC	30		
7445257	Total Oil & Grease	2021/07/06			98	85 - 115	ND, RDL=0.50	mg/L	1.5	25		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7445259	Total Oil & Grease Mineral/Synthetic	2021/07/06			98	85 - 115	ND, RDL=0.50	mg/L	5.2	25		

N/A = Not Applicable

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

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

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

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

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

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

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

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

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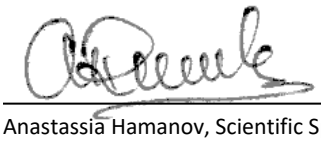
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H8682
Report Date: 2021/07/06

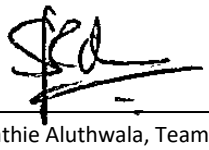
B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist



Sirimathie Aluthwala, Team Lead

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

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

BV Labs Job #: C1H8682
Report Date: 2021/07/06

B.I.G Consulting Inc.
Client Project #: BIGC-ENV-461A
Site Location: 789-795 Brant Street, Burlington
Sampler Initials: SL

Exceedance Summary Table – Burlington Storm Sewer

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

Exceedance Summary Table – Halton Sanitary Sewer

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

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MICRO

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Page of

28-Jun-21 19:50

Deepthi Shaji

C1H8682

Bottle Order #: 833962

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:			
Company Name:	#31796 B.I.G Consulting Inc.	Company Name:		Quotation #:	B64476		
Attention:	Accounts Payable	Attention:	Eileen Liu	P.O. #:			
Address:	12-5500 Tomken Road Mississauga ON L4W 2Z4	Address:		Project:	BIGC-ENV-461A	NP4	ENV-980
Tel:	(416) 214-4880 Fax:	Tel:	Fax:	Project Name:		COC #:	Project Manager:
Email:	ldougherty@brownfieldigi.com;admin@brownfieldigi.co	Email:	eliu@brownfieldigi.com	Site #:		C#833962-01-01	Deepthi Shaji
				Sampled By:			

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

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

Other Regulations
- ☐ CCME ☑ Sanitary Sewer Bylaw
- ☐ Reg 558 ☑ Storm Sewer Bylaw
- ☐ MISA Municipality Burlington
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

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

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

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

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

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Burlington storm sewer	Halton Sanitary & Combined Sewer (2-03)							# of Bottles	Comments
1		MW4	21/06/28	16:00	GW	N	✓	✓							15	
2																
3																
4																
5																
6																
7																
8																
9																
10																

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
Shirley Li	21/06/28	19:50		21/06/28	15:50		Time Sensitive	Temperature (°C) on Recei 22/23/23	Custody Seal Present	Yes ✓	No
									Intact		

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

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

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

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

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

APPENDIX E: CONSTRUCTION DEWATERING ESTIMATE RATE CALCULATIONS

Construction Dewatering Rate Estimate

789 and 795 Brant Street, Burlington, Ontario
Five (5) levels of underground parking, unconfined aquifer, groundwater seepage to square excavation (radial source)

Table E-1: Construction Dewatering Rate Estimates

Description	Symbol	Values	Unit	Explanation
Input				
Lowest Ground Elevation		92.12	m asl	Based on borehole logs
Highest Groundwater Level		90.20	m asl	Highest groundwater elevation on June 28, 2021
Footing Elevation		75.12	m asl	Assumed 17 m below ground
Aquifer Bottom		74.12	m asl	Assumed 1 m below footing elevation
Hydraulic Conductivity		2.03E-06	m/s	Geometric mean K
Length of Excavation	x	50.0	m	Based on aerial extent of the Site
Width of Excavation	a	45.0	m	Based on aerial extent of the Site
Output				
Top of Aquifer		90.20	m asl	Water table for unconfined aquifer
Target Water Level		74.12	m asl	Assumed 1.0 m below footing elevation
Water Level above aquifer bottom before dewatering	H	16.1	m	
Target water level above aquifer bottom	h	0.0	m	
Equivalent radius	R_e	26.8	m	Equal perimeter
Radius of Influence	L (R_0)	68.80	m	Sichardt's Formula (C=3000 for radial source)
Construction dewatering flow rate - Steady State	Q	151.2	m^3/day	Construction Dewatering flow – Dupuit Equation
Maximum construction dewatering flow rate (safety factor of 2.5)	2.5Q	378.0	m^3/day	During the initial period and after rains
Construction Dewatering Flow Rate - Steady State	Q	**151,000**	L/day	
Maximum Construction Flow Rate (safety factor of 2.5)	2.5Q	**378,000**	L/day	

APPENDIX F: LONG TERM DRAINAGE FLOW RATE ESTIMATE CALCULATIONS

Foundation Drain Flow Rate Estimate

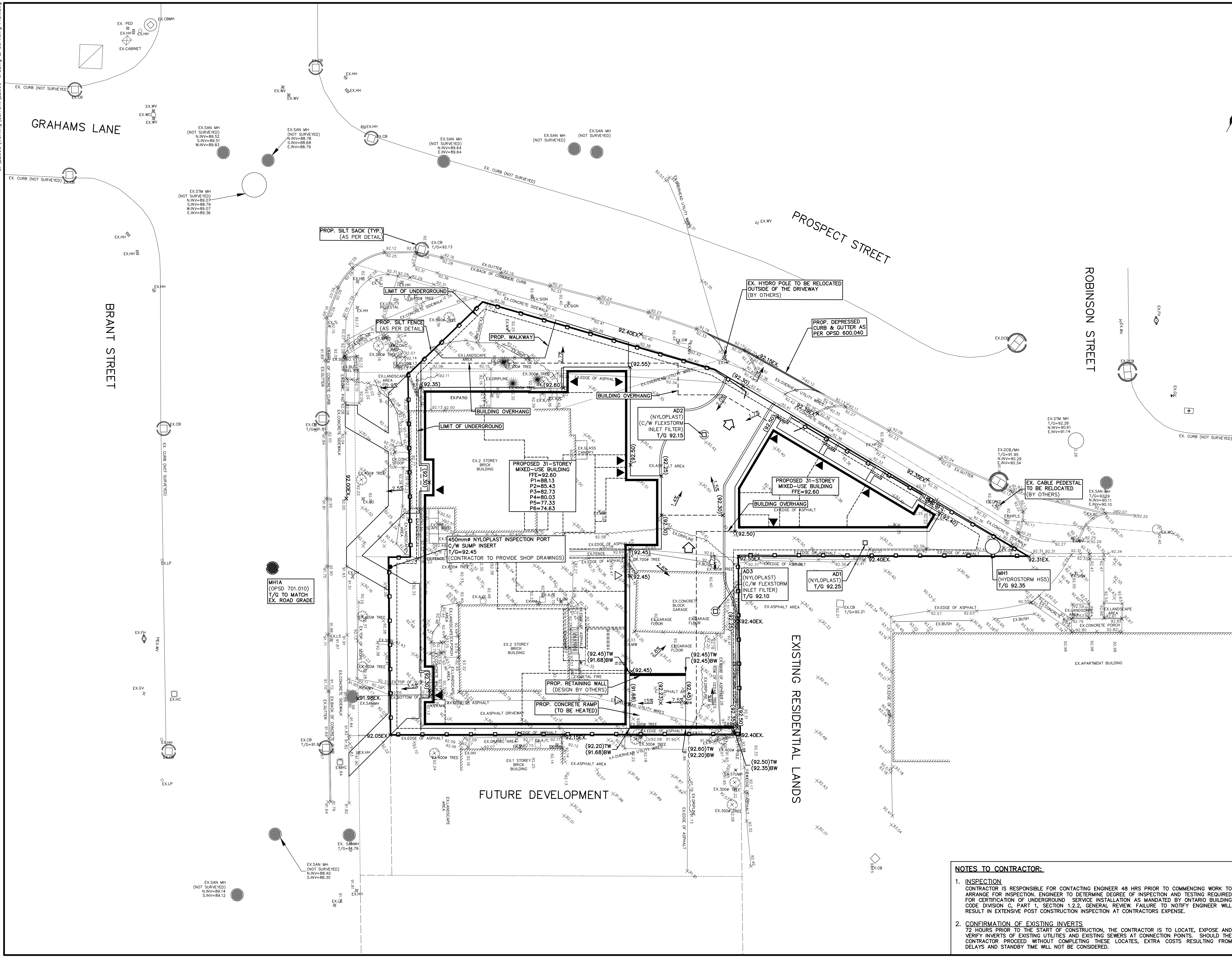
789 and 795 Brant Street, Burlington, Ontario
Five (5) levels of underground parking, unconfined aquifer, groundwater seepage to square excavation (radial source)

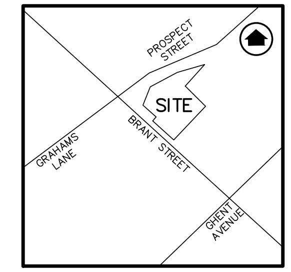
Table F-1: Foundation Drain Flow Rate Estimate of Southern Portion

Description	Symbol	Values	Unit	Explanation
Input				
Lowest Ground Elevation		92.12	m asl	Based on borehole logs
Highest Groundwater Level		90.20	m asl	Highest deep groundwater elevation on June 28, 2021
P5 Slab Elevation		77.12	m asl	Assumed 15 m below ground
Aquifer Bottom		76.12	m asl	Assumed 1 m below basement elevation
Hydraulic Conductivity		2.03E-06	m/s	Geometric mean K
Length of Excavation	x	50.0	m	Based on aerial extent of the Site
Width of Excavation	a	45.0	m	Based on aerial extent of the Site
Output				
Top of Aquifer		90.2	m asl	Water table for unconfined aquifer
Target Water Level		76.62	m asl	Assumed 0.5 m below basement floor level
Water Level above aquifer bottom before dewatering	H	14.1	m	
Target water level above aquifer bottom	h	0.5	m	
Equivalent radius	R_e	26.8	m	Equal perimeter
Radius of Influence	L (R_0)	115.60	m	Weber's Equation (from centre of drainage area)
Foundation Drain Flow Rate - Steady State	Q	74.7	m^3/day	Long-term flow rate – Dupuit Equation
Maximum Foundation Drain Flow Rate (safety factor of 1.5)	1.5Q	112.08	m^3/day	During the initial period and after rains
Estimated Long-term Foundation Drain Flow Rate	Q	**75,000**	L/day	
Estimated Maximum Foundation Drain Flow Rate	1.5Q	**112,000**	L/day	

APPENDIX F

ENGINEERING PLANS





KEY MAP
N.T.S.

LEGEND:

- ×(209.00) PROPOSED GROUND ELEVATION
- ×209.00EX PROPOSED ELEVATION TO MATCH EXISTING
- 2.0% PROPOSED DIRECTION OF SHEET FLOW
- PROPOSED AREA DRAIN
- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED GATE VALVE
- PROPOSED EMERGENCY OVERLAND FLOW ROUTE
- PROPOSED DRAINAGE BREAK LINE
- PROPOSED SILTATION CONTROL FENCE
- PROPOSED CATCHBASIN SILT SACK

BENCH MARK NOTE:
CITY OF BURLINGTON
BENCHMARK No. 446
BRASS PLAQUE SET ON EAST FACE OF CONCRETE BOX CULVERT ON PLAINS ROAD APPROXIMATELY 150m EAST OF BRANT STREET AND 20cm BELOW TOP OF WALL WEST OF THE COURT HOUSE.
ELEVATION = 100.192

NO.	DATE	BY	REVISIONS
.	.	.	.

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

DESIGN	SN	CHK'D	SN	DATE
DRAWN	MT	CHK'D	SN	Sep. 9, 22

SCALE 1:200 (0 5 10 20)

APPROVALS

STAMP: LICENSED PROFESSIONAL ENGINEER — Scott Nelson — S. J. NELSON 100228748 — Sept.9/22 — PROVINCE OF ONTARIO

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

CLIENT
CAMARRO DEVELOPMENTS INC.

PROJECT NAME
789-795 BRANT STREET
BURLINGTON, ON

TITLE
PRELIMINARY GRADING & EROSION CONTROL PLAN

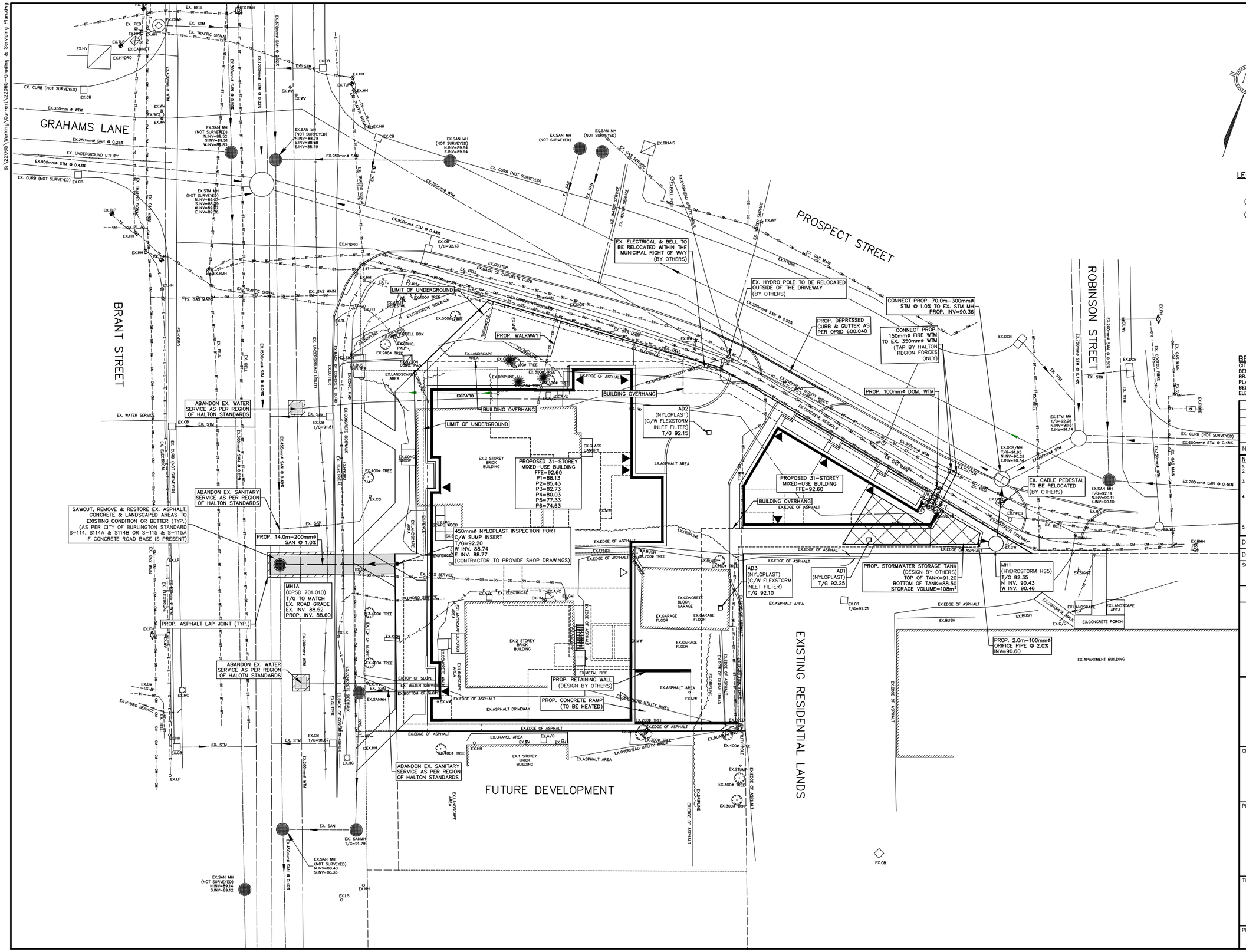
PROJECT No. 22065 | DRAWING No. C101

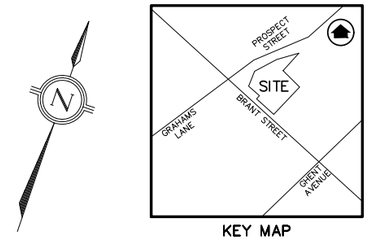
NOTES TO CONTRACTOR:

1. INSPECTION
CONTRACTOR IS RESPONSIBLE FOR CONTACTING ENGINEER 48 HRS PRIOR TO COMMENCING WORK TO ARRANGE FOR INSPECTION. ENGINEER TO DETERMINE DEGREE OF INSPECTION AND TESTING REQUIRED FOR CERTIFICATION OF UNDERGROUND SERVICE INSTALLATION AS MANDATED BY ONTARIO BUILDING CODE DIVISION C, PART 1, SECTION 1.2.2, GENERAL REVIEW. FAILURE TO NOTIFY ENGINEER WILL RESULT IN EXTENSIVE POST CONSTRUCTION INSPECTION AT CONTRACTORS EXPENSE.

2. CONFIRMATION OF EXISTING INVERTS
72 HOURS PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR IS TO LOCATE, EXPOSE AND VERIFY INVERTS OF EXISTING UTILITIES AND EXISTING SEWERS AT CONNECTION POINTS. SHOULD THE CONTRACTOR PROCEED WITHOUT COMPLETING THESE LOCATES, EXTRA COSTS RESULTING FROM DELAYS AND STANDBY TIME WILL NOT BE CONSIDERED.

S:\22065\Working\Current\22065-Grading & Servicing Plan.dwg





KEY MAP
N.T.S.

LEGEND:

- PROPOSED AREA DRAIN
- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED GATE VALVE
- (M) PROPOSED WATER METER
- (BP) PROPOSED BACKFLOW PREVENTOR

BENCH MARK NOTE:
CITY OF BURLINGTON
BENCHMARK No. 446
BRASS PLAQUE SET ON EAST FACE OF CONCRETE BOX CULVERT ON PLAINS ROAD APPROXIMATELY 150m EAST OF BRANT STREET AND 20cm BELOW TOP OF WALL WEST OF THE COURT HOUSE.
ELEVATION = 100.192

NO.	DATE	BY	REVISIONS

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

DESIGN	SN	CHK'D	SN	DATE Sep. 9, 22
DRAWN	MT	CHK'D	SN	

SCALE 1:200 (0, 5, 10, 20)

APPROVALS

STAMP: LICENSED PROFESSIONAL ENGINEER, Scott Nelson, S. J. NELSON, 100228748, Sept.9/22, PROVINCE OF ONTARIO

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

CLIENT
CAMARRO DEVELOPMENTS INC.

PROJECT NAME
789-795 BRANT STREET
BURLINGTON, ON

TITLE
PRELIMINARY SERVICING PLAN

PROJECT No.	DRAWING No.
22065	C102

S:\22065\Working\Current\22065-Grading & Servicing Plan.dwg

GENERAL NOTES:

1. CONSTRUCTION OF SEWERS, AND RELATED APPURTENANCES SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT STANDARD DRAWINGS OF THE CITY OF BURLINGTON, THE REGIONAL MUNICIPALITY OF HALTON AND THE ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD). THE TOWN AND THE REGION'S DRAWINGS SHALL TAKE PRECEDENCE OVER THE OPSD DRAWINGS.
2. ONTARIO PROVINCIAL STANDARD DRAWINGS TO BE READ IN CONJUNCTION WITH THE REGION OF HALTON REVISIONS.
3. RELOCATION OF EXISTING SERVICES AND/OR UTILITIES SHALL BE CONSTRUCTED AS SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER.
4. THE CONTRACTOR SHALL OBTAIN ALL PERMITS FOR CONSTRUCTION.
5. FOR ALL SEWERS AND WATERMAIN IN FILL SECTIONS, THE COMPACTION SHALL BE VERIFIED PRIOR TO LAYING OF PIPE.
6. NO SUBSTITUTIONS WILL BE ALLOWED WITHOUT WRITTEN APPROVAL FROM THE REGIONAL ENGINEER, CITY OF BURLINGTON OR THE ENGINEER.
7. ALL EXCAVATIONS TO BE BACKFILLED WITH SELECT NATIVE MATERIAL, APPROVED BY THE ENGINEER, TO 95% SPD.
8. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING AND MAINTAINING SILT CONTROL DEVICES AS SHOWN ON THE DRAWINGS AND AS DIRECTED BT THE ENGINEER.
9. TREE PROTECTION PROCEDURES TO BE IMPLEMENTED IN ACCORDANCE WITH CITY OF BURLINGTON STANDARDS.
10. THESE PLANS ARE NOT TO BE USED FOR CONSTRUCTION UNTIL SEALED BY THE ENGINEER AND INDICATED ISSUED FOR CONSTRUCTION ON THE DRAWING.
11. THIS/THESE PLAN(S) IS/ARE NOT TO BE REPRODUCED IN WHOLE OR IN PART WITHOUT THE WRITTEN PERMISSION OF S. LLEWELLYN AND ASSOCIATES LIMITED.
12. INFORMATION REGARDING ANY EXISTING SERVICES AND/OR UTILITIES SHOWN ON THE APPROVED SET OF CONSTRUCTION DRAWINGS ARE FURNISHED AS THE BEST AVAILABLE INFORMATION. THE CONTRACTOR SHALL INTERPRET THIS INFORMATION AS HE SEES FIT WITH THE UNDERSTANDING THAT THE OWNER AND HIS AGENTS DISCLAIM ALL RESPONSIBILITY FOR ITS ACCURACY AND /OR SUFFICIENCY. THE CONTRACTOR SHALL ASSUME LIABILITY FOR ANY DAMAGE TO EXISTING WORKS.
13. SITE PLAN INFORMATION TAKEN FROM PLANS PREPARED BY RAW DESIGN INC.
14. THIS/THESE PLAN(S) TO BE READ IN CONJUNCTION WITH THE FUNCTIONAL SERVICING REPORT (FSR) PREPARED BY S. LLEWELLYN AND ASSOCIATES LIMITED.
15. THIS PLAN TO BE USED FOR SERVICING AND GRADING ONLY, FOR BUILDING LOCATION REFER TO TO THE SITE PLAN.
16. MUNICIPAL APPROVAL OF THESE DRAWINGS IS FOR MATERIAL AND COMPLIANCE WITH CITY OF BURLINGTON AND PROVINCIAL SPECIFICATIONS AND STANDARDS ONLY. APPROVAL AND INSPECTION OF THE WORKS BY THE CITY OF BURLINGTON STAFF DOES NOT CERTIFIY THE LINE AND GRADE OF THE WORKS NOR RELIEVE THE CONTRACTOR OF CERTIFICATION OF ALL WORKS BY THE OWNER'S ENGINEER.
17. ALTERNATE MATERIALS MAY BE ACCEPTABLE PROVIDED WRITTEN APPROVAL HAS FIRST BEEN OBTAINED FROM THE CITY OF BURLINGTON AND THE THE ENGINEER.
18. THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S BONDED CONTRACTOR FROM THE REQUIREMENTS TO OBTAIN THE VARIOUS PERMITS/APPROVALS NORMALLY REQUIRED TO COMPLETE A CONSTRUCTION PROJECT, SUCH AS, BUT NOT LIMITED TO THE FOLLOWING:
    - ROAD CUT PERMITS
    - SEWER PERMITS
    - APPROACH APPROVAL PERMITS
    - RELOCATION OF SERVICES
    - COMMITTEE OF ADJUSTMENT
    - ENCROACHMENT AGREEMENTS
20. PRIOR TO CONSTRUCTION THE CONTRACTOR MUST:
    i. CHECK AND VERIFIY ALL DIMENSIONS AND EXISTING ELEVATIONS WHICH INCLUDE BUT ARE NOT LIMITED TO THE BENCHMARK ELEVATIONS, EXISTING SERVICE CONNECTIONS, EXISTING INVERTS AND REPORT FINDING IN WRITING TO THE ENGINEER.
    ii. OBTAIN ALL UTILITY LOCATES AND REQUIRED PERMITS AND LICENSES.
    iii. VERIFY ALL FINISHED FLOOR ELEVATIONS AND BASEMENT FLOOR ELEVATIONS WHICH MY APPEAR ON THESE PLANS COMPLY WITH THE FINAL ARCHITECTURAL DRAWINGS.
    iv. CONFIRM ALL DRAWINGS USED FOR CONSTRUCTION ARE OF THE MOST RECENT REVISION.
    v. NOTIFY THE ENGINEER OF THE PROPOSED CONSTRUCTION SCHEDULE FOR COORDINATION OF NECESSARY INSPECTIONS.
21. **THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE ENGINEER 48 HOURS PRIOR TO THE COMMENCING SITE WORKS TO ARRANGE FOR INSPECTION. THE ENGINEER SHALL DETERMINE THE EXTENT OF INSPECTION AND TESTING REQUIRED FOR CERTIFICATION OF THE UNDERGROUND SERVICE INSTALLATION AS MANDATED BY THE ONTARIO BUILDING CODE DIVISION C, PART 1, SECTION 1.2.2, GENERAL REVIEW. FAILURE TO MAKE SUITABLE ARRANGEMENTS FOR INSPECTION WILL LEAD TO POST CONSTRUCTION TESTING AND INSPECTION AS DETERMINED BY THE ENGINEER, THE COSTS OF WHICH INCLUDING ANY DELAYS IN CONSTRUCTION SHALL BE BOURNE BY THE CONTRACTOR. FULL PAYMENT FOR UN-INSPECTED WORKS MAY BE WITHHELD UNTIL THE COMPLETION OF THE POST CONSTRUCTION INSPECTION AND TESTING TO THE SATISFACTION OF THE ENGINEER.**
22. INSPECTION BY THE OWNER'S ENGINEER IS FOR CERTIFICATION AND GENERAL CONFORMANCE PURPOSES AND DOES NOT CERTIFY LINE AND GRADE OR IMPLY AN ASSURANCE OF QUALITY CONTROL. THE CONTRACTOR SHALL BE RESPONSIBLE TO ENSURE THE INSTALLATION OF THE WORKS TO PROPER LINE, GRADE AND QUALITY TO CURRENT INDUSTRY STANDARDS.
23. ANY UTILITY RELOCATIONS AND RESTORATIONS DUE TO THE DEVELOPMENT TO BE UNDERTAKEN AT THE EXPENSE OF THE OWNER/DEVELOPER AND SHALL BE COORDINATED BY THE CONTRACTOR.
24. ALL RESTORATIONS AND RECONSTRUCTIONS SHALL BE TO COMPLETED TO MATCH EXISTING CONDITIONS OR BETTER AND ARE TO BE PERFORMED TO THE SATISFACTION OF THE ENGINEER AND THE CITY OF BURLINGTON.
25. SERVICING CONTRACTOR TO MAINTAIN A "CONFINED TRENCH CONDITION" IN ALL SEWER AND WATERMAIN INSTALLATION TRENCHES.
26. THE SITE SERVICING CONTRACTOR SHALL TERMINATE ALL SERVICES 1.0m FROM THE BUILDING FACE.
27. NO BLASTING WILL BE PERMITTED.

ROADWORKS:

1. APPROVED FILL, FREE OF DELETERIOUS AND ORGANIC MATERIAL AND BOULDERS SHALL BE COMPACTED TO A DRY DENSITY NOT LESS THAN 95% THAN THE STANDARD PROCTOR DENSITY. AFTER COMPACTION, SOIL DENSITY TESTS SHALL BE CONDUCTED TO ENSURE ADEQUATE COMPACTION AND STABILITY OF THE FILL AND TEST RESULTS SHALL BE SUBMITTED TO THE ENGINEER.
2. SUBGRADE TO BE PROOF ROLLED PRIOR TO PLACEMENT OF SUB BASE. UNSUITABLE MATERIAL TO BE REMOVED AND REPLACED WITH SELECT FILL OR GRANULAR "B" AND COMPACTED TO 98% SPD.
3. ASPHALTIC CONCRETE TO BE COMPACTED TO 97% MARSHALL DENSITY.
4. BOULEVARDS TO BE SODDED WITH #1 NURSERY SOD ON A MINIMUM 150mm OF SELECT TOPSOIL.
5. MANHOLE FRAMES AND COVERS AND WATER VALVE BOXES SHALL BE SET FLUSH WITH BASE COURSE ASPHALT AND ADJUSTED TO FINAL GRADE AFTER INSTALLATION OF SURFACE ASPHALT AS PER CITY OF BURLINGTON STANDARD DRAWINGS S-130.
6. TRAFFIC CONTROL SHALL BE MAINTAINED AT ALL TIMES FOR WORKS ON EXISTING ROADWAYS TO THE SATISFACTION OF THE DIRECTOR OF ENGINEERING. THE EXPENSE FOR THE ERECTION OF SIGNS, DELINEATORS AND OTHER TRAFFIC CONTROL DEVICES SHALL BE BORNE BY THE CONTRACTOR.

GRADING NOTES

1. ALONG ADJOINING PROPERTIES GRADE TO MEET EXISTING OR PROPOSED ELEVATIONS WITH SODDED SLOPES (MIN. 3H TO 1V) AND/OR RETAINING WALLS AS SPECIFIED.
2. ALL RETAINING WALLS, WALKWAYS, CURBS, ETC., SHALL BE PLACED A MIN. OF 0.3m OFF THE PROPERTY LINE. ALL WALLS 1.0m OR HIGHER SHALL BE DESIGNED BY A P.ENG.
3. SHOULD A RETAINING WALL BE REQUIRED, THE TOP OF WALL ELEVATIONS SHALL BE SET 150mm ABOVE THE PROPOSED SIDE YARD SWALES.
4. RETAINING WALLS 0.6m IN HEIGHT OR GREATER REQUIRE CONSTRUCTION OF A FENCE OR GUARD RAIL AT THE TOP OF THE REAR OF THE WALL. GUARDS FOR RETAINING WALLS SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF EXTERIOR GUARDS AS CONTAINED IN THE ONTARIO BUILDING CODE.
5. TOP OF FOUNDATION WALLS FOR BUILDINGS SHALL BE 150mm (MIN) ABOVE FINISHED GRADE.
6. IF GRADING IS REQUIRED ON LANDS ADJACENT TO THE DEVELOPMENT WHICH ARE NOT OWNED BY THE DEVELOPER, THEN THE DEVELOPER MUST OBTAIN WRITTEN PERMISSION FROM THE ADJACENT PROPERTY OWNER TO ALLOW THE DEVELOPER TO GRADE ON THE ADJACENT LANDS, OTHERWISE RETAINING WALLS MUST BE USED.
7. THE WRITTEN PERMISSION REQUIRED FROM THE ADJACENT LANDOWNER SHALL BE OBTAINED PRIOR TO ENTERING THE LANDS. SHOULD PERMISSION NOT BE OBTAINED OR IS WITHDRAWN PRIOR TO COMMENCING THE WORK, THEN THE DEVELOPER SHALL LIMIT HIS ACTIVITIES TO THE LIMITS OF THE DEVELOPMENT SITE.
8. DRIVEWAY AND DRIVEWAY APPROACHES SHALL BE LOCATED SUCH THAT HYDRO VAULTS AND OTHER STREET FURNITURE ARE A MIN. OF 1.2m FROM THE DRIVEWAY ENTRANCE CURB RADII.
9. ANY CHANGES IN GRADES AND CATCH BASINS REQUIRE THE APPROVAL OF THE CITY'S MANAGER OF DEVELOPMENT ENGINEERING.

SILTATION AND EROSION CONTROL

1. SILTATION CONTROL BARRIERS SHALL BE PLACED AS DETAILED.
2. ALL SILTATION CONTROL MEASURES SHALL BE CLEANED AND MAINTAINED AFTER EACH RAINFALL AS DIRECTED AND TO THE SATISFACTION OF THE CITY OF BURLINGTON AND/OR THE HALTON CONSERVATION AUTHORITY.
3. ADDITIONAL SILT CONTROL LOCATIONS MAY BE REQUIRED AS DETERMINED BY THE ENGINEER, THE CITY OF BURLINGTON AND/OR THE HALTON CONSERVATION AUTHORITY.

SANITARY SEWERS:

1. SANITARY SEWERS SHALL BE PVC. PVC PIPE IS TO BE BELL AND SPIGOT AND COMPLY TO ASTM D-3034 WITH MINIMUM SDR 35.
2. MINIMUM BEDDING REQUIREMENTS FOR ALL SANITARY SEWER MAINS AND RELATED CONNECTIONS IN A SINGLE TRENCH SHALL BE CLASS B GRANULAR BEDDING AS PER OPSD 802.010 UNLESS OTHERWISE NOTED.
3. SANITARY SEWER MANHOLES FRAME AND COVER AS PER OPSD 401.010.
4. TAPPING AT EXISTING SANITARY SEWERS SHALL BE UNDERTAKEN IN ACCORDANCE WITH REGION OF HALTON REQUIREMENTS.
5. ALL SEWERS TO BE VIDEO INSPECTED.
6. ALL SEWERS TO BE FLUSHED PRIOR TO VIDEO INSPECTION.
7. ALL PVC SEWERS ARE TO BE TESTED FOR DEFLECTION (MANDREL PASSAGE) AFTER INSTALLATION. SANITARY SEWERS SHALL ALSO BE TESTED FOR LEAKAGE (LOW AIR PRESSURE). PRIOR TO ASSUMPTION BY THE CITY, PIPE DEFLECTION TESTING SHALL BE REPEATED.

STORM SEWERS:

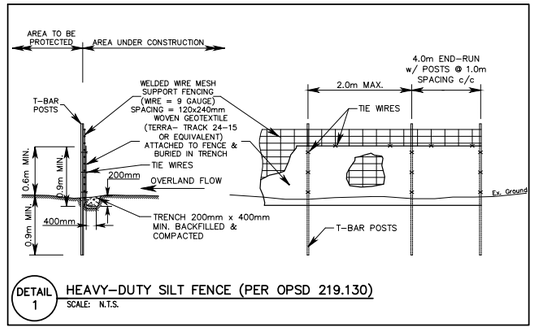
1. 300mm-450mm STORM SEWERS SHALL BE PVC, BELL AND SPIGOT AND SHALL COMPLY TO ASTM D-3034 WITH MINIMUM SDR 35.
2. MINIMUM BEDDING REQUIREMENTS FOR ALL SINGLE STORM SEWER MAINS AND ALL RELATED CONNECTIONS SHALL BE HIGH PERFORMANCE CLEAR STONE (HL-8 GRADED) AS PER CITY OF BURLINGTON STANDARD DRAWINGS S-188.
3. STORM SEWER MANHOLES SHALL BE IN ACCORDANCE WITH OPSD 701.010. AND 703.010. FRAME AND COVER AS PER OPSD 401.01 TYPE A. FRAMES TO BE STAMPED "DANGER" AND "STORM".
4. CATCHBASINS SHALL BE IN ACCORDANCE WITH OPSD 705.010. CATCHBASIN MANHOLES SHALL BE IN ACCORDANCE WITH OPSD 701.010 AND 701.030 UNLESS OTHERWISE SPECIFIED. CATCHBASINS TO LOCATED WITHIN LANDSCAPED AREAS TO BE SUMPLESS. FRAME AND COVER FOR CATCHBASINS AND CATCHBASIN MANHOLES SHALL BE AS PER OPSD 400.100 (ROADS) AND PER CITY OF BURLINGTON STANDARD DRAWING S-176 (REAR YARDS).
5. DOUBLE CATCH BASINS SHALL BE IN ACCORDANCE WITH OPSD 705.020 WITH 250mm DIA. LEAD. FRAMES AND COVERS TO BE OPSD 400.11 (ROADS) AND CITY OF BURLINGTON STD. S-176 (REAR YARDS). LEADS TO BE PVC SDR 35.
6. CATCH BASIN AND MANHOLE TOPS SHALL BE INITIALLY SET TO BASE COURSE ASPHALT ELEVATION AND ADJUSTED TO GRADE PRIOR TO PLACEMENT OF TOP LIFT OF ASPHALT.
7. ALL TRENCH EXCAVATIONS ARE TO BE BACKFILLED WITH SELECT NATIVE MATERIAL PLACED IN MAXIMUM 200mm LIFT THICKNESSES WITHIN 3% OF THE OPTIMUM MOISTURE CONTENT AND COMPACTED TO A MINIMUM OF 95% SPD, UNLESS OTHERWISE SPECIFIED.
8. INVERTS OF ALL SWALES TO BE SODDED TO A MINIMUM WIDTH OF 3.0m. ALL OTHER DISTURBED AREAS TO BE TOPSOILED AND SEEDED. SOD SHALL BE #1 NURSERY LAID ON A MINIMUM OF 150mm OF TOPSOIL.
9. ALL SEWERS TO BE VIDEO INSPECTED.
10. ALL SEWERS TO BE FLUSHED PRIOR TO VIDEO INSPECTION.
11. ALL PVC SEWERS (SANITARY AND STORM) ARE TO BE TESTED FOR DEFLECTION (MANDREL PASSAGE) AFTER INSTALLATION. PRIOR TO ASSUMPTION BY THE CITY, PIPE DEFLECTION TESTING SHALL BE REPEATED.

RESTORATIONS:

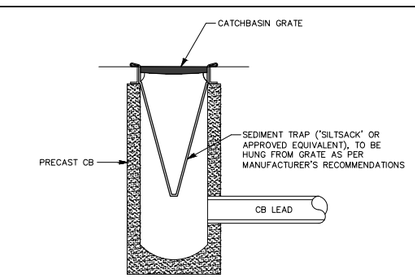
1. ALL TRENCH EXCAVATIONS WITHIN EXISTING ROAD ALLOWANCES SHALL BE AS BACKFILLED AS PER CITY OF BURLINGTON STANDARD DRAWING S-114 AND S-114A, OR S-115 AND S-115A WHERE CONCRETE ROAD BASE IS PRESENT.
2. EXISTING PRIVATE FENCING IS TO BE MAINTAINED THROUGHOUT CONSTRUCTION. WHERE REMOVAL OR RELOCATION OF FENCING IS NECESSARY IT SHALL BE RESTORED OR REPLACED TO ORIGINAL CONDITIONS OR BETTER UNDER THE DIRECTION OF THE ENGINEER.
3. DAMAGED CURB, GUTTER AND SIDEWALK TO BE REPLACED WITH 28 MPa CONCRETE TO EXISTING CONDITIONS OR BETTER.

WATERMAINS:

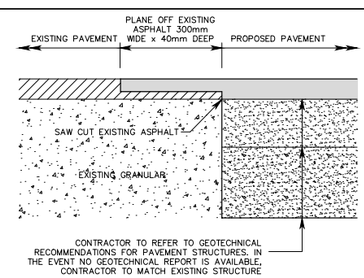
1. FLEXIBLE WATERMAIN PIPE UP TO 300mm DIAMETER TO BE P.V.C. DR-18 AND CONFORM TO A.W.W.A. C-900 WITH MECHANICAL JOINTS AS PER A.W.W.A. C-110, AND TO BE INSTALLED WITH A 10 GAUGE TRACER WIRE.
2. FLEXIBLE PIPE BEDDING TO BE OPSD 802.010 WITH COMPACTED GRANULAR B MATERIAL.
3. MINIMUM COVER TO BE 1.7m TO TOP OF PIPE.
4. DEFLECTION AT JOINTS NOT TO EXCEED 2.5 DEGREES AND SHALL BE EQUAL AT ALL JOINTS.
5. GATE VALVES AND BOXES FOR 150mm DIAMETER WATERMAINS AS PER A.W.W.A. STANDARD C-500 AND ARE TO OPEN TO THE LEFT (COUNTER CLOCKWISE).
6. HYDRANTS SHALL MEET THE REQUIREMENTS OF A.W.W.A. STANDARD C-502 AND SHALL BE SET IN ACCORDANCE WITH REGION OF HALTON, AND CITY OF BURLINGTON BUILDING DEPARTMENT STANDARDS, COMPLETE WITH STEAMER CONNECTIONS. THE 100mm STEAMER PORT SHALL FACE THE FIRE ROUTE AND SHALL BE UNOBSTRUCTED BY ANY PROPOSED LANDSCAPING.
7. ALL FITTINGS TO HAVE MECHANICAL RESTRAINTS THAT MEET UNI-B-13-92.
8. ALL TEMPORARY AND PERMANENT WATERMAIN PLUGS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH OPSD 1103.01.
9. TAPPING AT EXISTING WATERMAINS SHALL BE UNDERTAKEN IN ACCORDANCE WITH REGION OF HALTON REQUIREMENTS.
10. ALL WATER CUSTOMERS SUPPLIED BY A WATERMAIN TO BE SHUT DOWN SHALL BE NOTIFIED BY THE CONTRACTOR AT LEAST 48 HOURS IN ADVANCE OF THE SHUT DOWN AS PER REGION OF HALTON SPECIFICATIONS. NOTIFICATION SHALL TAKE PLACE UNDER THE ENGINEER'S DIRECTION.
11. MINIMUM HORIZONTAL SEPERATION BETWEEN WATERMAINS (INCLUDING PRIVATE SERVICES) AND STORM AND SANITARY SEWERS SHALL BE 2.5m. WATERMAINS MUST HAVE A MINIMUM VERTICAL CLEARANCE OF 500mm BETWEEN ALL OTHER UTILITIES WHEN CROSSING.



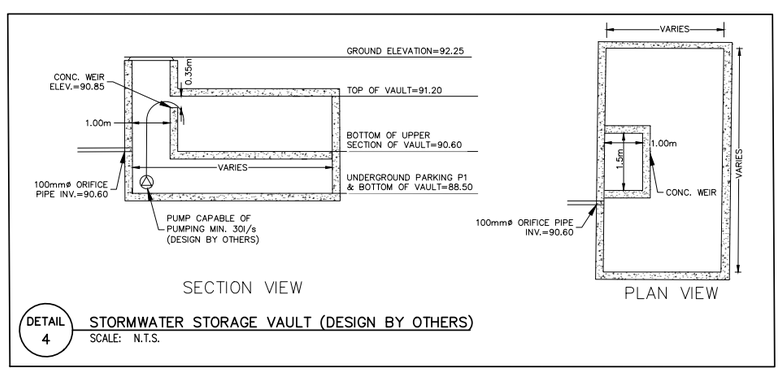
DETAIL 1 — HEAVY-DUTY SILT FENCE (PER OPSD 219.130)
SCALE: N.T.S.



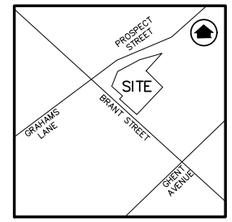
DETAIL 2 — CATCH BASIN SEDIMENT TRAP
SCALE: N.T.S.



DETAIL 3 — ASPHALT LAP JOINT
SCALE: N.T.S.



DETAIL 4 — STORMWATER STORAGE VAULT (DESIGN BY OTHERS)
SCALE: N.T.S.



KEY MAP
N.T.S.

BENCH MARK NOTE:

CITY OF BURLINGTON
BENCHMARK No. 446
BRASS PLAQUE SET ON EAST FACE OF CONCRETE BOX CULVERT ON PLAINS ROAD APPROXIMATELY 150m EAST OF BRANT STREET AND 20cm BELOW TOP OF WALL WEST OF THE COURT HOUSE.
ELEVATION = 100.192

NO.	DATE	BY	REVISIONS

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

DESIGN	SN	CHK'D	SN	DATE Sep. 9, 22
DRAWN	MT	CHK'D	SN	

SCALE 1:200 (0, 5, 10, 20)

APPROVALS

STAMP: LICENSED PROFESSIONAL ENGINEER, Scott Nelson, S. J. NELSON, 100228748, Sept.9/22, PROVINCE OF ONTARIO

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

CLIENT
CAMARRO DEVELOPMENTS INC.

PROJECT NAME
789-795 BRANT STREET
BURLINGTON, ON

TITLE
GENERAL NOTES & DETAILS PLAN

PROJECT No. 22065
DRAWING No. C103