FUNCTIONAL SERVICING &
PRELIMINARY STORMWATER MANAGEMENT REPORT
FOR
150 CEMETERY ROAD

TOWNSHIP OF UXBRIDGE

January 2022

Ref No.: 21571

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1.0 INTRODUCTION

1.1 Background

Politis Engineering Ltd. has been retained by 1093560 Ontario Limited (Coral Creek Homes) to prepare a functional servicing and preliminary stormwater management report in support of the proposed residential subdivision located at 150 Cemetery Road in the Township of Uxbridge.

The purpose of this report is to provide site-specific information for the Township and Region to review with respect to the municipal infrastructure required to support the proposed development regarding sanitary sewers, water supply and storm drainage. More specifically, the report will present the following:

1. Regional sanitary servicing including review of the existing and proposed sanitary flows; impact on the existing sanitary sewer system including determining whether there is capacity in the receiving municipal sewers to accommodate the additional sanitary flows from the proposed development.
2. Regional municipal water system review, including calculating the proposed domestic water and firefighting supply needs; and confirming that it has adequate flow to meet the required domestic and fire flow demands for the proposed development.
3. Preliminary Stormwater Management (SWM) review, including calculate the allowable and proposed runoff rates for the development; provide possible methods for attenuation and treatment of stormwater runoff; on-site control measures and compliance of the proposed stormwater control measures with the Township's, local conservation authority (LSRCA), MOECC/MECP and MNR regulations and criteria. A detailed SWM report will be provided as part of the detailed Subdivision application.

The following documents were reviewed and referenced as part of the preparation of this report:

- Draft Plan of Subdivision prepared by H.F. Grander Co. Ltd., OLS dated October 9, 2021 which includes a detailed topographic survey of the property.
- Cemetery Road Plan & Profile – Cemetery Road Sanitary Sewer Extension, drawing number PP-01 prepared by Cole Engineering, dated July 2017, Revision 8 dated June 22, 2018 – Not As-Constructed.
- Cemetery Road Reconstruction preliminary drawing set prepared by Chisholm, Fleming and Associates, Revision 2 dated September 2021 – 90% Design Submission.
- Report on Geotechnical Investigation – 150 Cemetery Road, Uxbridge, Ontario prepared by Toronto Inspection Limited, dated January 12, 2021.
- Hydrogeological Investigation - 150 Cemetery Road, Uxbridge, Ontario prepared by Toronto Inspection Limited, dated February 10, 2021.
- Summary of Infiltration Testing for Proposed Development at 150 Cemetery Road, Uxbridge, Ontario prepared by prepared by Toronto Inspection Limited, dated October 26, 2021.
- Natural Heritage Evaluation – Plan of Subdivision 150 Cemetery Road, prepared by GHD, dated January 6, 2021.

1.2 Site Description

The subject property has a total area of approximately 43,765 square meters or 4.38 Ha in size and is located on the west side of Cemetery Road north of Toronto Street South as shown in **Figure 1**. It is comprised of Part of Lot 27, Concession 6, in the Township of Uxbridge and the Regional Municipality of Durham. The property is

occupied by a brick raised bungalow with and integrated double car garage. The existing house is accessed by a paved driveway from Cemetery Road. There is also a paved tennis court on the property.

The Town of Uxbridge has retained the services of Chisholm, Fleming and Associates to design the urbanization of Cemetery Road including a storm drainage system, curb and gutter and sidewalk from Toronto Street South to the point where the road was previously urbanized in front of Uxbridge Cemetery.

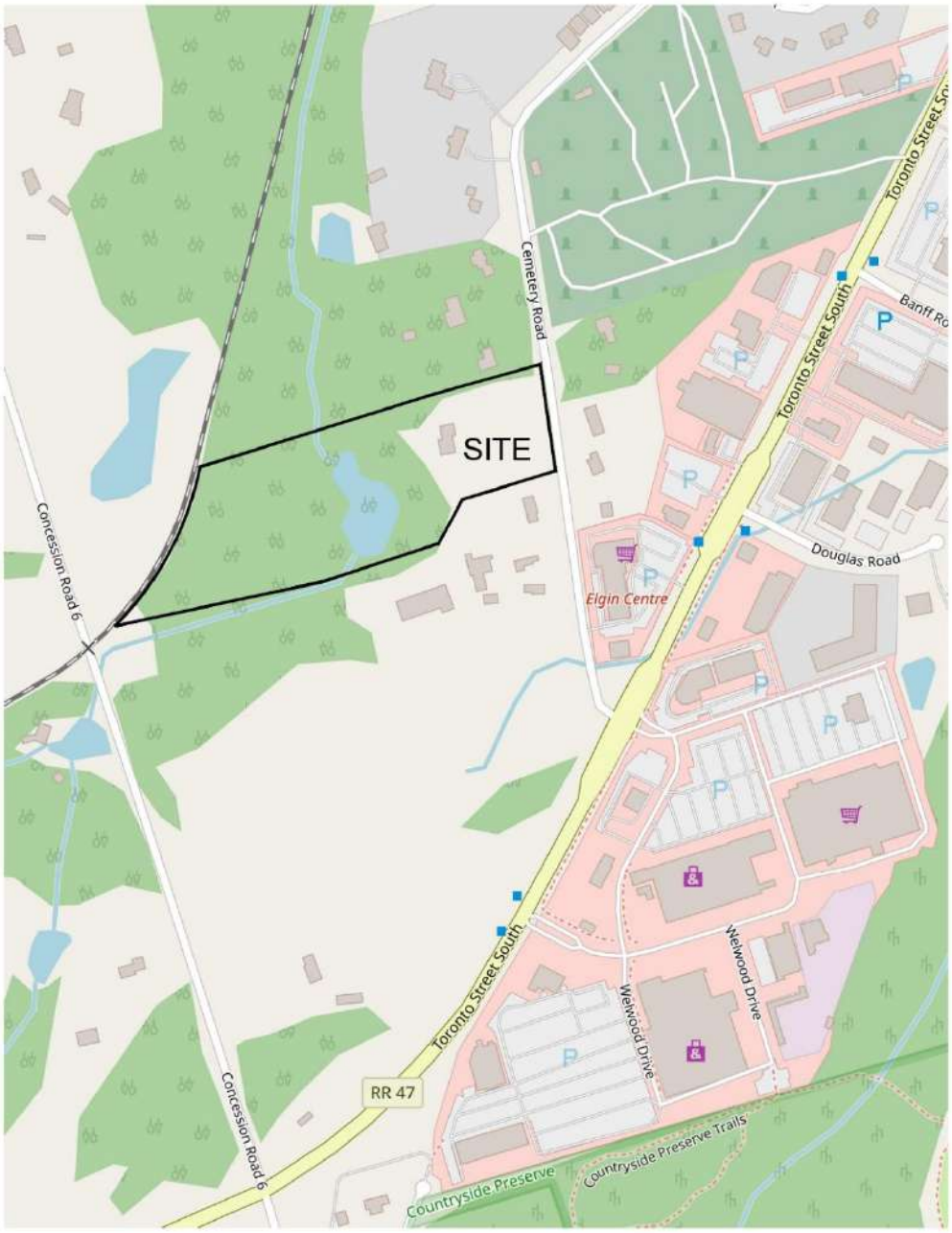

Figure 1 – Key Plan (Not to Scale)

1.3 Proposed Development

The proposed subdivision will occupy approximately 1.0 Ha of the eastern portion of the property with the balance to remain undisturbed.

The intention is to demolish the existing house to re-develop the property as a residential subdivision with a municipal road extending from Cemetery Road and ending in a cul-de-sac, creating 5 blocks with a total of 23 freehold townhouses and 1 block with a pair of semi-detached units, for a total unit count of 25.

1.4 Existing Topography

A topographic survey prepared by H.F. Grander shows that the property slopes generally in 2 directions with a ridge located more or less where the existing house is located, resulting in a pre-development storm drainage area of 0.736 Ha directed to the Cemetery Road drainage ditch and the balance draining west to Uxbridge Brook which traverses the west end of the property. There is no drainage from neighbouring properties that is directed into the subject site that drains to Cemetery Road.

The existing slope from the existing house to the front property line is approximately 5%.

2 EXISTING MUNICIPAL INFRASTRUCTURE

Figure 2 shows the existing municipal infrastructure in the vicinity of the subject property on Cemetery Road:

- 200 mm sanitary sewer with a depth of approximately 6.4 m located along the centerline of the pavement of Cemetery Road more or less and terminated at the projection of the south property line
- 300 mm watermain located on the east side of the pavement of Cemetery Road just south of the projection of the south property line.
- Currently there are no storm sewers on Cemetery Road. The Township has retained the services of Chisholm, Fleming & Associates, Consulting Engineers to design a storm sewer system as part of the urbanization of Cemetery Road.

3 SANITARY SEWER SYSTEM

3.1 Existing Sanitary Sewer Drainage System

With the recent development of the property to the south, a 200 mm diameter sanitary sewer was extended on Cemetery Road from Toronto Street South to the north limit of the adjacent development.

The Region of Durham has indicated through the Pre-Consultation process that the extension of the 200 mm sanitary sewer on Cemetery Road will be required across the entire frontage of the property and they will review the downstream sanitary system in order to confirm if the system has capacity for this development site. The Region's Pre-Consultation comments are enclosed in **Appendix 1** for reference.

3.2 Existing Sanitary Flows

The subject property does not contribute sanitary drainage to the new sanitary sewer on Cemetery Road nor do the adjacent properties to the north and the east side of Cemetery Road. All the existing houses utilize septic systems.

PROPERTY LINE

EX TENNIS COURT

EX TENNIS COURT

EX HOUSE

2.45

1.00 TOE EROSION ALLOWANCE

EX HOUSE # 150

4.18

EX GARAGE

3.69

EX DRIVEWAY

PS

EX PAVED DRIVEWAY

EX DRIVEWAY

EX DRIVEWAY

EX DRIVEWAY

PROPERTY LINE

PROPERTY LINE

EX EDGE OF PAVEMENT

EX CENTERLINE OF ROAD

EX EDGE OF PAVEMENT

FUTURE CENTERLINE OF ROAD

(PART 2, PLAN 40R - 9382)

(PART 3, PLAN 40R - 9382)

(PART 4, PLAN 40R - 9382)

CEMETERY ROAD

PROP 300 mmØ WATERMAIN

0.5M CSP

FUTURE CENTERLINE OF ROAD

EX EDGE OF PAVEMENT

EX CENTERLINE OF ROAD

EX 250Ø PVC SANITARY

EX EDGE OF PAVEMENT

EX 300 mmØ WATERMAIN

EX HYDRANT

0.5M CSP

0.5M CSP

0.5M CSP

0.5M CSP

BLOCK

7

11

9382)

0 5 10 15 20 25 m

EX 250mmØ SANITARY SEWER

EX 300mmØ WATERMAIN

FIGURE 2 – EXISTING MUNICIPAL INFRASTRUCTURE (SCALE = 1:500)

3.3 Proposed Sanitary Flows

The proposed sanitary design flows generated by the development of the subject property is calculated based on the Region of Durham design criteria which stipulates an average residential flow of 364 litres per person per day. The "equivalent population" is 3.5 persons per semi-detached unit and 3.0 persons per townhouse unit. A peaking factor using the Harmon peaking factor with a maximum of 3.8 is used and an infiltration allowance of 22.5 cu.m. per gross hectare per day is applied where foundation drains are not connected to the sanitary sewer, as is the case for this project.

Table 1 - Equivalent Population			
Dwelling Type	No. Units	P/Unit	Population
Townhouses	23	3.0	69
Semi-Detached	2	3.5	7
	Total Population =		76

Using a maximum peaking factor of 3.8 and applying the average residential flow, the daily sanitary flow is 105,123.2 litres per day. The gross sanitary tributary area is 9414 sq.m. (0.9141 Ha) resulting in an infiltration daily volume of 21.1815 cu.m. or 21,181.5 litres per day for a total sanitary design flow of 126,304.7 litres per day or 1.46 litres per second.

A sanitary sewer main will need to be extended into the site within the proposed road allowance with individual service connections provided to each dwelling per the Region of Durham standards and criteria.

4 WATER DISTRIBUTION SYSTEM

4.1 Existing Water Distribution System

The Region of Durham has indicated through the Pre-Consultation process that the extension of the 300 mm watermain on Cemetery Road will be required across the entire frontage of the property and for security and looping purposes, a secondary watermain feed from the existing 200 mm watermain located approximately 285 m to the north and east will be required. The Region's design criteria requires watermains shall be sized to carry the greater of maximum day plus fire flow or maximum hour demand.

4.2 Proposed Domestic Water Demand

Referring to the equivalent population (76 persons) and average residential flow derived from above (364 L/P/day) the average water demand is 27,664 L/day or 19.2 L/minute.

4.3 Proposed Fire Water Demand

The fire demand is calculated based on the "Water Supply for Fire Protection, A Guide to Recommended Practice" issued by the Fire Underwriters Survey of the Insurance Bureau of Canada. The maximum fire flow required will be for Block 2 which has 6 units and a gross footprint area of 619.1 sq.m. Assuming no fire separation between units and ordinary construction (brick or other masonry walls, combustible floor and interior) the fire flow has been calculated to be 12,500 L/minute. The detailed calculations are in **Appendix 2**.

4.4 Total Water Design Demand

From the MOECC (formerly MOE) "Guidelines for the Design of Water Distribution Systems", peaking factors are recommended for populations between 500 to 1000 as follows:

Maximum Day Factor = 2.75
Peak rate factor (peak hour) = 4.13

Therefore,

Maximum day is 19.2 L/min x 2.75 = 52.8 L/min

Peak hour is 19.2 L/min x 4.13 = 79.3 L/min

The water distribution system will need to be designed to provide maximum day plus fire demand or 12,552.8 L/min or rounded up to 13,000 L/min.

A watermain will need to be extended into the site within the proposed road allowance with individual service connections provided to each dwelling and individual water meters. A fire hydrant will be required at the termination of the watermain per the Region of Durham standards and criteria.

5 STORMWATER MANAGEMENT & STORM DRAINAGE

5.1 Peak Flow and Quantity Control

The LSRC Technical Guidelines for Stormwater Management (SWM) Submissions requires that peak flow control be implemented to maintain the pre-development peak flow discharge rate for the 2 through 100 year storm events. Drawing ST-1 is the Pre-Development Storm Drainage Plan and **Tables 2** and **3** show the calculation of the pre-development peak flows directed to Cemetery Road and to the valley to the west. The runoff coefficients and rainfall intensities are based on the Township's Design Criteria:

Table 2 - Pre-Development Peak Flows to Cemetery Road

Return Period	Rainfall Intensity (mm/hour)	Runoff Coefficient C	Peak Flow (L/s)
2	76.76	0.26	39.5
5	107.01	0.26	55.1
10	126.06	0.26	64.9
25	154.64	0.26	79.7
100	200.63	0.26	103.4
	Total Area =	7064.3	sq.m.
	Impervious Area =	589	sq.m.
	Pervious Area =	6475.3	sq.m.
	Impervious C =	0.20	
	Pervious C =	0.95	

Table 3 - Pre-Development Peak Flows to Valley			
Return Period	Rainfall Intensity (mm/hour)	Runoff Coefficient C	Peak Flow (L/s)
2	76.76	0.39	19.6
5	107.01	0.39	27.3
10	126.06	0.39	32.2
25	154.64	0.39	39.4
100	200.63	0.39	51.2
	Total Area =	2349.8	sq.m.
	Impervious Area =	597.8	sq.m.
	Pervious Area =	1752.0	sq.m.
	Impervious C =	0.20	
	Pervious C =	0.95	

Drawing ST-1 is the Post Development Storm Drainage Plan and **Tables 4** and **5** calculate the uncontrolled post development storm peak flows directed to Cemetery Road and the valley respectfully:

Table 4 - Post Development Uncontrolled Peak Flows to Cemetery Road			
Return Period	Rainfall Intensity (mm/hour)	Runoff Coefficient C	Peak Flow (L/s)
2	76.76	0.62	104.8
5	107.01	0.62	146.1
10	126.06	0.62	172.1
25	154.64	0.62	211.1
100	200.63	0.62	273.9
	Total Area =	7871.0	sq.m.
	Impervious Area =	4453.0	sq.m.
	Pervious Area =	3418.0	sq.m.
	Impervious C =	0.20	
	Pervious C =	0.95	

Table 5 - Post Development Uncontrolled Peak Flows to Valley			
Return Period	Rainfall Intensity (mm/hour)	Runoff Coefficient C	Peak Flow (L/s)
2	76.76	0.28	9.1
5	107.01	0.28	12.7
10	126.06	0.28	14.9
25	154.64	0.28	18.3
100	200.63	0.28	23.7
	Total Area =	1543.1	sq.m.
	Impervious Area =	156.1	sq.m.
	Pervious Area =	1387.0	sq.m.
	Impervious C =	0.20	
	Pervious C =	0.95	

Table 6 compares the uncontrolled pre and post development peak flows:

Table 6 - Comparison of Uncontrolled Pre to Post Development Peak Flows						
	Cemetery Road			Valley		
Storm Event	Pre L/s	Post L/s	Change L/s	Pre L/s	Post L/s	Change L/s
2	39.5	104.8	65.3	19.6	9.1	-10.5
5	55.1	146.1	91.0	27.3	12.7	-14.6
10	64.9	172.1	107.2	32.2	14.9	-17.3
25	79.7	211.1	131.4	39.4	18.3	-21.1
100	103.4	273.9	170.5	51.2	23.7	-27.5

The uncontrolled peak flow directed to the valley is reduced while the uncontrolled peak flows to Cemetery Road is increased and will require mitigation measures to maintain the pre-development levels.

A storm drainage system will be provided as part of the urbanization of Cemetery Road which will provide a storm outlet for the proposed subdivision, subject to controlling the peak flows. **Table 7** is a summary of the detention volumes required to maintain the pre-development peak flows to Cemetery Road. The detailed calculations are found in **Appendix 3**:

Table 7 - Storm Detention Volumes Required		
Storm Event	Controlled Peak Flow (L/s)	Detention Volume (cu.m.)
2	39.5	39.5
5	55.1	55
10	64.9	64.8
25	79.7	78.5
100	103.4	102.5

A 150 mm diameter orifice tube (actual inside diameter is 150.29 mm) will be provided to control the peak flows

and the required detention storage will be achieved by providing 32.5 m of 3000 x 1500 concrete box culvert as shown on Drawing 101. The stage-storage characteristics are calculated in **Table 8**:

Table 8 - Stage-Storage for 3000 x 1500 Box Culvert Super-Pipe								
		Orifice	END AREA			AVAILABLE	STORM	REQUIRED
INVERT	H	Flow	D/S	U/S	AVG	VOLUME	EVENT	VOLUME
	(m)	(L/s)	(sq.m.)	(sq.m.)	(sq.m.)	(cu.m.)		(cu.m.)
290.42								
290.80	0.38	34.4	1.06	0.80	0.93	32.6		
290.87	0.45	38.5	1.29	1.02	1.16	40.5		
290.889	0.469	39.5	1.34	1.08	1.21	42.5	**2 YEAR**	39.5
290.97	0.55	43.3	1.59	1.33	1.46	51.0		
291.07	0.65	47.7	1.89	1.62	1.76	61.5		
291.17	0.75	51.6	2.19	1.93	2.06	72.0		
291.27	0.85	55.3	2.49	2.23	2.36	82.5		
291.37	0.95	58.8	2.79	2.52	2.66	93.0	**5 YEAR**	55.0
291.47	1.05	62.1	3.09	2.83	2.96	103.5		
291.60	1.15	66.1	3.48	3.22	3.35	117.1		
291.637	1.217	67.2	3.59	3.33	3.46	121.0	**10 YEAR**	73.0
291.67	1.25	68.1	3.69	3.43	3.56	124.5		
291.92	1.50	75.0	4.38	4.17	4.28	149.7		
292.00	1.58	77.1	4.38	4.38	4.38	153.3		
292.02	1.60	77.6	4.38	4.38	4.38	153.3		
292.12	1.70	80.1	4.38	4.38	4.38	153.3		
292.575	2.155	90.7	4.38	4.38	4.38	153.3	**25 YEAR**	99.2
293.00	2.58	99.5	4.38	4.38	4.38	153.3		
293.20	2.78	103.4	4.38	4.38	4.38	153.3	**100 YEAR**	150.2
	SLOPE =	0.25%						
	LENGTH =	35.0			ORIFICE TUBE I.D. =		150.29	mm
	DS INVERT =	290.42			ORIFICE COEFFICIENT =		0.80	

5.2 Safe Conveyance to a Sufficient Outlet

Since the peak flows to the valley will be reduced, the conveyance of flows will not be an issue as long as concentrated discharge points are avoided. A “level spreader” can be provided to achieve this and will be addressed as part of the detailed design.

For the storm sewer system to outlet to the proposed Cemetery Road storm sewer, the peak flow is controlled to the 5 year pre-development level respecting the minor system is designed for up the 5 year level. Detention storage is provided for up to the 100 year post development storm and therefore only in the case of a blockage or a storm event exceeding the 100 year return period will there be overland flow to Cemetery Road. The proposed roadway will act as an emergency overland route as well there could be overflow from the proposed RLCB at the back of Block 3 which is the lowest inlet in the storm system upstream of the control orifice. Provisions will be provided to allow for safe conveyance to Cemetery Road as part of the detailed design.

5.3 Water Quality Control - TSS Removal

The requirement is to provide 80% TSS removal as part of an enhanced level treatment. A Hydroworks HydroDome Model HD4 has been sized to provide treatment of the storm runoff prior to discharging to the Cemetery Road storm system. The sizing summary shows it will provide treatment for 100% of the annual runoff and provides 85% annual TSS removal. The HydroDome has received ETV certification for removal of TSS in excess of 80%. The sizing documentation, ETV certificate and maintenance manual are enclosed in **Appendix 4.**

5.4 Phosphorus Removal

As part of the hydrogeological report prepared by Toronto Inspection Ltd. (TIL), a Phosphorus loading balance analysis was prepared, the summary of which is enclosed in **Appendix 5**. The pre-development annual load is 0.12 kg/year and the post development load is 1.24 kg/year or an increase of 1.12 kg/year. Therefore mitigation measures must be taken to reduce the loading.

It is proposed to provide infiltration trenches below the rear swales for Blocks 1 to 5 and to pipe roof downspouts to soakaway pits for Block 6. In-situ percolation testing was done by Toronto Inspection Ltd. on October 1, 2021. The report is in **Appendix 6**. The proposed infiltration systems will be sized to infiltrate 25 mm of rainfall and infiltrate the runoff over 48 hours. The infiltration system design calculations are in **Appendix 7**. The proposed infiltration system will reduce the post development loading to 0.99 kg/year.

The HydroDome will provide more than 80% TSS removal which will provide a further reduction of 50% of Phosphorus loading.

The proposed infiltration system and proposed HydroDome OGS will provide reduction in the release of Phosphorus to the downstream receiving system. The total post development loading will therefore be 0.48 kg/year or an increase of 0.37 kg/year. The actual loading will be addressed at the detailed design stage.

5.5 Water Quality - Other Pollutants

As per the 2003 MOE SWM Planning and Design Manual, urban stormwater runoff may contain elevated levels of nutrients, bacteria, heavy metals, oil and grease, and pesticides. A single SWM control will not be effective at mitigating all contaminants. Therefore, multiple SWM controls employed in series, comprising a treatment train become necessary. To this end, infiltration is proposed where possible and the proposed OGS will provide a treatment train in series system which will provide 85% TSS reduction prior to discharge to the downstream receiving system.

5.6 Water Balance

As part of the hydrogeological report prepared by TIL, a water balance analysis was prepared. The findings were the post development condition will leave the water balance deficient by 490 cu.m. annually. The proposed infiltration system will be designed to capture 25 mm which is equivalent to 95% of annual precipitation. The annual precipitation for Udora Climate Station is taken to be 886 mm and therefore for the tributary area directed to the proposed infiltration systems, the estimated annual volume of retention and infiltration is 2,728 cu.m. which exceeds the water balance deficiency noted in the TIL Hydrogeological Investigation.

5.7 Stream Erosion Control

LSRCA's stormwater guidelines specify that for sites less than 2 hectares do not normally require erosion control. The area of the property being developed is less than 2 hectares, therefore no specific erosion control is provided, although the infiltration system proposed to treat for Phosphorus load reduction and water balance does reduce the runoff leaving the site.

5.8 Erosion and Sediment Control During Construction

Due to the very nature of construction and development, the potential for erosion and migration of sediment from the site is increased. By implementing “good housekeeping” measures such as providing silt fences around the perimeter of the site, silt filters at catchbasins, temporary tracking control at the construction vehicle entrance to the site, rock check dams with filter cloth in any temporary drainage swale, and stabilizing the site as soon as possible, the potential for erosion and sediment migration can be minimized. and shall be in accordance with the GTA CA's Erosion & Sediment Control Guidelines for Urban Construction (2006).

6 PROPOSED GRADING

The proposed grading will provide for a self-contained storm drainage system except for a small area at the back of Block 5 which will drain to the west. The area that will discharge to the valley is smaller than the pre-development condition and produces smaller peak flows for all storm return periods.

7 SUMMARY

The total area of the subject property is 4.38 Ha with the proposed development site to occupy an area of less than 1.0 hectares, and the balance of the property to remain undisturbed.

The existing topography of the property slopes generally in 2 directions with a ridge located more or less where the existing house is located, resulting in a pre-development storm drainage area of 0.736 Ha directed to the Cemetery Road drainage ditch and the balance draining west to Uxbridge Brook which traverses the west end of the property. There is no drainage from neighbouring properties that is directed into the subject site that drains to Cemetery Road.

There is a 200 mm sanitary sewer located along the centerline of Cemetery Road more or less at the projection of the south property line and a 300 mm watermain located on the east side of Cemetery Road more or less at the projection of the south property line. There are currently no storm sewers on Cemetery Road. The Township of Uxbridge has undertaken urbanize the road including storm sewers, curb and gutters and sidewalks.

The intention is to demolish the existing house and re-develop the property as a residential subdivision with a municipal road extending from Cemetery Road running west and ending in a cul-de-sac, creating 5 townhouse blocks with 23 units and 1 semi-detached block with 2 units.

With the recent development of the property to the south, a 200 mm diameter sanitary sewer was extended on Cemetery Road from Toronto Street South to the north limit of the adjacent development. The Region of Durham has indicated through the Pre-Consultation process that the extension of the 200 mm sanitary sewer on Cemetery Road will be required across the entire frontage of the property and they will review the downstream sanitary system in order to confirm if the system has capacity for this development site. The sanitary design flow

generated by the proposed development is 1.46 L/s including peaking and infiltration. A sanitary sewer main will need to be extended into the site within the proposed road allowance with individual service connections provided to each dwelling per the Region of Durham standards and criteria.

The Region of Durham has indicated through the Pre-Consultation process that the extension of the 300 mm watermain on Cemetery Road will be required across the entire frontage of the property and for security and looping purposes, a secondary watermain feed form the existing 200 mm watermain located approximately 285 m to the north and east will be required. The Region's design criteria requires watermains shall be sized to carry the greater of maximum day plus fire flow or maximum hour demand.

The average domestic water demand is 19.2 L/minute and the required fire flow is 12,500 L/minute based on "Water Supply for Fire Protection, A Guide to Recommended Practice" issued by the Fire Underwriters Survey of the Insurance Bureau of Canada. The fire flow is calculated for largest building which is Block 2 and includes 6 units with no fire separation. The water design flow is therefore 13,000 L/minute.

A watermain will need to be extended into the site within the proposed road allowance with individual service connections provided to each dwelling and individual water meters. A fire hydrant will be required at the termination of the watermain per the Region of Durham standards and criteria.

The LSRC Technical Guidelines for Stormwater Management (SWM) Submissions requires that peak flow control be implemented to maintain the pre-development peak flow discharge rate for the 2 through 100 year storm events. The proposed grading will result in a reduction of peak flows to the valley lands and an increase to the Cemetery Road storm drainage system. No further action is required for the reduced drainage directed to the valley. Flow and quantity control will be provided for the storm drainage directed to Cemetery Road by implementing a 150 mm orifice tube and super-pipe in the form of 35.0 m of 3000 x 1500 mm box culvert. The peak flows directed to the future storm sewer on Cemetery Road will maintain the pre-development peak flows for the 2 and 5 year storm events and will maintain the 10 through 100 year storm events at the 5 year storm level which the storm sewer on Cemetery Road will be designed to convey.

Since the peak flows to the valley will be reduced, the conveyance of flows will not be an issue as long as concentrated discharge points are avoided, which will be addressed at the detailed design stage.

For the proposed storm system, since the design is based on controlling up to the 100 year event at the 5 year pre-development level, the 100 year storm will be conveyed via the piped system. In the case of blockage or an extreme storm event in excess of the 100 year return period, the new roadway will act as an emergency overland flow route. The proposed RLCB at the back of Block 3 is the lowest inlet in the proposed storm system upstream of the control orifice. Provisions should be provided to allow for safe conveyance to Cemetery Road as part of the detailed design.

A Hydroworks HydroDome Model HD4 has been sized to provide quality treatment. The HydroDome has received ETV certification for removal of TSS in excess of 80%. The sizing report shows the HD4 will provide treatment for 100% of the annual runoff and provides 85% annual TSS removal.

Infiltration systems will be provided within the private side which will reduce Phosphorus loading. The actual reduction will be calculated at the detailed design stage.

The proposed infiltration systems and HydroDome will act as a treatment train and provide for reductions in other pollutants such as elevated levels of nutrients, bacteria, heavy metals, oil and grease, and pesticides.

The development of the property will result in a reduction in infiltration. The proposed infiltration systems will provide a means of eliminating the water balance deficiency.

The area of the property being developed is less than 2 hectares, therefore no specific erosion control is provided, although the infiltration system proposed to treat for Phosphorus load reduction and water balance does reduce the runoff leaving the site.

Due to the very nature of construction and development, the potential for erosion and migration of sediment from the site is increased. By implementing “good housekeeping” measures such as providing silt fences around the perimeter of the site, silt filters at catchbasins, temporary tracking control at the construction vehicle entrance to the site, rock check dams with filter cloth in any temporary drainage swale, and stabilizing the site as soon as possible, the potential for erosion and sediment migration can be minimized. and shall be in accordance with the GTA CA's Erosion & Sediment Control Guidelines for Urban Construction (2006).

Respectfully submitted

Politis Engineering Ltd.

Per:

Tim Politis, P.Eng.

APPENDIX 1

Via Email Only

July 13, 2020

The Regional Municipality of Durham

Planning and Economic Development Department

Planning Division

605 ROSSLAND RD. E.
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PO BOX 623
WHITBY ON L1N 6A3
CANADA
905-668-7711
1-800-372-1102
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www.durham.ca

Brian Bridgeman, MCIP, RPP
Commissioner of Planning and Economic Development

Mr. Fabio Furlan
Email: furlan.fabio@rogers.com

Dear Mr. Furlan:

Re: Record of Pre-consultation for a proposed Draft Plan of Subdivision

Proponent: Fabio Furlan

Property Location: 150 Cemetery Road, Uxbridge

In accordance with By-law 2-2008 of the Regional Municipality of Durham, this letter is to confirm that a pre-consultation meeting was conducted in accordance with the provisions of this By-law.

Pre-consultation Date: Friday, July 10, 2020

Parties in Attendance:

Region of Durham

Lori Riviere-Doersam
Jeff Almeida
Charlotte Pattee

Township of Uxbridge and Consultants

Brian Pigozzo
Liz Howson
Peter Middaugh
Ken Maynard
Emilia Gruyters
Dave Barton
Willie Popp
Gordon Highet

LSRCA

Laura McGinnis

Proponent

Fabio Furlan
Ralph Grander
Tim Politis

"Service Excellence for our Communities"

If this information is required in an accessible format, please contact Planning Reception at 1-800-372-1102, extension 2551.

Site Location/Description:

The site is located at 150 Cemetery Road. The site is located within the Built Boundary for the Uxbridge Urban Area. There is an existing single detached home on the site which would remain. The site is also located within the Settlement Area of the Oak Ridges Moraine.

Purpose of the Application:

The purpose of the applicant's proposal is to develop a 23-unit freehold townhouse subdivision.

Durham Regional Official Plan (ROP) Designation: Living Areas, Oak Ridges Moraine – Settlement Area

Township of Uxbridge Official Plan: Residential and Environmental Constraint

Is the proposal in Conformity with the ROP: Yes

Conformity Details: The Regional Official Plan indicates that Living Areas are to be used predominately for housing purposes. In the consideration of development applications in Living Areas, regard shall be had for the following:

- a compact urban form;
- the use of good urban design principles;
- the provision of convenient pedestrian access to public transit, educational facilities and parks;
- a grid pattern of roads;
- the types and capacities of the existing municipal services, infrastructure and the feasibility of expansion; and
- the balance between energy efficiency and cost.

The Region will circulate the subdivision application to the Township and various agencies for review. The Region also requests that the Township provide Notice for a Complete Application and hold the statutory public meeting.

Information/Studies Required:

The Regional Planning and Economic Development Department will require the following information to be submitted to support the proposed Subdivision application.

- **A Planning Rationale/Justification Report** – prepared by a Registered Professional Planner, the report should address conformity with relevant Provincial Plans and Policies, Regional Official Plan policies, Township of Uxbridge Official Plan and Zoning By-law policies.
- **Neighbourhood Plan –** this study will be prepared by the Township at the cost of the applicant. The Township will prepare a Terms of Reference and budget for the study for the applicant's consideration. The study will examine the surrounding area and assess the implications of development on the surrounding neighbourhood.
- **Archaeological Assessment** – this study should address the potential archaeological resources on the site;
- **A Record of Site Condition Compliant Phase One Environmental Site Assessment (ESA) Report or a Site-Screening Questionnaire** completed and signed by a Qualified Person. If a Phase One ESA is submitted, the Region's Reliance Letter and Certificate of Insurance forms (attached) are required;
- **Noise Study** – address the impact of the railway noise and stationary noise from nearby commercial buildings;
- **Environmental Impact Study/Natural Heritage Evaluation** – this study should be scoped with the LSRCA;
- **Edge Management Plan**
- **Geotechnical Evaluation**
- **Hydrogeological Study, including water balance** – scope with the LSRCA, include in-situ testing of LIDs;
- **Phosphorous Offsetting Study/Phosphorous Reduction Strategy** – contact Jim Teefy at AECOM (jim.teefy@aecom.com) for requirements;
- **Landform Conservation Plan** - as per the policies of the ORMCP;
- **Functional Serving Report** – this study should address municipal services as well as stormwater management. The stormwater management component must be completed to the Township and LSRCA requirements. It should examine the three outlet options for development. As well, the study should examine the condo/freehold options in terms of infrastructure ownership;
- **Draft Subdivision Plan**

The studies should be accompanied with 3 USB sticks containing the studies/plans, for circulation purposes.

Fees

Region of Durham

- Subdivision $5,5000 (plus $100 for each unit over 50)

Township of Uxbridge

- Subdivision $15,650 plus $400.00 per lot/unit in excess of 10 lots.
- External costs including but not limited to legal, engineering, planning, consulting incurred by the Township in connection with the application

Lake Simcoe Region Conservation Authority

- Contact the LSRCA directly

We recommended the fee amounts be confirmed at the time of submission of the applications. Payments should be by Certified Cheque, Money Order, or Bank Draft.

In accordance with our procedures, please advise whether you concur with the above-noted information and study requirements within seven (7) days of receiving this Record of Pre-Consultation. Should you not agree with the above-noted requirements, another pre-consultation meeting may be requested.

Please contact me at (905) 668-4113, ext. 2572, if you have any questions.

Yours truly,

Lori A. Riviere-Doersam

Lori Riviere-Doersam, MCIP, RPP
Principal Planner

cc: Meeting attendees

Encl. LSRCA Pre-consultation Notes
Regional Works Pre-consultation Notes
Reliance Letter and Certificate of Insurance Template

Jo Ann. Merrick

From: Jeff Almeida <Jeff.Almeida@Durham.ca>
Sent: Friday, July 10, 2020 8:51 AM
To: Jo Ann. Merrick
Cc: Charlotte Pattee
Subject: RE: Virtual Pre-Consultation Meeting - 150 Cemetery Rd

Hi Jo Ann,

Our comments for the meeting:

- Water supply to the subject property will require the extension of a 300 mm watermain on Cemetery Road across the entire frontage of the property. For security and looping purposes, we will also require a secondary watermain feed from the existing 200 mm watermain located approximately 285 m northeasterly on Cemetery Road.
- Sanitary servicing to the subject property will require the extension of a 200 mm sanitary sewer on Cemetery Road across the entire frontage of the property. The Region is reviewing the downstream sanitary sewer system in order to confirm if the system has capacity for this site. We will advise if any additional analysis and/or potential downstream improvements are required.
- The Region provides municipal waste and recycling collection service to residential properties within the Township of Uxbridge. In order to receive municipal waste collection service, all roadways must meet the minimum design standards outlined in the Region's Waste By-law.
- Regional development charges will be assessed at the time of building permit issuance. The current medium density multiple (townhomes) rate is $27,135 per unit. The applicant will also receive development charge credit for the demolition of the single detached dwelling unit ($33,693). Please note these rates are valid until June 30, 2021.

Jeff Almeida
Development Approvals Division
Works Department
Regional Municipality of Durham
605 Rossland Road East
Whitby, ON L1R 1W8
Phone: (905) 668-7711 ext. 3721
Fax: (905) 668-2051

From: Jo Ann. Merrick <jmerrick@uxbridge.ca>
Sent: Monday, July 06, 2020 12:43 PM
To: Kristi Honey <khoney@uxbridge.ca>; Dave Barton <dbarton@uxbridge.ca>; Gord Highet <ghighet@uxbridge.ca>; Willie Popp <wpopp@uxbridge.ca>; Brian Pigozzo <bpigozzo@uxbridge.ca>; Emilia Gruyters <egruyters@uxbridge.ca>; Ken Maynard <kmaynard@uxbridge.ca>; Liz Howson (howson@mshplan.ca) <howson@mshplan.ca>; 'Laura McGinnis' <L.McGinnis@lsrca.on.ca>; Lino Trombino <Lino.Trombino@Durham.ca>; Lori Riviere-Doersam <Lori.Riviere-Doersam@Durham.ca>; 'peter.middaugh@aecom.com' <peter.middaugh@aecom.com>; Jeff Almeida <Jeff.Almeida@Durham.ca>
Cc: 'Fabio Furlan' <furlanfabio@rogers.com>
Subject: Virtual Pre-Consultation Meeting - 150 Cemetery Rd

We are looking are having a virtual pre-consultation meeting on Fri. July 10 at 10:30 for rezoning and Plan of Subdivision.

"The current property is located at 150 Cemetery Rd and it comprises of being 10 acres which is in Phase 1 of the Township of Uxbridge Official Plan. The existing house will remain on the property and it will be re-sold with the property behind (Lot 1). All the property between the existing house and Cemetery Rd will be developed with a freehold road comprising 23 - 20 ft townhomes fronting the new cul-de -sac which will be on full municipal services.(Block 2,3,4,5,6). Thus making this location an ideal location for infilling as per the Provincial/Regional Policies.

There will be 23 Townhome units . Each unit will be 6.02 m. (20 ft) each."

Emilia will send out the meeting request.

Jo Ann Merrick
Administrative Assistant
Public Works & Operations/
Development Services
Township of Uxbridge
51 Toronto St. S.
Uxbridge, ON L9P 1T1

(t)905-852-9181 ext 202
(f) 905-852-9674

Email: jmerrick@uxbridge.ca

Lake Simcoe Region
conservation authority

www.LSRCA.on.ca

PLANNING ACT APPLICATION - PRE-CONSULTATION

Date: July 9, 2020
Planner: Laura McGinnis
Contact #: 905.895.1281 ext. 299
Email: l.mcginnis@LSRCA.on.ca

Address: 150 Cemetery Road, Uxbridge **APID:** 218922

Type of Proposal (Please Highlight):

Official Plan Amendment	Plan of Subdivision/Condominium	Consent
Zoning By-law Amendment	Site Plan	Minor Variance

Description of Proposal:

"The current property is located at 150 Cemetery Rd and it comprises of being 10 acres which is in Phase 1 of the Township of Uxbridge Official Plan. The existing house will remain on the property and it will be re-sold with the property behind (Lot 1). All the property between the existing house and Cemetery Rd will be developed with a freehold road comprising 23 - 20 ft townhomes fronting the new cul-de -sac which will be on full municipal services.(Block 2,3,4,5,6).

There will be 23 Townhome units . Each unit will be 6.02 m. (20 ft) each."

Is the site within an area governed by Ontario Regulation 179/06? (Please Highlight)
YES (Permit Required) NO

Regulated Components (Please list):
The subject land is largely within an area that is regulated by the LSRCA under Ontario Regulation 179/06 of the *Conservation Authorities Act* for the following natural hazards and/or features:
-Ministry of Natural Resources and Forestry (MNRF) Provincially Significant Wetland (Uxbridge Brook Headwater Wetland Complex) and its associated 120 metre adjacent lands.
-A stream (permanent and/or intermittent stream) identified as Uxbridge Brook.
-Meander belt erosion hazard associated with Uxbridge Brook.
-Riverine flooding under the Regional Storm Event associated with Uxbridge Brook.
-Apparent valleylands, characterized by steep slopes, associated Uxbridge Brook.

Required Report / Study	Functional Submission	Detailed Design	Required Report / Study	Functional Submission	Detailed Design
Proposed Amendment Documents (OPA/ZBA)			Top of Bank Demarcation Mapping	X	X
Planning Justification Report (inclusive of Provincial Plan Conformity including LSPP)			Floodplain Analysis		
Environmental Impact Study/ Natural Heritage Evaluation	X	X	Geotechnical / Soils Report	X	X
Ecological Offsetting Strategy	X	X	Master Drainage Plan		
Tree Compensation Plan			Slope Stability / Erosion Assessment	X	X
Tree Inventory & Preservation Plan / Arborist Report			Topographic Survey prepared by an OLS	X	X
Watercourse / Shoreline Protection, Enhancement and Restoration Plans			Hydrogeological Analysis including a Water Balance	X	X
Coastal Engineering Study			Phosphorus Budget	X	X
Vegetation Protection, Enhancement and Restoration Plans	X	X	Functional Servicing Report	X	X
Edge Management Plan	X	X	Stormwater Management Report	X	X
Landscape Plan			Erosion and Sediment Control Plan	X	X
LSRCA Review Fee	X	X	Grading and Drainage Plan	X	X
			Site Plan / Draft Plan/R Plan	X	X

Comments:

The proposal includes the construction of a building with the ground floor area cumulatively equal to or greater than 500m2 (5382 sq. ft.), and any other impervious surface. It is noted that this scale of development meets the definition of "Major Development" per the Lake Simcoe Protection Plan (LSPP), the Oak Ridges Moraine Conservation Plan (ORMCP), the Greenbelt Plan (GBP), York Region Official Plan, Lake Simcoe Phosphorus Offsetting Policy (LSPOP), as well as the South Georgian Bay Lake Simcoe Source Protection Plan (SGBLSSPP).

A Stormwater Management Report will be required to satisfy DP-4.8 of the LSPP and in accordance with the LSRCA Technical Guidelines for Stormwater Management (SWM) Submissions, inclusive of a phosphorus budget and water balance. Please refer to the LSRCA Technical Guidelines for SWM Submissions: https://www.lsrca.on.ca/Shared%20Documents/permits/swm_guidelines.pdf.

The application will also be subject to the Lake Simcoe Phosphorus Offsetting Policy (LSPOP): https://www.lsrca.on.ca/watershed-health/phosphorus.

The lands are identified as being within the Recharge Management Area (WHPA Q2) per the South Georgian Bay Lake Simcoe Source Protection Plan. A Hydrogeological Analysis and pre- and post-development water balance assessment will be required in support of the application. Please see Policies LUP-12 / LUP-13 of the Source Protection Plan. The hydrogeological analysis is required to be prepared in accordance with "Hydrogeological Assessment Submissions: Conservation Authority Guidelines for Development Applications"
https://www.lsrca.on.ca/Shared%20Documents/permits/hydrogeological%20_guidelines.pdf?pdf=Hydrogeological-Guidelines

The subject lands are within a Significant Groundwater Recharge Area (SGRA), and therefore the application will be required to be in accordance with the applicable policies of the Oak Ridges Moraine Conservation Plan (ORMCP). This includes an accompanying study which demonstrates that the quality and quantity of groundwater and the function of the recharge area will be maintained. Please contact the LSRCA regarding soils information and scope of pre- and post-development water balance assessment.

Please contact LSRCA staff to delineate the boundary of the Natural Heritage features on the site through a feature staking. Future submissions should include detailed drawings with the location of natural heritage/hydrological features represented including setbacks to the features from the proposed development. Please note that development should be located outside of natural heritage/hydrological features and their associated Minimum Vegetation Protection Zones (MVPZ). All proposed development needs to meet the "no negative impact" test and demonstrate that there will be no negative impacts to the natural features and their ecological functions in accordance with Section 23 of the ORMCP per Section 2.1 of the Provincial Policy Statement (PPS) and Subsection 22(3) of the Oak Ridges Moraine Conservation Plan (ORMCP). A scoped Natural Heritage Evaluation (NHE) will be required to assess these features and determine an appropriate limit of disturbance/development footprint. For clarity regarding the determination/assessment of features, the Technical Definitions and criteria for Identifying Key Natural Heritage Features and Key Hydrologic Features for the Lake Simcoe Protection Plan (MNRF, 2015) document should be referenced. Please contact the LSRCA with a Terms of Reference.

A geotechnical investigation will need to be provided to assess slope stability process at the site to determine the surface, subsurface conditions (e.g., soil, rock, groundwater) and their potential for future slope instability based on the proposed changes in slope configurations, such as steepness or inclination, increases in loading on or near the slope, such as structures or filling, changes in ground water conditions or drainage of the soil, loss of vegetation cover and root systems, etc.

The subject lands are currently within an area that is regulated by the LSRCA under Ontario Regulation 179/06 of the *Conservation Authorities Act*. Accordingly, a permit from the LSRCA under Ontario Regulation 179/06 will be required prior to development or site alteration occurring within the regulated portion of the property.

NOTES AND REFERENCE DOCUMENTS

1. Please contact the LSRCA to scope any required Environmental Impact Study or Natural Heritage Evaluation
2. The stormwater management submission is required to be prepared in accordance with "LSRCA Technical Guidelines for SWM Submissions"
   https://www.lsrca.on.ca/Shared%20Documents/permits/swm_guidelines.pdf
3. Submissions are to be in accordance with the LSRCA Watershed Development Guidelines
   https://www.lsrca.on.ca/Shared%20Documents/permits/watershed-development-guidelines.pdf?pdf=Watershed-Development-Guidelines
4. The hydrogeological analysis is required to be prepared in accordance with "Hydrogeological Assessment Submissions: Conservation Authority Guidelines for Development Applications"

https://www.lsrca.on.ca/Shared%20Documents/permits/hydrogeological%20_guidelines.pdf?pdf=Hydrogeological-Guidelines

5. Where the LSPOP applies, submissions are to be in accordance with the LSPOP found here: https://www.lsrca.on.ca/watershed-health/phosphorus
6. Low Impact Development Treatment Train Tool can be found here: https://www.lsrca.on.ca/Pages/LIDTTTool.aspx
7. Lake Simcoe Protection Plan Water Budget Policy for LSPP 4.8-DP and 6.40-DP can be found here: https://www.lsrca.on.ca/Shared%20Documents/lspp-water-budget-policy.pdf
8. LSRCA Review Fees can be found here: https://www.lsrca.on.ca/permits/permit-fees

SUBMISSION / RESUBMISSION REQUIREMENTS

1. A completed response matrix which includes a detailed response outlining how each of the comments above have been addressed with reference to applicable reports/drawings (i.e. specific sections/pages/details or tab identifiers).
2. The response matrix is to also include a summary of any additional changes to the design (i.e. in addition to those not identified in the detailed response to comments, and includes changes to reports, drawings, details, facility design, etc.).
3. All drawings are to be folded (8.5 x 11).
4. Reports and engineering drawings/details are to be signed and sealed by a Professional Engineer.
5. Reports are to include a digital copy of applicable models on a Data CD or USB Thumb Drive.
6. All submissions/reports are to include applicable technical components which achieve the minimum requirements outlined in the LSRCA Technical Guidelines for Stormwater Management Submissions, September 2016.

LSRCA ENGINEERING SUBMISSION CHECKLIST

Check "Yes", "No" or "N/A (Not Applicable)" for each item. If "No" or "N/A" are checked, please provide an explanation of why the criteria do not apply in a particular instance and note that the submission may be deemed incomplete and that additional consultation with LSRCA will likely be required prior to submission acceptance. The sections noted in this check list refer to those contained within the **LSRCA Technical Guidelines for Stormwater Management Submissions**:

Yes	No	N/A	Item	Comment
			Pre-submission consultation with LSRCA has been completed as per Section 2.0	
			The SWM report has been prepared as per Section 3.4 as a **standalone document** (i.e. all references, calculations and modelling are included within the document or a referenced appendix).	
			Stormwater Quantity **Peak Flow Control** as per Section 2.2.1.	
			Stormwater Quantity **Volume Control** as per Section 2.2.2.	
			Safe conveyance of stormwater to a **sufficient outlet** as per Sections 2.2.3 / 2.2.4.	
			Stormwater Quality Control **(80% TSS removal/Enhanced Level Treatment/Level 1 Treatment)** as per Section 2.3.	
			Stormwater Quality Control **(Phosphorus Removal)** as per Section 2.3.2 and as outlined in the Lake Simcoe Protection Plan.	
			Stormwater Quality Control **(Other Pollutants)** as per Sections 2.3.3 – 2.3.5	
			Stream **Erosion Control** as per Section 2.4.	
			A **Water Balance / Groundwater** analysis as per Section 2.5.	
			Erosion and Sediment Control drawings and details including an applicable section in the SWM report as per Section 2.6.	
			The Lake Simcoe Phosphorus Offsetting Policy (LSPOP) including a **Phosphorous Budget** completed for the site using the MOE PTool or STEP's LID TTT.	
			Natural Hazards including floodplain (hydraulics, hydrology, mapping and cut / fill balance if applicable.)	
			SWM Modelling (hydrology and hydraulics) including digital files and all supporting SWM **calculations.**	
			The general requirements, as per **Appendix A** of the LSRCA Technical Guidelines for SWM Submissions. Please note that this Appendix is not an exhaustive list and that additional site-specific requirements may apply.	

LSRCA HYDROGEOLOGICAL SUBMISSION CHECKLIST

Check "Yes", "No" or "N/A (Not Applicable)" for each item. If "No" or "N/A" are checked, please provide an explanation of why the criteria do not apply in a particular instance and note that the submission may be deemed incomplete and that additional consultation with LSRCA will likely be required prior to submission acceptance. The sections noted in this check list refer to those contained within the **Hydrogeological Assessment Submission Guidelines (2013):**

Yes	No	N/A	Item	Comment
			Pre-submission consultation with LSRCA has been completed as recommended in the Hydrogeological Assessment Submission Guidelines (2013).	
			The hydrogeological report has been prepared as a **standalone document.** (i.e., all references, calculations and drawings are included within the document).	
			Geological Characterization as per Section 3.1	
			Test pits/Boreholes as per Section 3.1.6	
			Monitoring Wells as per Section 3.1.7	
			Private Well Survey as per Section 3.1.8	
			Characterization of the local hydrostratigraphy/hydrogeology as per Section 3.1.9	
			Description of Surface Water Features and Functions as per Section 3.1.10	
			Water Quality as per Section 3.1.12	
			D-5-5 Water Supply (private servicing only) as per Section 3.1.13	
			D-5-4 (OnsiteSewage Systems only) as per Section 3.2.6	
			Groundwater Levels as per Section 3.2.1	
			Pumping Tests as per Section 3.2.2	
			Groundwater Discharge (Baseflow) as per Section 3.2.3	
			Pre- and Post-Development Water Balance Assessment as per Section 3.2.4	
			Infiltration/recharge mitigation plan as per Section 3.3	
			In-situ infiltration testing as per Section 3.3	
			Low impact development design calculations	

APPENDIX 2

FIRE FLOW REQUIREMENTS

Based on "Water Supply for Public Fire Protection - 1999", Fire Underwriters survey

Address	Block 2 - 150 Cemetery Road, Uxbridge
NBC Occupancy	Group C
Construction Class	Ordinary Construction
Notes:	3 storey, 6 unit townhouse block - no fire separation between units

Foot Print Area	619.1	m2

STEP 1 - DETERMINE FIRE FLOW:

REQUIRED FIRE FLOW (F) F = 220 x C x A^0.5

Maximum Floor Area A =	1857.3	m2
C =	1	Wood Frame Construction
F =	10000	L/min (Round up to nearest 1,000 L/min)
STEP 2 - OCCUPANCY FACTOR:	25%	Reduction for Low Hazard Occupancy (Dwellings)
Decrease =	2500	L/min
STEP 3 - AUTO SPRINKLER FACTOR:	0%	No Automatic Sprinkler
Decrease =	0	L/min
STEP 4 - EXPOSURE FACTORS:	Maximum exposure increase is 75%	
Exposure 1	5%	South Exposure
Exposure 2	5%	East Exposure
Exposure 3	15%	North Exposure
Exposure 4	25%	West Exposure
Total	50%	
Increase =	5000	
STEP 5 - TOTAL REQUIRED FIRE FLOW	**12500**	L/min

APPENDIX 3

2 YEAR STORAGE REQUIREMENTS

SUBJECT SITE
AREA (ha) = 0.7871
C = 0.62

ALLOWABLE DISCHARGE RATE (m3/s) = 0.0395

RAINFALL INTENSITY

I = A / (C + T) ^ B

Where A= 645
B= 0.786
C= 5

REQUIRED STORAGE VOLUME (m3) = 39.5

TIME (min)	INTENSITY (mm/hr)	PEAK FLOW (m3/s)	RUNOFF VOLUME (m3)	DISCHARGE VOLUME (m3)	STORAGE VOLUME (m3)
10.0	76.76	0.104	62.4	23.7	38.7
11.0	72.97	0.099	65.3	26.1	39.2
12.0	69.57	0.094	67.9	28.4	39.5
13.0	66.51	0.090	70.3	30.8	39.5
14.0	63.75	0.086	72.6	33.2	39.4
15.0	61.23	0.083	74.7	35.6	39.1
16.0	58.92	0.080	76.7	37.9	38.8
17.0	56.81	0.077	78.5	40.3	38.3
18.0	54.86	0.074	80.3	42.7	37.7
19.0	53.05	0.072	82.0	45.0	37.0
20.0	51.38	0.070	83.6	47.4	36.2
21.0	49.82	0.068	85.1	49.8	35.3
22.0	48.36	0.066	86.5	52.1	34.4
23.0	47.00	0.064	87.9	54.5	33.4
24.0	45.72	0.062	89.2	56.9	32.4
25.0	44.52	0.060	90.5	59.3	31.3
26.0	43.39	0.059	91.7	61.6	30.1
27.0	42.32	0.057	92.9	64.0	28.9
28.0	41.31	0.056	94.1	66.4	27.7

5 YEAR STORAGE REQUIREMENTS

SUBJECT SITE
AREA (ha) = 0.7871
C = 0.62

ALLOWABLE DISCHARGE RATE (m3/s) = 0.0551

RAINFALL INTENSITY

I = A / (C + T) ^ B

Where A= 904
B= 0.788
C= 5

REQUIRED STORAGE VOLUME (m3) = 55.0

TIME (min)	INTENSITY (mm/hr)	PEAK FLOW (m3/s)	RUNOFF VOLUME (m3)	DISCHARGE VOLUME (m3)	STORAGE VOLUME (m3)
10.0	107.01	0.145	87.0	33.1	54.0
11.0	101.70	0.138	91.0	36.4	54.6
12.0	96.96	0.131	94.6	39.7	55.0
13.0	92.69	0.126	98.0	43.0	55.0
14.0	88.82	0.120	101.1	46.3	54.9
15.0	85.30	0.116	104.1	49.6	54.5
16.0	82.08	0.111	106.8	52.9	53.9
17.0	79.13	0.107	109.4	56.2	53.2
18.0	76.41	0.104	111.9	59.5	52.4
19.0	73.89	0.100	114.2	62.8	51.4
20.0	71.55	0.097	116.4	66.1	50.3
21.0	69.37	0.094	118.5	69.4	49.1
22.0	67.34	0.091	120.5	72.7	47.8
23.0	65.43	0.089	122.4	76.0	46.4
24.0	63.65	0.086	124.2	79.3	44.9
25.0	61.97	0.084	126.0	82.7	43.4
26.0	60.39	0.082	127.7	86.0	41.8
27.0	58.90	0.080	129.3	89.3	40.1
28.0	57.49	0.078	130.9	92.6	38.4

10 YEAR STORAGE REQUIREMENTS

SUBJECT SITE
AREA (ha) = 0.7871
C = 0.62

ALLOWABLE DISCHARGE RATE (m3/s) = 0.0649

RAINFALL INTENSITY

I = A / (C + T) ^ B

Where A= 1065
B= 0.788
C= 5

REQUIRED STORAGE VOLUME (m3) = 64.8

TIME (min)	INTENSITY (mm/hr)	PEAK FLOW (m3/s)	RUNOFF VOLUME (m3)	DISCHARGE VOLUME (m3)	STORAGE VOLUME (m3)
10.0	126.06	0.171	102.5	38.9	63.6
11.0	119.81	0.162	107.2	42.8	64.4
12.0	114.22	0.155	111.5	46.7	64.8
13.0	109.19	0.148	115.5	50.6	64.8
14.0	104.64	0.142	119.1	54.5	64.6
15.0	100.49	0.136	122.6	58.4	64.2
16.0	96.70	0.131	125.8	62.3	63.5
17.0	93.22	0.126	128.9	66.2	62.7
18.0	90.01	0.122	131.8	70.1	61.7
19.0	87.04	0.118	134.5	74.0	60.5
20.0	84.29	0.114	137.1	77.9	59.2
21.0	81.72	0.111	139.6	81.8	57.8
22.0	79.33	0.108	141.9	85.7	56.3
23.0	77.09	0.104	144.2	89.6	54.6
24.0	74.99	0.102	146.4	93.5	52.9
25.0	73.01	0.099	148.5	97.4	51.1
26.0	71.15	0.096	150.5	101.2	49.2
27.0	69.39	0.094	152.4	105.1	47.2
28.0	67.73	0.092	154.2	109.0	45.2

25 YEAR STORAGE REQUIREMENTS

SUBJECT SITE
AREA (ha) = 0.7871
C = 0.62

ALLOWABLE DISCHARGE RATE (m3/s) = 0.0797

RAINFALL INTENSITY

I = A / (C + T) ^ B

Where A= 1234
B= 0.787
C= 4

REQUIRED STORAGE VOLUME (m3) = 78.5

TIME (min)	INTENSITY (mm/hr)	PEAK FLOW (m3/s)	RUNOFF VOLUME (m3)	DISCHARGE VOLUME (m3)	STORAGE VOLUME (m3)
10.0	154.64	0.210	125.8	47.8	78.0
11.0	146.46	0.199	131.0	52.6	78.4
12.0	139.21	0.189	135.9	57.4	78.5
13.0	132.72	0.180	140.3	62.2	78.2
14.0	126.89	0.172	144.5	66.9	77.5
15.0	121.60	0.165	148.4	71.7	76.6
16.0	116.79	0.158	152.0	76.5	75.5
17.0	112.39	0.152	155.4	81.3	74.1
18.0	108.35	0.147	158.6	86.1	72.5
19.0	104.62	0.142	161.7	90.9	70.8
20.0	101.18	0.137	164.6	95.6	68.9
21.0	97.98	0.133	167.4	100.4	66.9
22.0	95.00	0.129	170.0	105.2	64.8
23.0	92.22	0.125	172.5	110.0	62.5
24.0	89.62	0.121	174.9	114.8	60.2
25.0	87.18	0.118	177.3	119.6	57.7
26.0	84.88	0.115	179.5	124.3	55.2
27.0	82.72	0.112	181.7	129.1	52.5
28.0	80.68	0.109	183.7	133.9	49.8

100 YEAR STORAGE REQUIREMENTS

SUBJECT SITE
AREA (ha) = 0.7871
C = 0.62

ALLOWABLE DISCHARGE RATE (m3/s) = 0.1034

RAINFALL INTENSITY

I = A / (C + T) ^ B

Where A= 1799
B= 0.81
C= 5

REQUIRED STORAGE VOLUME (m3) = 102.5

TIME (min)	INTENSITY (mm/hr)	PEAK FLOW (m3/s)	RUNOFF VOLUME (m3)	DISCHARGE VOLUME (m3)	STORAGE VOLUME (m3)
10.0	200.63	0.272	163.2	62.0	101.1
11.0	190.41	0.258	170.4	68.2	102.1
12.0	181.29	0.246	176.9	74.4	102.5
13.0	173.09	0.235	183.0	80.7	102.4
14.0	165.67	0.225	188.6	86.9	101.8
15.0	158.93	0.215	193.9	93.1	100.8
16.0	152.77	0.207	198.8	99.3	99.5
17.0	147.12	0.199	203.4	105.5	97.9
18.0	141.92	0.192	207.8	111.7	96.1
19.0	137.11	0.186	211.9	117.9	94.0
20.0	132.65	0.180	215.8	124.1	91.7
21.0	128.50	0.174	219.5	130.3	89.2
22.0	124.63	0.169	223.0	136.5	86.5
23.0	121.01	0.164	226.4	142.7	83.7
24.0	117.62	0.159	229.6	148.9	80.7
25.0	114.44	0.155	232.7	155.1	77.6
26.0	111.44	0.151	235.7	161.3	74.3
27.0	108.61	0.147	238.5	167.5	71.0
28.0	105.93	0.144	241.2	173.7	67.5

APPENDIX 4

Hydroworks Sizing Summary

150 Cemetery Road
Uxbridge, Ontario

01-05-2022

Recommended Size: HydroDome HD 4

A HydroDome HD 4 is recommended to provide 80 % annual TSS removal based on a drainage area of .79 (ha) with an imperviousness of 57 % and Toronto Central, Ontario rainfall for the City of Toronto particle size distribution.

The recommended HydroDome HD 4 treats 100 % of the annual runoff and provides 85 % annual TSS removal for the Toronto Central rainfall records and City of Toronto particle size distribution.

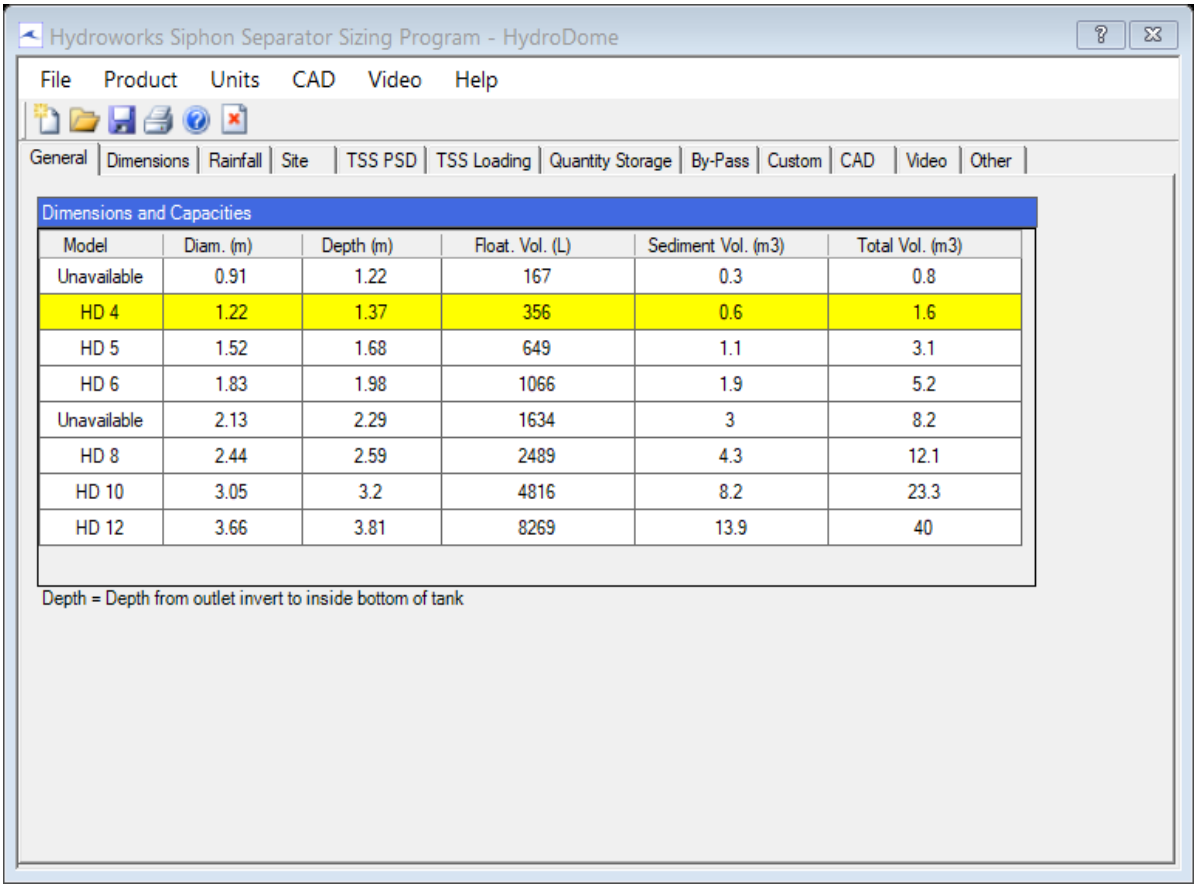
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .29 (m3/s) for the given 450 (mm) pipe diameter at 1% slope. The headloss was calculated to be 583 (mm) above the crown of the 450 (mm) outlet pipe.

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.

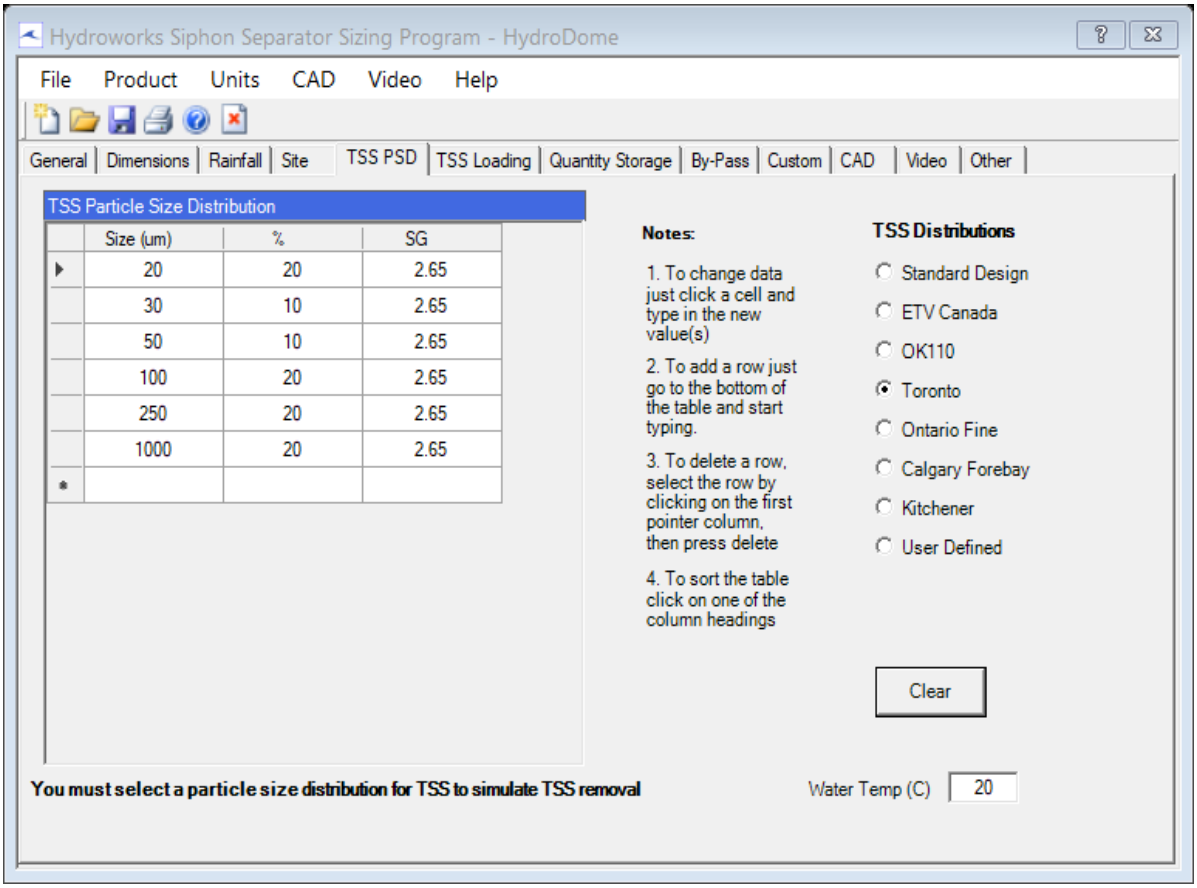
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 HydroDome .

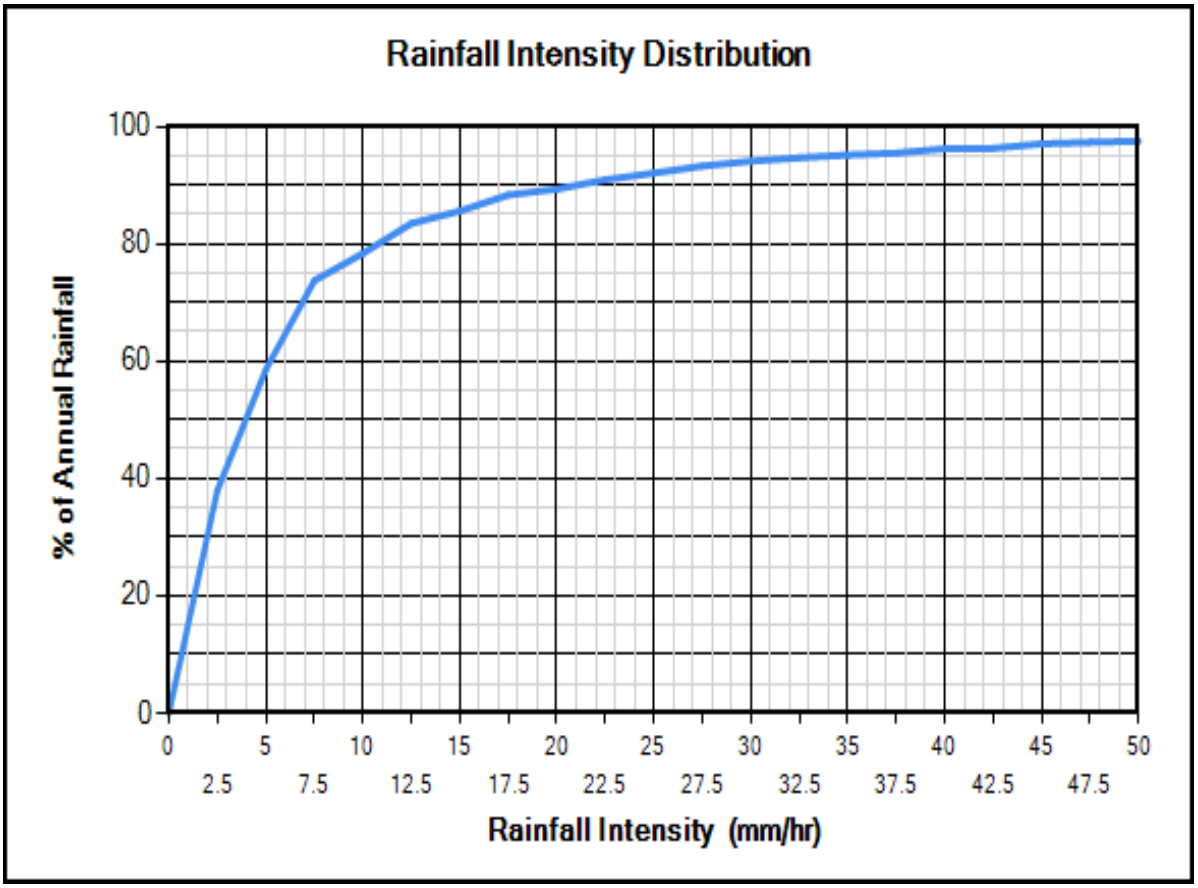
TSS Removal Sizing Summary



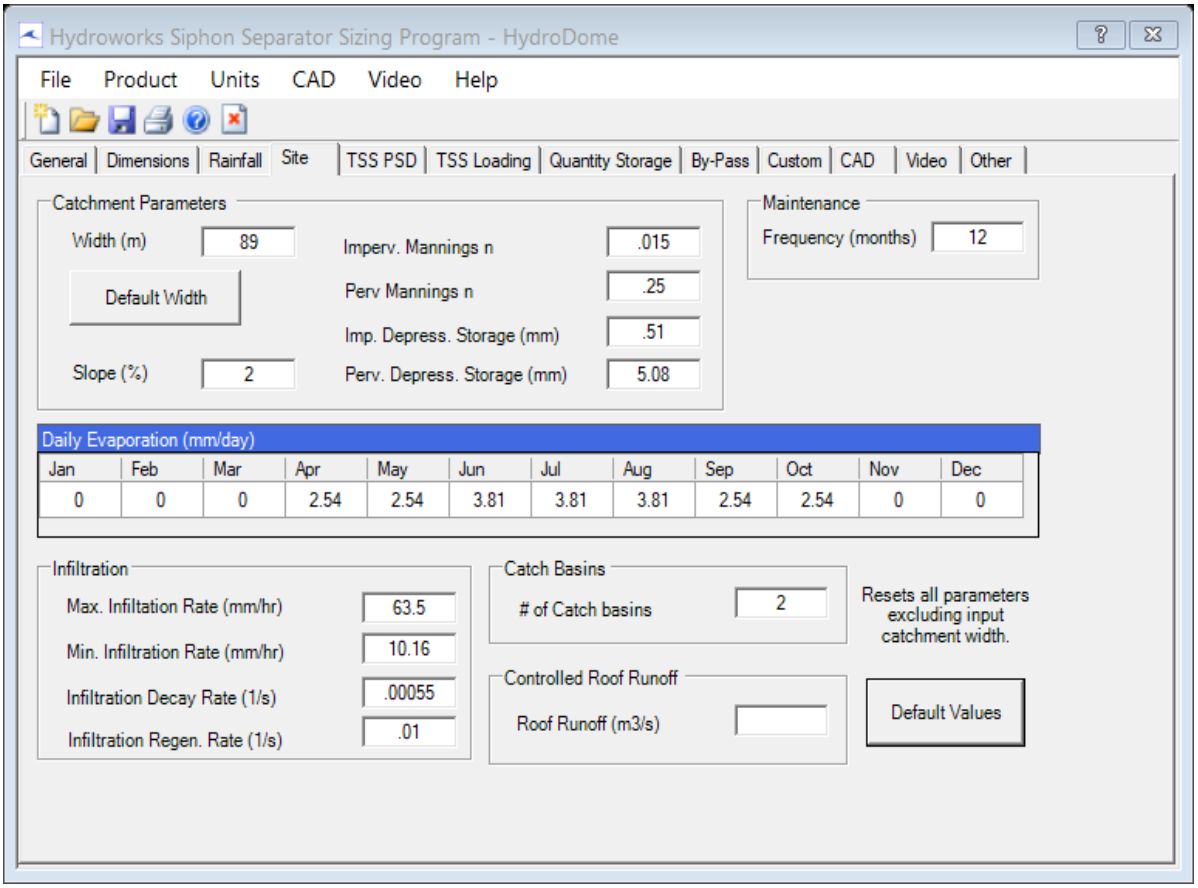
TSS Particle Size Distribution



Rainfall Station - Toronto Central, Ontario(1982 to 1999)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Siphon Separator Sizing Program - HydroDome

File Product Units CAD Video Help

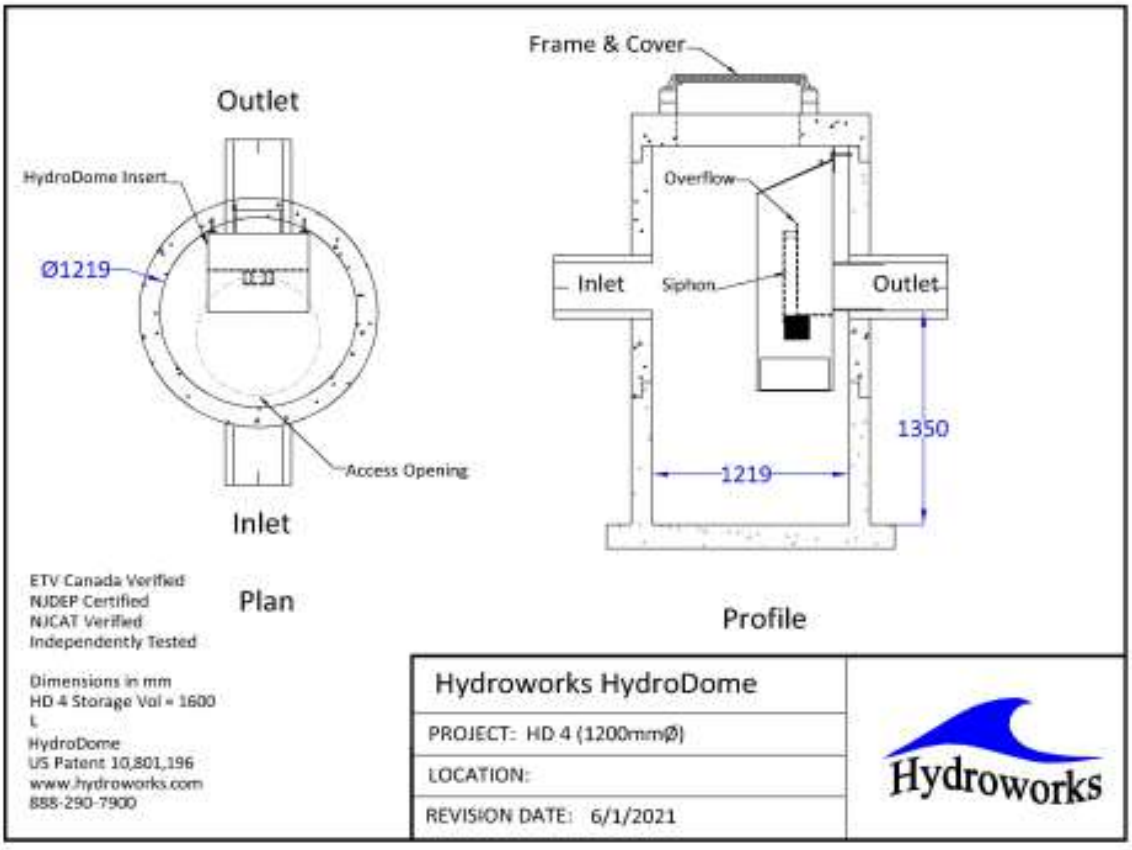
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

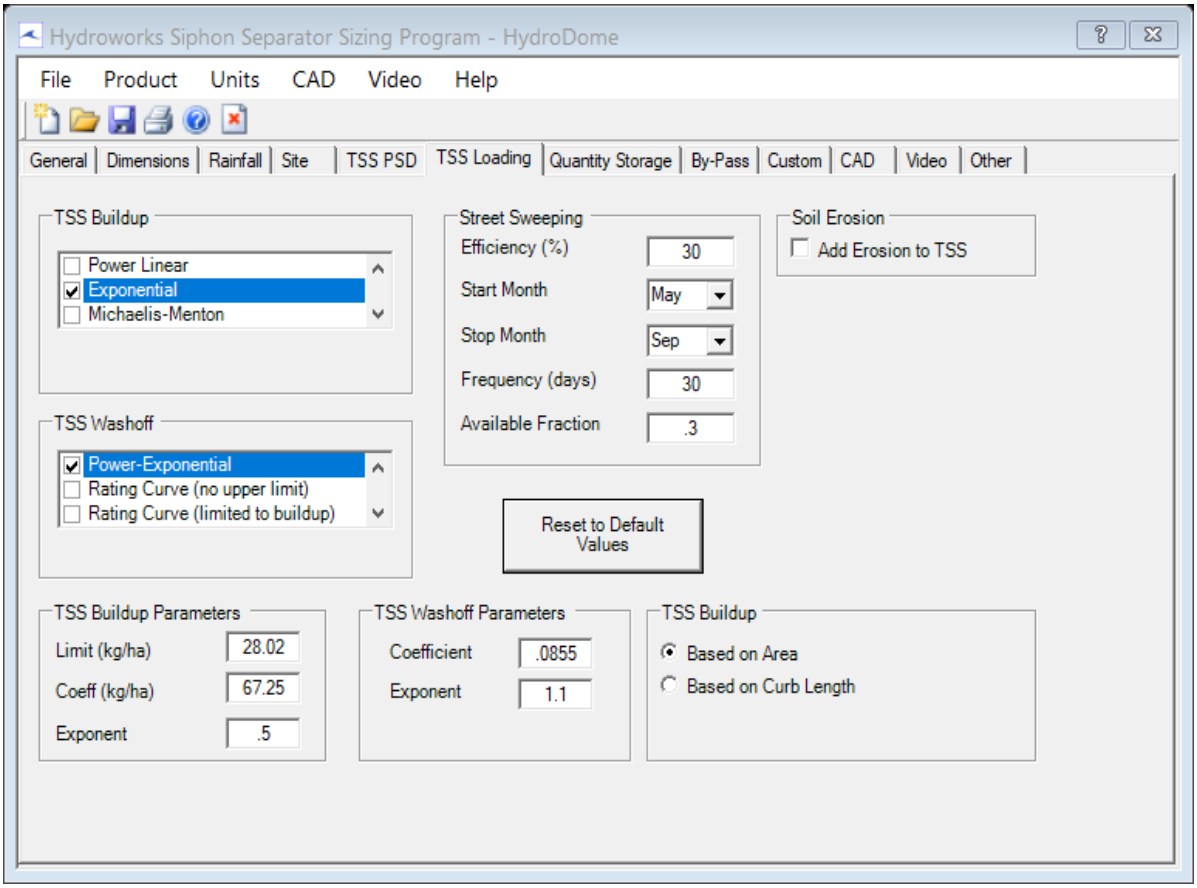
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
Unavailable	0.91	1.22	167	0.3	0.8
HD 4	1.22	1.37	356	0.6	1.6
HD 5	1.52	1.68	649	1.1	3.1
HD 6	1.83	1.98	1066	1.9	5.2
Unavailable	2.13	2.29	1634	3	8.2
HD 8	2.44	2.59	2489	4.3	12.1
HD 10	3.05	3.2	4816	8.2	23.3
HD 12	3.66	3.81	8269	13.9	40

Depth = Depth from outlet invert to inside bottom of tank

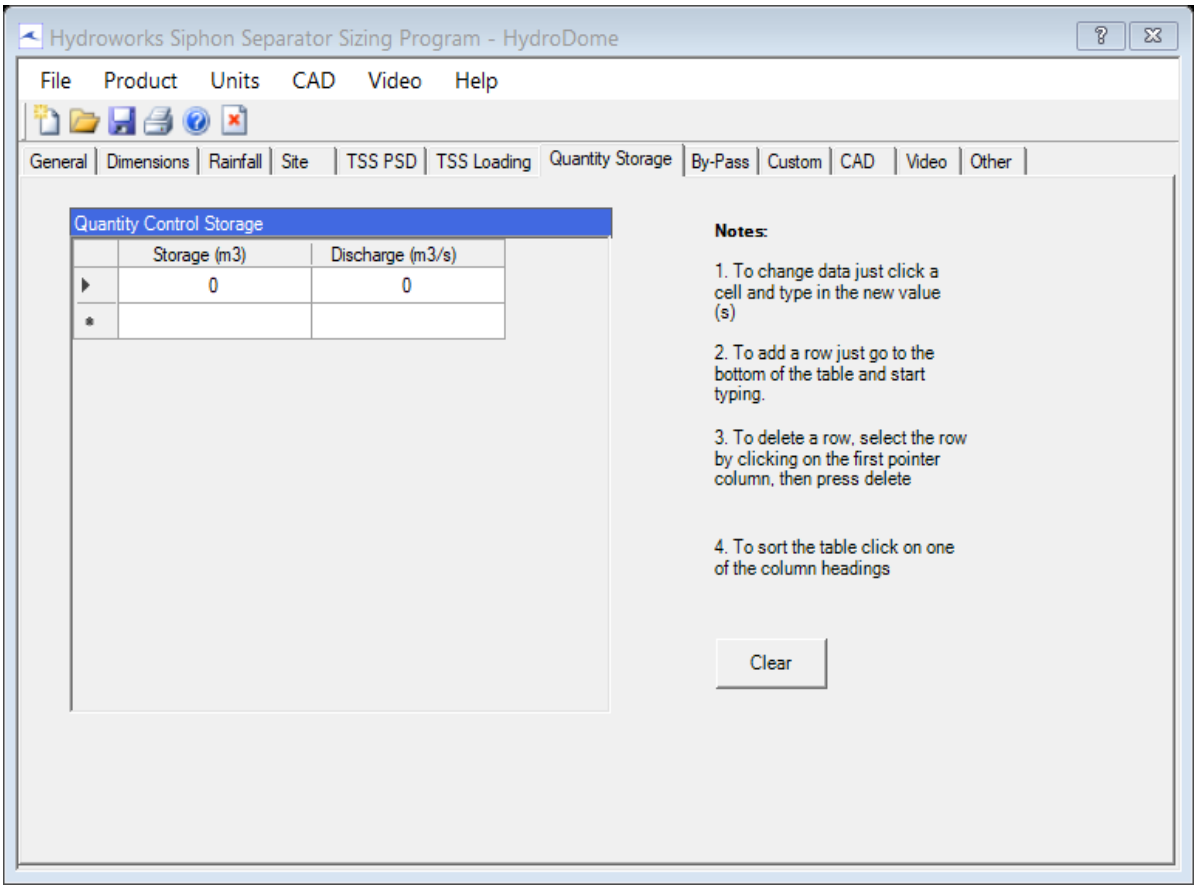
Generic HD 4 CAD Drawing



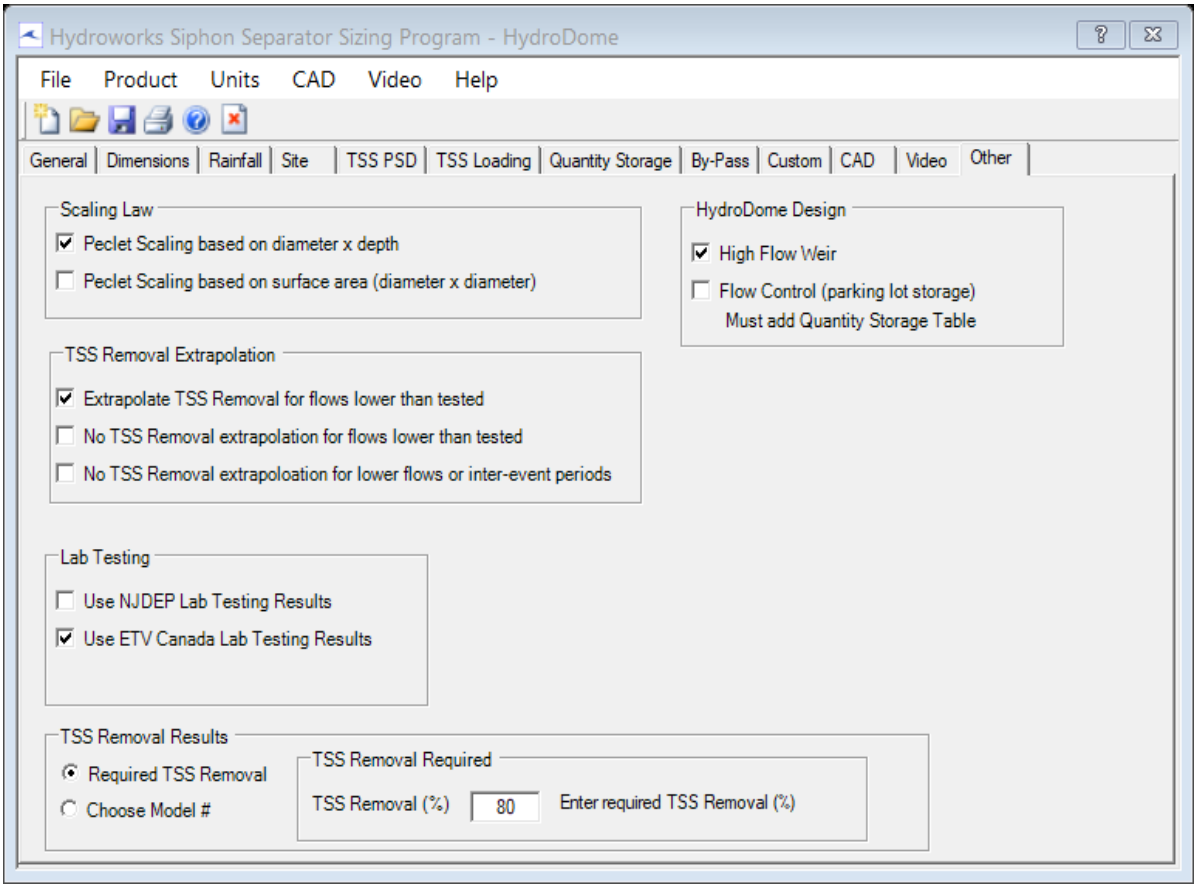
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Hydroworks Sizing Program - Version 5.5

Verification Statement

Hydroworks HydroDome HD3 Oil-Grit Separator
Registration number: (V-2021-09-02)
Date of issue: 2021-October-04

Technology type	Oil-Grit Separator		
Application	Technology to remove oil, sediment, trash and debris from storm-water and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals.		
Company	Hydroworks, LLC.		
Address	257 Cox St., Roselle, NJ 07203 USA	**Phone**	+1-888-290-7900
Website	https://hydroworks.com	**E-mail**	gbryant@hydroworks.com

Verified Performance Claims

The Hydroworks HydroDome HD3 Oil-Grit Separator (OGS) was tested by Alden Research Laboratory, Holden, Massachusetts, USA in 2021. The performance test results were verified by 'The Sir Sandford Fleming College of Applied Arts and Technology's Centre for Advancement of Water and Wastewater Technologies' (CAWT) following the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The following performance claims were verified:

Sediment removal test: The Hydroworks HydroDome HD3 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L and particle size distribution of 1-1000 µm, removed 83.9, 77.6, 68.4, 66.9, 59.4, 52.4, and 46.0 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2 respectively.

Scour test: The Hydroworks HydroDome HD3 OGS device with 15.2 cm (6 inch) of test sediment preloaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth, generated corrected effluent sediment concentrations on average of 0.54, 0.70, 0.0, 0.0, and 0.11 mg/L at 5-min duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test: The Hydroworks HydroDome HD3 OGS with surrogate low-density polyethylene beads preloaded within the inner chamber, representing a floating light-liquid volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area, retained 100, 100, 100, 100, and 99.7 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

The above verified claims can be applied to other units smaller or larger than the tested unit, provided that the untested units meet the scaling rule specified in the Procedure for Laboratory Testing of Oil Grit Separators (Version 3.0, June 2014)

Technology Application

HydroDome is a hydrodynamic separator that provides benefits for both water quality and water quantity (i.e., flow control). HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure. HydroDome also functions as an oil separator due to the submerged inlet design and the fact that the design raises the water level with flow to maximize the distance between any floatables (oil, trash) and the discharge entrance to the HydroDome.

Technology Description

HydroDome comes complete and slides into the outlet pipe from a drainage structure and is secured to the wall with anchor bolts. It consists of a siphon with flow control, that regulates the water level in the structure and the flow rate in the outflow, and an optional high flow weir. A schematic of the Hydroworks HydroDone OGS is shown in Figure 1.

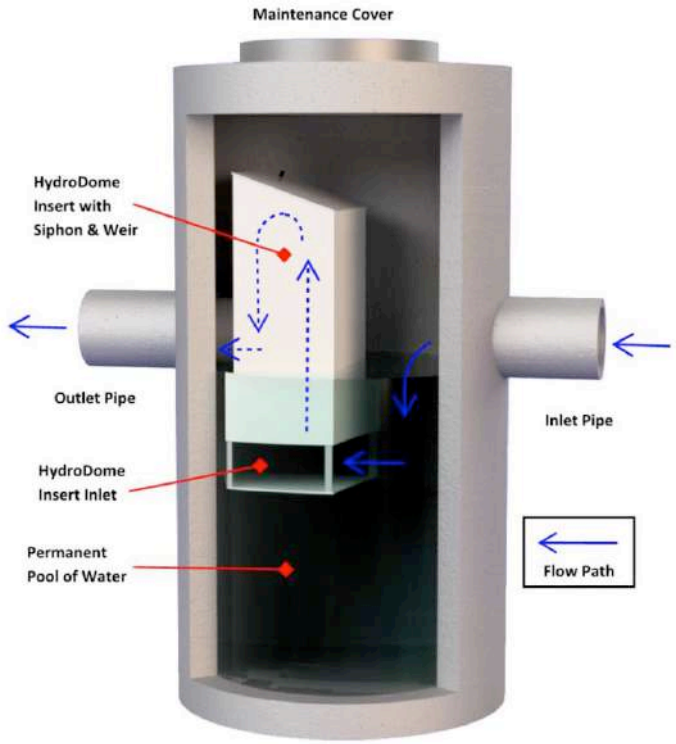


Figure 1: Schematic of the Hydroworks HydroDome Oil-Grit Separator

The siphon raises the water level to a pre-determined level without allowing water to exit the structure. The raised water level provides:
- Greater time for initial total suspended solids (TSS) removal and for floatables to prevent re-entrainment in the flow,
- Additional dilution to reduce effluent concentrations of any pollutants, and
- A greater volume, or buffer, of water to prevent scour of previously settled solids.

Water flows into the device through horizontal openings at the bottom of the HydroDome. Water then must travel upwards through the siphon. A foam filter is located at the entrance to the siphon inlet to provide secondary protection from its clogging (the outer housing of the HydroDome and submerged inlet provide primary protection). Once the water level reaches a pre-determined height, the siphon begins to engage, and water flows out of the structure downstream. The siphon flow is controlled by an orifice, whose size can be changed to provide the desired flow control. The water level continues to rise or begins to lower depending on the rate of flow from the orifice compared to the inflow of water to the structure.

An optional weir above the siphon provides a high flow path to prevent the system from surcharging. In cases where parking lot storage is desired, there would not be a high flow weir. A scour protection plate minimizes scour by preventing upward velocities/flow from the structure floor during periods of peak flow. Therefore, HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure.

Description of Test Procedure

For the purposes of this verification, a Hydroworks HydroDome 3-ft diameter (HD3) stormwater treatment unit was tested. The HD3 test unit was a full-scale 3 ft (0.91 m) diameter tank with an internal treatment hood that included a high flow weir. The test tank was fabricated from plastic and included 18-inch (457 mm) diameter inlet and outlet pipes, oriented along the center-line of the tank. The pipe inverts were located 48 inches (1.22 m) above the sump floor and were set with 1% slopes. The 100% and 50% sediment sump storage depths were 12 inches (0.305 m) and 6 inches (0.152 m), respectively. The effective treatment sedimentation area was 7.07 ft^2 (0.656 m^2).

The test data and results for this verification were obtained from independent testing conducted at Alden Research Laboratory in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)*[1]. Use of this procedure is intended to ensure that technologies in this category are subjected to stringent requirements in generating verifiable performance test data.

The verification plan was followed with one minor variance from the *Procedure*. This variance includes the required minimum amount of test sediment to be fed into the test unit for each tested surface loading rate (SLR). Although the *Procedure* requires a minimum of 11.3 kg of test sediment, during the 40 L/min/m^2 SLR test, only 6.45 kg was fed into the unit, which is 4.85 kg less than the specified minimum. This variance to the *Procedure* was agreed to by Toronto and Region Conservation Authority (TRCA), the author of the *Procedure*, based on previous conversations with Alden Labs, noting that the length of time to conduct the test with 11.3 kg of sediment at 40 L/min/m^2 would be over 36 hours.

Verification Results

CAWT verified the performance test data and other information pertaining to the HydroDome HD3 Oil-Grit Separator. A Verification Plan was prepared to guide the verification process based on the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol.

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure.

The "*Procedure for Laboratory Testing of Oil Grit Separators"* (TRCA, 2014) requires that the three-sample average of the test sediment particle size distribution (PSD) meet the specified PSD. The allowable tolerance of 6% variation from the specified PSD curve was met at each discrete particle size tested and the d50 was finer than 75 µm.

Comparison of the individual sample and average test sediment PSD to the specified PSD is shown in Figure 2. This figure indicates that the test sediment used for the removal and scour tests met the above-mentioned criteria. The median particle size was 64 µm.

Samples from test sediment batches used for each run met the specified PSD within the required tolerance thresholds.

The capacity of the HydroDome HD3 device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run.

[1] The *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)* was originally prepared by the Toronto and Region Conservation Authority (TRCA) in association with a 31 member advisory committee from various stakeholder groups.

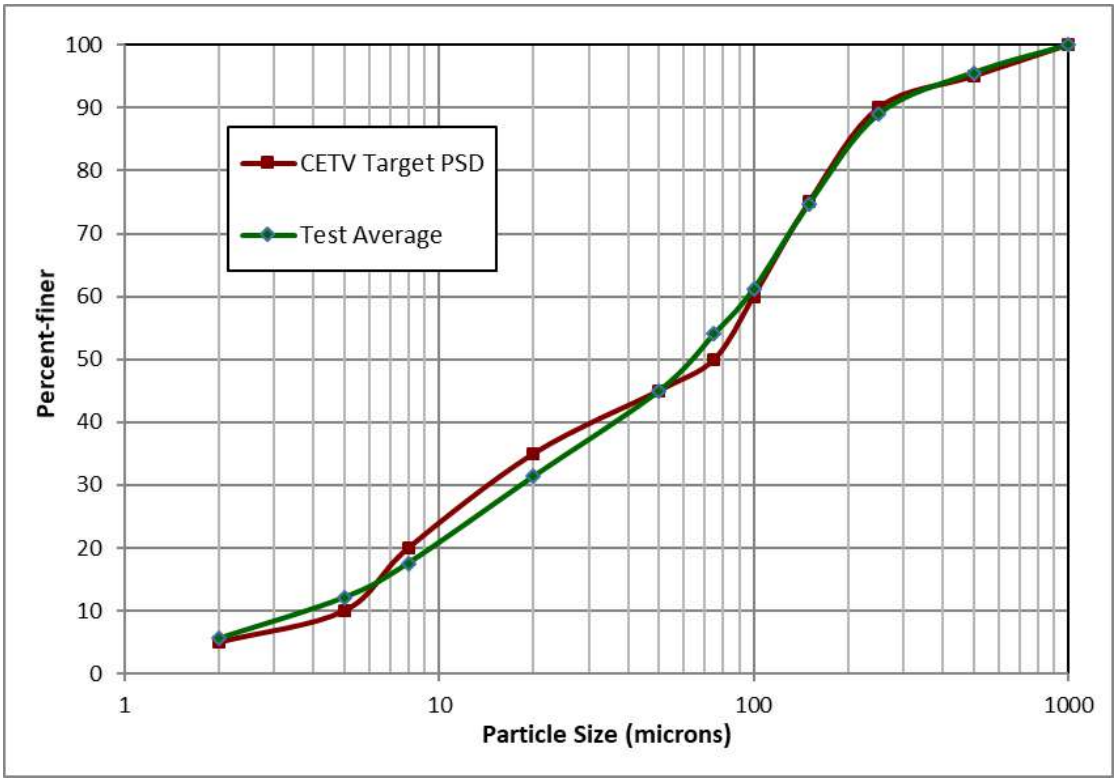


Figure 2 - Average particle size distribution (PSD) of the test sediment used for the sediment removal and scour test compared to the specified PSD

Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment, as a whole, were determined for each of the tested surface loading rates (Table 1).

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and are attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001).

Particle Range (µm)	**40** L/min/m^2	**80** L/min/m^2	**200** L/min/m^2	**400** L/min/m^2	**600** L/min/m^2	**1000** L/min/m^2	**1400** L/min/m^2	**Average**
>500	100%	125%	140%	140%	200%	200%	180%	155%
250-500	114%	129%	150%	143%	143%	183%	217%	154%
150-250	150%	136%	157%	153%	179%	221%	220%	174%
100-150	116%	126%	129%	148%	157%	162%	139%	140%
75-100	136%	155%	178%	190%	180%	170%	133%	163%
50-75	91%	100%	128%	270%	126%	82%	75%	125%
20-50	111%	97%	93%	51%	58%	42%	73%	75%
8-20	75%	79%	38%	34%	29%	17%	26%	42%
5-8	53%	34%	16%	7%	0%	0%	23%	19%
2-5	37%	29%	14%	0%	0%	0%	1%	12%

Table 1 - Removal efficiencies (%) of the HydroDome HD3 Oil-Grit Separator for individual particle size classes at specified surface loading rates

Figure 3 compares the particle size distribution (PSD) of the three-sample average of the test sediment to the PSD of the sediment retained by the HydroDome HD3 OGS device at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased, particularly in the 400 to 1400 L/min/m^2 range.

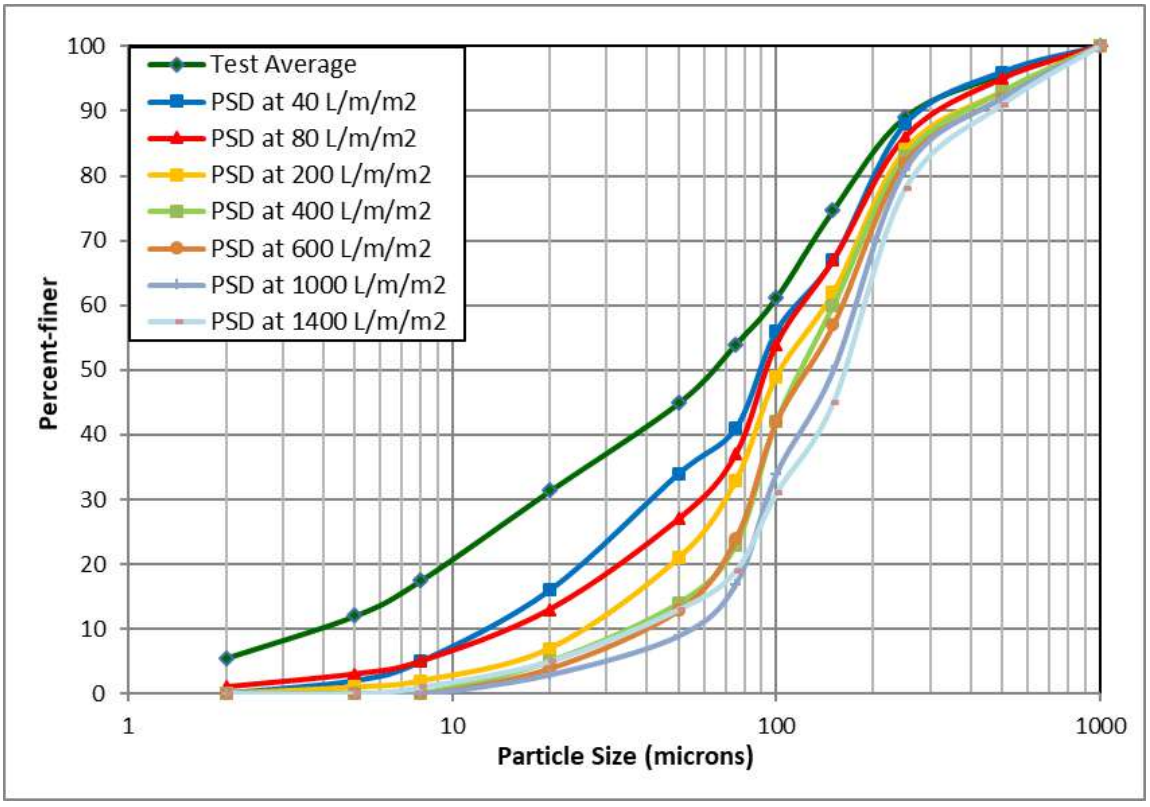


Figure 3 - Particle size distribution of sediment retained in the HydroDome HD3 Oil-Grit Separator in relation to the injected test sediment average

Table 2 shows the results of the sediment scour and re-suspension test for the HydroDome HD3 Oil-Grit Separator unit. The scour test involved preloading 15.2 cm (6 inches) of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth.

Measured Concentration at Each surface Loading Rate					
Effluent Sample No.	200 L/min/m^2	800 L/min/m^2	1400 L/min/m^2	2000 L/min/m^2	2600 L/min/m^2
1	1.2	0.3	0.0	0.0	0.0
2	0.7	0.0	0.0	0.0	0.0
3	0.5	0.0	0.0	0.0	0.5
4	0.1	3.2	0.0	0.0	0.0
5	0.3	0.0	0.0	0.0	0.0
Average	**0.5**	**0.7**	**0.0**	**0.0**	**0.1**

Table 2 - Scour test adjusted effluent sediment concentration at each surface loading rate

Clean water was run through the device at five surface loading rates over a 30-minute period. Each flow rate was maintained for 5 minutes with a one-minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for suspended solids concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water.

Results showed average adjusted effluent sediment concentrations below 0.7 mg/L at all surface loading rates. The magnitude of scour is dependent on the internal flow patterns (velocity and turbulence) and water volume within the unit, which is related to the depth below the inlet and outlet. The HD3 possessed a large water volume in the sump and consequently, low velocity, which prevented incipient motion of the sediment of sufficient magnitude for scour to occur.

The average measured effluent scour sediment concentrations (adjusted for background) for each tested SLR were not adjusted for particle size based on the D5 of particles captured for the 40 L/min/m^2 removal efficiency test since there was negligible scour.

The capacity of the device to retain light liquid was determined at five surface loading rates in a range between 200 and 2600 L/min/m^2 using low-density polyethylene beads, Dow Chemical Dowlex^{tm} 2517, with a density of 0.917 g/cm^3. This material was specified as the acceptable surrogate to represent floating liquid for a qualitative assessment of liquid behaviour during operation.

Performance was evaluated with a total of 32.8 litres (18.94 kg) of pellets preloaded into the treatment vault by introducing them into the crown of the influent pipe, to a volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area of 0.66 m^2. The effluent was collected in flow-designated nets to allow for quantification of any re-entrained pellets for each test SLR. The collected pellets were dried and the mass of collected pellets was quantified for each SLR, as well as the overall test.

The recorded average flow data, as well as quantified volume and mass of collected pellets for each target SLR and overall test, is shown in Table 3. The maximum re-entrainment of 0.3% occurred at 2600 L/min/m^2. The total retention rate was 99.7%.

Light-liquid Re-Suspension Data				**Starting Volume**	(Liters) **32.8**	**Starting Mass**	(grams) **18938**
Action	**Time Stamp** (minutes)	**Meter**	**Target Flow** (L/min/m^2)	**Recorded Flow** (L/min/m^2)	**COV**	**Collected Mass** (grams)	**Retained Mass**
Start D.A. Recording	0.0						
Flow set	1.0	4"	200	**207**	0.057	0	**100.0%**
Stop Collection	6.0			3.4%			
Flow set	7.0	4"	800	**826**	0.008	0	**100.0%**
Stop Collection	12.0			3.2%			
Flow set	13.0	6"	1400	**1407**	0.009	0	**100.0%**
Stop Collection	18.0			0.5%			
Flow set	19.0	6"	2000	**2022**	0.004	0.3	**100.0%**
Stop Collection	24.0			1.1%			
Flow set	25.0	6"	2600	**2599**	0.003	54.9	**99.7%**
Stop Collection	30.0			-0.1%			
Hydroworks HD 3				Interim Collection Net		1.3	
					Total	**56.5**	**99.7%**

Table 3 - Light-liquid recorded flow and re-entrainment data

Quality assurance

Performance testing and verification of the HydroDome HD3 Oil Grit Separator were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The verifier, CAWT, has confirmed that quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity.

In addition, QA/QC measures are documented in the *"Procedure for Laboratory Testing of Oil-Grit Separators"* (TRCA, 2014) to ensure results are accurate and precise, and that testing conducted by multiple vendors of the same category of technology are employing the same test method. The QA/QC measures include the use of certified laboratories, established test methods, calibration of equipment, tolerance limits for results variation, data checks during testing, and stringent documentation requirements.

Table 4 provides a summary of the acceptance criteria for particle size distribution, solids concentration in test water, water temperature, flow measurement equipment, flow rate variation, sediment feed, sediment moisture content, and sample analysis.

QC Parameter	Acceptance Criteria
Particle Size Distribution	Analyzed by a certified laboratory in accordance with ASTM D422-63(2007)e1. Percentages for size ranges vary by <6%, median < 75 um. PSD in water determined by ASTM D422-63(2007)e1 upon prior drying in designated pre-weighed nonferrous trays in compliance with ASTM D4959-07.
Solids concentration in test water	Suspended solids concentration (SSC) concentration of test water of less than 20 mg/L.
Water temperature	Temperature of water less than 25ºC.
Flow measurement equipment	Equipment calibration reports submitted to confirm that reported flow rate match actual flow rate. Flow rates from calibrated flow instruments recorded at no longer than 30 second intervals over the duration of the test.
Flow rate variation	Flow rates have COV < 0.04; maintained with ±10% of target flow rate.
Sediment feed	TSS concentration target = 200 mg/L with a tolerance limit of ±25 mg/L. Injection location is 5 pipe diameters upstream of the inlet to the device, as per the *Procedure*. Six calibration samples taken over duration of each test run. The allowed Coefficient of Variance (COV) for the measured samples was 0.10.
Sediment moisture content	Determined by ASTM D4959-07 "Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating".
Sample analysis	Conducted by qualified laboratories using standard methods and meeting the requirements of ISO.

Table 4. Validation of QA/QC procedures

Summary of Verification Results and Verified Performance Claim for Hydroworks HydroDome HD3 Oil-Grit Separator (OGS)

In summary, the HydroDome HD3 Oil Grit Separator is designed to remove oil, sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals. Verification of performance claims for the Hydroworks HydroDome HD3 Oil Grit Separator was conducted by CAWT based on independent third-party performance test results provided by Alden Research Laboratory, as well as additional information provided by Hydroworks.

Table 5 summarizes the verification results in relation to the technology performance parameters that were identified to determine the efficacy of the HydroDome HD3 Oil Grit Separator. The claims stated in Table 5 were verified using the modified mass balance method for sediment removal by measuring the total mass of sediment entering the unit and retained by the unit at prescribed surface loading rates. Effluent sampling was conducted every minute over a 30-minute duration for the scour test, using approved sampling methods as per the verification procedure. The light liquid re-entrainment test was conducted using a mass balance methodology which accounted for all the beads input, captured, and scoured from the separator.

Parameters	Verified Claims	Accuracy
Sediment Removal	During the sediment removal test, the Hydroworks HydroDome HD3 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L and particle size distribution of 1-1000 µm, removed 83.9, 77.6, 68.4, 66.9, 59.4, 52.4, and 46.0 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2 respectively	The sediment removal characteristics were quantified at various surface loading rates (SLRs), including particle size fractions, using a modified mass balance methodology. Performance results are presented as the true values.
Sediment Scour	During the scour test, the Hydroworks HydroDome HD3 OGS device with 15.2 cm (6 inch) of test sediment preloaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth, generated corrected effluent sediment concentrations on average of 0.54, 0.70, 0.0, 0.0, and 0.11 mg/L at 5-min duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m2, respectively.	5 samples analyzed for sediment (n=5) at each flow rate There was negligible scour once corrected for background concentrations.
Light Liquid Re-entrainment	During the light-liquid re-entrainment test, the Hydroworks HydroDome HD3 OGS with surrogate low-density polyethylene beads preloaded within the inner chamber, representing a floating light-liquid volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area, retained 100, 100, 100, 100, and 99.7 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.	Performance results are presented as the true values. Under the "Procedure for Laboratory Testing of Oil-Grit Separators" (TRCA, 2014), the light-liquid re-entrainment test is also not amenable to statistical analysis as the tests were only conducted once at various flow rates following a mass balance procedure.

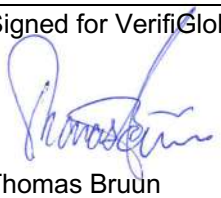
Table 5. Verified performance claims

What is ISO 14034?

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

Benefits of ETV

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

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

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

VerifiGlobal and the Verification Expert, CAWT, provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Hydroworks® HydroDome

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 email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

Introduction

The HydroDome (Figure 1) is a state-of-the-art hydrodynamic separator. HydroDome can be used for water quality and quantity flow control if desired.

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 HydroDome 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 HydroDome.

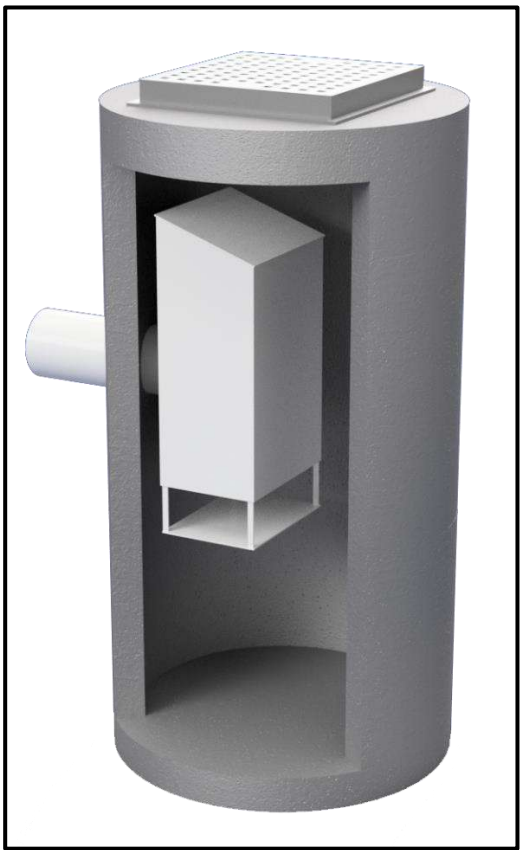


Figure 1. Hydroworks HydroDome

Hydroworks

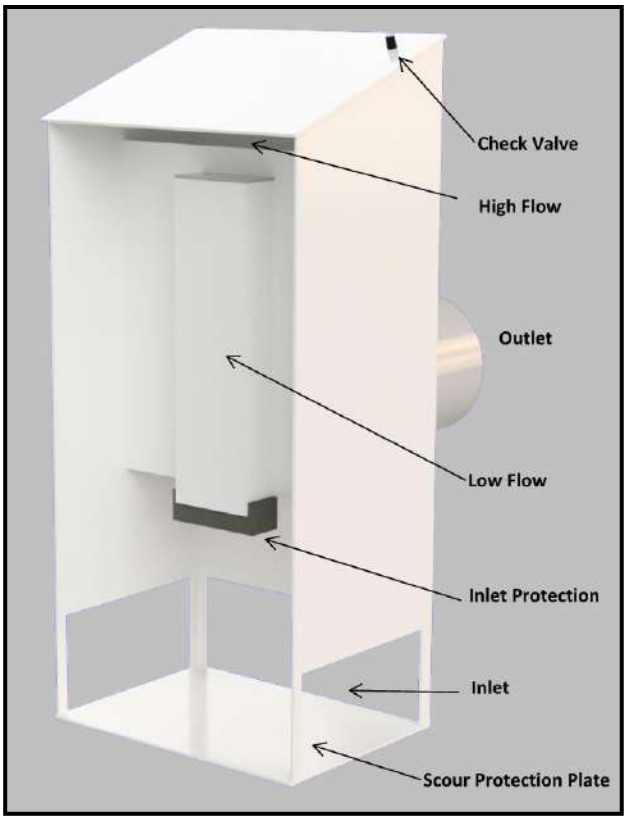


Figure 2 HydroDome Internal Components

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the separator.

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. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The water level during periods without rain should be near the outlet invert of the structure. If the water level remains near the top of the HydroDome this may suggest that there is an obstruction downstream of the HydroDome or that the inlet protection at the HydroDome may need to be cleaned.

Frequency

Construction Period

The HydroDome 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 HydroDome 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 areas (storage piles, exposed soils), the HydroDome separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required 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, elevated water level)
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 HydroDome unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroDome 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.

The area around the HydroDome provides clear access to the bottom of the structure (Figure 3). This is the area where a vacuum hose would be lowered to clean the unit.

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.

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.

Maintenance of a Hydroworks HydroDome unit will typically take 1 to 2 hours depending on size of unit and using a vacuum truck. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

Inlet protection (Figure 2) is located at the inlet to the low flow opening in the HydroDome to ensure the opening does not become clogged. Although it is not anticipated that the inlet protection will have to be replaced on a regular (i.e. annual) basis since the inlet protection is protected by the submerged entrance to the HydroDome , the inlet protection should be checked each time the HydroDome is inspected or maintained. The inlet protection is removable and should be rinsed with water to ensure any debris caught on the protection is discarded. Unless damaged, the inlet protection can be reinstalled. A replacement piece can be bought through Hydroworks and/or retail stores. Hydroworks can provide information on the inlet protection and where it can be bought. A sign that the inlet protection needs cleaning/replacement would be a water level near the crown of the outlet pipe in the structure during periods with no flow.

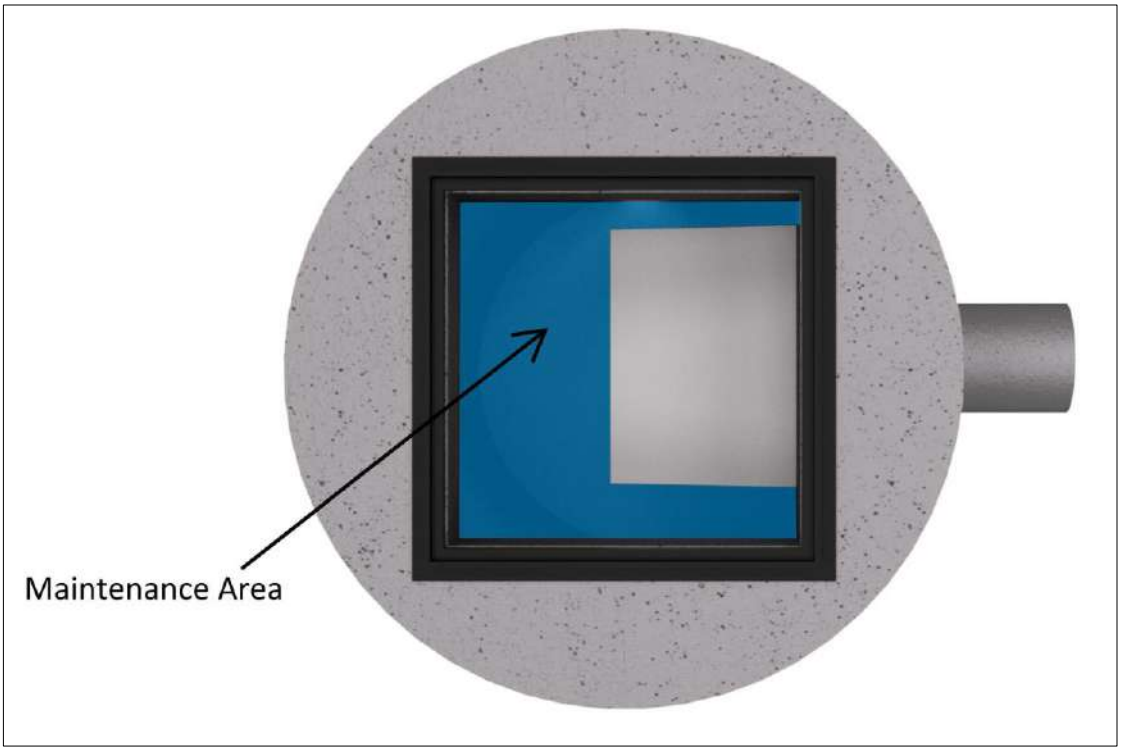


Figure 3. HydroDome Maintenance Access

Frequency

Construction Period

A HydroDome separator can fill with construction sediment quickly during the construction period. The HydroDome 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 HydroDome separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The 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. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome was designed with extra sump depth to extend the frequency of maintenance.

The HydroDome 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 75% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroDome Models

Model	Diameter ft (mm)	Maintenance Sediment Depth in (mm)
HD 3	3 (900)	12 (300)
HD 4	4 (1200)	12 (300)
HD 5	5 (1500)	12 (300)
HD 6	6 (1800)	12 (300)
HD 7	7 (2100)	12 (300)
HD 8	8 (2400)	12 (300)
HD 10	10 (3000)	12 (300)
HD 12	12 (3600	12 (300)

HYDRODOME 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	☐	☐

HydroDome	**Yes**	**No**
Obstructions in the inlet	☐ *	☐
Damage to HydroDome (cracked, broken, loose pieces)	☐ **	☐
Improperly installed outlet pipe	☐ ***	☐
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	☐ **	☐
Raised water level (water level close to top of HydroDome)	☐ ***	☐
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	**< 75% of surface area**	☐	**> 75% surface area**	☐ *
Sludge depth	**< 12" (300mm)**	☐	**> 12" (300mm)**	☐ *****

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

Note: Inspections should not be made within 24 hours of a storm to allow the water to drain from the structure to assess a raised water level or water level seepage

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroDome

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 HydroDome 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 HydroDome 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 HydroDome, or the cost of other goods or services related to the purchase and installation of the HydroDome. For this Limited Warranty to apply, the HydroDome 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 HydroDome 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 HydroDome, whether the claim is based upon contract, tort, or other legal basis.

APPENDIX 5

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: Residential Subdivision 150 Cemetery Road, Uxbridge, ON
Subwatershed: Pefferlaw-Uxbridge Brook

Total Pre-Development Area (ha):	**0.9430**	Total Pre-Development Phosphorus Load (kg/yr):	**0.12**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Low Intensity Development	0.943	0.13	0.12

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.6188	1.32	NONE	0%	0.82
High density residential subdivision.					
High Intensity - Residential	0.3242	1.32	Soakaways - Infiltration trenches	60%	0.17
Block 6 Soakaway Pits, Blocks 1-5 Infiltration Trenches					

			P Load (kg/yr)
Post-Development Area Altered:	**0.94**		
Total Pre-Development Area:	**0.94**		
Unaffected Area:	**0**	Pre-Development:	**0.12**
		Post-Development:	**1.24**
		Change (Pre - Post):	**-1.12**
		915% Net Increase in Load	
		Post-Development (with BMPs):	**0.99**
		Change (Pre - Post):	**-0.87**
		705.96% Net Increase in Load	

January 23, 2022

APPENDIX 6

TIL Toronto Inspection Ltd.
GEO-ENVIRONMENTAL CONSULTANTS
110 KONRAD CRESCENT,
UNIT 16
MARKHAM, ONTARIO
L3R 9X2
TEL.: 905-940-8509
FAX : 905-940-8192

Date: October 26, 2021
Project No.: 5431W-21-HB

Coral Creek Homes
145 Joicey Boulevard
Toronto, Ontario
M5M 2V1

Attn: Mr. Fabio Furlan

Re: Summary of Infiltration Testing for Proposed Development at 150 Cemetery Road, Uxbridge, Ontario

Toronto Inspection Ltd. (TIL) was retained by Coral Creek Homes (Client) to carry out an infiltration testing program to assess the infiltration rate of the underlying soil material for the infiltration Low Impact Developments (LIDs) to be proposed by consulting engineer, Tim Politis, from Politis Engineering Ltd at 150 Cemetery Road, Uxbridge, Ontario (Site).

The testing locations were provided and confirmed on-site by Tim Politis. The location of the Site and testing locations are attached as **Figure 1**.

1 Background

There are in total three LIDs proposed: one near the southeast corner of the Site, one near the northeast corner of the Site, and one on the west of the existing driveway. Test depths of approximately 2.0 m below ground surface(mbgs) and 3.5 mbgs were tested as requested by Tim Politis.

2 Work Program and Results

2.1 Test Pits

Three test pits, 21TP-1, 21TP-2 and 21TP-3 were conducted on October 1, 2021 to facilitate in-situ infiltration testing, soil logging and sampling of grain size analysis. The test pits remained open and dry for two hours. No groundwater seepage was observed at any test pit location. Further, seasonal groundwater level monitoring from the Hydrogeological Investigation[1] at the Site indicated dry conditions up to 6.1 mbgs at 20BH-3 (MW), 20BH-4 (MW) and 20BH-5 (MW), locations shown on Figure 1.

The visual observations from the two test pits are summarized in **Table 2-1**.

[1] Toronto Inspection Ltd.. 2021. Hydrogeological Investigation 150 Cemetery Road, Uxbridge, Ontario.

Table 2-1 Test Pit Observations

Test Hole ID	Depth of Investigation (mbgs)	Soil Conditions	Water Seepage Observations
21TP-1	3.5	0 - 0.45 m -- topsoil 0.45 - 3.0 m -- silty sand, brown, very moist (top 1 m) to moist 3.0 – 3.5 – coarse silt, brown, very moist	No seepage observed
21TP-2	3.5	0 - 0.3 m -- topsoil 0.3 - 1.3 m -- silty sand, brown, very moist 1.3 - 3.5 m -- silt, brown, very moist	No seepage observed
21TP-3	3.5	0 - 0.25 m -- topsoil 0.25 - 1.3 m -- silty sand, brown, very moist 1.3 - 3.5 m -- silt, brown, moist	No seepage observed

2.2 Laboratory Grain Size Analyses

Grain size analyses for soil samples were completed in the laboratory using sieve and hydrometer methods. The purpose of completing the grain size analyses was to determine the particle size distribution of the soil samples collected.

The Hazen Permeability is directly proportional to the infiltration rate, indicating lower values are likely to exhibit lower infiltration rates relative to higher values.

Grain size analysis were conducted at depths of 2.0 mbgs and 3.5 mbgs at 21TP-1, 21TP-2 and 21TP-3 to assess the particle size distribution at the location of the in-situ infiltration testing. The grain size distribution curves are appended. To determine the corresponding soil infiltration rate, the conversion discussed in **Section 3.2** was used. A summary of the results from the analyses are provided in **Table 2-2**.

Table 2-2 Hazen Permeability Summary

Test ID	Test Depth (mbgs)	Soil Description	Hazen Permeability (cm/s)	Laboratory Infiltration Rate (mm/hr)
21TP-1	2.0	Silty Sand	2.8×10^{-3}	113
	3.5	Silt (coarse)	3.3×10^{-3}	118
21TP-2	2.0	Silt	1.0×10^{-5}	25
	3.5	Silt	3.4×10^{-5}	35
21TP-3	2.0	Silt	6.4×10^{-5}	41
	3.5	Silt	2.1×10^{-5}	30

2.3 In-situ Infiltration Test

Infiltration testing was carried out using a Guelph Permeameter in accordance with the equipment's operating instructions (Soilmoisture Equipment Corp., 2012)[2]. For the tests, a 6 cm diameter holes were hand-augured to depths of approximately 2.0 mbgs and 3.5 mbgs at all test pit locations.

The infiltration test details are summarized in **Table 2-3**. The approximate infiltration test locations are shown on **Figure 1** and the field Guelph Permeameter data tables documenting stabilization of drawdown rates are appended.

Table 2-3 Infiltration Test Summary

Test ID	Test Depth (mbgs)	Well Hole Soil Description	Water Column Height (cm)	Reservoir Used	Method
21TP-1	2.0	Silty Sand	5, 10	Combined	Average of Single Head
	3.5	Silt (coarse)	5, 10	Combined	Average of Single Head
21TP-2	2.0	Silt	5, 10	Combined	Average of Single Head
	3.5	Silt	5, 10	Combined	Average of Single Head
21TP-3	2.0	Silt	5, 10	Combined	Average of Single Head
	3.5	Silt	5, 10	Combined	Average of Single Head

[2] Soilmoisture Equipment Corp.. 2012. 2800 Guelph Permeameter Operating Instructions dated December 2012

3 Discussion

3.1 Soil Condition

Based on the field logging of soil samples, the subsoil within the anticipated operating depth of proposed LIDs at the Site is primarily silty sand to silt at 21TP-1, and silt at 21TP-2 and 21TP-3. The calculation of infiltration rates associated with this soil condition is discussed in the sections below.

3.2 Estimated Field Saturated Hydraulic Conductivity and Infiltration Rate

The field saturated hydraulic conductivity (Kfs) was calculated using the Single Head Method via "Guelph Permeameter Calculator" prepared by Soilmoisture Equipment Corp (Soilmoisture Equipment Corp., 2012)[1]. This method is expressed by the following equation:

$$K_{fs} = \frac{C_1 Q_1}{2\pi {H_1}^2 + \pi\alpha^2 C_1 + 2\pi\left({H_1}/{\alpha}\right)}$$

Where:
Kfs =Field saturated hydraulic conductivity (entrapped air present) (cm/sec)
C1 = Shape factor
Q1 = Discharge from combined reservoir (cm^3/min)
H1 = Well height (cm)
a = Well radius (cm)
α = Soil texture (cm^{-1})

Based on the output from the Guelph Permeameter Calculator using the appended inputs, the estimate of Kfs for the silty sand deposit at 21TP-1 was 1.62×10^{-3} cm/s at depth 2.0 mbgs and 1.49×10^{-2} cm/s at depth 3.5 mbgs. The estimate of Kfs for the silt deposit at 21TP-2 was 1.17×10^{-4} cm/s at depth 2.0 mbgs and 4.58×10^{-4} cm/s at depth 3.5 mbgs. The estimate of Kfs for the silt deposit at 21TP-3 was 5.85×10^{-5} cm/s at depth 2.0 mbgs and 1.44×10^{-4} cm/s at depth 3.5 mbgs.

To determine the corresponding soil infiltration rate, the Kfs must be converted to a rate of infiltration (T). The approximate relationship between Kfs and T is provided in the Toronto and Region Conservation Authority (TRCA) Stormwater Management Criteria (TRCA, 2012)[3] to complete this conversion.

Based on the measured saturated hydraulic conductivity, the corresponding unfactored infiltration rate calculated for the silty sand deposit at 21TP-1 was 181 mm/hr at depth 2.0 mbgs and 177 mm/hr at depth 3.5 mbgs. The unfactored infiltration rate calculated for the silt deposit at 21TP-2 was 48 at depth 2.0 mbgs and 70 at depth 3.5 mbgs. The unfactored infiltration rate calculated for the silt deposit at 21TP-3 was 40 mm/hr at depth 2.0 mbgs and 51 mm/hr at depth 3.5 mbgs.

[3] Toronto and Region Conversation Authority (TRCA). 2012. Stormwater Management Criteria August 2012 Version 1.0.

A summary of the Kfs from the current investigation is presented in **Table 3-1.**

Table 3-1 Unfactored Infiltration Rate from In-situ Testing

Location	Depth mbgs	Soil Unit	Kfs (cm/s)	Unfactored Infiltration Rate (mm/hour)
21TP-1	2.0	Silty Sand	1.62×10^{-2}	181
	3.5	Silt (coarse)	1.49×10^{-2}	177
21TP-2	2.0	Silt	1.17×10^{-4}	48
	3.5	Silt	4.58×10^{-4}	70
21TP-3	2.0	Silt	5.85×10^{-5}	40
	3.5	Silt	1.44×10^{-4}	51

4 Recommendations

Through field logging and laboratory testing the soil condition at the proposed bases of the infiltration trenches was identified to be a continuous silty sand to silt deposit. Based on the grain size analysis and in-situ Guelph Permeameter infiltration testing completed, at the locations of the proposed bases of the LIDs, an unfactored infiltration rate of 110 mm/hr was determined for 21TP-1, an unfactored infiltration rate of 35 mm/hr was determined for 21TP-2 and 21TP-3.

It will be at the discretion of the designer to select a factor of safety to applied to the unfactored infiltration rates calculated.

It should be noted that the field infiltration rates are specific to the areas tested at the Site, at the point in time when the tests were conducted. Test results may therefore not be applicable to other areas of the Site where subsurface conditions are not consistent with those at the test locations.

We trust that the findings from this investigation will meet your needs. Should you have any questions or comments, please do not hesitate to contact the undersigned.

Yours truly,

Toronto Inspection Ltd.

Peining Guan, M.Sc
Junior Environmental Scientist

Simran Panesar, P.Geo.
Project Manager

Appended:

Figure 1 Test Pit Location and Monitoring Well Location Plan
Grain Size Distribution Curves
Field Data and Kfs Calculation

Source: Durham Region Interactive Map

LEGEND:

Borehole and Monitoring Well Location | Test Pit Location | Site Boundary

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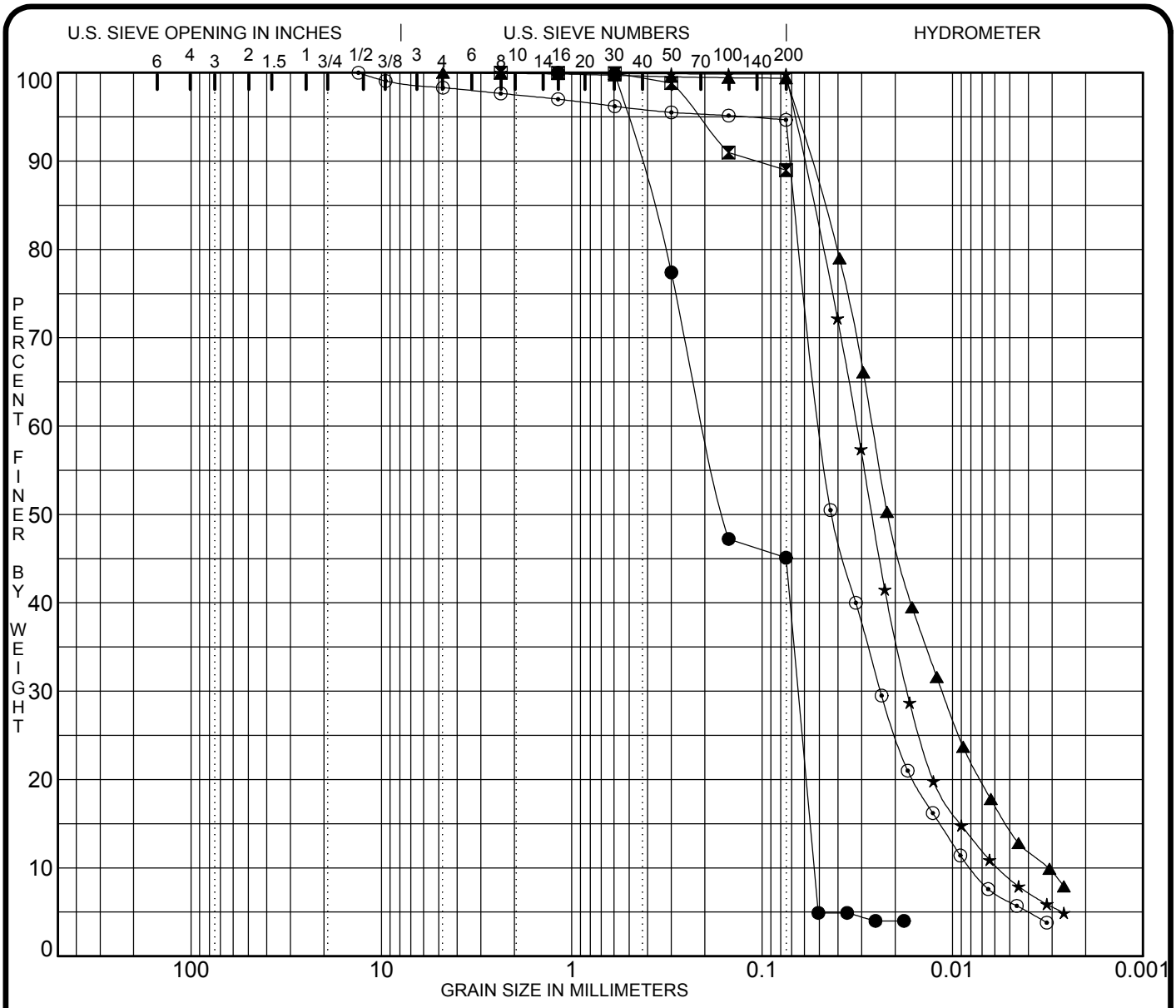
TITLE:	Test Pit and Monitoring Well Location Plan		
LOCATION:	150 Cemetery Road, Uxbridge, Ontario		
PROJECT NO. 5431W-20-HB	DATE : October 2021	FIGURE NO : 1	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	21TP-1	2.0						0.39	3.8
⊠	21TP-1	3.5							
▲	21TP-2	2.0						1.56	8.4
★	21TP-2	3.5						1.64	5.5
⊙	21TP-3	2.0						1.45	6.1

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	21TP-1	2.0	1.18	0.20	0.065	0.0533	0.0	54.9	45.1	
⊠	21TP-1	3.5	2.36				0.0	11.0	89.0	
▲	21TP-2	2.0	4.75	0.03	0.011	0.0031	0.0	0.6	85.0	14.4
★	21TP-2	3.5	2.36	0.03	0.017	0.0058	0.0	0.1	91.1	8.8
⊙	21TP-3	2.0	13.20	0.05	0.024	0.0080	1.7	3.6	88.5	6.2

PROJECT **Geotechnical Investigation - 150 Cemetery Road, Uxbridge, Ontario**

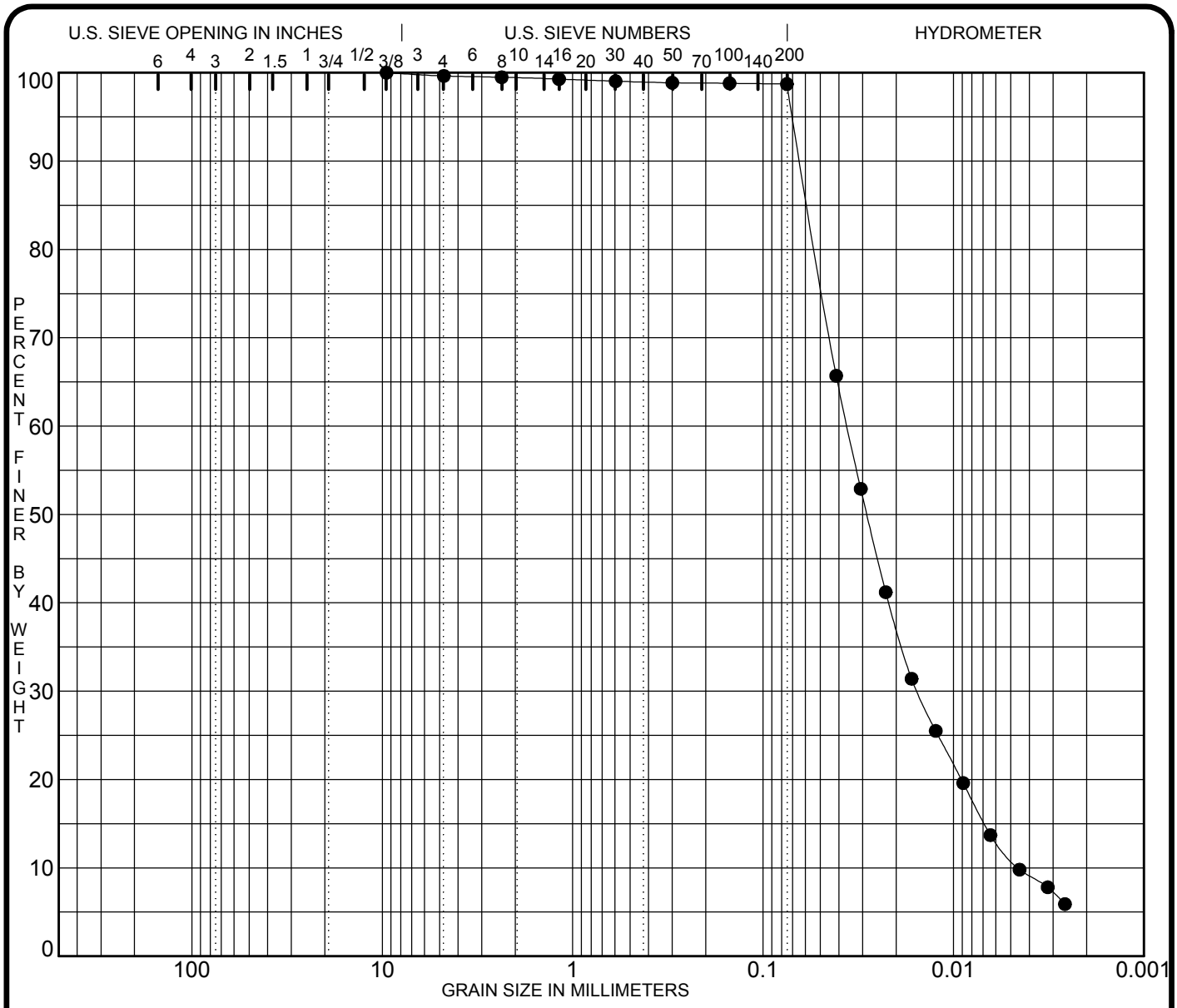
JOB NO. **5431W-20-HB**

DATE **10/15/21**

GRADATION CURVES

Toronto Inspection Ltd.

FIGURE NO.1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● **21TP-3**	**3.5**						**1.45**	**7.9**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **21TP-3**	**3.5**	**9.50**	**0.04**	**0.015**	**0.0046**	**0.4**	**0.9**	**87.7**	**11.0**

PROJECT **Geotechnical Investigation - 150 Cemetery Road, Uxbridge, Ontario**

JOB NO. **5431W-20-HB**

DATE **10/15/21**

GRADATION CURVES

Toronto Inspection Ltd.

Guelph Permeameter

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter water Head Height ("H" in cm): 5

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.1500

Res Type 35.22
H 5
a 3
H/a 1.667
a* 0.12
C0.01 0.809
C0.04 0.842
C0.12 0.803
C0.36 0.803
C 0.803
R 0.150
Q 0.088
pi 3.142

α^*= 0.12 cm^{-1}

C = 0.803154

Q = 0.08805

K_{fs} = 1.60E-04 cm/sec
9.61E-03 cm/min
1.60E-06 m/sec
3.78E-03 inch/min
6.31E-05 inch/sec

Φ_m = 1.33E-03 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter water Head Height ("H" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.2000

Res Type 35.22
H 10
a 3
H/a 3.33333
a* 0.12
C0.01 1.21841
C0.04 1.29023
C0.12 1.28754
C0.36 1.28754
C 1.28754
R 0.200
Q 0.1174
pi 3.1415

α^*= 0.12 cm^{-1}

C = 1.287543

Q = 0.1174

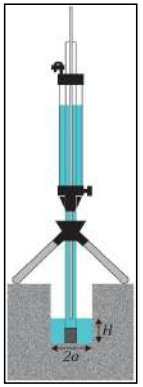
K_{fs} = 1.27E-04 cm/sec
7.63E-03 cm/min
1.27E-06 m/ses
3.00E-03 inch/min
5.01E-05 inch/sec

Φ_m = 1.06E-03 cm^2/min

Average

K_{fs} = 1.44E-04 cm/sec
8.62E-03 cm/min
1.44E-06 m/s
3.39E-03 inch/min
5.66E-05 inch/sec

Φ_m = 1.20E-03 cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter the first water Head Height ("H1" in cm): 5

Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^*= 0.12 cm^{-1}

α= 0.0154

Steady State Rate of Water Level Change ("R1" in cm/min): 0.1500

Steady State Rate of Water Level Change ("R2" in cm/min): 0.2000

Q_1 = 0.08805

Q_2 = 0.1174

Res Type: 35.22
H1/a: 1.666667
H2/a: 3.333333
C1-0.01: 0.809485
C2-0.01: 1.21841
C1-0.04: 0.842059
C2-0.04: 1.290234
C1-0.12: 0.803154
C2-0.12: 1.287543
C1-0.36: 0.803154
C2-0.36: 1.287543
G-Denominator: 1525.687

C_1 = 0.803154

C_2 = 1.287543

G_1 = 0.005264

G_2 = 0.00422

G_3 = 0.055692

G_4 = 0.024148

K_{fs} = 3.19E-05 cm/sec
1.91E-03 cm/min
3.19E-07 m/sec
7.53E-04 inch/min
1.25E-05 inch/sec

Φ_m = 2.07E-03 cm^2/min

Θ_{fs} = cm^3/cm^3

Θ_i = cm^3/cm^3

Sorptivity 0.0000 $(cm\ min^{-\frac{1}{2}})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.081 + 0.121\left(\frac{H_2}{a}\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(\frac{H_1}{a}\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(\frac{H_2}{a}\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(\frac{H_1}{a}\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(\frac{H_2}{a}\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(\frac{H_1}{a}\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(\frac{H_2}{a}\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_1 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_3Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$

APPENDIX 7

Infiltration Trench Design									
	Contributing Area			25 mm	Area	Trench	Trench	Trench	Stone
	Roof	Grass	Totals	Capture	Required	Length	Width	Depth	Void
Block	(sq.m.)	(sq.m.)	(sq.m.)	(cu.m.)	(sq.m.)	(m)	(m)	(m)	(cu.m.)
1	153.5	222.8	376.3	9.4	16.9	30.1	1.2	1.0	14.4
2	204.7	571.5	776.2	19.4	34.9	40.2	1.2	1.0	19.3
3	206.0	336.7	542.7	13.6	24.4	29.3	1.2	1.0	14.1
4	207.2	377.9	585.1	14.6	26.3	37.2	1.2	1.0	17.9
5	156.1	540.8	696.9	17.4	31.3	25.2	1.2	1.0	12.1
Totals	927.5	2049.7	2977.2	74.4	133.7	162			77.8

Average factored percolation rate = 29 mm/hr

Clear stone porosity = 0.4

Soakway Pit Design								
	Contributing Area			25 mm	Area	Area	Stone	Stone
	Roof	Grass	Totals	Capture	Required	Provided	Depth	Void
Block	(sq.m.)	(sq.m.)	(sq.m.)	(cu.m.)	(sq.m.)	(sq.m.)	(m)	(cu.m.)
6	264.4	0.0	264.4	6.6	21.5	21.6	0.8	6.9

Nearest Test Pit = 2

Factored P = 16 mm/hr