S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

KALAR ROAD, LOT 186

CITY OF NIAGARA FALLS

M5V DEVELOPMENT INC.

January 2024

SLA File: 21045

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION AND BACKGROUND

1.1 Overview

S. Llewellyn & Associates Limited has been retained by M5V Development Inc. to provide Consulting Engineering services for the proposed development at 7640 Kalar Road and Part of Township Lot 186 in the City of Niagara Falls (see Figure 1.0 for location plan).

The 4.72 ha site is bound by Kalar Road to the west, vacant land to the north, wetlands to the east and existing residential to the south. The proponent proposes to construct 113 townhouse units with associated asphalt driveways, concrete curbing and landscaped areas.

This Functional Servicing and Stormwater Management Report will provide detailed information of the proposed stormwater management and functional servicing scheme for this development. Please refer to the Preliminary Site Engineering Plans prepared by S. Llewellyn and Associates Limited and the Site Plan prepared by P3Architecture for additional information.

1.2 Background Information

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

Ref. 1: *The City of Niagara Falls Engineering Design Guidelines Manual* (April 2016)

Ref. 2: *City Standards for Site Planning* (April 1992).

Ref. 3: *MOE Stormwater Management Practices Planning and Design Manual*, Ministry of Environment (March 2003).

Ref. 4: *Erosion & Sediment Control Guidelines for Urban Construction* (2019).

Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Niagara Falls and the Niagara Peninsula Conservation Authority (NPCA) requirements:

Quantity Control
The stormwater discharge rate from the proposed site shall be controlled to the pre-development condition discharge rate for the 5-year storm event.

Quality Control
The stormwater runoff from the proposed condition site must meet Level 2 (Normal) stormwater quality control (70% TSS removal, 80% average annual runoff treatment).

Erosion Control
Erosion and sediment control measures will be implemented in accordance with the standards of the City of Niagara Falls and NPCA.

2.1 Pre-Development Conditions

In the pre-development condition, the 4.72 ha subject site is comprised of an existing residential dwelling with landscaped areas and wetland regulated by the NPCA to the east. There is an existing 450mmø storm sewer, which flows south along Kalar Road.

Two catchment areas, Catchment 101 and 102 have been identified in the existing condition. Catchment 101 represents the drainage area from the site, which sheet drains west to the ditch along Kalar Road and is captured by the existing 450mmø storm sewer along Kalar Road. Catchment 102 represents the drainage area from the site, which sheet drains east towards the wetland. See Table 2.1 and the Pre-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.1: Pre-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	To Kalar Road	0.77	3%	0.27
102	To Wetlands	0.69	0%	0.25

The existing conditions discharge from the site was calculated for Catchment 101 and 102 using the Rational Method based on the above runoff coefficient (C) and the City of Niagara Falls storm intensities at a time of concentration of 10 minutes (Tc=10min). An example of the 2-year calculation for Catchment 101 is shown below and a summary can be found in Table 2.2.

$Q_{5\text{-yr (Catchment 101)}}$ = 2.78CiA=2.78(0.27)(84.02 mm/hr)(0.77ha)
= **48.5 *l/s (0.0485 m^3/s)***

Table 2.2: Pre-Development Condition Site Discharge

Storm Event	Catchment 101 Runoff (m^3/s)	Catchment 102 Runoff (m^3/s)
5-Yr Event	0.0485	0.0403

2.2 Post-Development Conditions

The proposed development consists of constructing 113 townhouse units including asphalt driveways, concrete curbing and landscaped areas. It is proposed to service the site with a private storm sewer system, designed and constructed in according to the City of Niagara Falls standards.

Three (3) catchment area, Catchment 201, 202, and 203 have been identified in the proposed condition. Catchment 201 represents the drainage area which is captured from the roof of the proposed townhouses, the asphalt driveways and landscaped areas and will outlet via the proposed storm sewer and discharge to the existing 450mmø storm sewer along Kalar Road. Catchment 202 represents the uncontrolled drainage area, which sheet drains west to the ditch along Kalar Road and is captured by the existing 450mmø storm sewer along Kalar Road. Catchment 203 represents the uncontrolled drainage area from the roof of the proposed townhouses and landscaped areas, which will outlet to the adjacent wetlands. The drainage from the Catchment 203 has been directed to the adjacent wetlands instead of Kalar Road in order to provide water balance for the wetlands. Refer to the Environmental Impact Assessment prepared by Myler Environmental Consulting, which discusses the benefits of discharging to the wetlands.

See Table 2.3 and the Post-Development Storm Drainage Area Plan in Appendix A for details.

Table 2.3: Post-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
201	Controlled to Kalar Road	1.13	98%	0.89
202	Uncontrolled to Kalar Road	0.07	3%	0.27
203	Uncontrolled to Wetlands	0.26	66%	0.68

2.2.1 Water Quantity Control

It is required to restrict the 5-year post-development discharge rate from the subject site to the 5-year pre-development discharges rates. Stormwater quantity control for Catchment 201 will function through a combination of ACO Stormbrixx SD storage tanks and a 140mmø orifice plate located within MH2. The 140mmø orifice plate will restrict discharge from the site to the allowable discharge rate. Details of this design can be found on the Preliminary Servicing Plan, prepared by S. Llewellyn and Associates Limited. A summary of the stage-storage-discharge characteristics and proposed discharge rates for the proposed condition can be seen in Table 2.4 and Appendix A.

Table 2.4: Proposed Condition Stage-Storage-Discharge for Catchment 201

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
177.99 (Orifice Invert)	0	0.0000
178.06 (Bottom of Tank)	0	0.0000
178.26	44	0.0183
178.46	89	0.0259
178.66	133	0.0317
179.03 (Top of Tank)	215	0.0403

The maximum discharge rates for Catchment 202 were calculated using the Rational Method based on the proposed condition runoff coefficients for the 5-year storm event. Additionally, the 5-year storage volume for Catchment 201 was calculated using the Modified Rational Method (MRM). The proposed discharge rate and required storage volume is summarized in Table 2.5 below and in Appendix A for details.

Table 2.5: Proposed Condition Stormwater Discharge (To Kalar Road)

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)
5-Yr	0.0403	0.0044	0.0447	0.0485	205

Table 2.6: Proposed Condition Stormwater Discharge (To Wetlands)

Storm Event	Catchment 203 Uncontrolled Discharge (m^3/s)	Catchment 102 Uncontrolled Discharge (m^3/s)
2-Yr	0.0324	0.0316
5-Yr	0.0413	0.0403
10-Yr	0.0524	0.0512
25-Yr	0.0544	0.0531
100-Yr	0.0657	0.0641

This analysis determined the following:

- The post-development condition discharge rates to Kalar Road will not exceed the pre-development condition discharge rate during the 5-year storm event.

- The post-development condition discharge rates to the existing wetlands will exceed the pre-development condition discharge rates by 3% during all storm events. Refer to the Environmental Impact Assessment prepared by Myler Environmental Consulting, which discusses the benefits to discharging to the wetlands.

- Sufficient stormwater storage is provided on-site by means of ACO Stormbrixx SD storage tanks. A total storage volume of $215m^3$ is provided while only $205m^3$ of storage is required during the 5-year storm event.

2.2.2 Water Quality Control

The proposed development is required to achieve a “Normal” (70% TSS removal) level of water quality protection. To achieve this criteria, discharge from Catchment 201 will be subject to treatment from a HydroStorm oil/grit separator before ultimately discharging to the existing storm sewer system along Kalar Road. The HydroStorm sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a HydroStorm HS8 will provide 84% TSS removal and 96% average annual runoff treatment. See HydroStorm unit sizing procedures in Appendix B for details.

HydroStorm units require regular inspection and maintenance as per the manufacturer’s specifications to ensure the unit operates properly. See HydroStorm Maintenance Manual in Appendix B for details.

2.2.3 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 catchbasins 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.

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

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

Details of the proposed erosion & sediment control measures are provided on the Preliminary Grading and Erosion Control Plan.

3.0 SANITARY SEWER SERVICING

3.1 Existing Conditions

There is an existing 300mmø sanitary sewer which runs along Kalar Road and flows to the south.

3.2 Sanitary Demand

Niagara Region requires that the Peak Dry Weather Flow (DWF) and Peak Wet Weather Flow (WWF) be provided for the site in accordance with Section C.1 of Niagara Region Water-Wastewater Project Design Manual. Table 3.1 summarizes the Peak DWF and WWF.

Table 3.1: Post-Development Sanitary Sewer Discharge

RDII[1] (l/s)	DWF[2] (l/s)	**Peak DWF[3] (l/s)**	WWF[4] (l/s)	**Peak WWF[5] (l/s)**
0.41	2.18	**8.72**	2.59	**9.14**

Population = 113 units x 3 persons/unit = 339 persons
Peaking Factor = $(1+(14/(4+P^{0.5})))$ with P expressed in thousands, Min. 2.0, Max. 4.0
Dry Weather Infiltration = Area x Infiltration Rate = 1.46 ha x 0.28 l/ha/s = 0.41 l/s
[1]RDII (Rain Derived Inflow and infiltration) = Area x 0.286 l/s/ha = 1.46 ha x 0.286 l/s = 0.42 l/s
[2]DWF (Dry Weather Flow) = Average Sanitary Flow + Dry Weather Infiltration = (average daily per capita flow x population) + Dry Weather Infiltration = (450 lcpd x 339 persons) + 0.41 l/s= 2.18 l/s
[3]Peak DWF = DWF x Peaking Factor = 2.18 x 4.0 = 8.72 l/s
[4]WWF (Wet Weather Flow) = DWF + Inflow and All Infiltration (Dry Weather and Rain Derived) = 2.18 l/s + 0.41 l/s = 2.59 l/s
[5] Peak WWF = Peak DWF + RDII = 8.72 l/s + 0.42 l/s = 9.14 l/s

3.3 Proposed Sanitary Servicing

The proposed site will be serviced by a 200mmø sanitary sewer system, and will be designed and constructed in accordance with the City of Niagara Falls standards. Drainage from the proposed sanitary sewer system will discharge to the existing 300mmø sanitary sewer along Kalar Road.

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

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 Existing Conditions

The existing municipal water distribution system consists of a 300mmø watermain along Kalar Road. There is an existing fire hydrant fronting the site on Kalar Road.

4.2 Domestic Water Demand

Water demand for the site was estimated in accordance with the Ministry of the Environment Design Guidelines for Drinking-Water Systems. Table 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)**
339 persons	1.41	3.45	5.20	**4.86**	**7.33**

[A] Population (P) = 113 units x 3 persons/unit = 339 persons
[B] Average Daily Demand = (270 l/cap/day + 450 l/cap/day)/2 = 360 l/cap/day x population
[C] Max. Daily Peaking Factor = 3.45 (refer to Table 3-3 from MOE Manual)
[D] Max. Hourly Peaking Factor = 5.20 (refer to Table 3-3 from MOE Manual)
[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 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 Fire Underwriters Survey - 1999 was used to determine the required flow rate for the proposed development which was based on the worst-case scenario which is Block F.

There is an existing fire hydrant fronting the site on Kalar Road. Two additional private fire hydrants are proposed to meet the required 90m separation to the building face of the proposed buildings (as per Sentence 3.2.5.7 of the 2020 Ontario Building Code).

Block F is wood frame construction type (C=1.5), with limited combustible occupancy (15% correction) and no sprinkler system (0% correction). Exposure corrections are based on the following:

North Face: 15% correction (10.1m to 20m)
South Face: 20% correction (3.1m to 10m)
East Face: 20% correction (3.1m to 10m)
West Face: 15% correction (10.1m to 20m)
Total: 65%

An estimate of the required flow rate for Block F can be found in Appendix C. The flow rate was determined in accordance with the Fire Underwriters Survey – 1999 Water Supply for Public Fire Protection. It has been determined that the required fire flow for the site is **23000 l/min (383 l/s)**.

A hydrant flow test was completed for the existing hydrant adjacent to the site and the data is shown in Table 4.2 and can be found in Appendix C. The hydrant flow test result indicates that the water distribution system can supply **420 l/s** at the minimum allowable pressure of 20 psi. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

Table 4.2: Hydrant Flow Test Data	
Location	Kalar Road, Lot 186
Test Date (mm/dd/yyyy)	4/22/2022
Static Pressure	100 psi
Residual Pressure During Test #1	96psi
Test #1 Flow Rate	1321 USGPM (83.3 l/s)
Residual Pressure During Test #2	94 psi
Test #2 Flow Rate	2122 USGPM (133.9 l/s)
Theoretical Flow @ 20 psi	**6659 USGPM (420 l/s)**

4.4 Proposed Water Servicing and Analysis

The proposed development will be serviced with a 200mmø watermain feeding off the existing 300mmø watermain along Kalar Road. The municipal watermain and fire hydrants will supply firefighting water for the development.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that:

- The development be graded and serviced in accordance with the Preliminary Grading & Erosion Control Plan and Preliminary Servicing Plan prepared by S. Llewellyn & Associates Limited;

- A 140mmø orifice plate be installed within MH2 as per the Preliminary Servicing Plan and this report to achieve effective stormwater quantity control for the subject site;

- Two (2) ACO Stormbrixx SD storage tanks be installed on site as per the Preliminary Servicing Plan and this report to provide adequate stormwater storage during storm events;

- A Hydrostorm HS8 oil/grit separator, or approved equivalent, be installed as per the Preliminary Servicing Plan and this report to provide effective stormwater quality control;

- The proposed sanitary and water servicing system be installed as per the Site Servicing Plan and this report to adequately service the proposed development;

- Erosion and sediment controls be installed as described in this report, and as per the standards and specifications of the City of Niagara Falls;

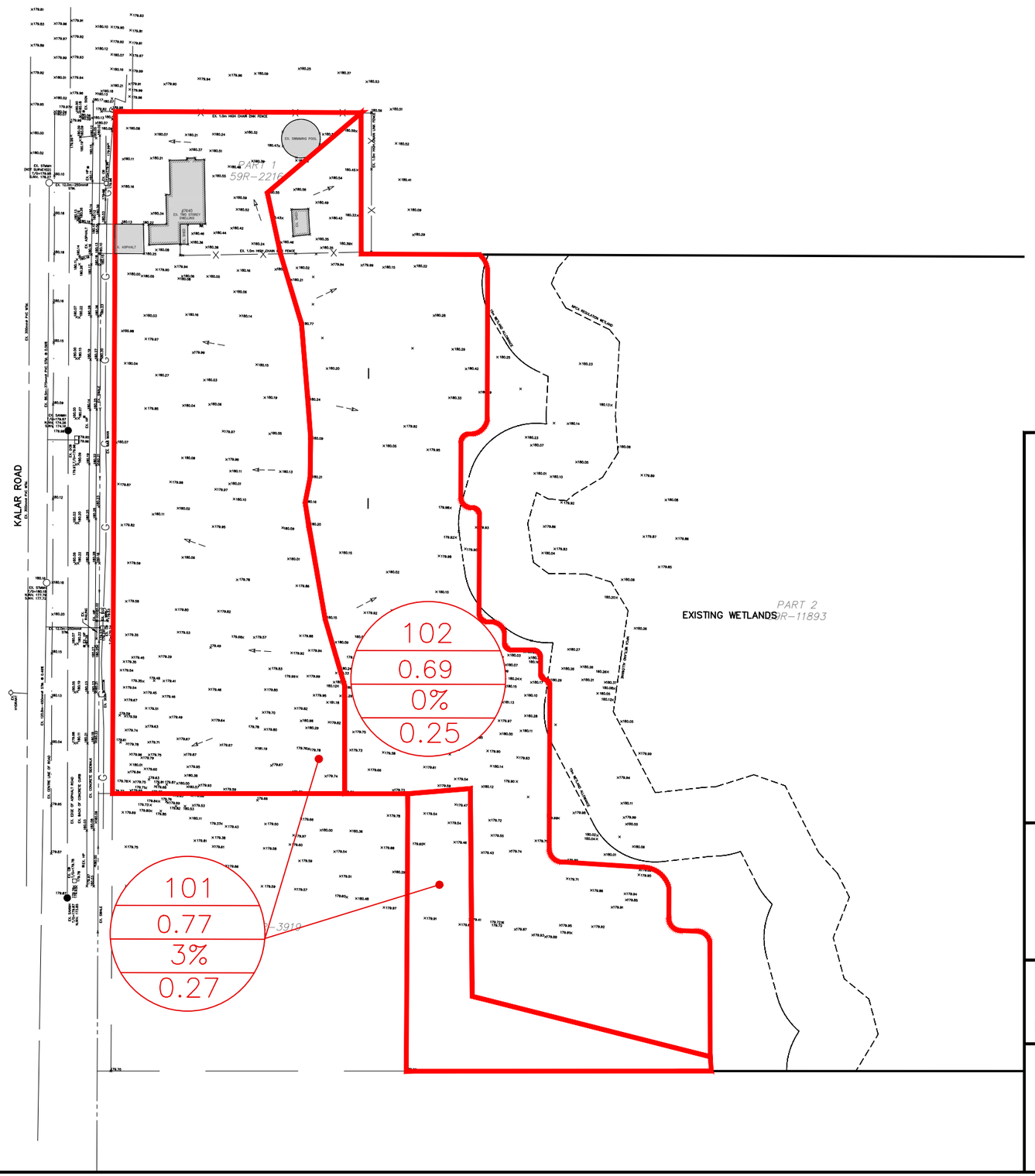
We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED

S. Nelson, P. Eng.

APPENDIX A
STORMWATER QUANTITY INFORMATION



LEGEND

IMPERVIOUS AREA

DRAINAGE BOUNDARY

201
14.60
77%
0.75

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

DIRECTION OF EXISTING SHEET FLOW

FIGURE 1.0

PRE–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:750

PROJECT: 186 KALAR ROAD,
NIAGARA FALLS, ONTARIO

PROJECT No.: 21045

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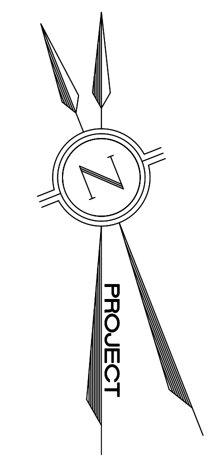

LEGEND

(red line)	DRAINAGE BOUNDARY
201	DRAINAGE AREA I.D.
14.60	DRAINAGE AREA (ha)
77%	PERCENT IMPERVIOUS
0.75	RUNOFF COEFFICIENT

FIGURE 2.0

POST–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:750

PROJECT: 186 KALAR ROAD,
NIAGARA FALLS, ONTARIO

PROJECT No.: 21045

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S. LLEWELLYN & ASSOCIATES LIMITED
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STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	**140**
Area (m^2)	0.01539
Invert Elev. (m)	177.99
C/L Elev. (m)	178.06
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes			Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	177.99	0	0	0	0.000	0.0000
Bottom of Tank	178.06	222	0	0	0.000	0.0000
0.20m Deep	178.26	222	44	44	0.200	0.0183
0.40m Deep	178.46	222	44	89	0.400	0.0259
0.60m Deep	178.66	222	44	133	0.600	0.0317
Top of Tank	179.03	222	82	215	0.970	0.0403

5-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information		
City/Town/Region:	**Niagara Falls**	
Return Period:	**5**	Years
A =	**719.500**	
B =	**6.340**	
C=	**0.7687**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) =	**1.13**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.89**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0403**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	111.263	0.0000309	0.311	0.0	0.3108	93.25	18.14	75.11
10	600	84.024	0.0000233	0.235	0.0	0.2347	140.84	24.18	116.66
15	900	68.435	0.0000190	0.191	0.0	0.1912	172.06	30.23	141.84
20	1200	58.211	0.0000162	0.163	0.0	0.1626	195.14	36.27	158.87
25	1500	50.931	0.0000141	0.142	0.0	0.1423	213.42	42.32	171.11
30	1800	45.453	0.0000126	0.127	0.0	0.1270	228.56	48.36	180.20
35	2100	41.165	0.0000114	0.115	0.0	0.1150	241.50	54.41	187.09
40	2400	37.706	0.0000105	0.105	0.0	0.1053	252.81	60.45	192.36
45	2700	34.850	0.0000097	0.097	0.0	0.0974	262.87	66.50	196.37
50	3000	32.447	0.0000090	0.091	0.0	0.0906	271.93	72.54	199.39
55	3300	30.394	0.0000084	0.085	0.0	0.0849	280.20	78.59	201.62
60	3600	28.618	0.0000079	0.080	0.0	0.0799	287.81	84.63	203.18
65	3900	27.063	0.0000075	0.076	0.0	0.0756	294.85	90.68	204.18
70	4200	25.690	0.0000071	0.072	0.0	0.0718	301.42	96.72	204.70
75	4500	24.467	0.0000068	0.068	0.0	0.0684	307.58	102.77	204.82
80	4800	23.370	0.0000065	0.065	0.0	0.0653	313.38	108.81	204.57
85	5100	22.381	0.0000062	0.063	0.0	0.0625	318.86	114.86	204.01
90	5400	21.482	0.0000060	0.060	0.0	0.0600	324.07	120.90	203.17
95	5700	20.663	0.0000057	0.058	0.0	0.0577	329.02	126.95	202.08
100	6000	19.912	0.0000055	0.056	0.0	0.0556	333.75	132.99	200.76
105	6300	19.221	0.0000053	0.054	0.0	0.0537	338.28	139.04	199.25
110	6600	18.583	0.0000052	0.052	0.0	0.0519	342.62	145.08	197.54
115	6900	17.991	0.0000050	0.050	0.0	0.0503	346.79	151.13	195.67
120	7200	17.441	0.0000048	0.049	0.0	0.0487	350.81	157.17	193.64

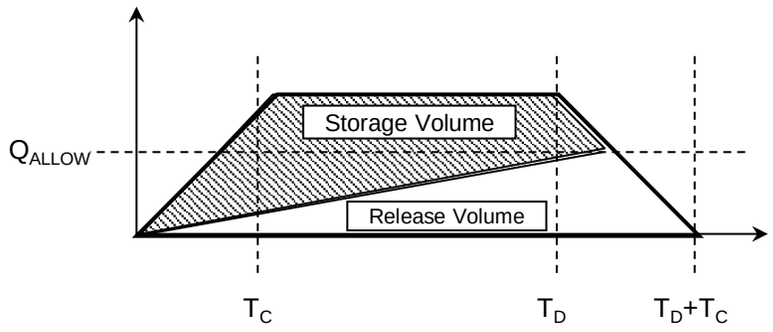
Max. required storage volume = 204.82 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

Runoff Volume = Area under trapezoidal hydrograph
= $(T_D - T_C)Q_{POST} + (T_C\, Q_{POST})$

Release Volume = Area under triangular outflow hydrograph
= ½ $(T_D + T_C)\, Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



APPENDIX B
STORMWATER QUALITY INFORMATION

Hydroworks Sizing Summary

186 Kalar Road

11-03-2023

Recommended Size: HydroStorm HS 8

A HydroStorm HS 8 is recommended to provide 80 % annual TSS removal based on a drainage area of 1.06 (ha) with an imperviousness of 98 % and Hamilton Airport, Ontario rainfall for the 20 um to 2000 um particle size distribution.

The recommended HydroStorm HS 8 treats 96 % of the annual runoff and provides 84 % annual TSS removal for the Hamilton Airport rainfall records and 20 um to 2000 um particle size distribution.

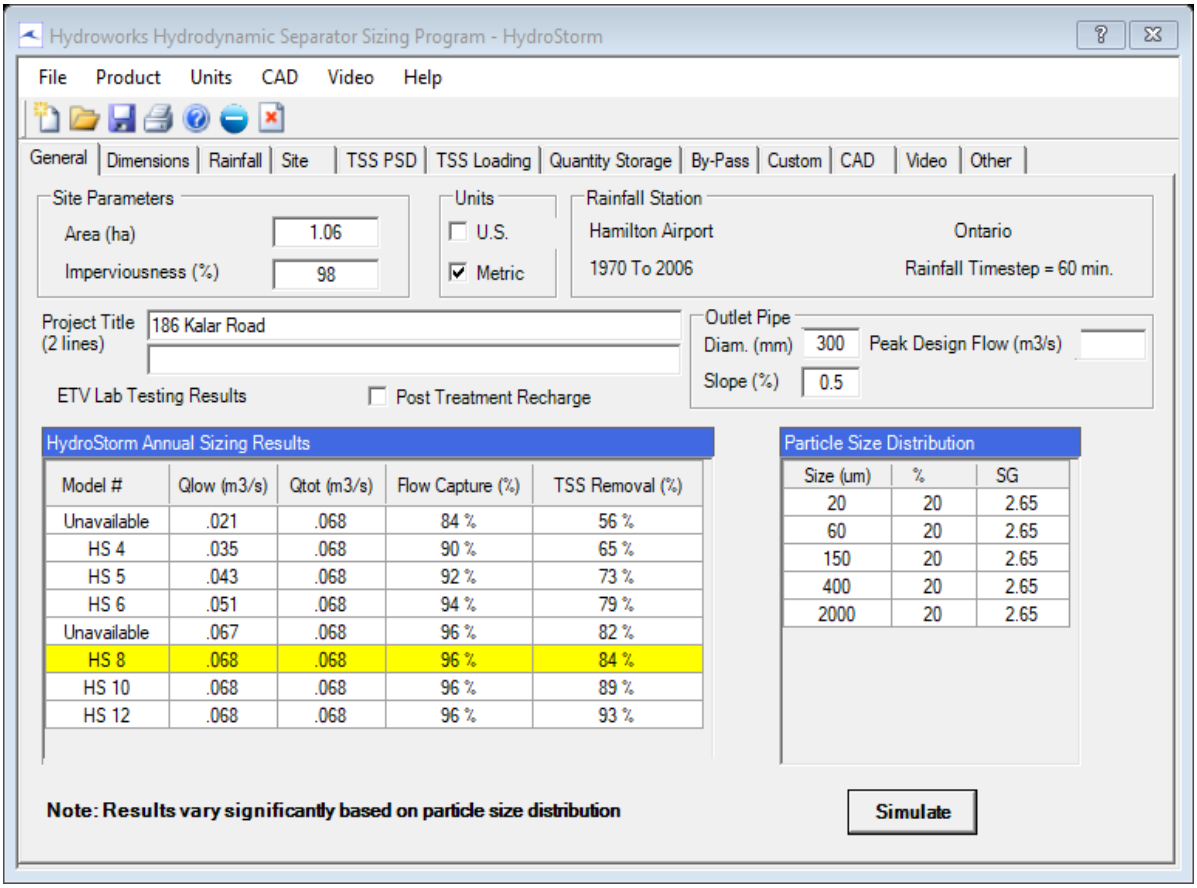
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .07 (m3/s) for the given 300 (mm) pipe diameter at .5% slope. The headloss was calculated to be 50 (mm) based on a flow depth of 300 (mm) (full pipe flow).

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.

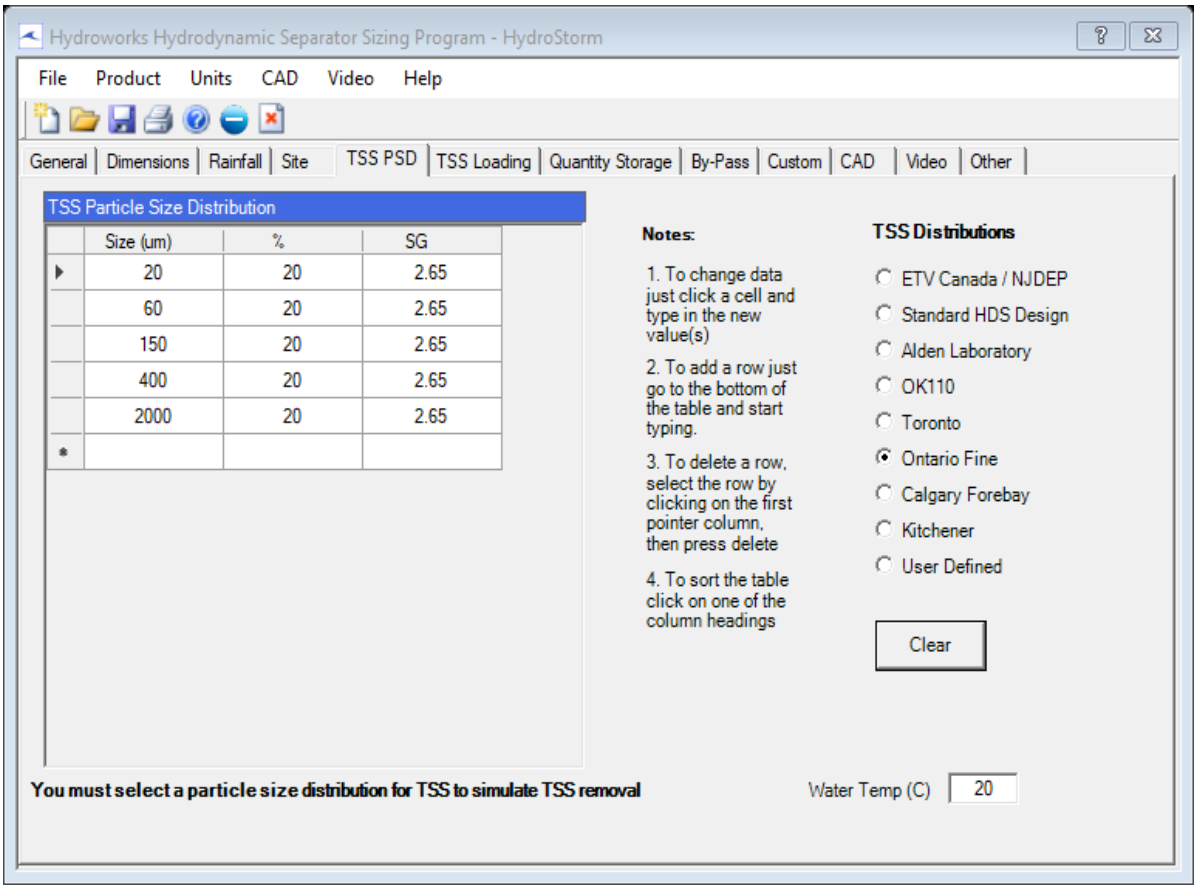
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 .

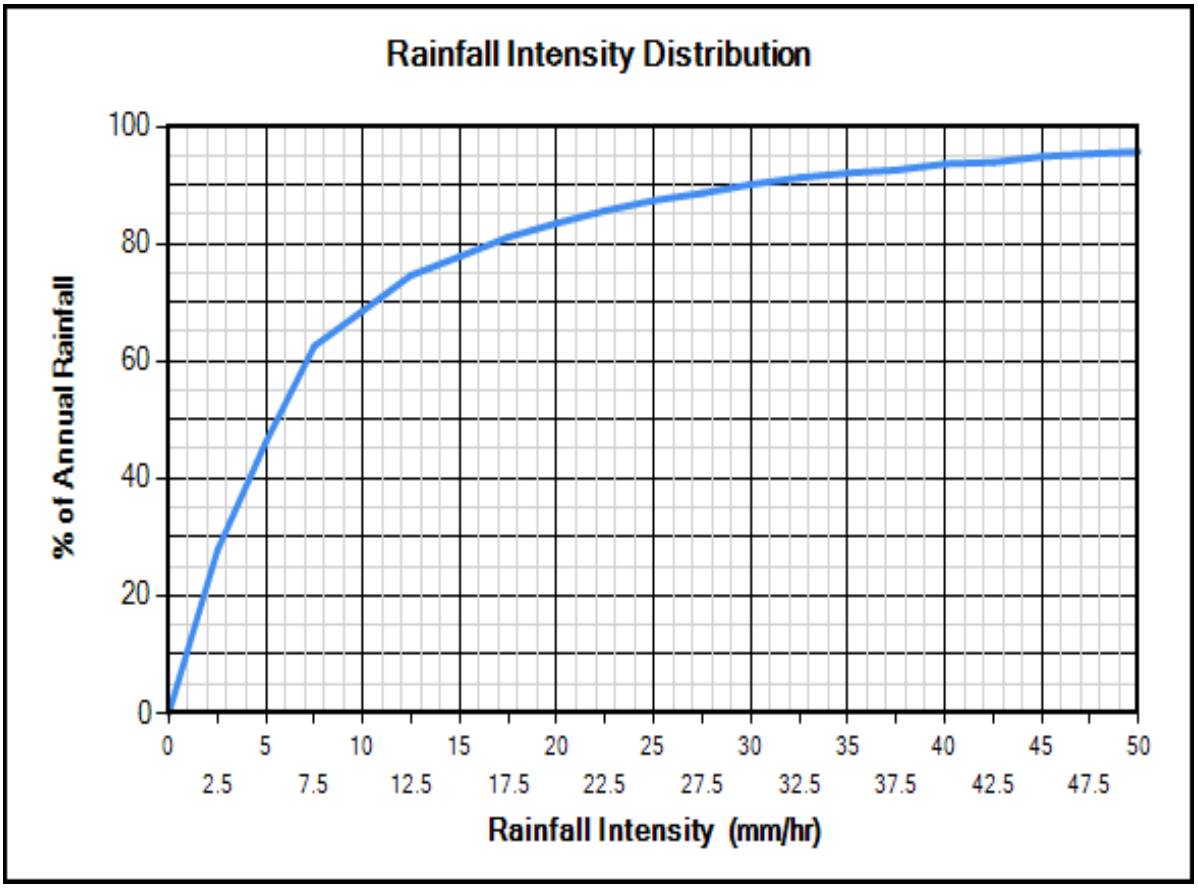
TSS Removal Sizing Summary



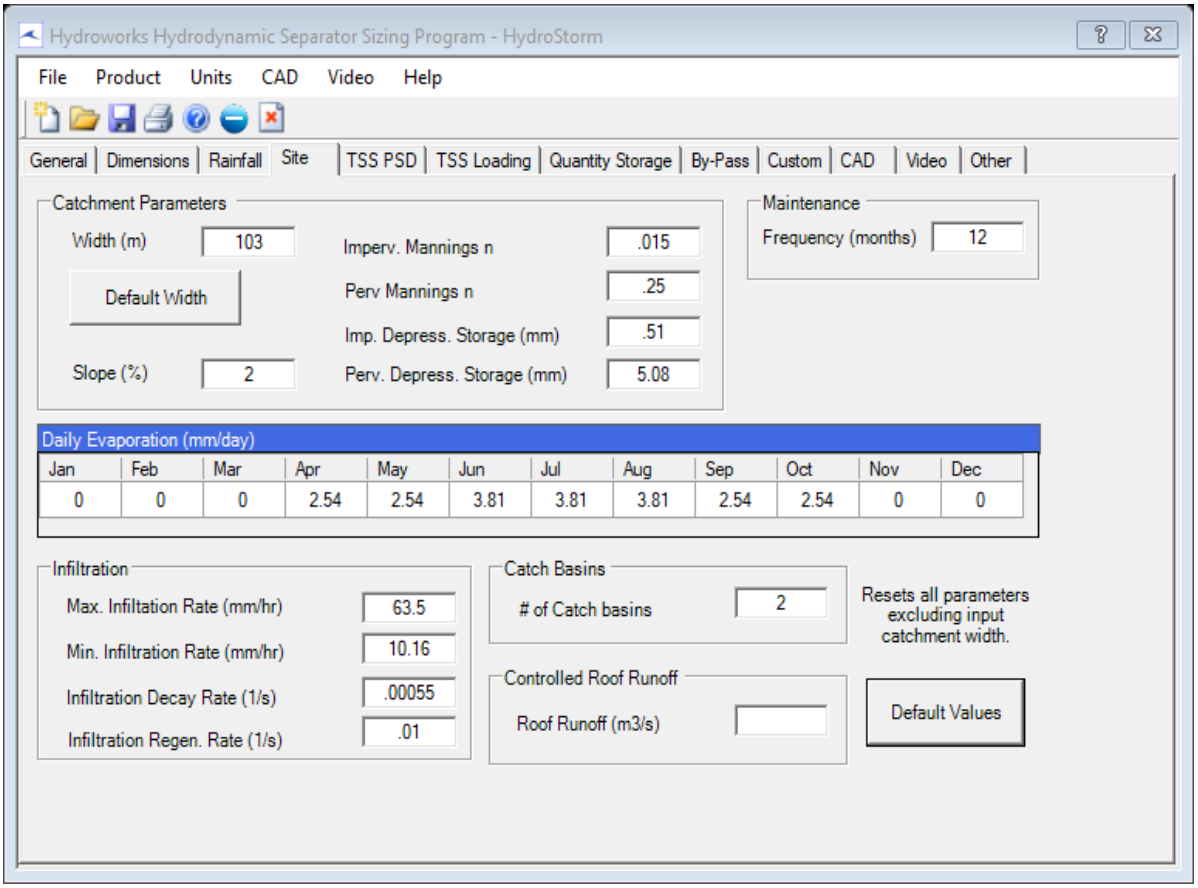
TSS Particle Size Distribution



Rainfall Station - Hamilton Airport, Ontario(1970 To 2006)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

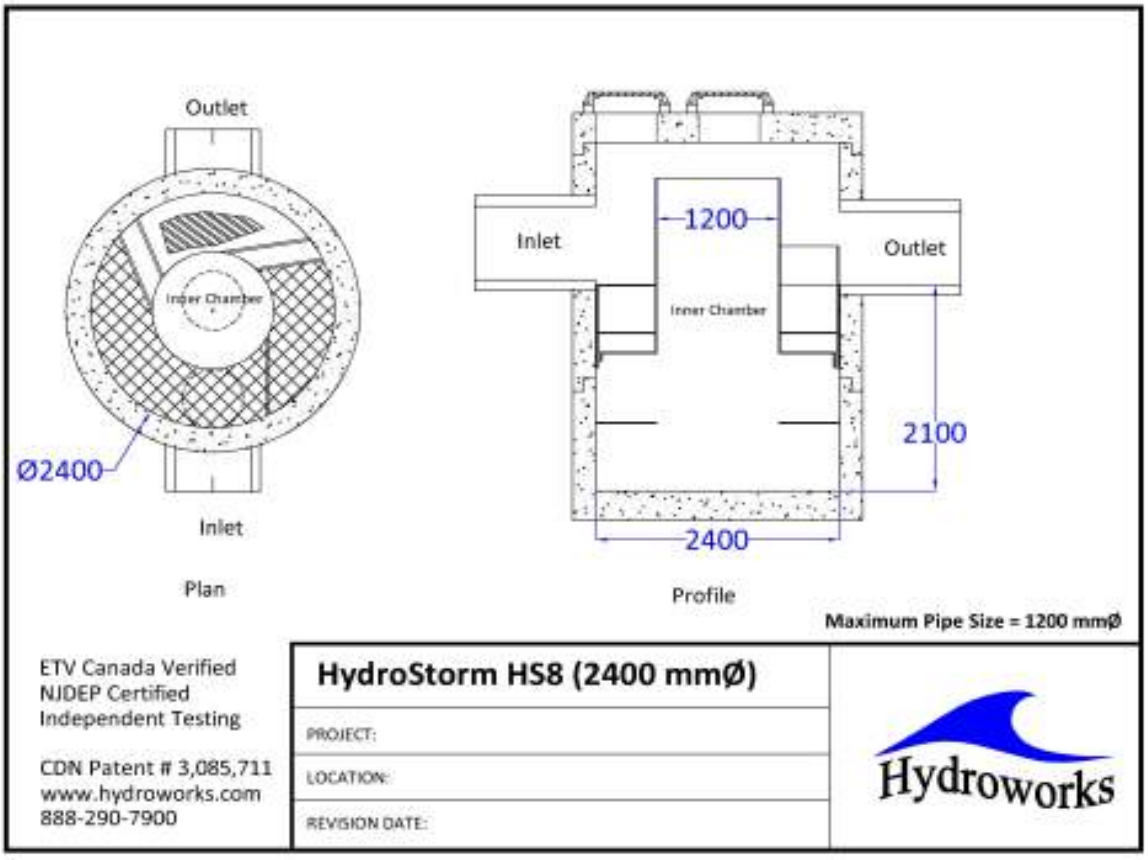
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

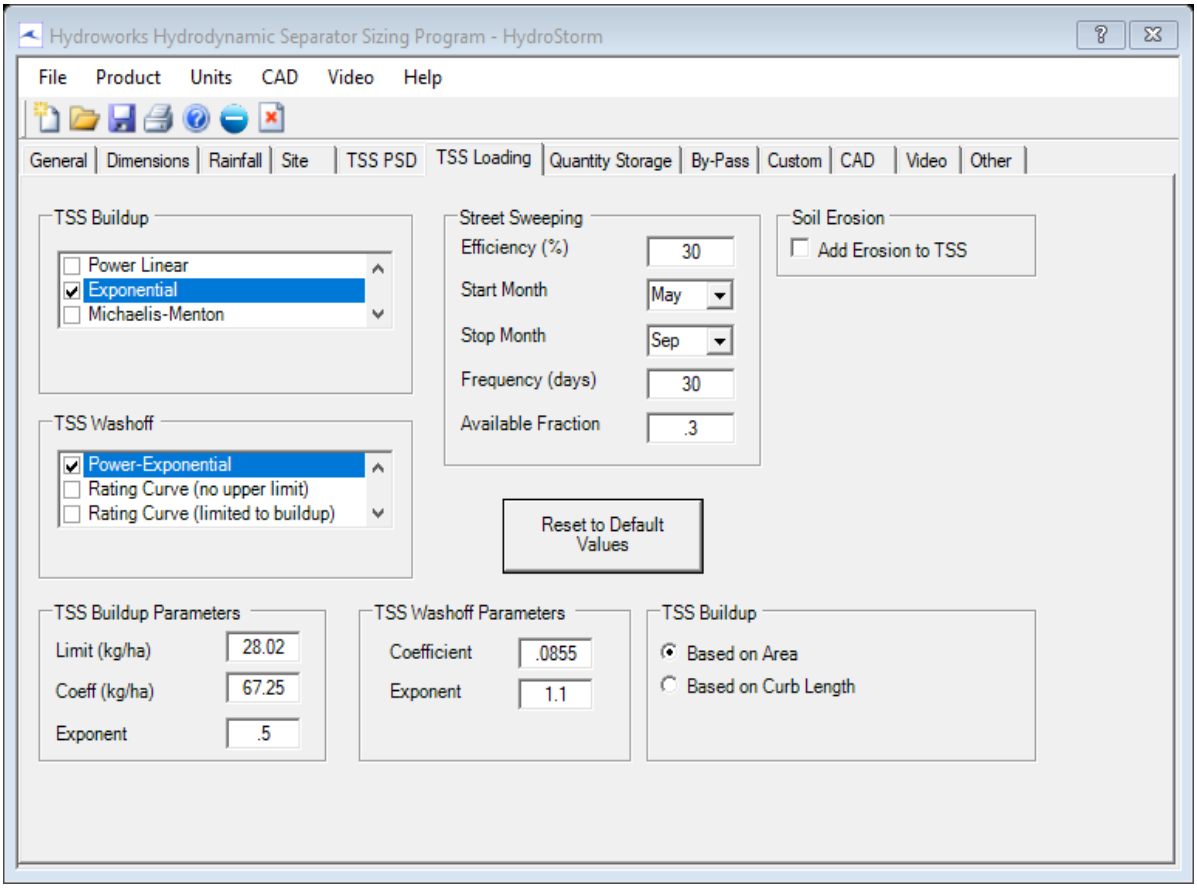
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

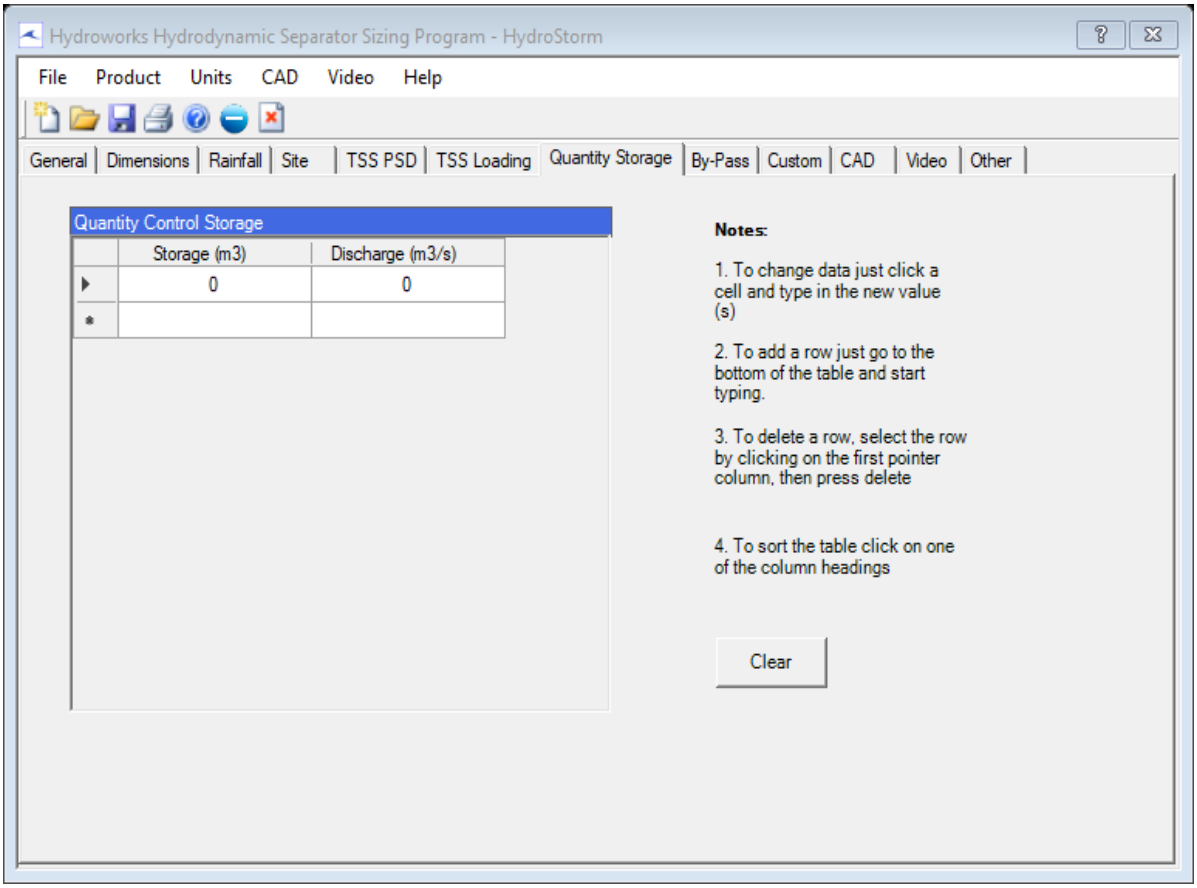
Generic HS 8 CAD Drawing



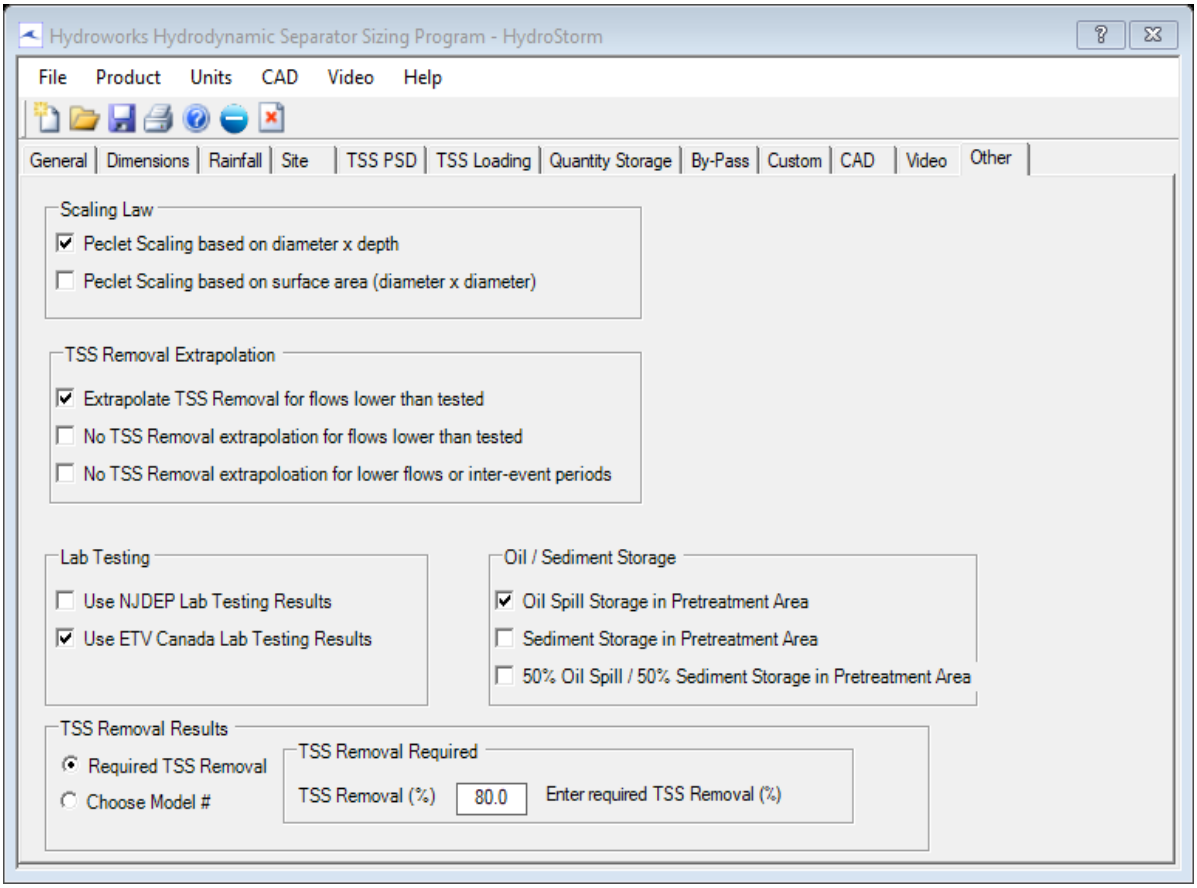
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.7
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.

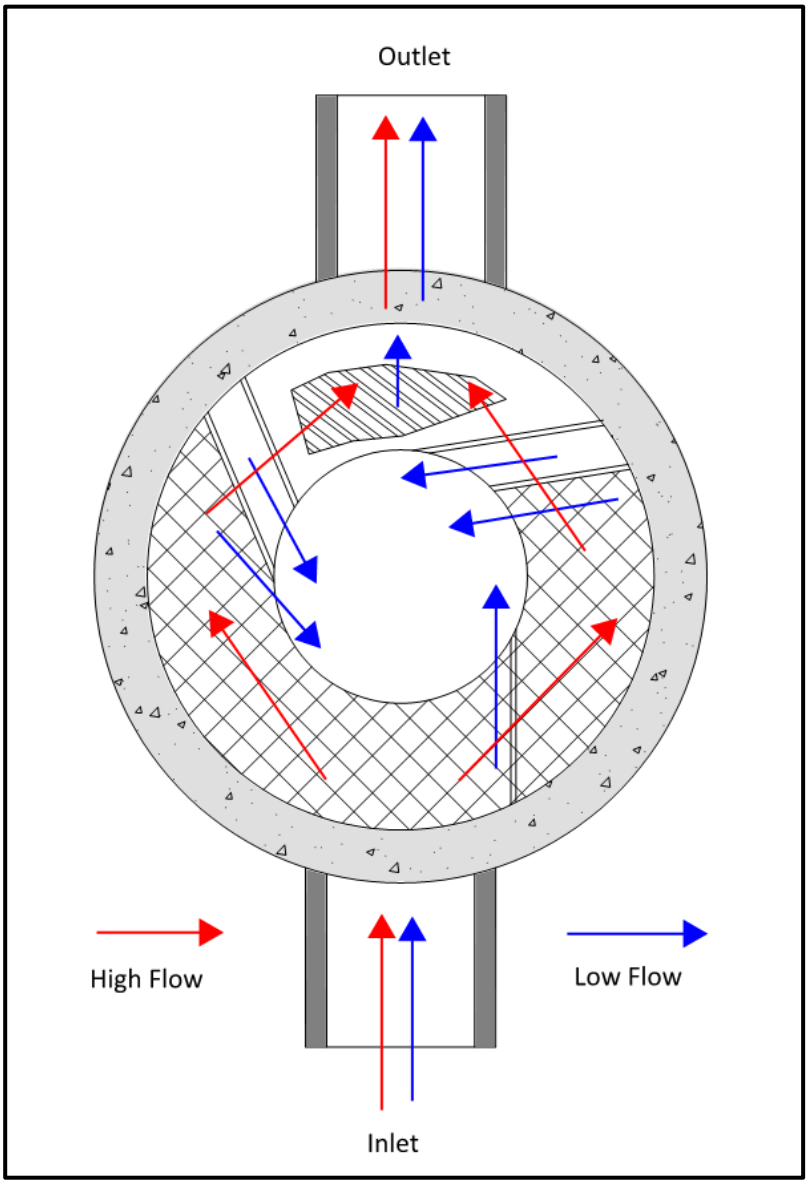


Figure 1. Hydroworks HydroStorm Operation – Plan View

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

Hydroworks

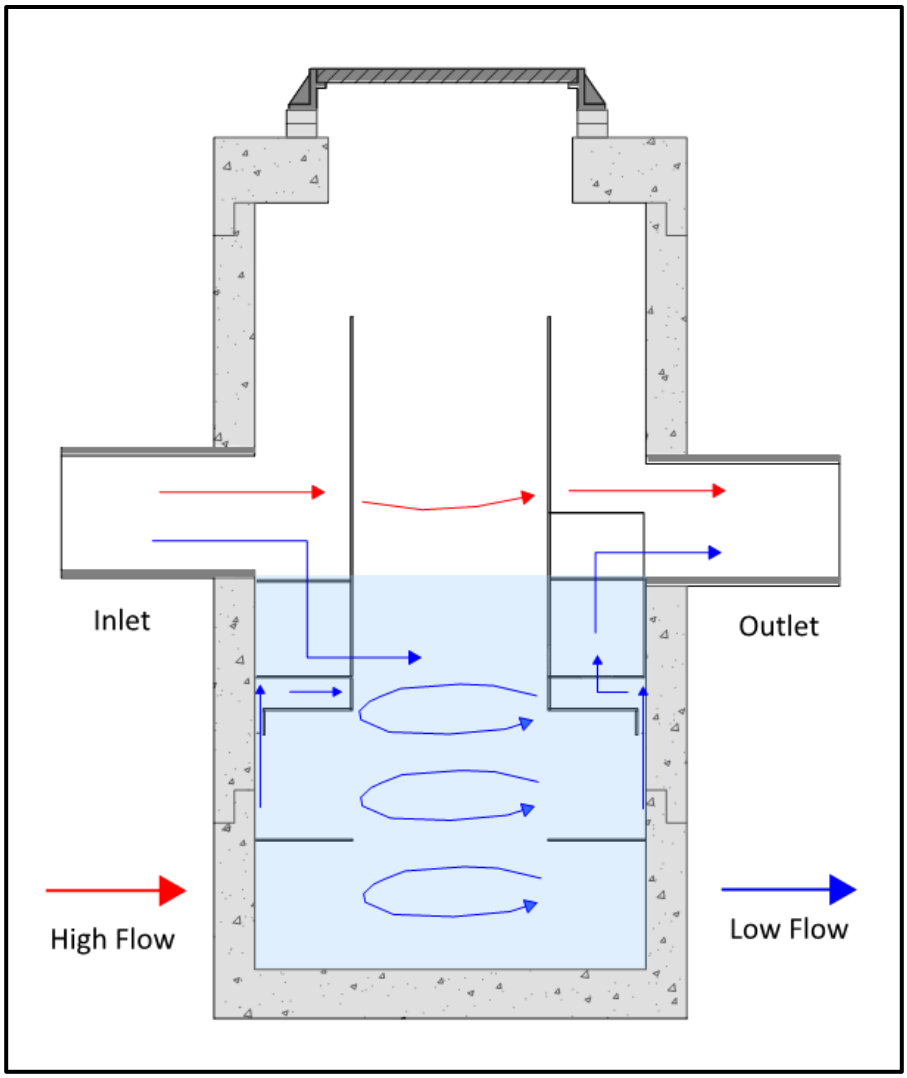


Figure 2. Hydroworks HydroStorm Operation – Profile View

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

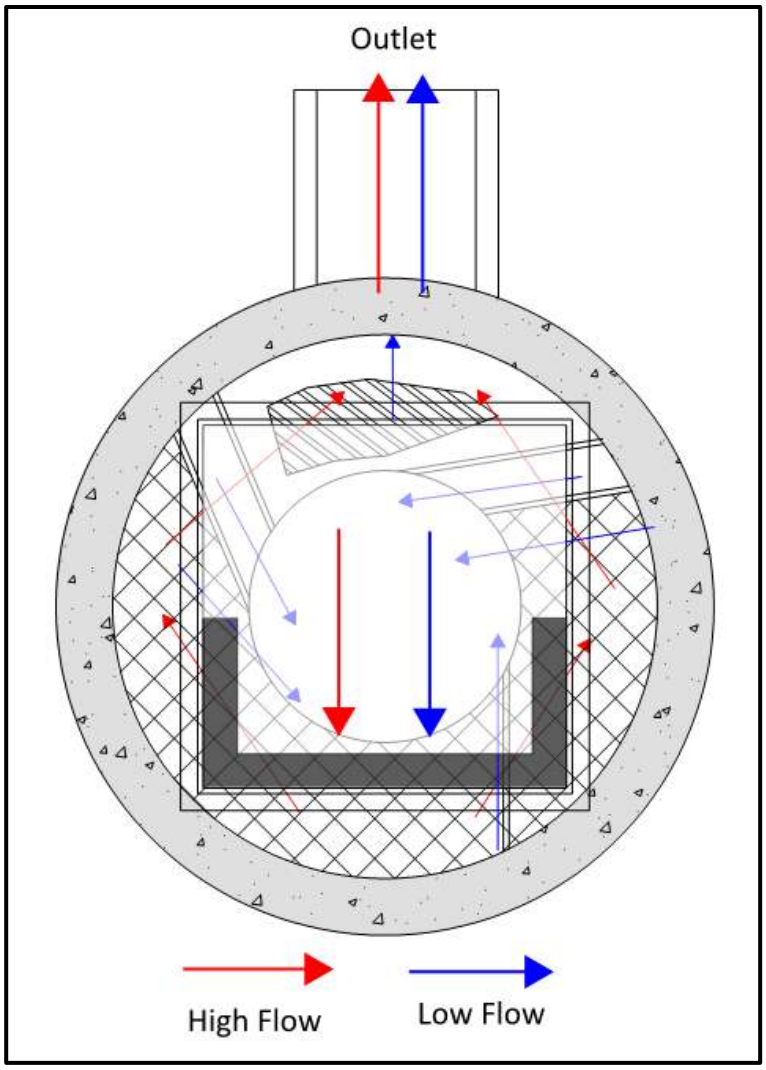


Figure 3. Hydroworks HS 4i Funnel

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).

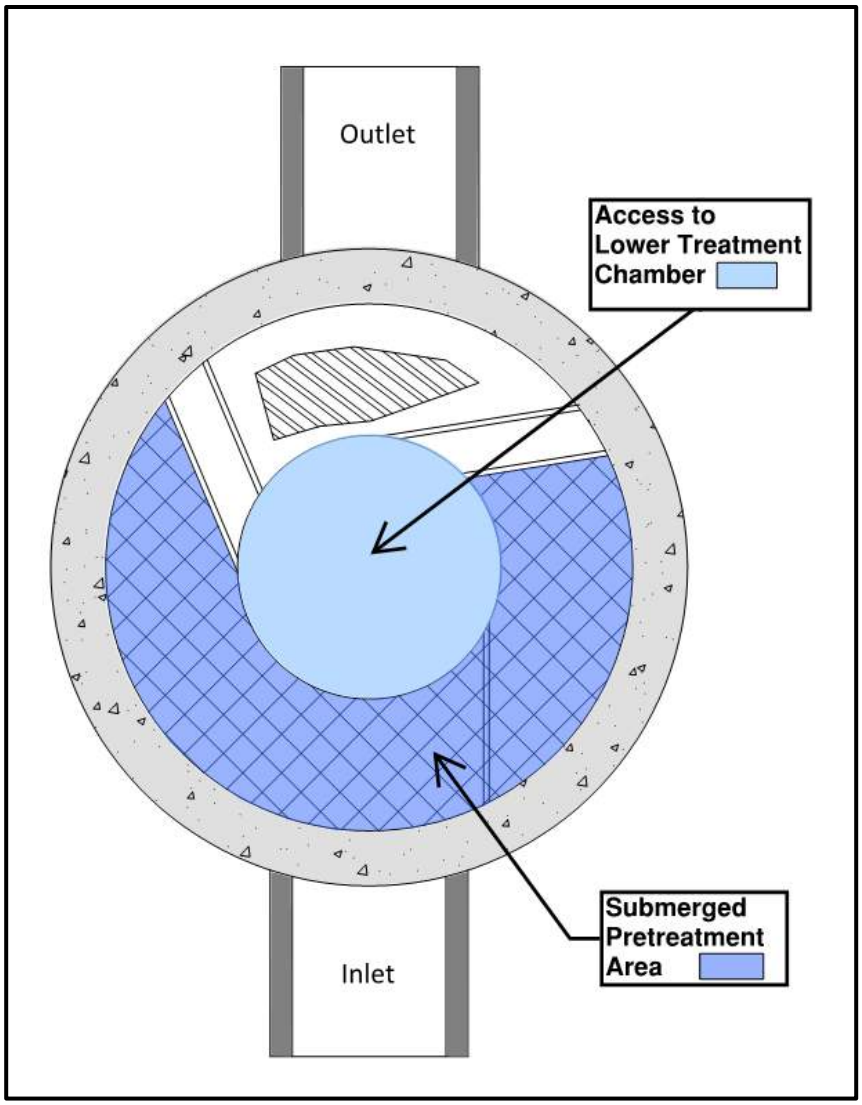


Figure 3. Maintenance Access

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.

APPENDIX C
FIRE FLOW CALCULATIONS

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

Project Number: **21045**
Project Name: **186 Kalar Road**
Date: **01-Nov-23**

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)**
Townhouse Block F	**600.0**	**4**	**2400**	**1.5**	16000	266.7	**-15**	-2400.0	**13600.0**	**0**	0.0	70	9520.0	**23000**	**383**

(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%

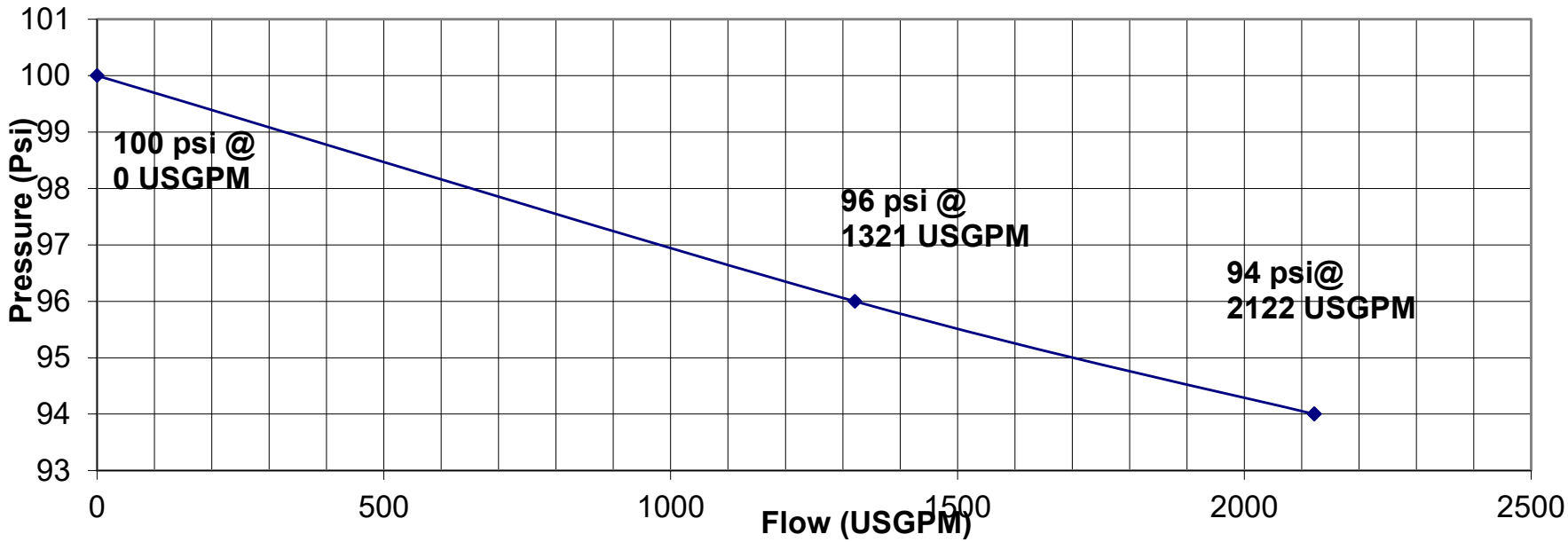
Side	Exposure (m)	Charge (%)
North =	**10.1 to 20m**	**15**
South =	**3.1 to 10m**	**20**
East =	**3.1 to 10m**	**20**
West =	**10.1 to 20m**	**15**
Total Expoure =		***70***

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: 186 Kalar Rd.

Static Pressure (Psi)		**Pitot Reading 1**	62	**# of Outlets Flowed 1**	1
	100	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	40	**# of Outlets Flowed 3**	2
	96	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	40	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	94	**Outlet Size 3**	2.5	100	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		96	1321
	94		1321.2	94	2122
		Flow 2 Calculated		94	2122
			2122.4	**Date & Time of Test :**	**April 22/2022**
Coefficient value		**Flow 3 Calculated**			**10:00am**
	0.9		2122.4	**Performed by:**	Alex & Sean

Water Graph



APPENDIX D
ENGINEERING PLANS

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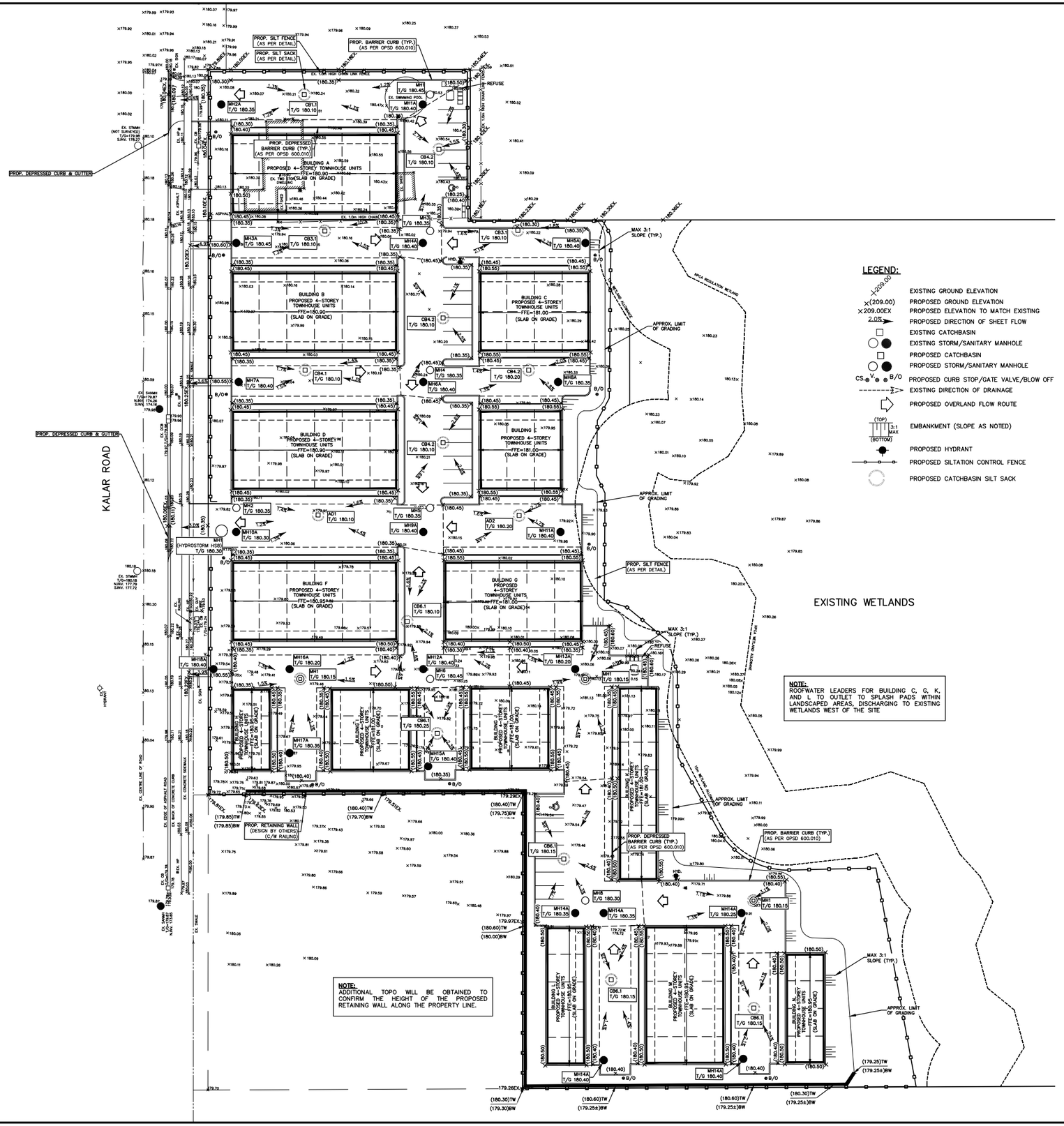

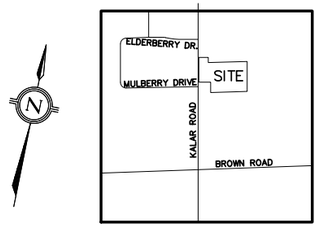

KEY MAP
N.T.S.

LEGEND:

- EXISTING GROUND ELEVATION
- PROPOSED GROUND ELEVATION
- PROPOSED ELEVATION TO MATCH EXISTING
- PROPOSED DIRECTION OF SHEET FLOW
- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED CURB STOP/GATE VALVE/BLOW OFF
- EXISTING DIRECTION OF DRAINAGE
- PROPOSED OVERLAND FLOW ROUTE
- EMBANKMENT (SLOPE AS NOTED)
- PROPOSED HYDRANT
- PROPOSED SILTATION CONTROL FENCE
- PROPOSED CATCHBASIN SILT SACK

BENCH MARK NOTE:

BENCHMARK NO. 748521

LARGE CONCRETE CULVERT UNDER QEW, 0.8 KM WEST OF CONCRETE AND STEEL BRIDGE CARRYING QEW OVER WELLAND RIVER IN THE CITY OF NIAGARA FALLS AND 0.4 KM WEST OF CHIPPAWA CREEK RD (NIAGARA REGIONAL RD 63). TABLET IS SET VERTICALLY IN TOP OF CULVERT, 52 CM EAST OF WEST WALL, 49 CM NORTH OF SOUTH END AND 16.4 M SOUTH OF CENTERLINE OF EASTBOUND LANE OF QEW.

ELEVATION=176.012m CGVD-1928:1978

NO.	DATE	BY	REVISIONS
02.	NOV/23	AS	REVISED SITE PLAN
01.	APR/22	YM	REVISED SITE PLAN

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	YM	CHK'D	SN	DATE
DRAWN	YM	CHK'D	SN	Jan. 18, 24

SCALE 1:400 (0 5 10 25 40)

APPROVALS

STAMP

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

CLIENT

M5V INC.
501 QUEEN STREET WEST,
TORONTO, ON M5V 2B4

PROJECT NAME

KALAR ROAD, LOT 186
NIAGARA FALLS, ON

TITLE

PRELIMINARY GRADING AND EROSION CONTROL PLAN

PROJECT No. 21045

DRAWING No. C101

S:\21045\Working\Current\21045-Grading & Servicing Plan.dwg
Plotted: Thursday, January 18, 2024 2:09:30 PM By: Scott Nelson

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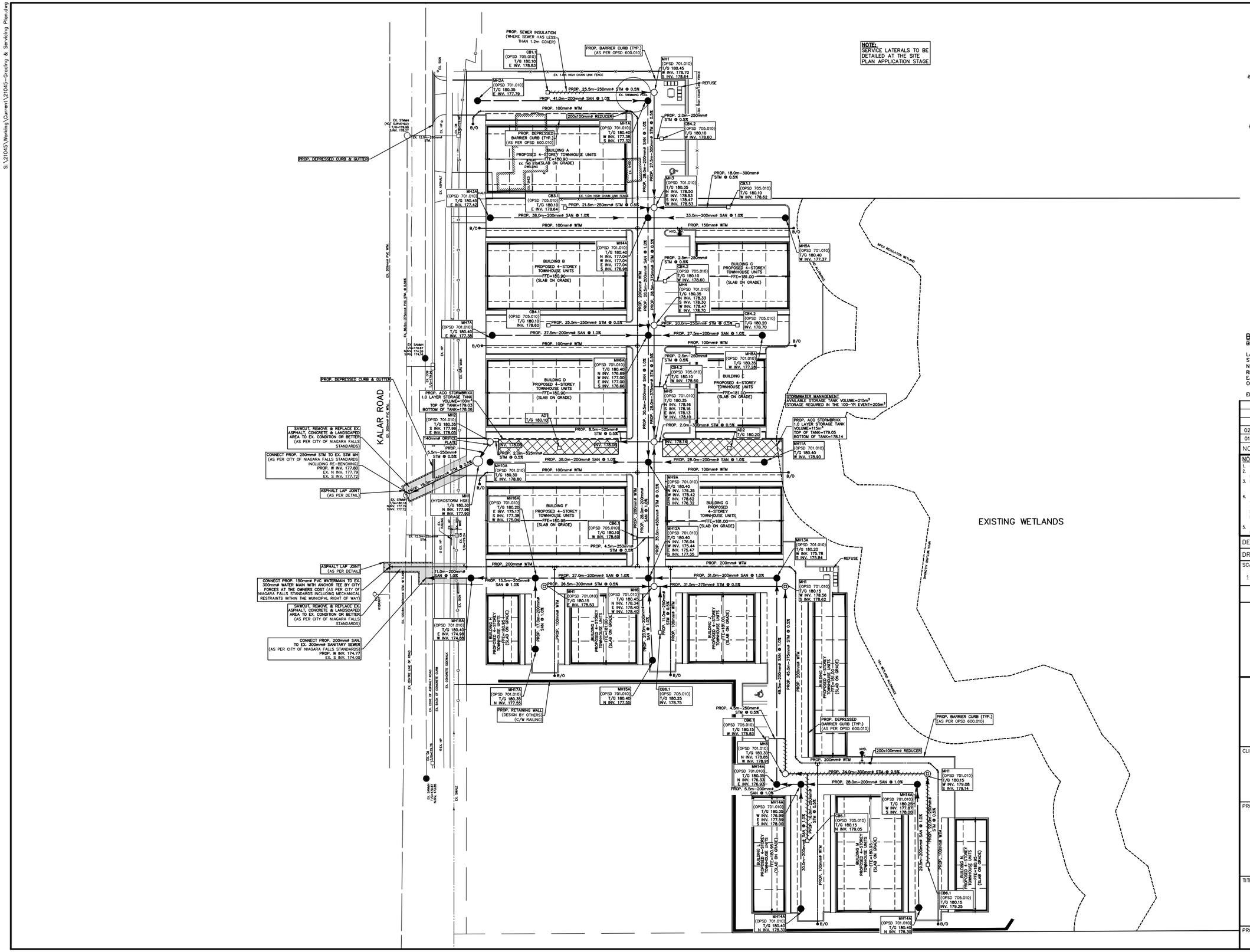
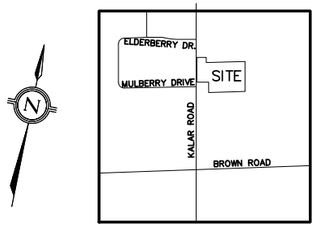


NOTE:
SERVICE LATERALS TO BE DETAILED AT THE SITE PLAN APPLICATION STAGE



KEY MAP
N.T.S.

LEGEND:

- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED CURB STOP/GATE VALVE/BLOW OFF
- PROPOSED SEWER INSULATION
- PROPOSED ROAD RESTORATION

BENCH MARK NOTE:
BENCHMARK NO. 748521

LARGE CONCRETE CULVERT UNDER QEW, 0.8 KM WEST OF CONCRETE AND STEEL BRIDGE CARRYING QEW OVER WELLAND RIVER IN THE CITY OF NIAGARA FALLS AND 0.4 KM WEST OF CHIPPAWA CREEK RD (NIAGARA REGIONAL RD 63). TABLET IS SET VERTICALLY IN TOP OF CULVERT, 52 CM EAST OF WEST WALL, 49 CM NORTH OF SOUTH END AND 16.4 M SOUTH OF CENTERLINE OF EASTBOUND LANE OF QEW.

ELEVATION=176.012m CGVD-1928:1978

NO.	DATE	BY	REVISIONS
02.	NOV/23	AS	REVISED SITE PLAN
01.	APR/22	YM	REVISED SITE PLAN

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	YM	CHK'D	SN	DATE Jan. 18, 24
DRAWN	YM	CHK'D	SN	

SCALE 1:400 (0, 5, 10, 25, 40)

APPROVALS

STAMP

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

CLIENT

M5V INC.
501 QUEEN STREET WEST,
TORONTO, ON M5V 2B4

PROJECT NAME

KALAR ROAD, LOT 186
NIAGARA FALLS, ON

TITLE

PRELIMINARY SITE SERVICING PLAN

PROJECT No.	DRAWING No.
21045	C102

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